IS 2596 (2004): Bulbs (Lamps) for Miners' Cap-Lamps [ETD 23: Electric Lamps and their Auxiliaries]

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भारतीय मानक

खनिकों की टोपी के लैम्पों के बल्ब (लैम्प) — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

BULBS (LAMPS) FOR MINERS' CAP-LAMPS — SPECIFICATION

(Second Revision)

ICS 29.140.99; 73.100.99

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

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Price Group 7

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electric Lamps and Their Auxiliaries Sectional Committee had been approved by the Electrotechnical Division Council.

This standard was first published in 1964 and revised in 1980. Since the publication of this standard further developments have taken place, and this revision has been brought out in order to update many of the essential requirements and to include those types of light sources which are in common use.

Miner's cap-lamp consists of a number of components, such as battery, bulb (lamp), connecting cable, reflector, mechanical protective covers, safety devices, etc. The unit should be durable in service, suitable for conditions of underground use and practical in operation. Since these cap-lamps are neither explosion-proof nor inherently safe, great care is to be taken in their design and construction so that they shall offer no probable explosion hazard when used in gassy or dusty mine atmospheres as they may be suspected as sources of ignition when an explosion occurs in mine, or any bodily hazard from the spilling of electrolyte of the battery.

Although the term 'lamp' is generally to be used to denote the lighting source in a lighting assembly, in this standard the term 'bulb' is used in view of its adoption in mining regulations. For the purpose of clarification the term 'lamp' also is given within parentheses.

Bulb (lamp) may be supplied along with a unit which has to be approved by Director General of Mines Safety. If the bulbs (lamps) are separately supplied, they should be approved by Director General of Mines Safety.

This standard covers the requirements and methods of tests for bulbs (lamps) employed in the miners' cap-lamps. It is anticipated that this standard will assist in purchase of original equipment as well as replacement of bulbs (lamps) wherever necessary.

Requirements for bulbs (lamps) specified in this standard have been arrived at after giving due consideration to safety of personnel working in gassy mines.

An auxiliary (pilot) bulb, if so agreed between the purchaser and the supplier, may also be fitted in the miners' cap lamp. No detailed requirements regarding auxiliary bulb have been included in the standard. However, the general guidance regarding the requirements for auxiliary lamps are given in Annex A.

While preparing this standard, assistance has been derived from BS 535 : 1973 'Light sources for portable miners' electric lamps' issued by the British Standards Institution and IEC 60983 (1995) 'Miniature lamps' issued by the International Electrotechnical Commission (IEC).

In order to comply with the statutory regulations under the Mines Act, only the types of bulbs (lamps) approved by Director General of Mines Safety are to be used in cap-lamp assemblies.

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, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard

Indian Standard

BULBS (LAMPS) FOR MINERS' CAP-LAMPS — SPECIFICATION

(Second Revision)

1 SCOPE

This standard lays down the requirements and methods of test for electric bulbs (lamps) used in the miners' cap-lamps.

2 REFERENCES

The following standards are necessary adjuncts to this standard:

IS No.	*Title*
2261 : 1975	Lamps for flashlights (*first revision*)
2407 : 1963	Photometric integrators

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Type — Denotes bulbs (lamps) of the same general construction, which are intended to be similar in photometric and electrical ratings.

3.2 Batch — Denotes all the bulbs (lamps) of one type put forward in a lot at one time for acceptance to be tested for compliance with this standard.

3.3 Test Quantities

3.3.1 *Inspection Test Quantity (ITQ)* — The number of bulbs (lamps) selected from a batch according to the method specified in **5.3.1**, the test on which shall determine whether or not the batch complies with the mechanical and physical requirements specified in **4.1** and the marking requirements specified in **6**.

3.3.2 *Rating Test Quantity (RTQ)* — The number of bulbs (lamps) selected from a batch according to the method specified in **5.3.2**, the initial rating tests on which shall determine whether or not the batch complies with the initial rating requirements specified in **4.2**.

3.3.3 *Life Test Quantity (LTQ)* — The number of bulbs (lamps) selected from a batch according to the method specified in **5.3.3**, the life test and measurements for lumen maintenance on which shall determine whether or not the batch complies with the life performance requirements specified in **4.3**.

3.4 Light Centre Length — For bulbs (lamps) with E10/13 cap (*see* Fig. 1), it is the distance from the geometric centre of the filament to the contact plate of the cap including the solder. For bulbs (lamps) with P13.5s cap (*see* Fig. 2 and 3), it is the distance from the geometric centre of the filament to the top of the flange of the cap.

