# इंटरनेट मानक

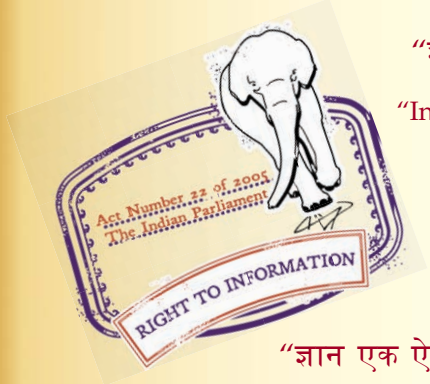
## Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 10322-3 (1984): Luminaires, Part 3: Screw and Screwless Terminals (Superseding IS 6585) [ETD 24: Illumination Engineering and Luminaries]




"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"


"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

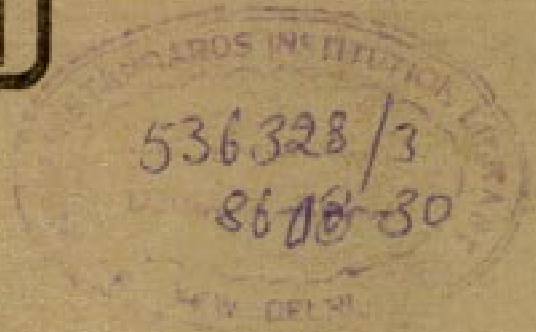

IS : 10322 ( Part 3 ) - 1984
( Superseding IS : 6585 - 1972 )
( Reaffirmed 2005 )

# *Indian Standard*

# SPECIFICATION FOR LUMINAIRES

## PART 3 SCREW AND SCREWLESS TERMINALS

UDC 628·95 : 621·315·684






INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 7

*February* 1986

**IS : 10322 ( Part 3 ) - 1984**
**( Superseding IS : 6585 - 1972 )**

# *Indian Standard*

# SPECIFICATION FOR LUMINAIRES

## PART 3 SCREW AND SCREWLESS TERMINALS



( *Continued on page* 2 )

( *Continued from page* 1 )

| *Members* | *Representing* |
|---|---|
| SHRI S. B. NIYOGI | Directorate of Technical Development and Production ( Air ) |
| SHRI J. K. GHOSH ( *Alternate* ) | |
| SHRI J. R. PARI | The General Electric Co of India Ltd, Calcutta |
| SHRI S. K. NEOGI ( *Alternate* ) | |
| LT-COL B. B. RAJPAL | Engineer-in-Chief's Branch, Army Headquarters |
| SHRI R. S. KANWAR ( *Alternate* ) | |
| SHRI K. S. SARMA | National Physical Laboratory ( CSIR ), New Delhi |
| SHRI K. P. SHANBHOGUE | National Industrial Development Corporation Ltd, New Delhi |
| SHRI H. SINHA | Illuminating Engineering Society of India, Calcutta |
| SHRI K. K. ROHATGI ( *Alternate* ) | |
| SHRI V. K. SOOD | The Mysore Lamp Works Ltd, Bangalore |
| SHRI SURESH DHINGRA ( *Alternate* ) | |
| SHRI P. N. SRINIVASAN | PNS Lighting Design & Consultancy, Bangalore |
| SHRI G. S. SRIVASTAVA | Metallurgical Engineering & Consultants, Ranchi |
| SHRI H. S. SAINI ( *Alternate* ) | |
| SHRI G. N. THADANI | Engineers India Ltd, New Delhi |
| SHRI S. K. GHOSH ( *Alternate* ) | |
| SHRI S. P. SACHDEV, Director ( Elec tech ) | Director General, ISI ( *Ex-officio Member* ) |

*Secretary*

SHRI SUKH BIR SINGH
Deputy Director ( Elec tech ), ISI

## Panel for Preparing Standards for Luminaires in Multipart, ETDC 45/P11

*Convener*

| | |
|---|---|
| SHRI P. K. BANDYOPADHYAY | Peico Electronics & Electricals Ltd, Bombay |

*Members*

| | |
|---|---|
| SHRI P. K. SANYAL ( *Alternate* to Shri P. K. Bandyopadhyay ) | |
| SHRI N. S. CHARI | Crompton Greaves Ltd, Bombay |
| CHIEF ENGINEER ( ELEC ) - II | Central Public Works Department, New Delhi |
| SURVEYOR OF WORKS (E) - III ( *Alternate* ) | |
| SHRI V. H. NAVKAL | The Bombay Electric Supply & Transport Undertaking, Bombay |
| SHRI S. H. MILLER ( *Alternate* ) | |
| SHRI J. R. PARI | Genelec Limited, Bombay |
| SHRI K. S. SARMA | National Physical Laboratory ( CSIR ), New Delhi |
| SHRI P. N. SRINIVASAN | PNS Lighting Design and Consultancy, Bangalore |

# *Indian Standard*

# SPECIFICATION FOR LUMINAIRES

## PART 3 SCREW AND SCREWLESS TERMINALS

## 0. FOREWORD

**0.1** This Indian Standard ( Part 3 ) was adopted by the Indian Standards Institution on 8 June 1984 after the draft finalized by the Illuminating Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

**0.2** This standard is one of the series of Indian Standards which deals with luminaires. This series will have the following parts:

Part 1 General requirements,

Part 2 Constructional requirements,

Part 3 Screw and screwless terminals,

Part 4 Methods of tests, and

Part 5 Particular requirements.

**0.3** In general, Parts 1, 2, 3 and 4 of this standard cover safety requirements for luminaires. The object of these parts is to provide a set of requirements and tests which are considered to be generally applicable to most of the types of luminaires and which can be called up as required by the detail specifications under Part 5. Parts 1, 2, 3 and 4 are thus not to be regarded as specifications by themselves for any type of luminaires, and their provisions shall apply only to particular types of luminaires to the extent determined by the appropriate section of Part 5.

**0.4** A luminaire shall comply with one of the section of Part 5. If, however, an appropriate section of Part 5 does not exist for a particular luminaire or group of luminaires, the nearest applicable section of Part 5 may be used as a guide to the requirements and tests.

**0.5** The different sections of Part 5, in making reference to any other part of this standard, specify the extent to which that section is applicable and the order in which the tests are to be performed; they also include additional requirements as necessary.

**0.6** This standard covers the requirements of screw and screwless terminals and their electrical connections for luminaires. With the publication of this standard, IS : 6585-1972* which covered earlier the requirements for screwless terminals will be withdrawn.

**0.7** This standard is intended to establish essential requirements of general nature and minimum standard for design and construction of lighting fittings in order to ensure their safe performance, good construction and high class of workmanship.

**0.8** In the preparation of this standard assistance has been derived from IEC Publication: 598-1 ( 1979 ): Luminaires: Part 1 General requirements and tests published by the International Electrotechnical Commission.

**0.9** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## 1. SCOPE

**1.1** This standard ( Part 3 ) specifies the requirements of screw and screwless terminals and their electrical connections for luminaires for use with tungsten filament, tubular fluorescent and other discharge lamps on supply voltages not exceeding 1 000 V.

**1.2** In the case of screwless terminals the standard specifies requirements, excluding dimensions, for all types of terminals and electrical connections which do not employ screws, for solid or stranded copper conductors up to 2·5 $mm^2$, for internal wiring of luminaires and for connections to external wiring of luminaires.

