DRAFT FOR DEVELOPMENT

DD ENV
50234:1997

Aeronautical ground lighting electrical installation — Flashing lights: Equipment specifications and tests

ICS 93.120

National foreword

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because it is an interim draft. A revised version of this document is being produced by IEC/TC 97. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the European organization responsible for its conversion into a European Standard. A review of this publication will be initiated 2 years after its publication by the European organization so that a decision can be taken on its status at the end of its three-year life. The commencement of the review period will be notified by an announcement in *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into a European Standard, to extend the life of the prestandard or to withdraw it. Comments should be sent in writing to the Secretary of BSI Technical Committee EPL/97, Lighting and beaconing of aerodromes, at 389 Chiswick High Road, London W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the ENV title page, pages 2 to 12 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

This Draft for Development, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 September 1997

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English version

Aeronautical ground lighting electrical installation Flashing lights: Equipment specifications and tests

This European Prestandard (ENV) was approved by CENELEC on 1996-07-02 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CENELEC will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard (EN).

CENELEC members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Prestandard was prepared by the CENELEC BTTF 72-3, Lighting fittings for aerodromes.

The text of the draft was submitted to the CENELEC questionnaire and vote and was approved as ENV 50234 on 1996-07-02.

The following date was fixed:

— latest date by which the existence of the ENV has to be announced at national level (doa) 1996-12-01

Contents

1 Scope

This prestandard specifies general requirements for classification of flashing light systems used on airports or for ground based aviation lighting systems, for the luminaries, for the control cabinets and for their mechanical and electrical construction erection, together with the related tests.

This prestandard is applicable to flashing light systems used for:

— Sequential flashing approach lighting systems;

— Runway threshold identification lights;

— Runway lead-in lighting systems;

— Medium and high intensity obstruction lighting systems.

Alternately flashing lights used as runway guard lights are excluded from this prestandard. Attention is drawn to the fact that this prestandard covers all aspects of safety (electrical, thermal and mechanical).

The purpose of this prestandard is to provide a set of requirements and tests which are applicable to the luminaries and their control equipment. In general, this prestandard covers safety requirements for all components of the system.

2 Normative references

This prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this prestandard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 50081-2, *Electromagnetic compatibility — Generic emission standard — Part 2: Industrial environment.*

EN 50082-2, *Electromagnetic compatibility — Generic immunity standard — Part 2: Industrial environment.*

EN 55015, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment.*

EN 60204, *Safety of machinery — Electrical equipment of machines.*

EN 60529, *Degrees of protection provided by enclosures (Code IP) (IEC 529).*

EN 60598-1, *Luminaires — Part 1: General requirements and tests.*

EN 60742, *Isolating transformers and safety isolating transformers — Requirements.*

EN 60950, *Safety of information technology equipment, including electrical business equipment.*

EN 60984, *Sleeves of insulating material for live working.*

EN 61000-3-2, *Electromagnetic compatibility (EMC) — Part 3: Limits — Section 2: Limits for harmonic current emissions (equipment input current up to and including 16 A per phase).*

EN 61000-3-3, *Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current up to 16 A.*

EN 61547, *Equipment for general lighting purposes EMC immunity requirements.*

HD 384, *Electrical installations of buildings.*

ICAO, *International standards and recommended practices Aerodromes Annex 14 to the Convention on International Civil Aviation, Volume 1 and 2, Aerodrome Design and Operations (Issued by International Civil Aviation Organisation).*

3 Definitions

For the purposes of this prestandard the following definitions apply, as well as those given in ICAO Annex 14 and HD 384, EN 60598-1 and EN 60950.

Where the terms voltage and current are used, they imply true RMS values unless otherwise stated.

3.1
flashing light system

system including one or several flashing lights together with their electrical wiring used as an aid either during en route phase and during the approach to an airport

3.2
flashing light

luminaire including its control cabinet and part of a flashing light system

4 Assessment of general characteristics

4.1 General test requirements

4.1.1 *Tests according to this prestandard are type tests*

4.1.2 Unless otherwise stated, luminaries and their associated control equipment shall be tested at ambient temperature (between 10 °C and 30 °C). Each flashing light submitted to the test shall be tested "as delivered" and as installed in normal use, including one lamp.

Each sample shall satisfy all the relevant tests. In order to reduce the time of testing and to allow for any test which may be destructive, the manufacturer may submit additional components provided that these are of the same material and design as the one used in the original equipment and that the results of tests are the same as if carried out on an identical piece of equipment.