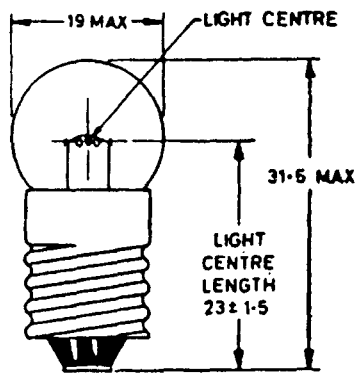


FIG. 1 4 V 0.8 A ARGON-FILLED AND KRYPTON-FILLED BULB (LAMP) WITH E 10/13 CAP FOR MINERS' CAP-LAMPS

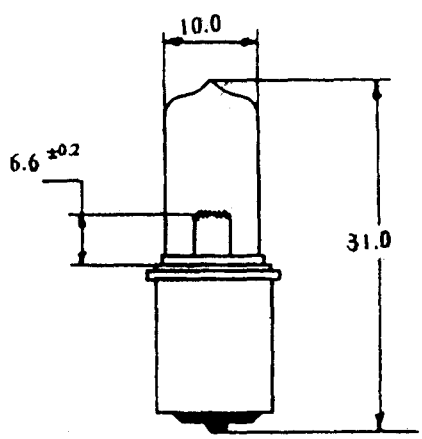


FIG. 2 4 V 1.0 A HALOGEN-FILLED BULB (LAMP) WITH P 13.5S CAP FOR MINERS' CAP-LAMP

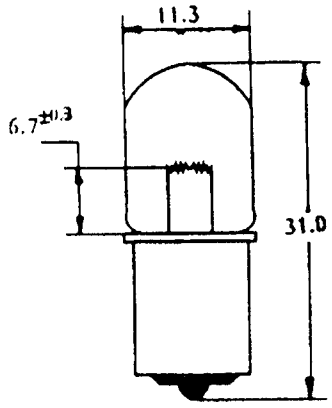


FIG. 3 4 V 1.0 A KRYPTON BULB (LAMP) WITH P 13.5s CAP FOR MINERS' CAP-LAMP

3.5 Lumen — The unit of luminous flux. It is equal to the flux emitted in a solid angle of one steradian by a uniform point source of one candela.

NOTE — The Candela (abbreviated: cd) is the unit of luminous intensity. It is of a magnitude such that the luminance of a full radiator at the temperature of solidification of platinum is 60 units of luminous intensity per square centimetre.

3.6 Initial Readings — The photometric and electrical measurements made at the end of the ageing period.

3.7 Life — The life of a bulb (lamp) is the number of hours it operates to 'burn out' or to any other criterion of life performance laid down in the standard.

3.7.1 *Average Life* — The arithmetic mean of the lives of the bulbs (lamps) in a life test quantity.

3.7.2 *Specified Life* — The life of a bulb (lamp) in hours given in Table 1.

3.8 Rated Voltage — The voltage marked on the bulb (lamp).

3.9 Rated Current — The current in amperes marked on the bulb (lamp).

3.10 Axiality — The perpendicular distance of the light centre from the axis of the cap.

3.11 Lumen Maintenance — The luminous flux of an individual bulb (lamp) at the specified time of measurement during the life test expressed as a percentage of that measured in the rating test.

4 REQUIREMENTS

4.1 Mechanical and Physical Requirements

4.1.1 *Bulbs (Lamps)*

4.1.1.1 The dimensions of the bulbs (lamps) shall be in accordance with Table 1 read with Fig. 1 for 4V 0.8A argon-filled and krypton-filled bulbs (lamps), with Fig. 2 for 4 V 1.0 A krypton-filled bulbs (lamps) and with Fig. 3 for 4 V 1.0 A halogen bulbs (lamps).

4.1.1.2 The finished bulb (lamp) shall withstand the test given in **6.1.2**.

4.1.2 *Glass Shells* — The glass shells of the bulbs (lamps) shall be clean, uncoloured and free from detrimental defects.

4.1.3 *Caps* — The dimensions of screw caps shall be in accordance with those specified in Annex B and the dimensions of the pre-focus caps shall be in accordance with those specified in Annex C.

The dimensions for the screw threads shall be checked with the help of 'Go' and 'No Go' gauges specified in Annex D. Caps shall be attached to the bulb (lamp) strong enough so that they do not become loose under normal usage. The screw cap shall withstand the torque specified in **7.1.3**. Torque test is not applicable for bulbs (lamps) with pre-focus cap.