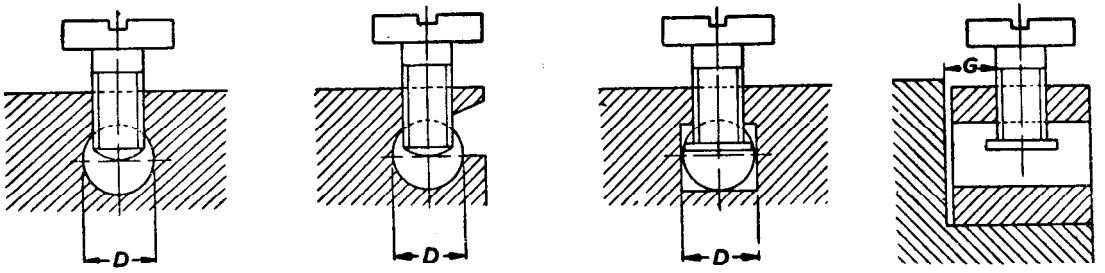
**1.3** Examples of screw terminals are shown in Fig. 1 to 5.

**1.4** Examples of screwless terminals are shown in Fig. 6 to 8.

## 2. TERMINOLOGY

**2.0** For the purpose of this standard the following definitions shall apply.

*Specification for screwless terminal and electrical connections for lighting fittings.
†Rules for rounding off numerical values ( *revised* ).




Terminals without pressure plate

Terminals with pressure plate

$D$ = Conductor space

$G$ = Distance between clamping screw and end of conductor when fully inserted ( in mm )

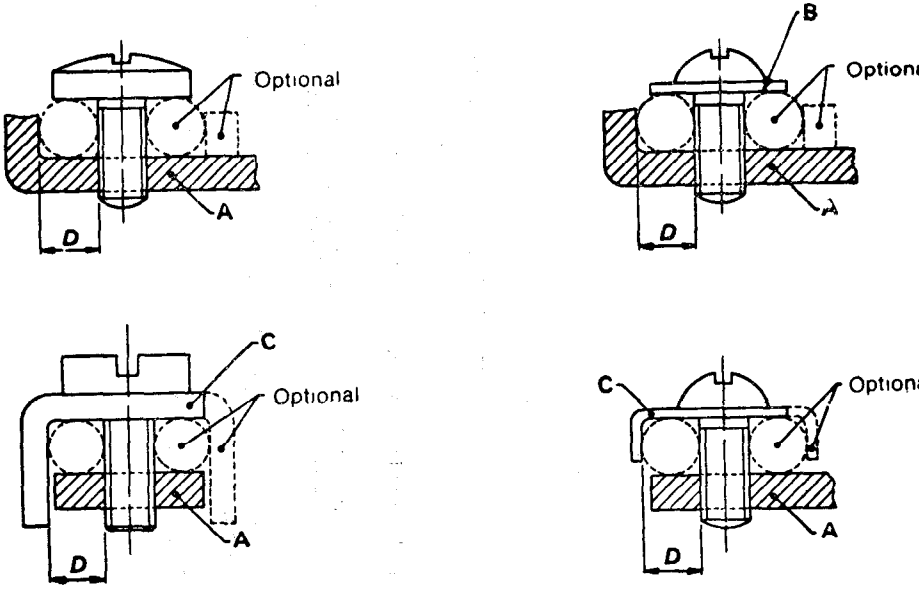
NOTE — The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts, as in the case of terminals provided with stirrup.

The shape of the conductor space may differ from those shown, provided a circle with a diameter equal to the minimum value specified for $D$ can be inscribed.

FIG. 1 PILLAR TERMINALS

Screw not requiring washer or clamping plate

Screw requiring washer or clamping plate

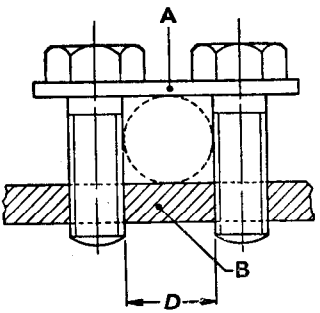


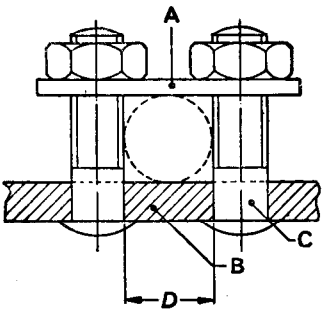

Screw terminals


*A* = Fixed part
*B* = Washer or clamping plate
*C* = Anti-spread device
*D* = Conductor space
*E* = Stud

NOTE — The part which retains the conductor in position may be of insulating material provided the pressure necessary to clamp the conductor is not transmitted through the insulating material.

FIG. 2 SCREW TERMINALS AND STUD TERMINALS



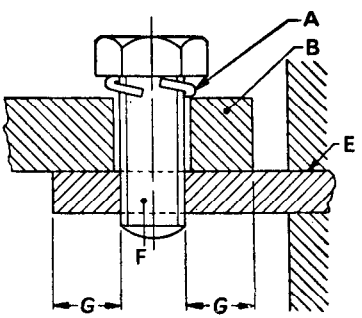

*A* = Saddle
*B* = Fixed part
*C* = Stud
*D* = Conductor space

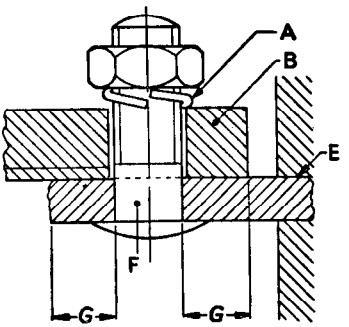
NOTE — The shape of the section of the conductor space may differ from that shown in the figures, provided a circle with a diameter equal to the minimum value specified for *D* can be inscribed.

The shape of the upper and lower faces of the saddle may be different to accommodate conductors of either small or large cross-sectional area, by reversing the saddle.

The terminals may have more than two clamping screws or studs.

FIG. 3 SADDLE TERMINALS

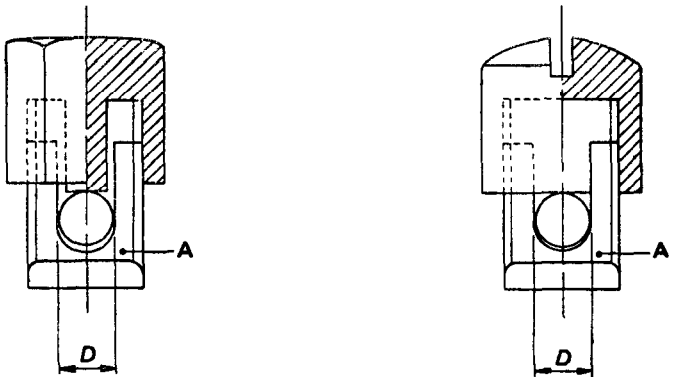



*A* = Locking means
*B* = Cable lug or bar
*E* = Fixed part
*F* = Stud
*G* = Distance between edge of hole and side of clamping area

NOTE — For certain types of equipment, the use of lug terminals of a size smaller than those specified is allowed.

