IEC 62035

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 2
AMENDEMENT 2

Discharge lamps (excluding fluorescent lamps) – Safety specifications

Lampes à décharge (à l'exclusion des lampes à fluorescence) – Prescriptions de sécurité

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FOREWORD

This amendment has been prepared by subcommittee 34A: Lamps, of IEC technical committee 34: Lamps and related equipment.

The text of this amendment is based on the following documents:

FDIS	Report on voting
34A/1575/FDIS	34A/1599/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

5.2 Metal halide lamps

5.2.1.2 UV radiation

Add the following new paragraph:

For compliance testing, lamps of a family may be grouped if differences in design do not contribute to differences in UV-visible spectral characteristics.

NOTE Examples of where design is likely to contribute to spectral differences are differences in arc tubes and bulb glass. Examples of where design is not likely to contribute to spectral differences are differences in lamp caps and beam angles of reflector lamps.

5.2.2.3 Containment

Replace the existing second paragraph by the following:

For test procedures and conditions of compliance, see Annexes I and J.

Table 1 – Grouping of test records – Sampling and acceptable quality levels (AQL)

In column 4, line 5.2.1.2, replace the existing text by the following:

By group, type or family

Add, after Annex H, the following new Annexes I and J:

Annex I
(normative)

Containment testing procedure for metal halide lamps with quartz arc tubes[1]

I.1 General

I.1.1 Purpose

This method of measurement applies to metal halide lamps with quartz arc tubes, that are designed to contain all particles within the outer bulb should an arc tube rupture occur. These lamps are permitted to be used in open luminaires. This is not a sufficient procedure for evaluation of particle containment designs which employ protective coatings, e.g. a plastic coating over the outer bulb.

I.1.2 Test description

The test consists of discharging a capacitor through an operating lamp to simulate an end-of-life arc tube rupture. In the first part of the test, the median energy required to ensure rupture of the arc tube is determined. In the second part of the test, arc tubes are forced to rupture at the median energy, and the lamps are examined for damage to the outer bulb. The test differs from real end-of-life situations in a number of ways, including: a) the lamps are new, b) a high energy input into the arc tubes is required to make them rupture, leading to higher pressures and greater energies than typical end-of-life ruptures, and c) the arc tube rupture mechanism may not be the same as that for end-of-life lamps.

I.2 Experimental setup

I.2.1 Safety precautions

High voltages and high electrical energy levels are involved in this test, so extreme caution is required. Fragments of hot lamp parts can be ejected if the outer bulb is damaged, so a physical enclosure is required. Precautions should be taken to contain and clean up mercury and other hazardous materials from the lamp in the event of penetration of the outer bulb.

I.2.2 Electrical circuit

The basic electrical circuit used for containment testing of metal halide lamps is shown in Figure I.1. The main components include: (1) a power supply for operating the lamp, (2) a ballast for limiting current to the lamp, (9) a d.c. power supply for charging the discharge capacitor, (5) a discharge capacitor for storing energy for the containment test, (8) a charging resistor for charging the discharge capacitor, (6) a discharge resistor for discharging the capacitor after the test, (3) a VAW meter for measuring the lamp electrical operating characteristics and (7) a V meter for measuring the capacitor voltage. Specific details for designing and operating such a circuit can be found in SR91[2].

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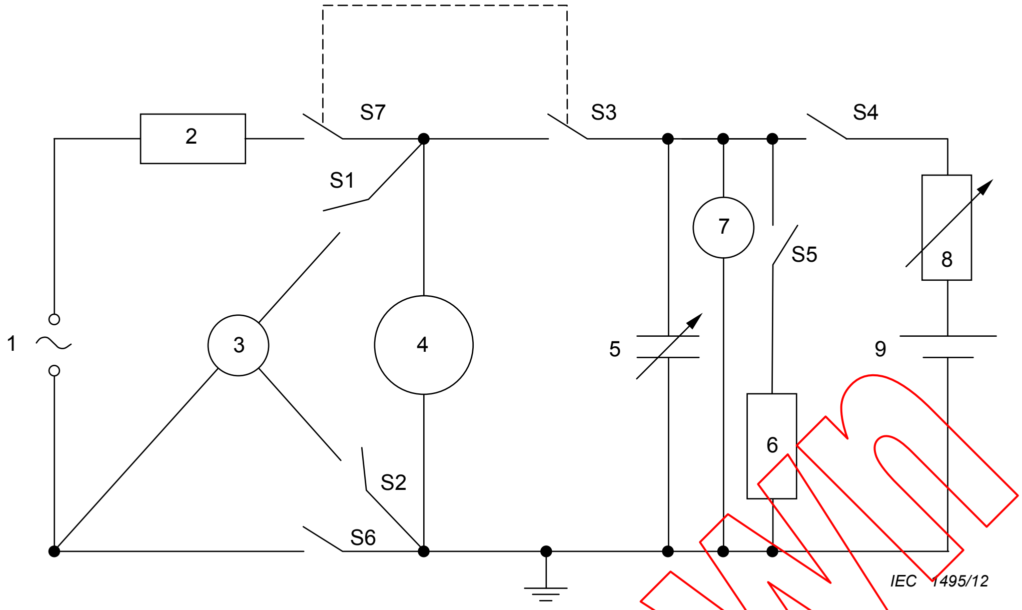
[1] Lamps, complying with the requirements of this annex are sometimes called “containment rated”, “open rated” or “self-shielded”, the latter expression being preferred.

