Designation: F 1505 – 94

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 acceptance testing of insulated and insulating hand held 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 is 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 900 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 tools*—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 tools*—those made predominantly of insulating material, except for metal inserts used for reinforcement but with no exposed metal parts, 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*—a contractual test to prove to the customer that the device meets certain conditions of its specification.

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

3.2.3 *sampling test*—a test on a number of devices taken at random from a batch.

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

4. Significance and Use

4.1 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.

4.2 The technical requirements of this specification are in compliance with IEC 900 at the time of issue.

5. Performance Requirements

5.1 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 properly used.

5.2 The mechanical specifications for insulated and insulating hand tools having a similar 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 live working in an environment of live parts at different

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[1] This specification is under the jurisdiction of ASTM Committee F-18 on Electrical Protective Equipment for Workersand is the direct responsibility of Subcommittee F18.35 on Tools and Equipment.

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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.

potentials (boxes with electrical equipment, live working on underground cables, etc.), that are generally 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.

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

5.4 The insulating coating shall consist of one or more layers. If two or more layers are utilized, contrasting colors shall be employed. (The inner layer may be transparent.)

5.5 The handle of the tool shall be slip resistant.

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

5.7 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.

5.8 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.

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

5.10 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 inadvertently touched or cause a flashover.

6. Other Requirements

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

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

6.1.2 Other types of screwdrivers 18-mm (¾-in.) maximum length, and

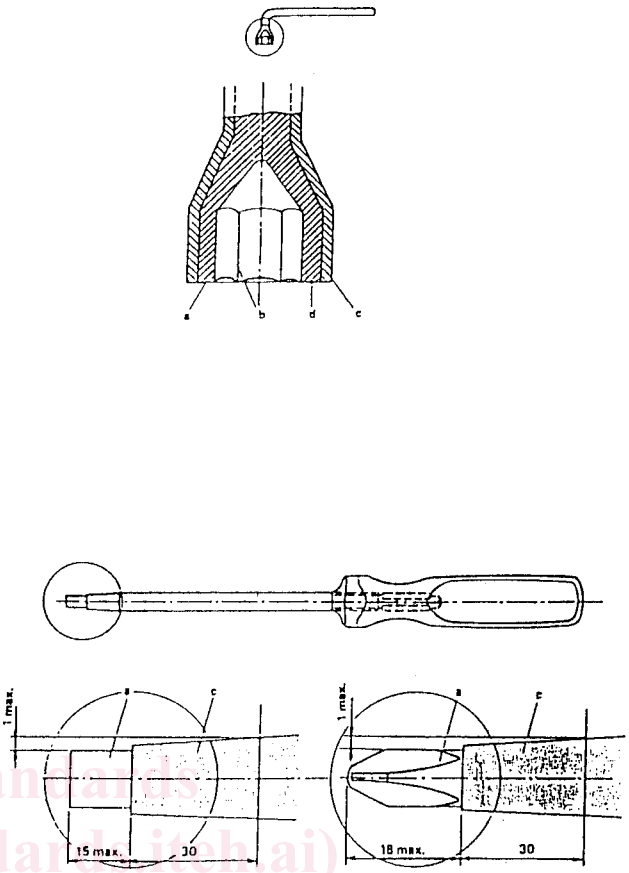
6.1.3 Open-end wrenches, box wrenches, socket wrenches, and tee wrenches: the working surfaces that contact the fastener.

6.2 The blade insulation of screwdrivers shall be bonded to the handle. The outer diameter of the insulation, over a length of 30 mm (1 3⁄16 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.

6.3 *Pliers, Strippers, Cable Cutting Tools (and Other Hinge-Jointed Tools)*:

6.3.1 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*).) The height of the guard shall be sufficient to resist slippage of the fingers towards the conductive part during work. For pliers, theminimum dimensions of the guard shall be 10 mm (⅜ in.) on the left and the right side of the pliers positioned on a flat surface; 5 mm (3⁄16 in.) on the top and on the bottom of the pliers positioned on a flat surface (see Fig. 2(*a*)).

6.3.2 The minimum insulated distance between the inner edge of the guard and the tool shall be 12 mm (½in.). (See Fig. 2(*a*).) The insulating material shall extend as far as possible towards the working end of the tool.



NOTE 1—a = conductive part,
b = working part,
c = insulation, and
d = contact area.

NOTE 2—Dimensions in millimetres.