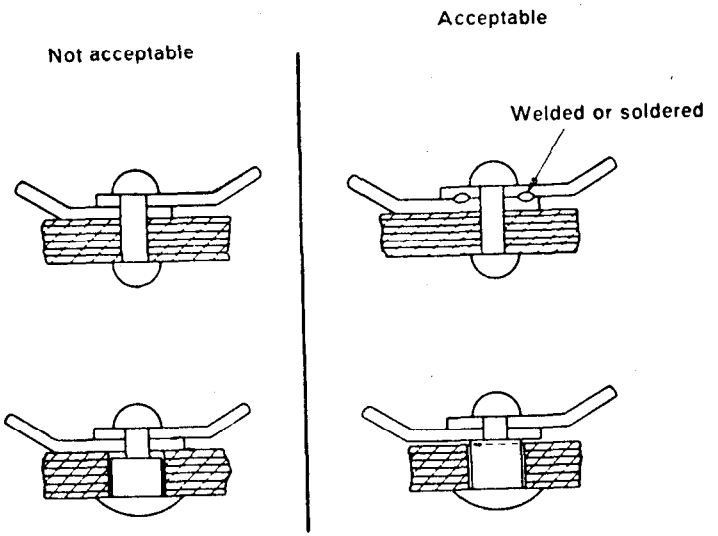
FIG. 4 LUG TERMINALS




$A$ = Fixed Part

$B$ = Conductor space

FIG. 5 MANTLE TERMINALS




The pressure essential for good electrical conductivity is independent of the insulating material if the connection is not influenced by removing the insulating material

FIG. 6 CONSTRUCTION OF ELECTRICAL CONNECTIONS

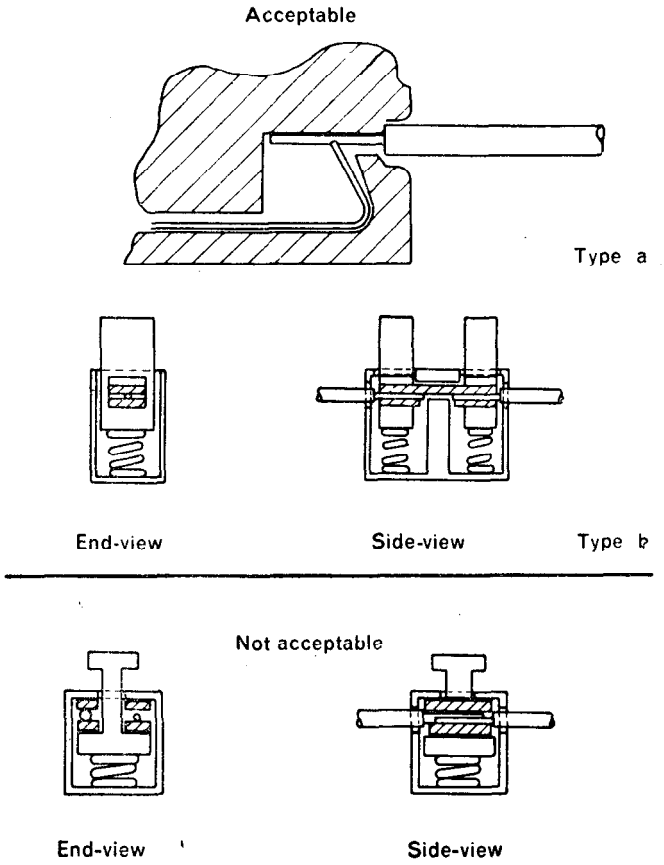



FIG. 7 EXAMPLES OF SPRING-TYPE SCREWLESS TERMINALS

## 2.1 Terms Relating to Screw Terminals

**2.1.1** *Pillar Terminal* — A terminal in which the conductor is inserted in a hole or cavity, where it is clamped under the shank of the screw or screws. The clamping pressure may be applied directly by the shank of the screw or through an intermediate clamping member to which pressure is applied by the shank of the screw.

Examples of pillar terminals are shown in Fig. 1.

**2.1.2** *Screw Terminal* — A terminal in which the conductor is clamped under the head of the screw. The clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device.

Examples of screw terminals are shown in Fig. 2.