[2] American National Standard Lighting Group Special Report #91: “Capacitive Discharge Tester – Design and Operation Guide”.



NOTE The switches are shown in open state. This does not correlate to a certain step in I.3.2.

Key

1	lamp power supply	6	discharge resistor
2	ballast or Hi-pot inductor	7	voltmeter
3	VAW meter	8	charging resistor
4	lamp	9	capacitor DC power supply
5	discharge capacitor	S1...S7	switches

Figure I.1 – Basic electrical diagram for quartz metal halide lamp containment test

Since circuit impedance can affect the test results, the lead wires between the discharge capacitor and the lamp shall be less than 1 m long and have a cross sectional area of 20 mm^2 or larger, except in the last section, where a smaller diameter may be used to facilitate connection to a lampholder.

The capacitor discharge d.c. power supply shall be capable of charging the discharge capacitor to any voltage up to 5 000 V. The value of the charging resistor can be adjusted so that the power supply can charge the capacitor within a reasonable amount of time.

The discharge capacitor may be adjusted to a value of 10 μF to 50 μF (higher values may be required for lamps of higher power) and shall be capable of handling 5 000 V.

The lamp power supply shall be capable of supplying the lamp with sufficient voltage and current to operate the lamp at its rated operating power. A timing circuit may be inserted into the circuit so that the capacitor is discharged at the point in the electrical phase when the current is at its maximum.

The operational ballast may comprise a suitable linear reactor or commercial ballast, with a suitable impedance as specified in the applicable lamp standard. It shall be capable of withstanding short-term high voltage pulses of 5 000 V.

The switches shall be capable of withstanding short-term high voltage pulses of 5 000 V in their open condition.

The discharge resistor shall have a rating of at least 1 000 Ω and 25 W.

I.2.3 Enclosure requirements

The enclosure for containment testing of metal halide lamps shall be constructed of materials capable of withstanding the impact of hot particles (particles of up to 1,1 g at 1 200 °C travelling at 50 m/s). Suitable materials include sheet metal and impact-resistant, high-temperature polymers. Metal enclosures shall be electrically grounded.

The enclosure shall be equipped with a suitable lamp holder for operating the lamp under test in the base up position, or in the specified operating position of the lamp.

The dimensions of the enclosure are not critical, but they should be large enough to accept the lamp under test and provide sufficient clearance at the sides and below the lamp.

I.3 Test procedures

I.3.1 Lamp selection and preparation

Lamps for this test shall be selected randomly from normal production or from pilot runs. The lamp construction dimensions shall fall within the values of the lamp data sheets or the manufacturer's specified values.

I.3.2 Determination of median rupture energy

In order to determine the median energy setting needed to rupture the arc tube within the lamp, the following procedure shall be carried out, with reference to Figure I.1. Note that these steps need to be carried out for each different lamp type.

1) Take care that the condition at the beginning is that the energy sources of charging and lamp operation are not connected, lamp not inserted.
2) Select an initial energy value of at least 5 J by selecting the capacitor d.c. power supply voltage according to $U = (2\,E / C)^{1/2}$, where U is the capacitor voltage in volts (V), E is the energy in joules (J), and C is the capacitor value in farads (F).
3) Open switches S1, S2, S3, S4; close switches S5, S6 and S7.
4) Insert a lamp into the test lampholder.
5) Turn on the lamp power supply and adjust to approximately the correct parameters to operate the lamp. Use of this power supply may or may not require additional means of starting.
6) Close the enclosure securely.
7) After 5 min, close switches S1 and S2, and open switch S6.
8) Determine the lamp electrical operating point by means of the VAW meter and adjust the power supply as necessary to bring the lamp to its rated operating point.
9) Allow the lamp to operate for 20 min.
10) While waiting for the lamp to warm up, turn on the capacitor d.c. power supply, open switch S5 and close switch S4 to begin charging the capacitor; monitor the capacitor voltage by means of the voltmeter.
11) After the capacitor has reached its final charge and the lamp has operated at least 20 min, close switch S6 and open switches S1, S2 and S4.
12) Open switch S7 that triggers the closing of switch S3 to discharge the capacitor through the lamp.
13) After the discharge, open switch S3 and close switch S5; turn off both power supplies.
14) If the arc tube ruptured at step 12, then repeat steps 3 to 13 until 8 lamps have been tested. If at least 4 out of 8 arc tubes ruptured, then the energy and voltage values shall be recorded, and these values shall be used for the rest of the test as described in I.3.3.