Where the test for compliance is shown as being "by inspection" this shall include any necessary handling.

4.2 Components of the system

Components complying with the requirements of the relevant Europeen standards for those components and not requiting additional protection shall not be subjected to further testing or appraisal as part of the equipment. Those components which rely upon the construction of the equipment for electrical and mechanical safety shall be tested in accordance with the relevant clause of this prestandard.

4.3 Fundamental principles

Flashing light systems are used on airports.

One or several lights are installed to form one system.

All lights of one system are emitting short duration light flashes of equal light intensity to guide an approaching pilot to the runway or to mark a hazard to air traffic.

Every light of a system flashes at given intervals eventually at a given time in a sequence.

The control cabinets are powered by a single or three phases mains network, generally 230/400 V AC, 50 or 60 Hz or by series circuits in 6,6 A. They are remotely controlled and have the ability to operate, in many cases at three levels of energy. They do also provide back indication signals to a remote monitoring system. They provide some form of energy storage in order to keep the variation of power supply current below 150 % of the average value.

4.4 Purpose, supplies and structure

4.4.1 ***Purpose***

Flashing light systems are used for:

— sequential flashing approach lighting systems;

— threshold identification;

— lead-in lighting systems;

— medium and high intensity obstruction lighting systems.

4.4.1.1 *Sequential flashing approach lighting systems*

Such systems consist of a row of lights installed along the extended runway centre line at regular intervals of 30 m, at the location of the steady burning approach light barrettes. The steady burning lights shall not obstruct the visibility of the flashing lights, and vice versa. Each light consists of one luminaire including a discharge lamp and its triggering or starting device, connected via a special cabling to a control cabinet.

These individual control cabinets are connected together and to a central or master control device serving as interface between the system and the mains and control/monitoring lines.

A control system shall ensure the correct firing sequence (timing) of every light and the brightness or energy level control.

A monitoring system shall give information on the status of the system, brightness level and correct or faulty operation of one or several light units.

4.4.1.2 *Threshold identification*

A threshold identification lighting system shall consist of two lights installed in line with the threshold and symmetrically about the runway centre line at approximately 10 m outside each line of runway edge lights.

These two lights shall be flashing in synchronism at a frequency of one or two flashes per second.

For operational reasons an interlock between the two control cabinets shall ensure that both units are operating.

Should one of the fittings fail, the other one shall stop flashing to avoid a misleading information to the pilot.

In some cases, the threshold identification lighting system is installed at the end of an approach lighting system equipped with sequential flashing lights. In such case, the operation of the threshold identification lights shall be synchronized with the approach flashing lights to form a complete system.

4.4.1.3 *Lead-in lighting systems*

Lead-in lighting systems are used to indicate the pilot of an approaching aircraft the route to follow to reach the approach to the runway. This system is only used when a curved route is mandatory to avoid obstacles located on the extended runway centre line.

The lights used are the same as those used for a sequential approach lighting system. They are installed by groups of lights spaced at 60 m, separated by a large space which can extend over approx. 1 600 m.

All the lights shall be synchronized and fixed in a way to show the pilot the correct route to follow the reach the prestandard approach lighting system to which the sequence shall be synchronized in case it is equipped with a sequential flashing approach lighting system. A case by case custom design is necessary for this system.

4.4.1.4 *Medium or high intensity obstruction lighting system*

Where it is imposed by the ICAO Annex 14 to install medium or high intensity lighting systems, the lights used may be flashing obstruction lights.

The performance of the lights and light colour, either white or red, shall be as defined in the ICAO Annex 14.

4.4.1.5 *Heliport beacons*

Condenser discharge lights may also be used as heliport beacons.

This subject shall be addressed in a separate specification on heliport lighting systems.

4.4.2 ***Supplies***

4.4.2.1 The control cabinets are powered by a single or three phases mains network,
generally 230/400 V AC, 50 or 60 Hz or by series circuits in 6,6 A, via a special power adaptor.

4.4.2.2 The system is generally remotely controlled from a control system generally located in the Airport Control Tower.

The control signals shall be SELV signals, generally 48 V DC.

The current in the control wires shall be kept to the minimum possible in order to avoid excessive voltage drops in the control wires. The monitoring signals shall use the same voltage as the one used for the control signals, current consumption shall be mentioned in the installation manual.