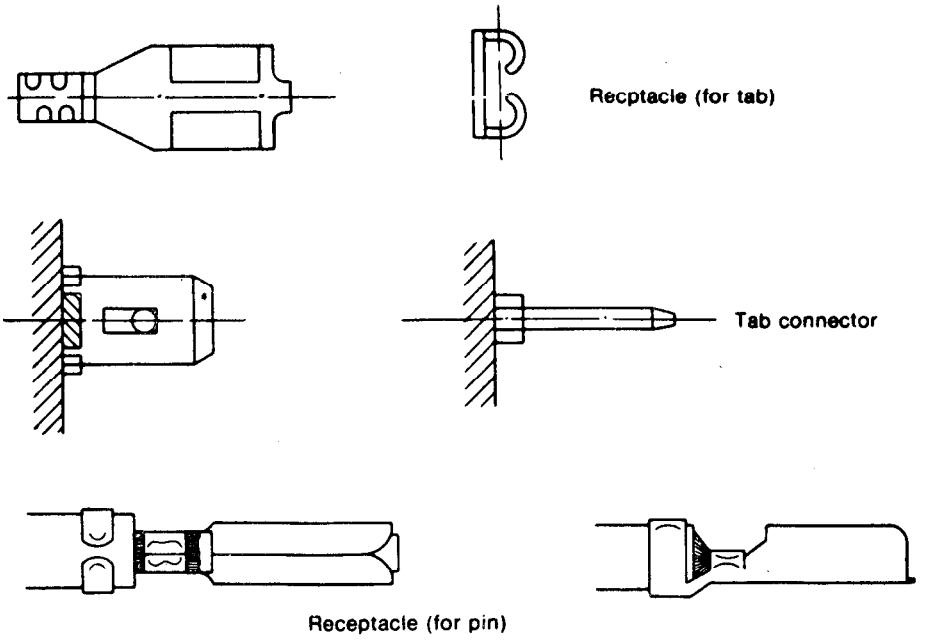



FIG. 8 FURTHER EXAMPLES OF SCREWLESS TERMINALS — *Contd*

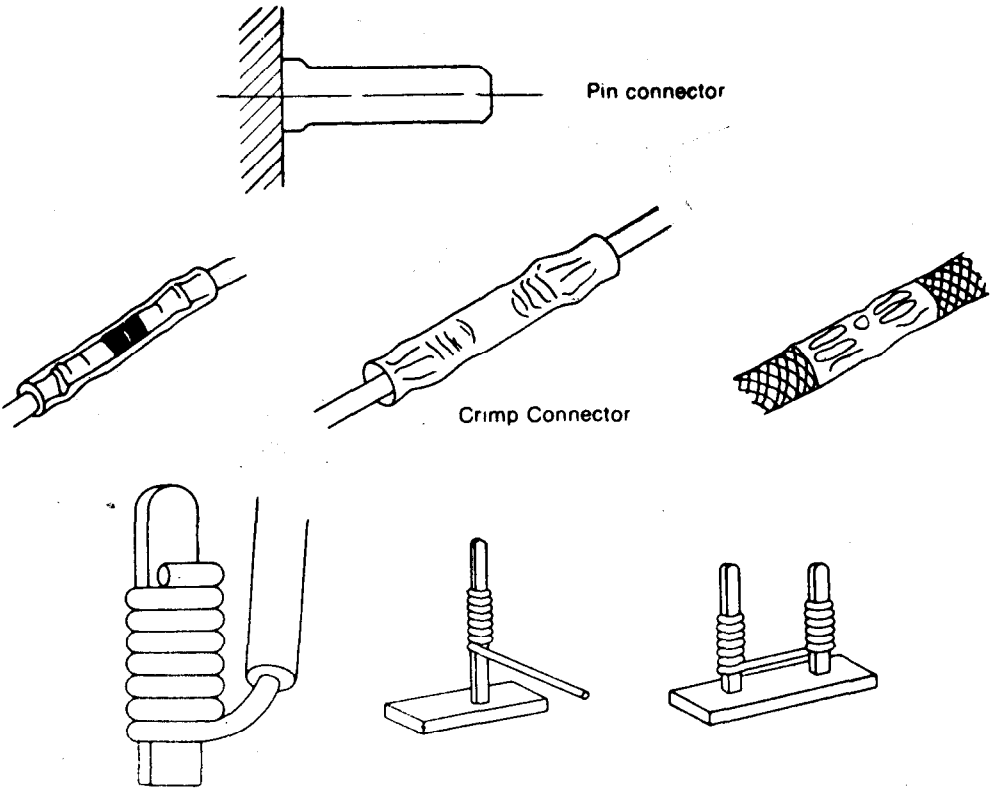



FIG. 8 FURTHER EXAMPLES OF SCREWLESS TERMINALS

**2.1.3** *Stud Terminal* — A terminal in which the conductor is clamped under a nut. The clamping pressure may be applied directly by a suttable shaped nut or through an intermediate part, such as a washer, clamping plate or anti-spread device.

Examples of stud terminals are shown in Fig. 2.

**2.1.4** *Saddle Terminal* — A terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts.

Examples of saddle terminals are shown in Fig. 3.

**2.1.5** *Lug Terminals* — A screw terminal or a stud terminal, designed for clamping a cable lug or bar by means of a screw or nut.

Examples of lug terminals are shown in Fig. 4.

**2.1.6** *Mantle Terminal* — A terminal in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut. The conductor is clamped against the base of the slot by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut, or by equally effective means for transmitting the pressure from the nut to the conductor within the slot.

Examples of mantle terminals are shown in Fig. 5.

### 2.2 Terms Relating to Screwless Terminals

**2.2.1** *Screwless Terminals* — Parts required to make connections in electrical circuits by mechanical means without screws.

**2.2.2** *Permanent Connections* — Connections designed to be made only once with the same conductor ( for example, wire wrapping or crimping ).

**2.2.3** *Non-permanent Connections* — Connections which allow lead assemblies or conductors to be connected and disconnected several times ( for example, pin or tab and receptacle, or some spring-type terminals ).

**2.2.4** *Lead Assemblies* — Conductors fitted with auxiliary parts usually by permanent connections.

**2.2.5** *Non-prepared Conductors*— Conductors without special preparation or auxiliary parts. Insulation may, however, be stripped to expose the conductor.

The term 'special preparation' covers the application of additional solder to the strands of the conductor, use of cable lugs, tabs and receptacles, formation of eyelets, etc, but not the reshaping of the conductor for its introduction into the terminal or the twisting of a stranded conductor to consolidate the end.

**2.2.6** *Test Current* — The current assigned to a terminal or connection by the manufacturer. When terminals are part of a component, the test current shall be the rated current of the component.

## SECTION 1 SCREW TERMINALS

### 3. GENERAL REQUIREMENTS AND BASIC PRINCIPLES

**3.1** These requirements apply to terminals with screw clamping carrying a current not exceeding 63 A, intended for the connection, by clamping only, of copper conductors of cables and flexible cords.

These requirements do not exclude terminals of types other than those shown in Fig. 1 to 5.

**3.2** Terminals are of varied design and have different shapes : they include, among others, terminals in which the conductor is clamped directly or indirectly under the shank of the screw, terminals in which the conductor is clamped directly or indirectly under the head of the screw, terminals in which the conductor is clamped directly or indirectly under a nut, and terminals intended solely for use with cable lugs or bars.

The basic principles governing these requirements are specified in **3.2.1** to **3.2.3.**

**3.2.1** Terminals are primarily for the connection of only one conductor, although, owing to the wide range of conductors that each terminal is required to clamp, they may in some cases be suitable for clamping two conductors having the same nominal cross-sectional area, which is smaller than the maximum value for which the terminal is designed.

Certain types of terminals, in particular pillar terminals and mantle terminals, may be used for looping-in, when two or more conductors of the same or different nominal cross-sectional area or composition have to be connected. In such cases, the terminal sizes specified in this standard may not be applicable.

**3.2.2** In general, terminals will be suitable for the connection of cables and flexible cords without special preparation of the conductor but provision is made in certain cases for connection by means of cable lugs or for connection to bars.

**3.2.3** A numerical classification for terminals is adopted, based on the nominal cross-sectional areas of the conductors that the terminal can accept. According to this classification each terminal can accept any one of three successive sizes of conductors in the range of nominal cross-sectional areas specified in relevant Indian Standard on cables.

With one exception, the sizes of the conductors within each range advance by one step for each increase in the size of the terminal.

The nominal cross-sectional areas of the conductors assigned to each terminal are given in Table 1 which also gives the diameter of the largest conductor that each terminal can accept.

**3.3** Terminals shall allow the proper connection of copper conductors having nominal cross-sectional areas as given in Table 2 and the conductor space shall be at least that given in Tables 6, 7, 8 or 10 as appropriate.

These requirements do not apply to lug terminals.

**TABLE 1 NOMINAL CROSS-SECTIONAL AREAS OF CONDUCTORS ACCORDING TO TERMINAL SIZE**

( *Clause* 3.2.3 )

| Terminal Size | Flexible Conductors | | | | Rigid Conductors, Solid or Stranded | | | |
|---|---|---|---|---|---|---|---|---|
| | Nominal Cross-Sectional Area | | | Diameter of Largest Conductor | Nominal Cross-Sectional Area | | | Diameter of Largest Conductor |
| | mm² | mm² | mm² | mm | mm² | mm² | mm² | mm |
| 0* | 0·5 | 0·75 | 1 | 1·45 | — | — | — | — |
| 1† | 0·75 | 1 | 1·5 | 1·73 | 0·75 | 1 | 1·5 | 1·45 |
| 2 | 1 | 1·5 | 2·5 | 2·21 | 1 | 1·5 | 2·5 | 2·13 |
| 3 | 1·5 | 2·5 | 4 | 2·84 | 1·5 | 2·5 | 4 | 2·72 |
| 4‡ | 2·5 | 4 | 6 | 3·87 | 2·5 | 4 | 6 | 3·34 |
| 5 | 2·5 | 4 | 6 | 4·19 | 4 | 6 | 10 | 4·32 |
| 6 | 4 | 6 | 10 | 5·31 | 6 | 10 | 16 | 5·46 |
| 7 | 6 | 10 | 16 | 6·81 | 10 | 16 | 25 | 6·83 |

*Not suitable for rigid conductors.

†Also suitable for flexible conductors having a nominal cross-sectional areas of 0·5 mm², if the end of the conductor is folded back on itself.

‡Not suitable for 6 mm² flexible conductors of some special constructions.

