DRAFT FOR DEVELOPMENT

DD ENV
50231:1997

Aeronautical ground lighting electrical installation — Constant current regulator: 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 13 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.

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Descriptors: Electrical installation, lighting, aerodrome, regulator, specification, designation, classification, test, marking

English version

Aeronautical ground lighting electrical installation Constant current regulator: 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 50231 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

Introduction

This prestandard concerns Constant Current Regulator (CCR) used to supply airport lighting luminaires, installed to give pilots visual cues during landing, take off and taxiing. These lights are not used to light any ground surface, but shall provide some references to pilots. The light intensity of each cue shall be adjusted with a good accuracy. This fact is obtained by ICAO requirements for isocandela diagrams of each type of source and by monitoring the current by a Constant Current Regulator.

The earth fault indicator is maintained in this Constant Current Regulator prestandard. In the future, the relevant clause should be included in installation and maintenance specifications under consideration.

1 Scope

This prestandard covers constant current regulators used in series circuits of aviation ground lighting installations.

This prestandard is applicable to constant current regulator assemblies, including control and monitoring devices, used for supply of a constant current to series connected light sources in airfield lighting systems. The Constant Current Regulator is designed to produce a constant current output independent of variations in the circuit load or, in some limits, of variations in the input voltage to the Constant Current Regulator.

The object is to provide equipment specifications and tests for constant current regulators used on airport that are considered necessary to meet the operational standards adopted by ICAO and to cover all aspects of safety (electrical, thermal and mechanical).

This prestandard is in accordance with ICAO Annex 14.

Any new operational need for Air Navigation Safety purposes could change some data or principles issued in this prestandard.

2 Normative references

This European prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at 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 European Standard 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.*

ENV 50232, *Aviation ground lighting electrical installation Isolating transformer: Equipment specifications and tests.*

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

EN 60240, *Characteristics of electrical infra-red emitters for industrial heating.*

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

EN 60947-2, *Low-voltage switchgear and controlgear — Part 2: Circuit breakers.*

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

HD 398, *Power transformers (IEC 76, modified).*

HD 472 S1, *Nominal voltages for low voltage public electricity supply systems (IEC 38, modified).*

HD 553 S2, *Current transformers (IEC 185, modified).*

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).*

ISO 9001, *Quality systems — Model for quality assurance in design, development, production, installation and servicing.*

3 Definitions, symbols and abbreviations

For the purposes of this prestandard the following definitions apply, as well as those given in ICAO Annex 14.

3.1 Definitions

3.1.1
constant current regulator

able to supply with a constant current, a serial loop built with airfield lighting luminaires, each of them very often supplied through an isolating transformer

3.1.2
constant current

constant as specified in this prestandard that no significant change could be noticed by an observer

3.2 Symbols and abbreviations

CCR:	Constant current regulator
In:	nominal current
LV:	Low Voltage
ELV:	Extra Low Voltage
HV:	High Voltage

4 General requirements

4.1 General characteristics

A CCR is designed to supply airport series lighting circuits with a constant current. The CCR shall be designed to produce a constant current output independent of variations in the circuit load or, in some limits, of variations in the input voltage to the CCR.

The rated current output by the CCR shall be 6,6 A.

The CCR shall comprise at least 5 *adjustable* intensity levels between 2,8 A and 6,6 A.

The standard power levels on the CCR secondary shall be:

2,5 kVA – 5 kVA – 7,5 kVA – 10 kVA – 12,5 kVA – 15 kVA – 20 kVA – 25 kVA – 30 kVA.

The standard input voltage should be obtained between two lines of the local network voltage.

The standard values are the following values as specified in HD 472 S1:1989 and IEC 38:1983:

$400\ \mathbf{V}\ ^{+10}_{-10}\ \%$

$230\ \mathbf{V}\ ^{+10}_{-10}\ \%$

The frequency shall be one of the two following values:

50 Hz ± 2 Hz or 60 Hz ± 2 Hz

4.2 Operating conditions

The equipment shall be designed to operate sheltered in the following conditions:

a) temperature limits: from – 20 °C to + 50 °C,

b) Relative humidity of 95 % or less, non-condensing.

c) Altitude from 0 m to 1 000 m, with the derating characteristics according to clause **9** of HD 553 S2.