15) If the arc tube did not rupture in step 12, or if fewer than 4 out of 8 arc tubes ruptured in the ensuing attempts, then the voltage at the discharge capacitor shall be increased to obtain an energy increase of at least 5 J, and steps 3 to 14 shall be repeated. If the arc tubes do not rupture reliably after increasing the voltage, an increase in capacitance may be required.

I.3.3 Rupture test procedure

After the median energy required to ensure rupture of the arc tube has been determined (see I.3.2), the following procedure shall be carried out to determine whether the lamps are self-shielded.

Follow steps 3 to 13 in the I.3.2 (with the median energy value that ensures rupture of the arc tube, as determined in that subclause). This procedure shall be followed until all the lamps of the test group have been evaluated. The quantity of lamps in the test group shall be sufficient to ensure at least 10 arc tubes rupture.

I.4 Self-shielded lamp design

I.4.1 Definition of damage to the outer bulb

Each of the lamps with ruptured arc tubes shall be examined for damage to the outer bulb. For the purposes of this test, damage to the outer bulb constitutes any shattering, punctures, or holes in the bulb wall. Scratches, cracks and chips on the bulb wall are allowed, as long as all fragments are contained within the bulb, and the bulb remains intact.

I.4.2 Determination of self-shielded

If none of the lamps from I.3.3 shows any damage to the outer bulb (as defined in I.4.1), then the lamp construction is self-shielded. If two or more of these lamps show damage to the outer bulb (as defined in I.4.1), then the lamp construction is not self-shielded. If only one of the lamps in the test group shows any damage to the outer bulb and this damage is limited to a hole of less than 3 mm diameter in the bulb wall, then the test shall be repeated with a new quantity of test lamps sufficient to ensure at least 10 arc tube ruptures. If none of the lamps in this second test group shows damage to the outer bulb, then the construction is self-shielded. If one or more of the lamps in this second test group shows any damage to the outer bulb, then the construction is not self-shielded.

Annex J
(normative)

Containment[3] testing procedure for metal halide lamps with ceramic arc tubes

J.1 General

J.1.1 Purpose

This method of measurement applies to metal halide lamps with ceramic arc tubes that are designed to contain all particles within the outer bulb should an arc tube rupture occur. These lamps are permitted to be used in open luminaires. This is not a sufficient procedure for evaluation of particle containment designs which employ protective coatings, e.g. a plastic coating over the outer bulb.

J.1.2 Test description

The test consists of switching extra impedance in parallel with the operational ballast to increase the energy in the arc tube and thereby simulate an end-of-life arc-tube rupture. In the first part of the test, the median energy required to ensure rupture of the arc tube is determined. In the second part of the test, arc tubes are forced to rupture at the median energy, and the lamps are examined for damage to the outer bulb. The test differs from real end-of-life situations in a number of ways, including: a) the lamps are new, b) a high energy input into the arc tubes is required to make them rupture, leading to higher pressures and greater energies than typical end-of-life ruptures, and c) the arc tube rupture mechanism may not be the same as that for end-of-life lamps.

J.2 Experimental setup

J.2.1 Safety precautions

High electrical energy levels are involved in this test, so extreme caution is required. Fragments of hot lamp parts can be ejected if the outer bulb is damaged, so a physical enclosure is required. Precautions should be taken to contain and clean up mercury and other hazardous materials from the lamp in the event of penetration of the outer bulb.

J.2.2 Electrical circuit

The basic electrical circuit used for containment testing of metal halide lamps is shown in Figure J.1. The main components include: (1) a power supply for operating the lamp and supplying extra energy to rupture the arc tube, (2) an operational ballast for operating the lamp, (3) an extra impedance to switch in parallel with the operational ballast, and (5) volt- and (4) ammeters for measuring the lamp electrical operating characteristics. The lamp power supply shall be capable of supplying the lamp with sufficient voltage and current to operate the lamp at its nominal operating power and at an increased energy level sufficient to rupture the arc tube (typically 5 to 20 times the nominal operating power). The operational ballast may comprise a suitable linear reactor or commercial ballast, with a suitable impedance as specified in the applicable lamp standard. The extra impedance may comprise a variable linear reactor, a reactor ballast, or a combination of reactor ballasts. The wiring and switches shall be capable of handling at least 40 A.