Compliance shall be checked by inspection, by measurement and by fitting conductors of the smallest and largest cross-sectional areas specified.

**3.4** Terminals shall provide adequate connection of the conductors. Compliance shall be checked by carrying out all the tests specified.

## 4. MECHANICAL TESTS

**4.1** For pillar terminals, the distance between the clamping screw and the end of the conductor when fully inserted, shall be at least that given in Table 6.

The minimum distance between the clamping screw and the end of the conductor applies only to pillar terminals through which the conductor cannot pass.

For mantle terminals, the distance between the fixed part and the end of the conductor when fully inserted, shall be at least that given in Table 10.

**TABLE 2 NOMINAL CROSS-SECTIONAL AREAS OF CONDUCTORS ACCORDING TO MAXIMUM CURRENT**

( *Clauses* 3.3, 4.1 *and* 4.6.1 )

| Maximum Current Carried by the Terminal | Flexible Conductors | | Rigid Conductors, Solid or Stranded | |
|---|---|---|---|---|
| | Nominal Cross-Sectional Areas* | Terminal Size | Nominal Cross-Sectional Areas | Terminal Size |
| A | $mm^2$ | | $mm^2$ | |
| 6 | 0·5 to 1 | 0 | 0·75 to 1·5 | 1 |
| 10 | 0·75 to 1·5 | 1 | 1 to 2·5 | 2 |
| 16 | 1 to 2·5 | 2 | 1·5 to 4 | 3 |
| 20 | 1·5 to 4 | 3 | 1·5 to 4 | 3 |
| 25 | 1·5 to 4 | 3 | 2·5 to 6 | 4 |
| 32 | 2·5 to 6 | 4 or 5† | 4 to 10 | 5 |
| 40 | 4 to 10 | 6 | 6 to 16 | 6 |
| 63 | 6 to 16 | 7 | 10 to 25 | 7 |

*These requirements do not apply to terminals used for the interconnection of different components of luminaires by means of cables or flexible cords not complying with relevant Indian Standard, if the other requirements of this standard are met.

†Terminal size 4 is not suitable for 6 $mm^2$ flexible conductors of some special constructions, in which case terminal size 5 should be used.

Compliance shall be checked by measurement, after a solid conductor of the largest cross-sectional area given in Table 2 has been fully inserted and fully clamped.

**4.2** Terminals shall be so designed or placed that neither a solid conductor nor a strand of a stranded conductor can slip out while the clamping screws or nuts are being tightened.

This requirement does not apply to lug terminals.

Compliance shall be checked by the following tests :

Terminals are fitted with a conductor having the composition given in Table 3.

Before insertion in the terminal, strands of rigid conductors are straightened and flexible conductors are twisted in one direction so that there is a uniform twist of one complete turn in a length of approximately 20 mm.

TABLE 3 COMPOSITION OF CONDUCTORS

( *Clause* 4.2 )

| Terminal Size | Number of Strands and Nominal Diameter of Strands in Millimetres | |
|---|---|---|
| | Flexible Conductors | Rigid Stranded Conductors |
| 0 | 32 × 0·20 | — |
| 1 | 30 × 0·25 | 7 × 0·50 |
| 2 | 50 × 0·25 | 7 × 0·67 |
| 3 | 56 × 0·30 | 7 × 0·85 |
| 4 | 84 × 0·30 | 7 × 1·04 |
| 5 | 84 × 0·30 | 7 × 1·35 |
| 6 | 80 × 0·40 | 7 × 1·70 |
| 7 | 126 × 0·40 | 7 × 2·14 |

The conductor is inserted in the terminal for the minimum distance prescribed or, where no distance is prescribed, until it just projects from the far side of the terminal and in the position most likely to assist the strand to slip out. The clamping screw is then tightened with a torque equal to two-thirds of that given in the appropriate column of Table 4.

For flexible conductors, the test is repeated with a new conductor which is twisted as before, but in the opposite direction.

After the test, no strand of the conductor shall have slipped out through the gap between the clamping means and the retaining device.

**4.3** Terminal sizes up to and including size 5 shall allow the conductor to be connected without special preparation.

Compliance shall be checked by inspection.

The term 'special preparation' covers the application of additional solder to the strands of the conductor, use of cable lugs, formation of eyelets, etc, but not the reshaping of the conductor for its introduction into the terminal or the twisting of a stranded conductor to consolidate the end.

**4.4** Terminals shall have adequate mechanical strength.

Screws and nuts for clamping the conductors shall have a metric ISO thread. Terminals for external wiring shall not serve to fix any other component, except that they may also clamp internal conductors if these are so arranged that they are unlikely to be displaced when fitting external conductors.

Screws shall not be made out of such metal which is soft or liable to creep, such as zinc or aluminium.

Compliance shall be checked by inspection and by the test of **3.3, 4.6** and **4.7.**

**4.5** Terminals shall be resistant to corrosion.

Compliance shall be checked by the corrosion test specified in Part 2 of this standard.

**4.6** Terminals shall be fixed to the luminaire or to a terminal block otherwise fixed in position. When the clamping screws or nuts are tightened or loosened, the terminals shall not work loose, internal wiring shall not be subjected to stress, and creepage distances and clearances shall not be reduced below the values specified in Part 4 of this standard.

These requirements do not imply that the terminals should be so designed that their rotation or displacement is prevented, but any movement shall be sufficiently limited so as to ensure compliance with this standard.

Covering with sealing compound or resin is sufficient to prevent a terminal from working loose, provided that the sealing compound or resin is not subject to stress during normal use and the effectiveness of the sealing compound or resin is not impaired by temperature attained by the terminal under the most unfavourable conditions specified in endurance test and thermal tests covered in Part 4 of this standard.

**4.6.1** Compliance shall be checked by inspection, by measurement and by the following test :

A rigid copper conductor of the largest cross-sectional area given in Table 2 is placed in the terminal.

Screws and nuts are tightened and loosened five times by means of a suitable test screw driver or wrench, the torque applied when tightening being equal to that given in the appropriate column of Table 4 or in the appropriate Tables 6, 7, 8, 9 and 10, whichever is the higher.

The conductor is moved each time the screw or nut is loosened.

Column I applies to screws without heads if the screw when tightened does not protrude from the hole, and to other screws which cannot be tightened by means of a screw driver with a blade wider than the diameter of the screw.

Column II applies to nuts of mantle terminals with cap nuts which are tightened by means of a screwdriver.

Column III applies to other screws which are tightened by means of a screwdriver.

Column IV applies to screws and nuts, other than nuts of mantle terminals, which are tightened by means other than a screwdriver.

Column V applies to nuts of mantle terminals in which the nut is tightened by means other than a screwdriver.

Where a screw has a hexagonal head with means for tightening with a screwdriver and the values in columns III and IV are different, the test is made twice, first applying to the hexagonal head the torque given in column IV, and then on another set of samples, applying the torque given in column III by means of a screwdriver. If the values in columns III and IV are the same, only the test with the screwdriver is made.

During the test, terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups that will impair the further use of the terminals.

For mantle terminals, the specific nominal diameter is that of the slotted stud.

The shape of the blade of the test screwdriver shall suit the head of the screw to be tested. The screws and nuts shall not be tightened in jerks.