4.4.3 ***Structure***

As explained above, a flashing light system is generally composed of several flashing lights. Each light consists of a luminaire housing the flashing lamp and a control cabinet housing electrical components and feeding the lamp.

Depending on the installation location of the light, the luminaire shall be either of an elevated type or of an inset type.

The elevated type shall be used when the light can be mounted above the ground level and the inset type shall be used when the light has to be mounted in a paved area where aircraft, vehicles or devices may pass over it.

The elevated type shall be frangible according to ICAO Annex 14. This means it shall be lightweight and mounted on a frangible structure so as not to damage an aircraft that would accidentally hit the luminaire or its mounting structure.

On the other hand, the inset type shall be of a sturdy construction to resist to the efforts imposed by an aircraft rolling or landing on its top part.

Elevated and inset luminaries shall have photometric performances meeting the same specification, using the same control cabinet.

Following the Airport Authority requirements, the control cabinet feeding each luminaire shall generally be installed at a distance from the luminaire itself in order to be installed outside of the critical safety area where only frangible (and light weight) components may be installed.

The central control cabinet shall also be installed as close as possible to the flashing lights but outside of the critical safety area or as required by the airport authority.

For obstruction lights, the control cabinets shall also be installed as close as possible to the luminaire but shall remain accessible for maintenance purpose.

4.5 Classification of external influences

4.5.1 ***Environmental influences***

The flashing light systems are used on airports or in their vicinity. They are installed outdoors.

They shall be designed to operate within the following environmental conditions:

— ambient operating temperature ranging from – 20 °C to + 55 °C;

— altitudes from sea level up to 3 000 m;

— relative humidity up to 100 % including conditions when condensation takes place in the form of water or frost;

— exposure of light emitting surfaces to sudden application of cold rain water when the optical head has reached its operating temperature;

— exposure to salt-laden atmosphere;

— exposure to windblown sand and dust particles;

— exposure to windblown rain;

— subject to jet blast and particularly the Threshold Identification Lights which should resist a blast of 560 km/h (310 knots);

— presence of aircraft requiring the equipment frangibility;

— presence of insects and rodents;

— subject to U.V. radiation;

— subject to the effects of deicing products and soils;

— subject to weed killing products;

— subject to partially burnt exhaust gases;

— subject to aircraft/vehicle impact/rollover (for inset lights);

— subject to standing water, hydraulic impact (for inset lights).

4.5.2 ***Electrical influences***

The flashing light systems are used in open areas. They are therefore subject to electrical perturbations encountered in open areas and particularly:

— transient surges on the input power supply and control cables

— lightning strikes in the vicinity of the units or hitting their supporting structure

— voltage fluctuations

— voltage drops in the power and control cables

— RadioFrequency radiations

4.6 Compatibility

4.6.1 ***Power supply***

The input voltage range of the cabinets of the system shall be adapted to the available mains voltage. Some systems include flashing lights spread over large distances form the mains distribution switchboard.

The central control cabinet shall be equipped with power supply input terminals having a sufficient capacity to allow the connection the cables (up to 35 mm^2 for the main feeder and up to 16 mm^2 to the individual units).

These particular capacities are normally sufficient for any system but, on request, it should be possible to increase the conductor cross sections to compensate for unusual cable lengths. Control cabinets and luminaries shall be earthed, if made of conductive materials.

4.6.2 ***Control signals***

The control signals are generally SELV DC voltages for safety of personnel. These signals shall at least include ON/OFF and brillancy selections as well as ON/OFF, brillancy and faults information.

4.6.3 The connection between the control cabinet and the luminaire shall use a cable with characteristics compatible with the correct operation of the flashing light.

4.6.4 Elevated luminaires shall be lightweight and mounted on a frangible supports in order to reduce to a minimum damages caused to an aircraft accidentally hitting a luminaire or its mounting structure.

The control cabinets housing all the heavy electrical components shall be mounted out of the critical safety zone on supporting columns.

4.7 Maintainability

The luminaire should be designed to allow for an easy relamping and easy beam adjustments. As lethal voltage exists inside the luminaire during its operation, a safety device shall be fitted in the fitting to switch off and remove lethal voltages as soon as the circuitry can be reached. The control cabinet of every flashing light shall be fitted with a lockable door. To open the door, a special tool/key shall be required to prevent unauthorized persons to open the cabinet doors.

Protections should be provided for all components subject to mains voltage. A warning sign shall be displayed to inform service personnel of existing hazards.