4.1.3.1 The shells of the caps shall be of brass.

4.1.4 *Solder* — Solder shall be evenly applied in such quantity so that while the soldering is strong, it shall not in any way interfere with the engagement of the cap and to ensure satisfactory electrical contact in the holder.

4.2 Initial Rating Requirements

The initial current and initial lumens measured at the rated voltage in accordance with **7.2** shall comply with the requirements specified in Table 1.

4.3 Life Performance and Lumen Maintenance Requirements

The average life and lumen maintenance at rated voltage, when tested in accordance with **7.3** shall be not less than those stated in Table 1.

5 SELECTION OF BULBS (LAMPS) FOR TEST (SAMPLING)

5.1 General

This clause gives details of procedures for the selection of the test quantities of bulbs (lamps) from a batch and the individual bulb (lamp) requirements against which they are to be tested. It states the sequence and methods of test which shall be applied to each individual bulb (lamp) of the test quantities. The compliance of the batch is assessed as described in **8** from the numbers of bulbs (lamps) which, in the tests, fail to satisfy the requirements.

Table 1 List of Bulbs (Lamps) and Their Characteristics

(*Clauses* 3.7.2, 4.1.1.1, 4.2, 4.3, 7.2.4, 7.3.7.1, 7.3.7.2, 8.3.1, 8.3.2 *and* 8.4.2)

Sl No.	Rating		Type of Gas Filling	Lamp Cap	Dimensions				Current *Max*	Luminous Flux *Min*	Average Life *Min*	Lumen Maintenance
	Voltage V	Current A			Bulb Diameter, mm *Max*	Overall Length, mm *Max*	Light Centre Length, mm	Axiality, mm	A	Lumens	Hours	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i)	4.0	0.8	Argon	E10/13	19	31.5	23 + 1.5	1	0.83	30	200	90
ii)	4.0	0.8	Krypton	E10/13	19	31.5	23 + 1.5	1	0.83	35	200	90
iii)	4.0	1.0	Krypton	P13.5s	11.3	31.0	1.7 + 0.3	0.3	1.05	44	200	80
iv)	4.0	1.0	Halogen	P13.5s	10.0	31.0	1.7 + 0.3	0.3	1.05	43	600	85

5.2 Batch Acceptance on a Statistical Basis

The batch shall be deemed to comply with this standard, if when a sample is tested according to the standard, in all the test quantities the numbers of bulbs (lamps) which fail to satisfy the specified test requirements are not greater than the related compliance numbers (*see* **8**) and the average life is not less than the related compliance life (*see* **8**). Individual bulb (lamp) belonging to a batch which complies with the requirements of the standard are in compliance with the standard by virtue of belonging thereto.

5.3 Test Quantities

5.3.1 *Inspection Test Quantity (ITQ)* — The inspection test quantity shall be 5 percent of the batch, with a minimum of 35 bulbs (lamps) and a maximum of 70 bulbs (lamps).

In order to ensure proper representation of the batch, the ITQ shall be selected at random as follows:

a) Batch of 1 000 bulbs (lamps) or less:

   1) *Batch packed in 10 or less containers* — Bulbs (lamps) shall be selected from every container.

   2) *Batch packed in more than 10 containers* — Bulbs (lamps) shall be selected from at least one-half of the total number of containers, with a minimum of 10.

b) Batch of more than 1 000 bulbs (lamps) — Bulbs (lamps) shall be selected as far as possible from one-third of the total number of containers with a minimum of 10.

5.3.2 *Rating Test Quantity (RTQ)* — The rating test quantity shall be five-sevenths of the ITQ selected at random from the bulbs (lamps) of the ITQ which satisfy the individual bulb (lamp) requirements of the inspection test. In the case of a fraction resulting from this calculation, the next higher whole number shall be taken.

5.3.3 *Life Test Quantity (LTQ)* — The life test quantity shall be half of the RTQ selected at random from the bulbs (lamps) of the RTQ which satisfy the individual bulb (lamp) requirements of the rating test. In the case of a fraction resulting from this calculation, the next higher whole number shall be taken.

5.3.4 *Accidentally Broken Bulbs (Lamps)* — Bulbs (lamps) which are accidentally broken during the test shall, when necessary, be replaced to ensure that the required number of bulbs (lamps) complete the test.