**TABLE 4 TORQUE TO BE APPLIED TO SCREWS AND NUTS**

( *Clauses* 4.2 *and* 4.6.1 )

| Nominal Diameter of Thread | Torque (Nm) | | | | |
|---|---|---|---|---|---|
| mm | I | II | III | IV | V |
| Up to and including 2·8 | 0·2 | — | 0·4 | 0·4 | — |
| Over 2·8 up to and including 3·0 | 0·25 | — | 0·5 | 0·5 | — |
| Over 3·0 up to and including 3·2 | 0·3 | — | 0·6 | 0·6 | — |
| Over 3·2 up to and including 3·6 | 0·4 | — | 0·8 | 0·8 | — |
| Over 3·6 up to and including 4·1 | 0·7 | 1·2 | 1·2 | 1·2 | 1·2 |
| Over 4·1 up to and including 4·7 | 0·8 | 1·2 | 1·8 | 1·8 | 1·8 |
| Over 4·7 up to and including 5·3 | 0·8 | 1·4 | 2·0 | 2·0 | 2·0 |
| Over 5·3 up to and including 6·0 | — | 1·8 | 2·5 | 3·0 | 3·0 |
| Over 6·0 up to and including 8·0 | — | 2·5 | 3·5 | 6·0 | 4·0 |
| Over 8·0 up to and including 10·0 | — | 3·5 | 4·0 | 10·0 | 6·0 |
| Over 10·0 up to and including 12·0 | — | 4·0 | — | — | 8·0 |
| Over 12·0 up to and including 15·0 | — | 5·0 | — | — | 10·0 |

**4.7** Terminals shall clamp the conductor reliably between metal surfaces.

For lug terminals, a spring washer, or equally effective locking means, shall be provided and the surface within the clamping area shall be smooth.

For mantle terminals, the bottom of the conductor space shall be slightly rounded in order to obtain a reliable connection.

Compliance shall be checked by inspection and by the following test:

The terminals are fitted with rigid conductors of the smallest and largest cross-sectional areas given in Table 2, the terminal screws being tightened with a torque equal to two-thirds of that given in the appropriate column of Table 4.

If the screw has a hexagonal head with a slot, the torque applied is equal to two-thirds of that given in column 4 of that table.

Each conductor is then subjected to a pull of the value, in newtons, given in Table 5; the pull is applied without jerks, for 1 min, in the direction of the axis of the conductor space.

During the test, the conductor shall not move noticeably in the terminal.

**TABLE 5 PULL TO BE APPLIED TO CONDUCTOR**

( *Clause* 4.7 )

| Terminal size | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Pull (N) | 30 | 40 | 50 | 50 | 60 | 80 | 90 | 100 |

**4.8** Terminals shall clamp the conductor without undue damage to the conductor.

Compliance shall be checked by inspection of the conductors, after conductors of the smallest and largest cross-sectional areas given in Table 2 has been clamped once and loosened, the torque applied to clamp the conductor being equal to two-thirds of that given in Table 4.

If the screw has hexagonal head with a slot, the torque applied is equal to two-thirds of that given in column IV of Table 4.

NOTE — Conductors are unduly damaged if they show deep or sharp indentations.

## TABLE 6 PILLAR TERMINALS

( *Clauses* 3.3 *and* 4.1 *and Fig.* 1 )

| Terminal Size | Minimum Diameter *D* of Conductor Space | Minimum Distance *G* Between Clamping Screw and End of Conductor When Fully Inserted | | Torque (Nm) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | I* | | III* | | IV* | |
| | | One Screw | Two Screw | One screw | Two screws | One screw | Two screws | One screw | Two screws |
| | mm | mm | mm | | | | | | |
| 1 | 2·5 | 1·5 | 1·5 | 0·2 | 0·2 | 0·4 | 0·4 | 0·4 | 0·4 |
| 2 | 3·0 | 1·5 | 1·5 | 0·25 | 0·2 | 0·4 | 0·4 | 0·5 | 0·4 |
| 3 | 3·6 | 1·8 | 1·5 | 0·4 | 0·2 | 0·8 | 0·4 | 0·8 | 0·4 |
| 4 | 4·0 | 1·8 | 1·5 | 0·4 | 0·25 | 0·8 | 0·5 | 0·8 | 0·5 |
| 5 | 4·5 | 2·0 | 1·5 | 0·7 | 0·25 | 1·2 | 0·5 | 1·2 | 0·5 |
| 6 | 5·5 | 2·5 | 2·0 | 0·8 | 0·7 | 2·0 | 1·2 | 2·0 | 1·2 |
| 7 | 7·0 | 3·0 | 2·0 | 1·2 | 0·7 | 2·5 | 1·2 | 3·0 | 1·2 |

*The torque values specified apply to the screws covered by the corresponding columns in Table 4.

## TABLE 7 SCREW TERMINALS AND STUD TERMINALS

( *Clauses* 3.3 *and* 4.6.1 *and Fig.* 2 )

| Terminal Size | Minimum Diameter *D* of Conductor Space | Torque ( Nm ) | | | |
|---|---|---|---|---|---|
| | | III* | | IV* | |
| | | One screw | Two screws | One screw or stud | Two screws or studs |
| | mm | | | | |
| 0 | 1·4 | 0·4 | — | 0·4 | — |
| 1 | 1·7 | 0·5 | — | 0·5 | — |
| 2 | 2·0 | 0·8 | — | 0·8 | — |
| 3 | 2·7 | 1·2 | 0·5 | 1·2 | 0·5 |
| 4 | 3·6 | 2·0 | 1·2 | 2·0 | 1·2 |
| 5 | 4·3 | 2·0 | 1·2 | 2·0 | 1·2 |
| 6 | 5·5 | 2·0 | 1·2 | 2·0 | 1·2 |
| 7 | 7·0 | 2·5 | 2·0 | 3·0 | 2·0 |

*The torque values specified apply to the screws or studs covered by the corresponding columns in Table 4.

**TABLE 8 SADDLE TERMINALS**

( *Clauses* 3.3 *and* 4.6.1 *and Fig.* 3 )

| Terminal Size | Minimum Diameter *D* of Conductor Space | Torque |
|---|---|---|
| | mm | Nm |
| 3 | 3·0 | 0·5 |
| 4 | 4·0 | 0·8 |
| 5 | 4·5 | 1·2 |
| 6 | 5·5 | 1·2 |
| 7 | 7·0 | 2·0 |

**TABLE 9 LUG TERMINALS**

( *Clause* 4.6.1 *and Fig.* 4 )

| Terminal Size | Minimum Distance *G* Between Edge of Hole and Side of Clamping Area | Torque | |
|---|---|---|---|
| | | III* | IV* |
| | mm | Nm | Nm |
| 6 | 7·5 | 2·0 | 2·0 |
| 7 | 9·0 | 2·5 | 3·0 |

*The torque values specified to the studs covered by the corresponding columns in Table 4.

**TABLE 10 MANTLE TERMINALS**

( *Clauses* 3.3, 4.1 *and* 4.6.1 *and Fig.* 5 )

| Terminal Size | Minimum Diameter *D* of Conductor Space* | Minimum Distance Between Fixed Part and End of Conductor When Fully Inserted |
|---|---|---|
| (1) | (2) | (3) |
| | mm | mm |
| 0 | 1·4 | 1·5 |
| 1 | 1·7 | 1·5 |
| 2 | 2·0 | 1·5 |
| 3 | 2·7 | 1·8 |
| 4 | 3·6 | 1·8 |
| 5 | 4·3 | 2·0 |
| 6 | 5·5 | 2·5 |
| 7 | 7·0 | 3·0 |

*The torque value to be applied is that which is specified in column II or V of Table 4 as appropriate.