The control cabinets should be identical and each cabinet should be compatible for use in any location within the same system.

The central control cabinet shall be fitted with a mains circuit breaker allowing to isolate the complete system from the mains. It should also be fitted with a local control switch allowing the local control of the whole system at the various energy levels, to switch the system “off” and to operate it via the remote control system.

In all cabinets, the design should take into account the accessibility to the main components to allow for an easy setup and maintenance.

4.8 Safety services

Insulating shields shall be installed to protect from accidental contact with any components presenting HV. This applies particularly to energy power circuitry.

The opening of the luminaire or its control cabinet shall automatically deenergize the electrical circuits and discharge all capacitors.

Reinforced insulation shall be used throughout in order to avoid any risk of medium/high voltage leakage to the sequence flashing light circuits.

No live circuits shall be accessible during operation.

4.9 Environmental protection

The equipment and circuitry shall be suitably protected for use in the environment prevailing at its installation site (see EN 60529).

A protection degree of at least IP 34 for elevated lights and IP 67 for inset lights and IP 54 for the control equipment shall be provided for the prestandard equipment. Higher protection might be required in some particular applications.

5 Protection for safety

5.1 Protection against electric shock

5.1.1 *Clearances, creepage distances, insulation*

Electrical safety of the equipment shall be ensured according to EN 60204, EN 60950 standards. Reinforced insulation shall be used between mains (resp. HV circuitry) and control circuitry. Transformers shall be safety type according to EN 60742 and subjected to double vacuum and pressure impregnation.

5.1.2 *DC high voltages*

The flashing lights are often using the discharge of a high voltage capacitor into the lamp to provide the light output. Therefore, a voltage up to 2 000 V is present inside the control cabinet and the luminaire.

As these voltages present a lethal hazard when the luminaire or the control cabinet is open, a safety device shall be incorporated in both to automatically deenergize the control cabinet and to discharge the high voltage capacitors as soon as the equipment is no longer perfectly closed. The discharge time of the capacitors shall not exceed 30 seconds.

Bypass, if any, enabling trouble shooting shall automatically be reset when the device is normally closed.

An insulation shield shall prevent accidental contact with any bare H.V. conductor (at terminals for example) to allow trouble shooting of the flashing lights.

5.1.3 *Transient surges*

Protection for high voltage transient surges on the power input and on control input/outputs shall be provided to protect the maintenance personnel from transient surge effects and also to protect the equipment against damage from such transient surges.

5.2 Protection against thermal effects

The equipment shall be designed for operation in ambient temperatures up to 55 °C. Suitable ventilation and/or sun radiation protection should be provided to avoid overheating of the components inside the equipment.

When the control cabinet is operating at low ambient temperatures, a heating system shall be included to keep a minimum temperature rise inside the cabinet and to avoid condensation on critical components.

For application in exposed countries a sunshield should be available on request.

5.3 Protection against overcurrent

Every flashing light control cabinet shall be suitably protected against overcurrent. These protecting devices shall meet the applicable subclauses of the EN 60950.

5.4 Protection against over and undervoltage

The system can be installed at a significant distance from the mains distribution switchboard.

Therefore relatively important voltage drops occur in the power supply cables.

The system itself is also spread over a quite large area and subsequently, the input voltage shall vary between the unit closest to the mains distribution switchboard and the farthest unit.

The actual input voltage at the various control cabinets of the complete system is thus varying and consequently, the input voltage range of the units shall be wide enough to allow for normal operation within a large voltage range.

Considering a prestandard 230 V/400 V mains voltage, the units shall be capable of operating continuously at their nominal output characteristics for input voltages varying between – 20 % and + 10 % of the nominal supply voltage (or 184 V and 253 V AC).

Adaptation either by automatic stabilisation or tap selection shall be provided at the input to cover the voltage range.

5.5 Isolation and switching

The central control cabinet of the system shall be equipped with a mains input circuit breaker allowing to isolate completely the system from the mains network.

The same cabinet shall also be equipped with a control switch allowing the local switching and control of the system for maintenance purpose, the switching “OFF” of the system or the remote switching of the whole system, via control cable, from the control desk installed in the control tower.

5.6 Electromagnetic compatibility

The flashing equipment shall be suitably protected against electromagnetic compatibility according to EN 50081-2 or EN 61000-3-2 and EN 61000-3-3 and EN 55015 for emission, and EN 50082-2 or EN 61547 for immunity.