The results obtained with a replacement bulb (lamp) shall be substituted for those of a broken bulb (lamp).

NOTE — In order to avoid unnecessary delay, it is recommended that spare bulbs (lamps) be carried through the tests.

6 MARKING

6.1 Each bulb (lamp) shall be distinctly and indelibly marked with the following information:

a) Manufacturer's trade-mark;

b) Rated voltage;

c) Rated current, in amperes;

d) Letter 'K' to indicate krypton filling, 'A' to indicate argon filling and 'H' to indicate halogen filling;

e) Country of manufacture; and

f) Any other special marks specified by the

Directorate General of Mines Safety for safety requirements.

NOTE — In view of the limited space available on the bulb (lamp) at the discretion of the supplier, the information given in items (e) and (f) may be marked on the carton instead of the bulb (lamp).

6.1.1 *BIS Certification Marking*

The bulbs (lamps) may also be marked with the Standard Mark.

6.1.1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers and producers may be obtained from the Bureau of Indian Standards.

7 TESTS

7.1 Inspection Test — Visual, Mechanical, Physical and Marking Requirements

7.1.1 Each bulb (lamp) of ITQ shall be examined visually as well as checked for physical and mechanical requirements detailed in **4.1.1** to **4.1.4** and marking requirements specified in **6**.

7.1.2 *Test on Bulb (Lamp)*

Finished bulb (lamp) shall withstand the application of a load 4.5 kg applied, through a hard plane surface, to the crown of the bulb (lamp) for a period of 3s. The load shall be applied gradually. Load test is not applicable for bulbs (lamps) with pre-focus cap.

7.1.3 *Test for Attachment of Caps*

The cap of the finished bulb (lamp) shall be so attached to the bulb (lamp) that they will withstand a torque of 0.226 Nm. The torque shall be applied by inserting the cap into the special test lamp holder described in Fig. 4 (*see* Annex E) and twisting the bulb (lamp). The torque shall not be applied suddenly but shall be increased continuously to the amount specified. This test shall be repeated on the LTQ after the completion of the life test. Torque test is not applicable for bulbs (lamps) with pre-focus cap.

7.1.4 *Ageing Procedure*

The bulb (lamp) shall be aged for 2 h at the rated voltage. A bulb (lamp) found to be inoperative when inspected at the end of this period shall be deemed to have failed to satisfy the requirements of this clause of the standard.

7.2 Test for Initial Rating

7.2.1 *Operating Position for Photometry*

The bulbs (lamps) shall be operated in the vertical cap up or cap down position.

7.2.2 *Photometric Measurements*

In view of difficulties of measuring accurately low lumen outputs, a recommended photometric measuring procedure is given in Annex F.

7.2.3 *Test Voltage*

The test voltage shall be the rated voltage.

7.2.4 *Initial Current and Luminous Flux Requirements*

After ageing as described in **7.1.4** measurements for initial current and luminous flux shall be made following a 4-min period of operating in the photometer without interruption of the supply. For each bulb (lamp) the current shall not exceed the relevant maximum value given in Table 1 and the lumens shall not be less than the relevant minimum value given in Table 1.

7.3 Life Test — Lumen Maintenance and Life

7.3.1 *Operating Position for Life Test*

The bulbs (lamps) shall be operated in vertical or horizontal position.

7.3.2 *Life Test Voltage*

The life test voltage shall be the rated voltage.

7.3.3 *Electricity Supply and Control*

The electricity supply for life test shall be ac at a nominal frequency of 50 Hz. The mean rms value of the test voltage throughout the life test shall not vary significantly from the rated rms voltage and any momentary fluctuations shall not exceed 1 percent.

7.3.4 *Life Test Procedure*

Bulbs (lamps) on life test shall be switched off for two periods of not less than 15 min in each period of 24 h. Such periods shall not be considered as part of the life of the bulb (lamp).

7.3.5 *Measurements During Life*

Each bulb (lamp) of the life test quantity shall be measured for luminous flux at the rated voltage at 75 ± 5 percent of the specified life.

7.3.6 *Duration of Life Test*

The life test shall be considered to have terminated

at 150 percent of the specified life. Any bulb (lamp) still operating shall have assigned to it 150 percent of the specified life.

7.3.7 *Lumen Maintenance and Life*

7.3.7.1 The lumen maintenance at 75 ± 5 percent of the specified life of individual bulbs (lamps) shall be not less than the value given in Table 1.