## SECTION 2 SCREWLESS TERMINALS AND ELECTRICAL CONNECTIONS

### 5. GENERAL REQUIREMENTS

**5.1** Parts of terminals or connections for carrying current shall be made of one of the following materials:

a) Copper;

b) Alloy containing at least 58 percent copper for parts that are worked cold, or at least 50 percent copper for other parts; and

c) Other metals no less resistant to corrosion than copper and having mechanical properties no less suitable.

**5.2** Terminals and connections shall clamp the conductor with sufficient pressure and without under damage to the conductor.

The conductor shall be clamped between metal surfaces. However, terminals for circuits having a rated current not exceeding 2A, may have one non-metallic surface if the requirements of **5.5** are met.

NOTE — Conductors are unduly damaged if they show deep or sharp indentations.

**5.3** Terminals shall be so designed that, when the conductor has been introduced and adequately inserted into the terminal, further insertion of its end is prevented by a stop.

**5.4** Terminals other than those for lead assemblies, shall accept 'non-prepared conductors' ( *see* **2.2.5** ).

Compliance with the requirement of **5.2**, **5.3** and **5.4** shall be checked by inspection of the terminals or connections, after fitting with appropriate conductors, and after the heating test of **7.2.2** or **8.3.2**.

**5.5** Electrical connections shall be so designed that the pressure essential for good electrical conductivity is not transmitted *via* insulating material other than ceramic, pure mica, or other material with characteristics no less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinking of the insulating material ( *see* Fig. 6 and 7 ).

**5.6** It shall be clear in which way the connection of the conductor to, and the disconnection from, spring-type non-permanent screwless terminals is effected.

The disconnection of a conductor shall require an operation other than a pull of the conductor and shall be such that it can be made by hand or with the aid of a simple, generally available device.

**5.7** Terminals for connection to several conductors under spring clamps clamp each conductor independently.

For terminals designed for non-permanent connections. It shall be possible to withdraw the connectors together or separately.

**5.8** Terminals shall be suitably fixed to the equipment or to a terminal block or otherwise fixed in position. They shall not work loose when conductors are inserted or withdrawn.

Compliance shall be checked by inspection and, if there is a doubt, by applying the mechanical test given in **7.1** or **8.2**. During the test, the terminals shall not work loose and there shall be no damage that will impair their further use.

The above conditions apply not only to terminals which are fixed to equipment but also to terminals which are delivered separately. Covering with sealing compound without other means of locking is not sufficient. Self-hardening resins may, however, be used to lock terminals which are not subject to torsion in normal use.

**5.9** Terminals and connections shall withstand the mechanical, electrical and thermal stresses occurring in normal use.

Compliance shall be checked by the tests of **7.1**, **7.2**, **8.2** or **8.3**, as appropriate.

**5.10** Manufacturers shall state the conductor size or sizes for which the component is designed and the type of conductor, for example, solid or stranded.

## 6. GENERAL INSTRUCTIONS ON TESTS

**6.1 Preparation of Samples** — The 'tests for ingress of dust and moisture', given in Part 4 of this standard, if appropriate, shall be carried out before testing terminals or connections contained within the luminaires.

**6.2 Test Conductors** — Tests shall be carried out with copper conductors of the types and dimensions recommended by the manufacturer. If a range of conductors is specified, the smallest and largest shall be selected for testing.

**6.3 Multi-conductor Terminals** — Screwless terminals, having provision for the simultaneous connection of several conductors, shall be tested with the number of conductors indicated in the data provided by the manufacturer.

**6.4 Multi-way Terminals** — Each terminal in a group or strip of terminals, for example, a terminal block on a ballast, may be used as separate sample.

**6.5 Test Quantities** — The tests described in **7.1** and **7.2** are carried out on four terminals ( or connections ). At least three terminals shall meet the requirements. If one terminal fails, four further terminals are tested and all these terminals shall meet the requirements.

The tests described in **8.1**, **8.2** and **8.3** are carried out on ten terminals and a further four terminals are subjected to the test in **8.2**.

## 7. TERMINALS AND CONNECTIONS FOR INTERNAL WIRING

### 7.1 Mechanical Tests

**7.1.1 Non-permanent Connections** — The mechanical strength of the terminals ( or connections ) is checked on a set of four terminals. If all the terminals contained within the luminaire are not of the same design, one set of four terminals of each design is subjected to the test.

**7.1.1.1** In the case of spring-type terminals ( *see* Fig. 7 ) the test is made with solid copper conductors of the size or sizes specified by the manufacturer. If a range of conductors is specified, the smallest and largest are selected for testing.

Of the four terminals, two are tested with conductors having the smallest cross-sectional area, and the two remaining samples with conductors having the largest cross-sectional area. These conductors are connected to, and disconnected from, each terminal five times.

For the first four connections, new conductors are used each time. For the fifth connection, the same conductor is used as for the fourth connection and it is clamped at the same place. For each connection, the conductors are pushed into the terminals as far as the stop.

If the terminal is suitable for stranded conductors, an additional test is then made with one rigid-stranded copper conductor. If, however, a range of conductors is specified, those with smallest and largest cross-sectional areas are selected for testing. Each conductor is subjected to only one connection and disconnection with the corresponding terminal used for the testing with solid conductors.

After the final connection, each conductor is subjected to a test pull of 4 N.

**7.1.1.2** Pin or tab and receptacle type connections are also subjected to a test pull of 4 N.

The pull is applied without jerks, for 1 minute, in the direction opposite to that used for the application or insertion of the conductor or lead assembly.

During the test, the conductor or lead assembly shall not move from the terminal and neither the terminal nor the conductor or lead assembly shall undergo any alteration impairing their further use.

The maximum force for application or insertion of the conductor or lead assembly shall not exceed 50 N, and in the case of pin or tab and receptacle type connection the force for disconnection shall not exceed this value.

**7.1.2 Permanent Connections** — The connection shall remain fully effective when a pull-off force of 20 N is applied, for 1 minute, in a direction opposite to that used for the application or insertion of the conductors. In some cases, a special tool may be used to apply the force correctly ( for example in the case of wire-wrapped terminals ).

Multi-conductor terminals are tested with the above force applied to each conductor in turn.

## 7.2 Electrical Tests

**7.2.1** *Contact Resistance Test* — The electrical performance of terminals ( or connections ) is checked on a set of four terminals. If all the terminals contained within the luminaire are not of the same design, one set of four terminals of each design is subjected to the test.

**7.2.1.1** For spring-type terminals, the test according to **7.2.1.3** is carried out with four solid copper non-insulated conductors.

If a range of conductors is specified, two of the terminals are tested with conductors having the smallest cross-sectional area and the two remaining terminals with conductors having the largest cross-sectional area.

**7.2.1.2** In the case of pin or tab and receptacle type terminals, the test according to **7.2.1.3** is made with lead assemblies.

**7.2.1.3** Each terminal with its conductor is loaded with the test current ( ac or dc ); and after 1 h, the voltage drop across the terminal, still at the test current, is measured. The measuring points are located as close as possible to the contact point across which the voltage drop is being measured. The measured voltage drop shall not exceed 15 mV.