NOTE It is recalled that due to their situation on the airfield these equipment may be lead to comply with EMC requirements specific to support structure where they are placed.

6 Selection and erection of equipment

6.1 Common rules

The equipment for a flashing light system shall be selected to meet the operational requirements specified in the ICAO Annex 14 and all applicable relevant Europeen standards.

6.2 Wiring system

The various elements of the system are connected together by means of cables. From the mains distribution switchboard and the control marshalling panel, an armoured underground power cable and an armoured underground control cable are laid down to the central control cabinet.

From this cabinet, underground armoured cables are laid down to every flashing light control cabinet.

The current drawn in these cables is quite small but the cable lengths are important.

Therefore, the cross section of the conductors shall be computed to guarantee the presence of sufficient voltages at the input terminals of every flashing light control cabinets.

This requests the use of conductors ranging generally from 6 to 35 mm^2 for the power supply cables and conductors of at least 0,5 mm^2 for the control cables. This cross section can reach 2,5 mm^2 or more in some configurations.

Between the control cabinet and the flashing luminaire, there may be a special HV cable. This cable shall be mechanically protected over its whole length.

6.3 Switchgear and controlgear

6.3.1 *Switchgears*

The system is powered from a mains distribution switchboard. The outgoing of this switchboard assigned for the flashing light system shall be fitted with a circuit breaker. This circuit breaker is the ultimate protection of the system. It is sized to protect the mains supply cable down to the central control cabinet or, in case of systems of less than five flashing lights, to protect all power feeders to these light control cabinets.

When used, the central control cabinet shall be equipped with a circuit breaker, suitably sized to provide an effective protection of the power cables feeding the flashing lights. The protective devices selectivity shall be in the following order:

- Individual control cabinet
- Central control cabinet
- Substation circuit breaker

Every flashing light control cabinet shall be protected against internal damage by means of circuit breaker and/or fuses having an adequate rupture capacity.

6.3.2 *Controlgear*

6.3.2.1 *Central control cabinet*

The central control cabinet, incorporating the main system circuit breaker, shall include an interface for the control signals in order to keep to a minimum the currents carried in the main control cable connecting the system to the remote control desk installed in the control tower. These signals shall be SELV DC voltages, generally 48 V DC.

The interface shall provide the power required for the control and monitoring of all the flashing lights of the system. The control signals shall have the same voltage characteristics as those coming or going to the remote control desk.

A control switch should be provided in the central control cabinet to allow the maintenance personnel to operate locally the system.

One position of the control switch should ensure the transfer of the controls to the remote control system and another position should allow to stop the operation of the system, keeping the power supply on the flashing lights power feeder.

Besides remote control, a monitoring circuit should give the status of the installation to tower personnel.

6.3.2.2 *Individual control cabinet*

The individual control cabinets, including power input circuit breakers or fuses shall include all electrical components ensuring the correct operation and monitoring of the flashing luminaire. The cabinet shall include also a device producing the triggering pulse for the discharge lamp. Safety switch(es) shall also ensure that the cabinet circuits are deenergized and, if any, that High voltage is removed when the door of the cabinet is not properly closed.

A heater is also generally included in the cabinet to prevent condensation of moisture. Care has to be taken in order to prevent excessive heating inside the cabinets.

The circuitry shall also provide monitoring signals to be sent to the central control cabinet and indicating the correct operation of the cabinet.

6.4 Earthing arrangements and protective conductor

All equipment shall be grounded.

The cable used shall include a protective conductor connected to a ground dispersion system having a maximum resistance of less than 10 Ω according to HD 384.

All metallic parts of the control cabinets shall be connected by means of suitable protective conductors to a main grounding terminal.

The special cable connecting the luminaire to the control cabinet shall have one of its conductors connected to the main grounding terminal.

General guidance on the earthing, grounding and protective conductors are given in EN 60984, EN 60950 and HD 384.

The applicable sections of these publications fully apply for this particular equipment.

6.5 Safety devices

In addition to the electrical safety devices described above, the mounting systems of the luminaries, shall be frangible according to operational requirements detailed in the ICAO Annex 14.

Moreover, all wires and cables shall be mechanically protected in the accessible areas to prevent any damage which could result to a hazard to personnel and/or to an unreliable operation of the system.