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

NOTE 1—Sufficient length of grip shall be provided so as to permit use of the tool without placing fingers over guards.

6.3.3 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.

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

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

6.4 *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 distance between the inner edge of the guard and the non-insulated part shall be 12 mm (½ in.) (see Fig. 2(*b*)). The maximum length of the uninsulated part of the knife blade shall be 65 mm (2½ in.).

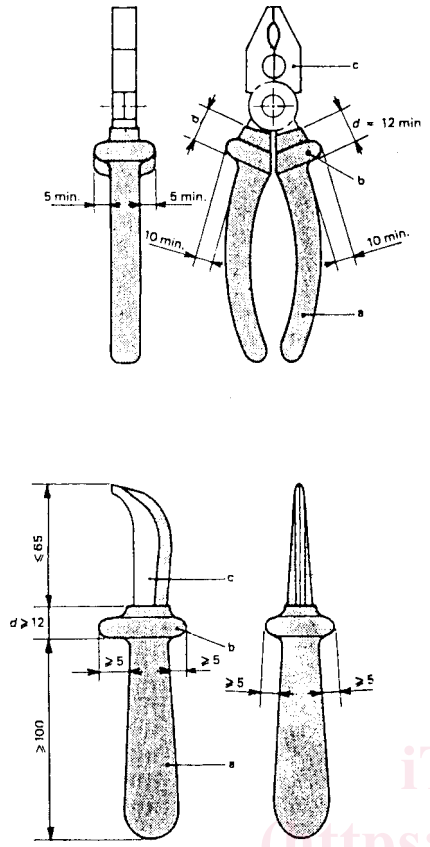
6.5 *Product Marking*:

6.5.1 Each tool or tool component, or both, shall be permanently and legibly marked with the following information:

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

6.5.3 On insulating material layer:

6.5.3.1 Type or product reference,



(*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

6.5.3.2 The double triangle symbol (see Fig. 3),

6.5.3.3 1000-V (the electrical working limit for alternating current), and

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

6.5.4 The symbol shall be at least 3 mm (⅛ in.) high; the letters and the figures shall be at least 2 mm (1⁄16 in.) high. (See Fig. 3.)

6.5.5 The voltage markings shown above shall be the only voltage shown on the tool.

NOTE 2—The indication of a test voltage may lead to the erroneous assumption that the tool is suitable for work at that voltage.

6.6 *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 X1.)

FIG. 3 Marking Symbol

7. Type Tests

7.1 *General Test Specification*—The following tests shall be utilized to check compliance with the requirements outlined above:

7.1.1 Carry out the test procedure in 7.2 through 7.10 on each specimen sample in the sequence listed.

7.1.2 Carry out the type test on at least three samples.

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. 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 in test clauses, deviations of 5 % from any test values required are permissible.

7.2 *Visual and Dimensional Check*:

7.2.1 *Visual*—The tool and insulation shall be visually checked and shall be free from external defects. The marking shall be checked for legibility and completeness in accordance with 6.5.

7.2.2 *Dimensional*— Check the dimensions in accordance with Section 6.

7.3 *Impact Test*:

7.3.1 Carry out the test in accordance with one of the two alternatives shown in Fig. 4(*a*) and Fig. 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, exfoliations, 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*:

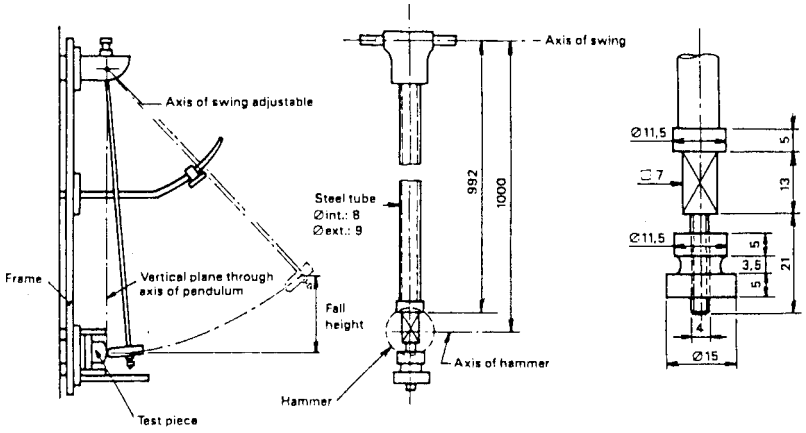
7.3.4.1 Test the tool at the ambient temperature of the test room.