The voltage drop for each joint or contact is considered separately, for example, the junction of conductor to receptacle is considered separately from the junction of receptacle to pin.

The total voltage drop of two inseparable joints, when measured together, shall not exceed twice the value given in **7.2.1.3**.

**7.2.2** *Heating Tests*

**7.2.2.1** Terminals ( or connections ) are then subjected to an ageing test, without current, of 25 cycles, each cycle of a duration of 30 minutes at a temperature of 100 ± 5°C, followed by a cooling down to a temperature between 15 and 30 °C.

**7.2.2.2** The voltage drop is again measured on each terminal,

a) after the 10th cycle, and

b) after the 25th cycle.

If, for all terminals, the voltage drop, in both cases, does not exceed by more than 50 percent the voltage drop measurements on the same terminal tested under **7.2.1**, or if the increase in voltage drop is less than 2 mV, the terminals comply with the requirement.

If the voltage drop of any terminals exceeds 22·5 mV, the terminals are rejected.

If, for one of the terminals, the voltage drop measured under (a) or (b) exceeds by more than 50 percent, with a minimum of 2 mV, the voltage drop measured on the same terminal under clause **7.2.1** but does not exceed 22.5 mV, the four terminals are subjected to a new ageing test of 25 cycles without current. After the 10th and the 25th cycles, the voltage drops are again measured. For any terminal, the voltage drop shall not exceed 22·5 mV.

The total voltage drop of two inseparable joints, when measured together shall not exceed twice the values given in this clause.

**7.2.2.3** If a terminal is so designed that the conductor is tightened against a surface of insulating material, this surface shall not be deformed during these heating tests.

Compliance shall be checked by inspection.

## 8. TERMINALS AND CONNECTIONS FOR EXTERNAL WIRING

**8.1 Conductors** — Spring-type terminals shall be suitable for the connection or rigid conductors, solid or stranded, with the nominal cross-sectional areas given in the following table:

| *Maximum Rated Current of Terminals* A | *Nominal Cross-Sectional Areas of Conductor* mm² |
|---|---|
| 6 | 0·5 to 1 |
| 10 | 1 to 1·5 |
| 16 | 1·5 to 2·5 |

NOTE — Terminals are usually referred to by a size designation and size O, for example, is generally a 6 A rating. If the component rating is less than the terminal capacity, the component rating is used.

Compliance shall be checked by inspection, by measurement and by fitting conductors of the smallest and largest cross-sectional areas specified.

**8.2 Mechanical Tests** — The mechanical strength of the terminals ( or connections ) shall be checked by the following test, which is made on one terminal of each of four samples.

**8.2.1** In the case of spring-type terminals, the test is made alternately with solid copper conductors having the largest and then the smallest cross-sectional areas specified in **8.1.** These conductors are connected to, and disconnected from, each terminal five times. If all the terminals contained within the luminaire are not of the same design, one terminal of each of the various designs is subjected to the test.

For the first four connections, new conductors are used each time. For the fifth connection, the same conductor is used as for the fourth connection and it is clamped at the same place. For each connection, the conductors are pushed into the terminals as far as the stop.

If the terminal is stated by the manufacturer to be suitable for stranded conductors ( *see* **5.10** ), an additional test is then made with two rigid stranded copper conductors, the first having the largest cross-sectional area specified in **8.1,** the second having the smallest cross-sectional area. These conductors are subjected to only one connection and disconnection.

After the final connection, each conductor is subjected to a pull test according to the table in **8.2.2.**

**8.2.2** Pin or tab and receptacle type connections are also subjected to a pull test according to the following table:

| *Maximum Rated Current of Terminals* | *Pull* | |
|---|---|---|
| A | Spring-type | Pin or tab and receptacle type |
| | N | N |
| 6 | 20 | 8 |
| 10 | 30 | 15 |
| 16 | 30 | 15 |

NOTE — If the component rating is less than the terminal capacity, the component rating is used.

The pull is applied without jerks, for 1 min, in the direction opposite to that used for the application or insertion of the conductor or lead assembly.

During the test, the conductor or lead assembly shall not move out from the terminal and neither the terminal nor the conductor or lead assembly shall undergo any alteration impairing their future use.

### 8.3 Electrical Tests

**8.3.1** *Contact Resistance Test* — The electrical performance of terminals ( or connections ) shall be checked on a set of ten terminals. If all the terminals contained within the luminaire are not of the same design, one set of the terminals of each design is subjected to the test.

**8.3.1.1** For spring-type terminals, the test according to clause **8.3.1.3** is made with ten solid copper non-insulated conductors.

Five conductors having the largest cross-sectional areas specified in **8.1** are connected as in normal use, each to one terminal.

Five conductors having the smallest cross-sectional areas specified in **8.1** are connected as in normal use, each to one of the five remaining terminals.

**8.3.1.2** In the case of pin or tab and receptacle type terminals, the test according to **8.3.1.3** is made with lead assmblies.

**8.3.1.3** Each terminal with its conductor is loaded with the test current ( ac or dc ) and after 1 h, the voltage drop across the terminal, still at the test current, is measured. The measuring points are located as close as possible to the contact point across which the voltage drop is being measured.

The measured voltage drop shall not exceed 15 mV.

The total voltage drop of two inseparable joints, when measured together, shall not exceed twice the value given in **8.3.1.3**.

**8.3.2** *Heating Tests* — The thermal performance of terminals ( or connections ) is checked on the terminals which have been subjected to the test given in **8.3.1**.

**8.3.2.1** After having cooled down to the ambient temperature, each conductor is replaced by a new solid copper non-insulated conductor having the largest cross-sectional areas specified in **8.1** which is then connected to, and disconnected from, the terminal five times.

The conductors are then replaced by new non-insulated conductors.

**8.3.2.2** Each terminal with its conductor is loaded with the test current ( ac or dc ) for a time just sufficient for the voltage drop to be measured.

For these measurements and the masurements of **8.3.2.4,** the requirements of **8.3.1** apply.

**8.3.2.3** Terminals are then subjected to an ageing test, without current, of 25 cycles, each cycle comprising 30 min at a temperature of 100 $\pm$ 5°C, followed by a cooling down to a temperature between 15 and 30°C.

**8.3.2.4** The voltage drop is again measured on each terminal,

a) after the 10th cycle, and

b) after the 25th cycle.

If, for all terminals, the voltage drop, in both cases, does not exceed by more than 50 percent, the voltage drop measurements on the same terminal under **8.3.2.2** if the increase in voltage drop is less than 2 mV, the terminals comply with the requirement.

If the voltage drop of any terminal exceeds 22·5 mV, the terminals are rejected.

If, for one of the terminals, the voltage drop measured under (a) or (b) exceeds by more than 50 percent, with a minimum of 2 mV, the voltage drop measured on the same terminal under **8.3.2.2** but does not exceed 22·5 mV, the ten terminals are subjected to a new ageing test of 25 cycles without current. After the 10th and the 25th cycles, the voltage drops are again measured. For any terminal, the voltage drop shall not exceed 22·5 mV.

The total voltage drop of two inseparable joints, when measured together, shall not exceed twice the value given in this clause.

**8.3.2.5** If a terminal is so designed that the conductor is tightened against a surface of insulating material, this surface shall not become deformed during these heating tests.

Compliance shall be checked by inspection.