7 Inspection and testing

7.1 Operation and reliability tests

The equipment shall be tested for operation and reliability as given in Table 1:

Table 1

TEST	QUALIFICATION (TYPE TEST)	ROUTINE FACTORY
OPERATION	YES	YES
RELIABILITY	96 h	8 h
TEMPERATURE	– 55 °C & – 20°C → + 55 °C	NO
VOLTAGE SUPPLY	YES	YES
SAFETY/ INSULATION	YES	YES

7.1.1 *Operation test*

A complete system shall be interconnected in order to form a complete sequenced flashing system supplemented by a Runway Threshold Indicator Lighting, all synchronical and operating at a 2 flashes per second rhythm.

The power supply being adjusted at nominal value.

The operation of each light shall be observed at each brightness step, for

— Synchronous operation

— No mis firing nor spurious firing within one hour

— Brightness shall change for all the lights within the same sequenced period

— Timing within tolerances

7.1.2 *Voltage supply test*

The system connect as described above, supplied by a source at project frequency shall be supplied for 15 min at nominal supply × 0,85 then for 15 min at nominal supply × 1,1, then for half an hour at nominal voltage.

The system shall be inspected for:

— No mix/spurious firing

— Synchronous operation

— Timing within tolerances

— Simultaneous brightness charge

7.1.3 *Reliability*

The system, interconnected as above shall be supplied at project frequency at the worst case power supply voltage within the 0,85 to 1,1 time nominal supply voltage and operated at maximum brightness and flashing rate at room temperature continuously.

The system shall be kept in this condition for the specified time (8 h routine factory or 96 h qualification) then a voltage supply test as described above shall be performed.

7.1.4 *Safety/insulation test*

The equipment shall be tested for electrical safety according to all applicable tests required in HD 384, EN 60598-1 and EN 60950.

Energy storing devices shall be discharged within 30 s after opening of door.

A dielectric test shall be performed on the interconnected mains supply terminals and control terminals to ground/housing if conductive

— Test voltage on mains: 3 000 V RMS for 1 min.

— Test voltage on control: 500 V RMS for 1 min.

An insulation resistance test shall be performed between the interconnected terminals and ground under a DC voltage of 3 000 V. The insulation resistance shall at least be 7 MΩ.

NOTE During this test surge protection devices shall be disconnected.

7.1.5 *Temperature*

A single flashing light with control cabinet shall be soaked for 24 h at – 55 °C.

Thereafter it shall be left at a temperature of – 20 °C for one hour then started at nominal voltage at the highest brightness steps for 15 min.

No misfiring, spurious firing, loss of timing may be observed.

Thereafter, the equipment shall be brought to an ambient temperature of + 55 °C for 3 h and the same high and low brightness step shall be run.

7.2 Equipment tests

The equipment shall also be tested for its operational characteristics.

7.2.1 ***Photometric tests***

The photometric tests consist of the luminous intensity measurements in the aperture of luminous beam. The aperture is defined in angular terms linked to operational characteristics in ICAO Annex 14 according to the use of the flashing light.

For the photometric tests a standard length of cable between fitting and control cabinet should be specified moreover, a curve showing the relation between the length of this cable and the light-output should be available.

7.2.1.1 The BLONDEL/REY formula (1) shall be used for calculating the luminous Effective Intensity of Flashing Signal Lights:

$$I_e = \frac{\int_{t_1}^{t_2} I \, dt}{0.2 + t_2 - t_1} \qquad (1)$$

where I_e is the effective intensity in Cd, I is the luminous instantaneous intensity in Cd The times t_1 and t_2 are generally chosen so I_e is equal to I at these times (expressed in s).

NOTE A proposal for flashing light measurement is given in Annex A (informative).

7.2.1.2 *Chromaticity*

The light output chromaticity shall be variable white as specified in ICAO Annex 14.

7.2.2 ***Mechanical tests***

Static load, horizontal shear, torsional shear, fatigue vibration, hydraulic impact, mechanical impact, frangibility shall be tested per corresponding paragraph of the prestandard for steady burning devices.

7.2.3 ***Environmental tests***

Low temperature, high temperature, thermal shock, rain, watertightness, corrosion, surface temperature, depression shall be tested per corresponding paragraph of the prestandard for steady burning devices.

NOTE Low temperature operating is limited to – 20 °C as no meteorological conditions justifying the rise of flashing lights exist under these temperatures. However this test shall follow a 24 h storage test at – 55 °C.

7.2.4 ***Visual inspection test***

A visual inspection for compliance to safety prestandards, quality of materials, processes and workmanship shall be performed.