7.3.4.2 Determine the fall height 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 m onto a hard surface:

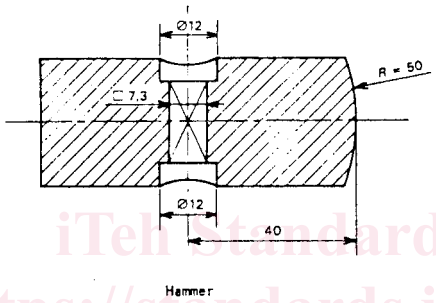
$$H = \frac{W}{P} = \frac{2 \times F}{P}$$

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

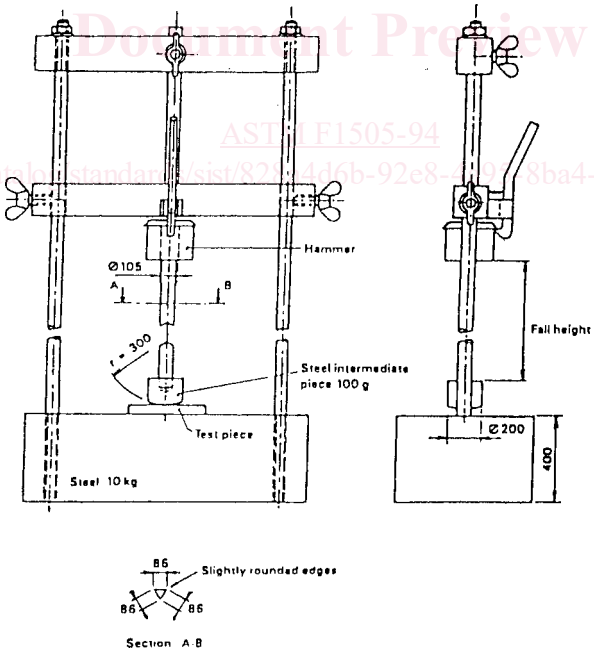
7.3.5 *Low-Temperature Test*—Condition the tool by placement in a cooling chamber for 2 h at − 25± 3°C. The impact test shall take place within 2 min after removal from the cooling chamber. The ambient temperature shall be 23 ± 5°C. Determine the fall height as a function of its weight, *P*, so that



Pendulum for impact test



(*a*) Method A



(*b*) Method B

NOTE 1—Dimensions in millimetres.

FIG. 4 Example of Test Arrangement for the Low-Temperature Impact Test

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:

$$H = \frac{W}{P} = \frac{0.6 \times F}{P}$$

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

7.4 *Dielectric Test—Conditioning Before Testing*—Condition the tools by total immersion in a bath of tap water at room temperature for a period of 24 ± 0.5 h. After this conditioning, wipe the tools dry and submit to the following tests:

7.4.1 *Insulated Tools*— Immerse the sample tool (see Fig. 5) 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.

7.4.1.1 Test pliers and similar tools in such a position that the gap "D" between the two inner sides of the insulated handles is 2 to 3 mm (1⁄16 to 1⁄8 in.), or the minimum possible by the tools construction, but not less than 2 mm (1⁄16 in.).

7.4.1.2 For tools capable of being field assembled, replace the water bath by a bath of 3-mm (1⁄8-in.) diameter nickel stainless steel or copper/steel balls (measured with normal industrial tolerances). Continuously apply a voltage of 10 kV (rms) at commercial power frequencies for 3 min in accordance with IEC 60, and measure the leakage current. This current shall be less than 1 mA for 20 mm (25⁄32in.) of coated tool. This corresponds to a maximum value of the leakage current of:

$$I = 5L$$

where:
I = leakage current rounded to the upper value, mA, and
L = coated developed length rounded to the lower value, cm.