7.3.7.2 The minimum average life of the LTQ shall be in accordance with the relevant values given in Table 1 subject to the tolerances given in **8.4.2**.

8 CONDITIONS OF COMPLIANCE

8.1 General

The conditions of compliance for a batch of bulbs (lamps) are stated in the following clauses. These conditions are applied to the results of the tests on individual bulbs (lamps) obtained in 7. A batch of bulbs (lamps) shall be deemed to comply with the requirements of this standard, if the conditions contained in **8.2**, **8.3** and **8.4** are satisfied. If the conditions of any of these clauses are not satisfied, the batch is deemed not to comply with the requirements of the standard (*see also* Annex G).

8.2 Inspection Test — Visual, Mechanical, Physical and Marking Requirements

A batch shall be considered to comply with the requirements of **4.1** and **6.1**, if the number of bulbs (lamps) not satisfying the requirements shall not exceed the compliance numbers given in Table 2.

8.3 Rating Test : Initial Current and Luminous Flux Requirements (*see* 6.2.4)

8.3.1 The number of bulbs (lamps), the current of which is above the relevant maximum value given in Table 1 shall not exceed the compliance number in Table 3.

8.3.2 The number of bulbs (lamps) the luminous flux of which is below the relevant minimum value specified in Table 1 shall not exceed the compliance number given in Table 3.

8.3.3 The total number of bulbs (lamps) outside the limits described in **8.3.1** and **8.3.2** added together shall not exceed the compliance number in Table 4. A bulb (lamp), which is outside both limits, shall be counted once only.

8.4 Life Test : Lumen Maintenance and Life (*see* 7.3.7)

8.4.1 The total number of bulbs (lamps) having lives shorter than 70 percent of the specified average life, plus those failing to pass the requirements of **7.3.7.1**, shall not exceed the compliance numbers given in Table 5.

8.4.2 The average life of the LTQ shall be not less than the following:

a) 13-19 lamps: 90 percent of the specified minimum average life, and

b) 20-25 lamps: 92.5 percent of the specified minimum average life.

NOTE — These values are lower than the specified average life of Table 1, in order to cover the statistical uncertainty in testing small quantities.

Table 2 Inspection Test Quantities and Compliance Numbers

(*Clause* 8.2)

A Lamps for ITQ Found to be Inoperative			
For Any One of the Clauses 4.1.1 to 4.1.4 and 6.1		For Any One of the Clauses 4.1.1 to 4.1.4 and 6.1	
Test Quantity	Compliance Number	Test Quantity	Compliance Number
(1)	(2)	(3)	(4)
35-54	3	35-44	5
55-70	4	45-56	6
		57-70	7

B Lamps for RTQ Found to be Inoperative at Any Time Up to the End of the Ageing Period of 7.1.4	
Test Quantity	Compliance Number
(1)	(2)
25-31	2
32-50	3

Table 3 Rating Test Quantities and Compliance Numbers

(*Clauses* 8.3.1 *and* 8.3.2)

Sl No.	RTQ	Compliance Number
(1)	(2)	(3)
i)	25-31	5
ii)	32-40	6
iii)	41-50	7

Table 4 Rating Test Quantities and Combined Compliance Numbers

(*Clause* 8.3.3)

Sl No.	Test Quantity	Compliance Number
(1)	(2)	(3)
i)	25-28	6
ii)	29-34	7
iii)	35-41	8
iv)	42-48	9
v)	49-50	10

Table 5 Life Test Quantities and Compliance Number

(*Clause* 8.4.1)

Sl No.	Test Quantity	Compliance Number
(1)	(2)	(3)
i)	13-15	3
ii)	16-23	4
iii)	24-25	5

ANNEX A

(*Foreword*)

REQUIREMENTS FOR AUXILIARY (PILOT) LAMP

A-1 Auxiliary (pilot) lamp shall be free from defects detrimental to service and shall meet the following general requirements:

Voltage	*Current* A	*Cap*	*Maximum Diameter* mm	*Maximum Overall Length* mm	*Minimum Average Life* h
4.0 V	0.25-0.50	E10/13	12	25	50

ANNEX B

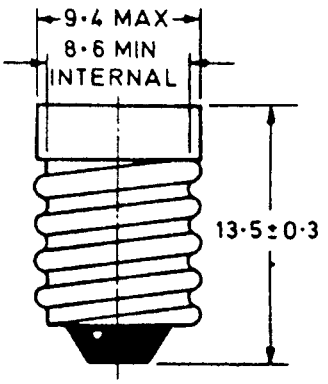
(*Clause* 4.1.3)