Presence and completeness of the technical documentation shall be checked.

Annex A (informative) Proposal of flashing light measurement

One method of obtaining the effective intensity of a flashing light at a known rate from measurements of the average intensity is developed below.

A.1 Definition of terms

- I = the instantaneous intensity of the test light during a flash.
- $\bar{I}$ = the average intensity of the test light during a complete flash cycle.
- I_e = the effective intensity of the test light.
- I_s = the intensity of the standard lamp.
- τ = the transmittance of the sector.
- D = the distance between the test light and the diffusing glass of the photometer.
- d = the distance between the prestandard lamp and the diffusing glass of the photometer.
- T = the time required for a complete flash cycle, i.e., from the beginning of one flash to the beginning of the next flash.
- R = the recorder reading.
- R_s = the recorder reading during calibration with the prestandard lamp.

A.2 Units of measurements

The above terms may be expressed in the following units.

a) I, $\bar{I}$, I_e and I_s — Usually in kilo-candelas.

b) τ — Has no applicable unit of measurement. (Express in decimals).

c) D, d — Usually in meters.

d) T — Time in seconds.

NOTE Items shown in a) may be in other units of intensity provided all are expressed in the same units. Items shown in c) may be in other dimensional system provided both are in the same units.

A.3 Basic relations

The effective intensity is defined as:

$$I_e = \frac{\int_{t_1}^{t_2} I\,dt}{0.2 + t_2 - t_1} \qquad (1)$$

The times t_1 and t_2 are generally chosen so I_e is equal to I at these times. However, the effective intensity is sufficiently small in proportion to the instantaneous intensity over most of the flash so that $\int_{t_1}^{t_2} Idt$ may be replaced by $\int_{0}^{T} Idt$ without introducing significant error.

In addition, the flash of a condenser-discharge light is so short that $(t_2 - t_1)$ is negligibly small in comparison to 0,2. Therefore,

$$I_e = 5\int_{t_2}^{T} I\,dt \qquad (2)$$

but

$$\bar{I} = \frac{\int_{0}^{T} Idt}{T} \qquad (3)$$

therefore,

$$Ie = 5\overline{IT} \qquad (4)$$

Because of the time constant of the input circuit, the light integrator responds to the average current of the photosensor. The phototube does not saturate and the photoelectric current is at all times proportional to the illuminance on the phototube.

Hence, the reading of the output meter is given by

$$R = \frac{KI}{D^2} \qquad (5)$$

where K is constant of proportionality which is a function of the photometric system.

Combining equations (4) and (5) yields:

$$\frac{L}{R} = \frac{5TD^2}{T} \qquad (6)$$

For ease in interpretation of the reading of the output meter recorder, the ratio I_e/R is made the product of either an integer, or the reciprocal of an integer, and an appropriate power of ten by adjusting the parameters of the circuit to obtain the proper value of K. The meter scale or chart can then be graduated in a convenient number of candelas per division.

A.4 Calibration

The calibration of the photometric system to obtain the proper value of K is accomplished by means of the prestandard lamp.

$$\text{Since } R_s = \frac{KI_sT}{d^2} \tag{7}$$

$$R_s = 5TD^2\,\frac{RI_2T}{I_e d^2} \tag{8}$$

A value of I_e/R is chosen and the parameters of the photometric system are adjusted to obtain the desired R_s.

The photometric system shall be calibrated by means of a certified standard lamp before each use. The illuminance of the photometer during calibration shall be approximately that which shall be produced by the unit under test.

Because it may be difficult to obtain a photometric system combination with a spectral response which is sufficiently close to the CIE luminous efficiency function, a calibrated flashtube-power-supply assembly shall be used for the calibration of the photometer. Calibration of flashtube-power-supply assemblies may be obtained from a certified laboratory.

The light output shall be measured in accordance with the photometric requirements relating to the type of flashing light systems used.

For type testing, the light output shall be measured within the aperture of the beam defined in ICAO Annex 14. The average value of the measured points (each averaging 5 flashes) shall be at least the specified value when it is required. No point shall be under the minimum value specified, the highest value may not exceed the maximum specified value.

For routine factory acceptance tests, 5 points shall be measured:

— one at 0° horizontal/0° vertical. Its value shall be within the maximum and the minimum specified value;

— four points at the extremities of the main axes of the beam, the measured value shall not be below the minimum value specified.

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