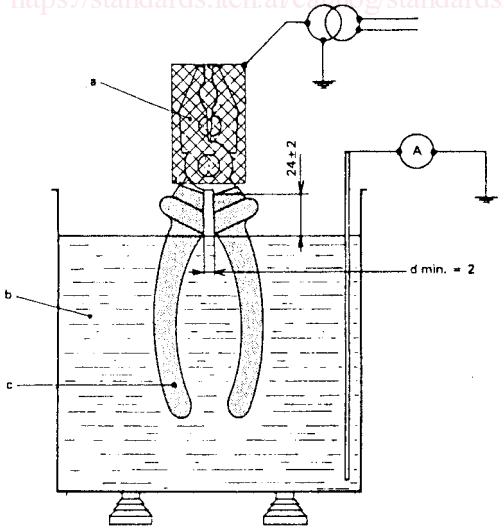
7.4.1.3 Test tools capable of being field assembled in all possible variations. Test tools with holding devices on both end positions, if applicable. The test is considered passed if no electrical puncture, sparkover, or flashover occurs during the test period, and the limits of the leakage current are not exceeded.

7.4.2 *Insulating Tools—Dielectric Test Between the Working Head and the Handle (or Handles)*:

7.4.2.1 *Tools Having Only One Working Head With or Without a Conductive Part*—Cover the working head with conductive tape, foil, or conductive paint in contact with all exposed conductive parts of the working head. Also cover the body of the tool (one or two handles) with conductive tape, foil, or conductive paint, and in the places usually touched by the user's hand (guard included). The distance between the conductive tape placed on the working head, or any metallic part related to it, and the conductive tape placed on the body of the tool nearest to the working head shall be 22 ± 2 mm. (See Fig. 6.)

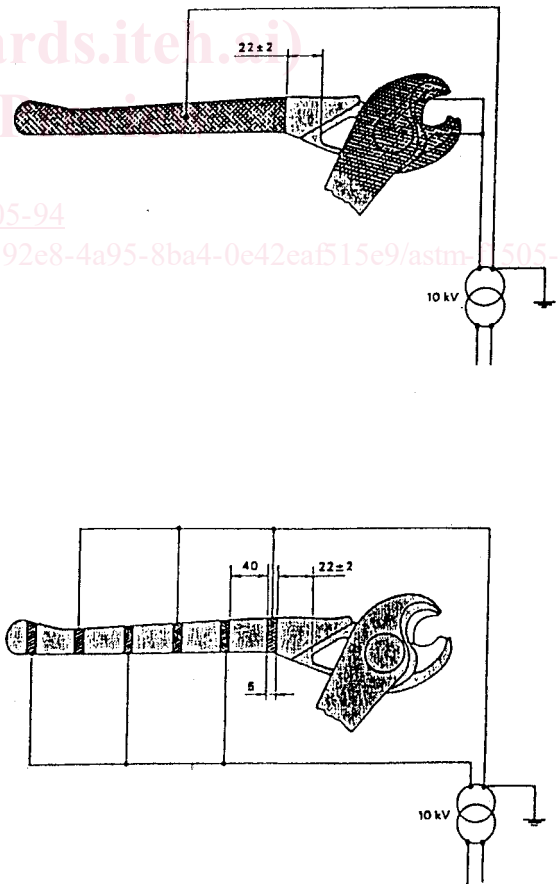
7.4.2.2 A voltage of 10 kV rms at commercial power frequencies shall be continuously applied for 3 min in accordance with Test Method D 149 between the working head and the handle of the tool. Measure the leakage current. The test is successful if no electrical puncture or flashover occurs during the test period, and if the leakage current measured is less than 0.5 mA.

7.4.2.3 *Tools Having Two or More Working Heads*—Repeat



NOTE 1—Dimensions in millimetres.
NOTE 2—a = conductive working head,
b = tap water bath,
c = insulated part of the tool, and
d = gap to be maintained between the two inner sides of the legs.

FIG. 5 Electric Testing Device for Insulated Tools



(*a*) Dielectric Test Between the Working Head and the Handle or the Legs
(*b*) Dielectric Test of the Handle or Legs

FIG. 6 Dielectric Testing Device for Insulating Tools

the same test as in 7.4.2.2 in all configurations.

7.4.3 *Dielectric Test of the Handles*—The purpose of this test is to check the dielectric quality of the material used for the handles. Electrodes (see Fig. 6) of conductive tape, foil, or conductive paint 5 mm (3⁄16 in.) wide are placed on the surface of the handles at 40 mm (1 19⁄32 in.) spacing. Continuously apply a voltage of 10 kV rms at commercial power frequencies for 3 min in accordance with Test Methods D 149 between two consecutive electrodes. The test is considered passed if no electrical puncture or flashover occurs during the test period and if the leakage current is less than 0.5 mA multiplied by the number of spaces between the electrodes.