ARTICLE SHEET FOR LAMP CAPS E10/13

B-1 EDISON SCREW

B-1.1 The dimensions of Edison screw caps (E10/13) shall be as given below:

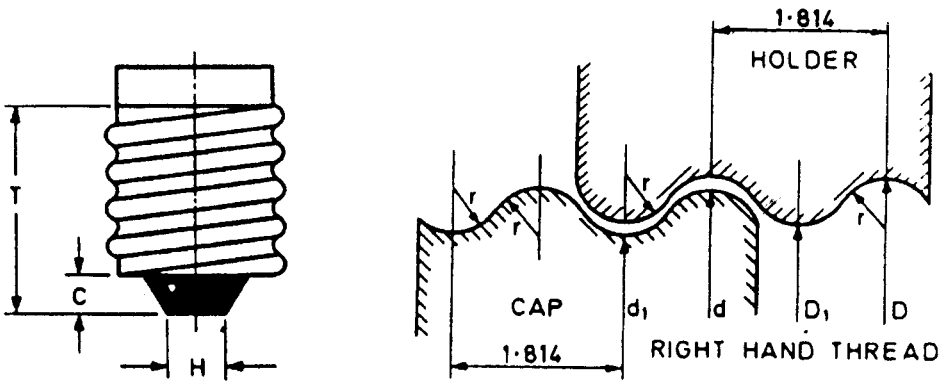
Only the dimensions intended to be controlled are indicated in the drawings.



All dimensions in millimetres.

Caps may be made with a flare[1)] the diameter of which shall be not more than 1 mm greater than the maximum permissible diameter of the corresponding cap without a flare.

For finished bulbs (lamps), the creepage distance over insulation shall be not less than 2 mm.



All dimensions in millimetres.

[1)]These drawings are solely for cap design and are not to be gauged on the finished bulb (lamp).

	Dimension	E10/13	
		Min	*Max*
Cap	C	Approximately 2.5[1]	
	H	3.5	4.0
	T[2]	9.5	—
	d	9.36	9.53
	d_1	8.34	8.51
Holder	D	9.61	9.78
			8.51
	D_1	8.59	8.76
	r		0.531

[1] These dimensions are solely for cap design and are not to be gauged on the finished lamp.

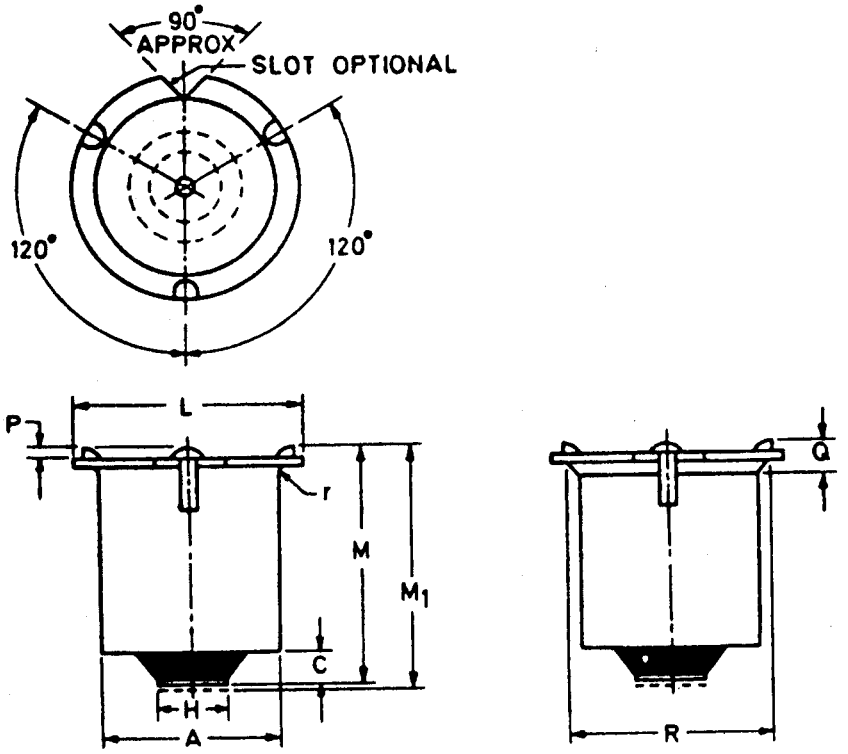
[2] 'T' is the distance from the contact plate of the cap to the completion of the thread.