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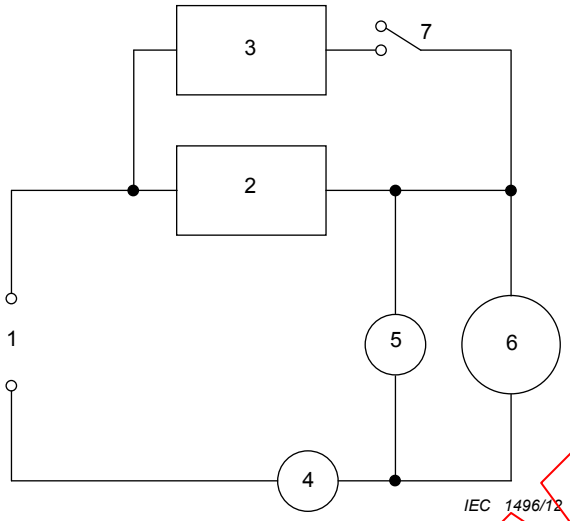
3 Lamps, complying with the requirements of this annex are sometimes called “containment rated”, “open rated” or “self-shielded”, the latter expression being preferred.



Key

1	power supply	4	ammeter
2	operational ballast	5	voltmeter
3	extra impedance	6	lamp
		7	switch

The voltmeter and ammeter may be set up to be switched out of the circuit if desired.

Figure J.1 – Electrical diagram for containment test

J.2.3 Enclosure requirements

The enclosure for containment testing of metal halide lamps shall be constructed of materials capable of withstanding the impact of hot particles (particles of up to 1,1 g at 1 200 °C travelling at 50 m/s). Suitable materials include sheet metal and impact-resistant, high-temperature polymers. Metal enclosures shall be electrically grounded.

The enclosure shall be equipped with a suitable lamp holder for operating the lamp under test in the base up position, or in the specified operating position of the lamp.

The dimensions of the enclosure are not critical, but they should be large enough to accept the lamp under test and provide sufficient clearance at the sides and below the lamp.

J.3 Test procedures

J.3.1 Lamp selection and preparation

Lamps for this test shall be selected randomly from normal production or from pilot runs. The lamp construction dimensions shall fall within the manufacturer's specified values.

J.3.2 Determination of median rupture energy

In order to determine the median energy setting needed to rupture the arc tube within the lamp, the following procedure shall be carried out, with reference to Figure J.1. Note that these steps need to be carried out for each different lamp type.

1) Take care that the condition at the beginning is that the energy sources of charging and lamp operation are not connected, lamp not inserted.
2) Select an impedance for the extra impedance of about 20 % of that of the operational ballast[4].
3) Open the switch and insert a lamp in the test lampholder.
4) Turn on the power supply and set the supply voltage to the rated voltage or greater for the lamp under test. Up to 110 % of rated voltage and/or 120 % of rated power is permitted.
5) Ignite the lamp and close the enclosure securely.
6) Operate the lamp for at least 10 min.
7) Close the switch to increase the energy in the arc tube.
8) Observe whether or not the arc tube ruptures within about 5 s.
9) Open the switch and turn off the power supply.
10) If the arc tube ruptured in step 8, then repeat steps 3) to 9) until 8 lamps have been tested. If at least 4 out of 8 lamps ruptured, then the voltage and impedance values shall be recorded, and these values shall be used for the second part of the test (see J.3.3).
11) a) If the arc tube stayed on but did not rupture within about 5 s, then the extra impedance value shall be decreased, and steps 3 to 10 shall be repeated.

    b) If the arc tube extinguished instead of rupturing, then the supply voltage shall be increased and the impedance of the operational ballast may be increased to assure operation of the lamp up to 120 % of rated power during the 10-min warm-up period. Thereafter steps 3) to 10) shall be repeated.

J.3.3 Rupture test procedure

After the median energy required to ensure rupture of the arc tube has been determined (see J.3.2), the following procedure shall be carried out to determine whether the lamps are self-shielded.

Follow steps 3) to 9) in J.3.2 (with the median energy value that ensures rupture of the arc tube, as determined in that subclause). This procedure shall be followed until all the lamps of the test group have been evaluated. The quantity of lamps in the test group shall be sufficient to ensure at least 10 arc tube ruptures.

J.4 Self-shielded lamp design

J.4.1 Definition of damage to the outer bulb

Each of the lamps with ruptured arc tubes shall be examined for damage to the outer bulb. For the purposes of this test, damage to the outer bulb constitutes any shattering, punctures, or holes in the bulb wall. Scratches, cracks and chips on the bulb wall are allowed, as long as all fragments are contained within the bulb, and the bulb remains intact.

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4 Practical impedance values determined for some typical lamp types are shown below. Note that these values may vary for different arc tube constructions.

- 39 W lamp 59 Ω (HPS 250 W ballast)
- 70 W lamp 38 Ω (HPS 400 W ballast)
- 150 W lamp 17 Ω (HPS 1 000 W (100 V) ballast)