7.5 *Indentation Tests*:

7.5.1 All parts of the insulated coating electrically tested in accordance with 7.4 shall pass this test. Perform the test on the most vulnerable part(s) for screwdrivers with insulated blades, and for other tools, at the external middle part of the handles.

7.5.2 If the radius, *r*, at the test point is greater than or equal to 10 mm (3⁄8 in.), make the test with a test device in accordance with Fig. 7 in a heating chamber with natural ventilation. The part of the mass, *M*, that contacts the test piece shall be a stainless steel hemispheric nose piece of 5-mm (3⁄16-in.) diameter. The force shall be 20 N (4.5 lbf).

7.5.3 If the radius, *r*, at the test point is less than 10 mm (3⁄8 in.), use a rod of 5 mm (3⁄16 in.) diameter at least 30 mm (1 3⁄16 in.) length with the same force, *F*, of 20 N (4.5 lbf) placed at right angles to the tool axis (see Fig. 8).

7.5.4 Position the tool in such a way that the insulating material coating at the test point is in a horizontal position. After setting up the testing device, hold the arrangement in accordance with Methods D 618 (2 h/70°C/<20 %). At the end of the heating time and after a cooling period outside the chamber of 5 min, apply a voltage of 10 kV rms at commercial power frequencies continuously between the testing device and the conductive part of the tool for 3 min in accordance with Test Method D 149. The test is successful if no electrical puncture, sparkover, or flashover occurs during the test period.

7.6 *Test for Adhesion of the Insulating Material Coating for Insulated Tools*:

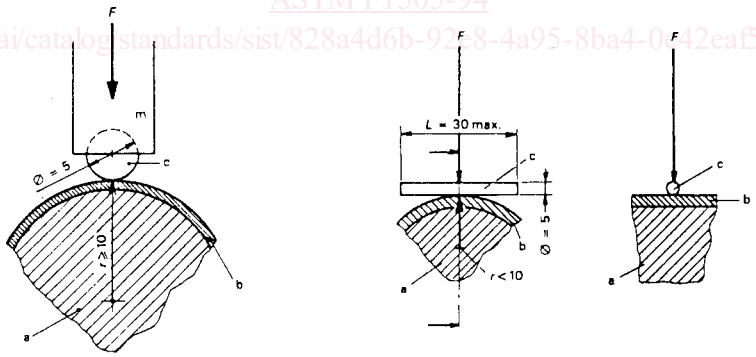
7.6.1 *Conditioning*— Condition the tools before the test in a heating chamber with normal ventilation at a temperature of 70 ± 2°C for 168 h in accordance with Test Method D 149. Carry out the following tests at room temperature between the third and fifth minute after removal from the heating chamber in accordance with Method D 618.

7.6.2 *Test on the Working Head*—Make the test on the following tools: wrenches (that is, open-end, box-end, and adjustable wrenches); any other tool with a covered working head; and tools capable of being assembled (except for pieces acting as screwdrivers). The test may be carried out using either method in Fig. 8 and Fig. 9 respectively.

7.6.2.1 *Test Method A (See* Fig. 8*)*—Place a hook having a cutting edge of 5-mm (3⁄16 in.) width in such a manner that it does not touch the conductive part. Apply a force, *F*, of 50 N (11.25 lbf) in the direction of the line dividing the insulating material coating from the conductive part for 3 min.

7.6.2.2 *Test Method B (See* Fig. 10*)*—Place a device having the cutting edges, each of 5-mm (3⁄16-in.) width, on the working head in such a manner they do not touch the conductive part. Apply a force, *F*, of 100 N (22.4 lbf) in the direction of the dividing line of the insulating material coating and the conductive part for 3 min.

7.6.2.3 Either test is considered passed if the insulating material coating does not move more than 3 mm (1⁄8 in.) from



(*a*) Radius at the Test Point of the Tool≥ 10 mm
(*b*) Radius at the Test Point of the Tool < 10 mm

NOTE 1—Dimensions in millimetres.
NOTE 2—For Fig. 7(*a*):
a = conductive part,
b = insulation (test point),
c = hemispheric nose-piece,
r = radius at the test point of the tool, and
m = testing mass.
NOTE 3—For Fig. 7(*b*):
a = conductive part,
b = insulation (test point),
c = rod, and
d = radius at the test point of the tool.

FIG. 7 Indentation Test