ANNEX C

(*Clause* 4.1.3)

ARTICLE SHEET FOR PREFOCUS CAP (P 13.5s)

C-1 The drawings are intended only to indicate the dimensions to be controlled.



All other relevant dimensions identical.

All dimensions in millimetres.

Dimension	*Minimum*	*Maximum*
A	9.09	9.25
C	1.3[1)]	—
H	3.5	4.0
L	13.39	13.54
M	13.90	14.40[1)]
M_1	—	15.40
P	0.07	0.25
Q	—	2.0
R	—	11.3
r	—	12.0

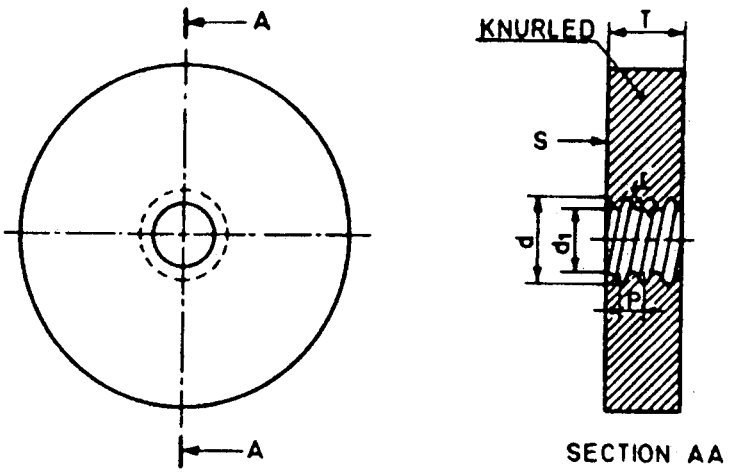
[1)]These dimensions are solely for cap design and are not to be gauged on the finished lamp.

ANNEX D

(*Clause* 4.1.3)

'GO' AND 'NO GO' GAUGES FOR E10 CAPS ON FINISHED LAMPS

D-1 'GO' GAUGE FOR E10 CAPS ON FINISHED LAMPS



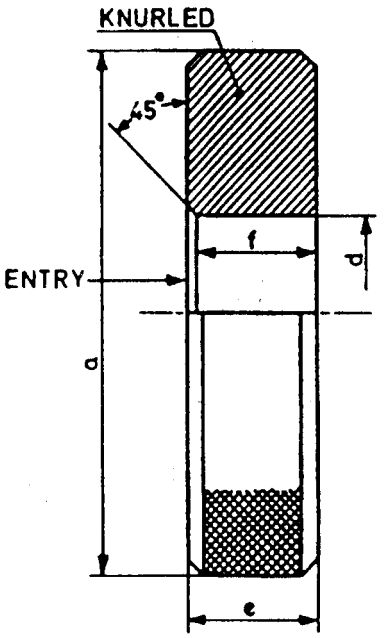
All dimensions in millimetres.

Dimension	*E10*	*Tolerance*
d	9.53	+0.03 −0.0
d_1	8.51	+0.03 −0.0
P pitch	1.814	+0.0 −0.03
T	9.5	—
r radius	0.531	

Purpose — For the control of thread and dimension *T*, *Min.*

Testing — The cap shall enter the gauge until the surface of the contact reaches or projects beyond surface *S*.

D-2 'NO GO' GAUGE FOR E10 CAPS ON FINISHED LAMPS



All dimensions in millimetres.

Dimension	*E 10*	*Tolerance*
a	33	Approximately
d	9.36	+0.0 −0.01
e	13.5	+0.1 −0.1
f	13	+0.1 −0.1

Purpose — To control the minimum major diameter of the male screw threads.

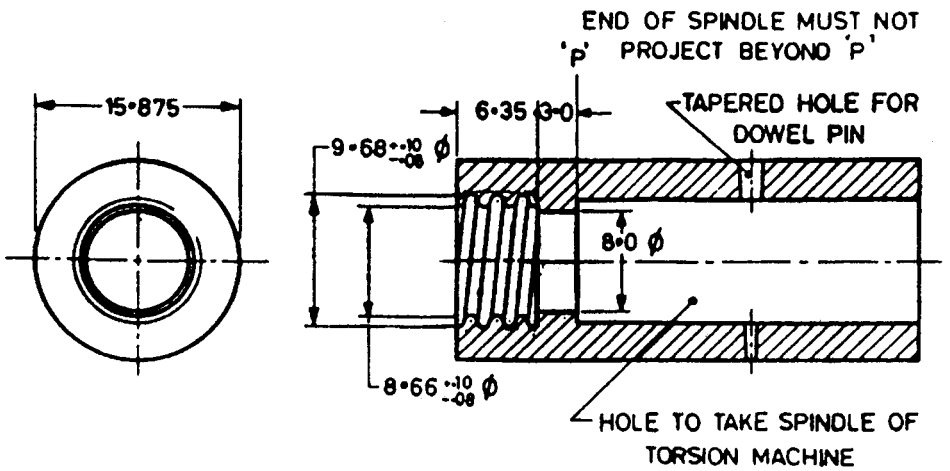
Testing — The cap on the finished lamp shall be assumed to be correct if the gauge does not pass over the threads by its own weight.

ANNEX E

(*Clause* 7.1.3)

HOLDER FOR TORQUE TEST

E-1 The dimensions of the holder for torque test of the cap shall be as given below:



All dimensions in millimetres.

HOLDER FOR TORSION TEST

ANNEX F

(*Clause* 7.2.2)

PHOTOMETRIC MEASUREMENT

F-0 GENERAL

While the photometry of the bulbs (lamps) covered by this specification is not difficult, if reliable results are to be obtained the measurements call for some care in the selection of suitable apparatus and the way in which it is used. A simple commercial apparatus is detailed in this annex. In the measurement of lumen values, possible error can be avoided by the use of pure substitution methods to the greatest extent practicable. Reference may also be made to IS 2407.

F-1 DESCRIPTION

The integrating sphere used is about 200 mm in diameter and is constructed of two hemispherical 'springs' (bowls). The sphere should have an internal finish of matt neutral white of about 80 percent reflection factor. The sphere should also be fitted with the lamp holder, photocell, screen and iris. The integrating sphere should be used together with instruments like microammeter/galvanometer, ammeter and voltmeter in a suitable circuit for photometric measurements. For the circuit arrangement, reference can be made to Annex A of IS 2261.

F-2 CALIBRATION

The sphere is calibrated by means of a suitable standard bulb (lamp). The standard bulb (lamp) is placed in the measuring lamp holder of the integrating sphere and the voltage is adjusted to the correct value. The iris diaphragm, mounted directly in front of the photocell for controlling the amount of light falling on the photocell, can be used for calibration at desired ranges. For example, in circuits using a microammeter directly connected to the photocell terminals, the iris diaphragm can be so adjusted that the amount of light falling on the photocell gives a deflection in microammeter which is in agreement with the lumen output of the standard bulb (lamp). Thus, if a standard bulb (lamp) gives 17.4 lumens at 4 V, the iris is so adjusted that the amount of light falling on the photocell gives a deflection of 174 divisions on the microammeter scale. The microammeter is thus calibrated to read directly in lumens.

F-3 MEASUREMENTS

F-3.1 After calibration, the standard bulb (lamp) is removed and the bulb (lamp) to be tested is placed at the correct position. The total lumens are read from the microammeter scale. The current taken by the bulb (lamp) is also read from the ammeter in the circuit.

ANNEX G

(*Clause* 8.1)

STATISTICAL BASIS OF THE TESTS

G-1 It is impracticable and uneconomical to test every bulb (lamp) in a batch but, by the use of statistical sampling theory, it is possible to design tests on small samples, which will determine whether the quality of the batch is acceptable.

Accordingly, test quantities, quality limits and compliance numbers have been so specified that if on testing the whole of a batch, the quality level for any requirement or group of requirements would have been found to be that given below, then if the batch were tested by sampling in accordance with this standard there would be at least a 0.975 (39/40) probability that it would meet the following condition of compliance for that requirement or group of requirements:

a) 98 percent of the bulbs (lamps) satisfy each single mechanical or physical requirement of **4.1.1** to **4.1.4** and **6.1**,

b) 95 percent of the bulbs (lamps) satisfy all the requirements of **4.1.1** to **4.1.4** and **6.1**,

c) 93 percent of the bulbs (lamps) satisfy the requirements for current,

d) 93 percent of the bulbs (lamps) satisfy the requirements for luminous flux,

e) 88 percent of the bulbs (lamps) satisfy the requirements for both current and luminous flux,

f) 93 percent of the bulbs (lamps) satisfy the individual life requirements, and

g) The average life is at the minimum specified.

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