4.3 Power transformer

This transformer shall comply with the requirements of HD 398.

The two following types could be accepted:

— dry type cooled by natural air convection;

— oil immersed.

The insulation requirements between primary and secondary, and between secondary and ground shall meet the requirements of following values:

Type I: Voltage test 3 000 V a.c.

Type II: Voltage test 10 000 V a.c.

Type III: Voltage test 20 000 V a.c.

4.4 Regulation

The CCR shall be equipped with at least five adjustable steps.

The nominal outputs are listed in Table 1.

4.4.1 *On resistive load*

The r.m.s. value of the output current shall be maintained within the limits 1 % for each setting, at any load between full load and short-circuit. The input voltage could vary from 95 % to 110 % of the nominal input voltage.

The CCR shall accept a sudden load variation of up to 50 % of the rated value, in which case the recovery to ± 1 % accuracy shall be less than 0,25 s.

Table 1 — For 5 steps CCR

Steps	Nominal Output (r.m.s.) A	Limits of minimal value A	Limits of maximal value A
5	6,6	6,53	6,67
4	5,2	5,14	5,26
3	4,1	4,05	4,15
2	3,4	3,35	3,45
1	2,8	2,75	2,85

4.4.2 *On reactive load*

The limits of the regulation shall be met at nominal voltage, with a load connected via isolating transformers. The percentage of secondaries of the transformers in open-circuit shall represented no more than 30 % of the connected load.

The load of the CCR before opening of the secondaries could be between 50 % and 100 % of the nominal load.

If more than 30 % of the transformers are in open circuit, the current shall not exceed 6,7 A.

4.5 Efficiency

The efficiency of the CCR operating on a full resistive load shall not be less than 0,90 for any CCR.

It shall be measured at maximum intensity step for rated supply voltage and frequency.

4.6 Power factor

With a nominal resistive load and at maximum intensity step brightness, for rated supply voltage and frequency, the power factor of the CCR shall be at least 0,90 for any CCR rating.

4.7 Load matching

Regulators, rated 10 kVA and more, shall match connected loads from rated load to approximately 50° of the rated load.

The following requirements shall be met:

On resistive loads in the range from 75 % to 100 % of the nominal load, at rated supply voltage, current set at 6,6 A, the efficiency and the power factor shall be not less than the value specified above.

If not, partial load taps shall be provided to allow a more precise adjustment.

Load steps of a value close to 1/8 of the nominal load are considered to be satisfactory.

4.8 Remote control system

The system shall be controlled remotely for any levels of output current by parallel wiring or serial interfaces.

The design of the remote control shall be such that the following inputs and outputs are available, given in Table 2:

Table 2 — Example for 6 brillancies

Input

Numbering	Designation
1	Common
2	Request brilliancy 1 (maximum i.e. 6,6 A)
3	Request brilliancy 2
4	Request brilliancy 3
5	Request brilliancy 4
6	Request brilliancy 5
7	Request brilliancy 6
8	
9	

Output

Numbering	Designation
1	Common
2	Brilliancy 1 (maximum i.e. 6,6 A) request and obtained
3	Brilliancy 2 request and obtained
4	Brilliancy 3 request and obtained
5	Brilliancy 4 request and obtained
6	Brilliancy 5 request and obtained
7	Brilliancy 6 request and obtained
8	
9	
10	CCR in local mode
11	CCR on
12	Open circuit fault
13	Regulation fault
14	Overcurrent fault
15	CCR in remote mode

Options

1	Common
2	Insulation of secondary circuit threshold alarm level 1
3	Insulation of secondary circuit threshold alarm level 2
4	Warning alarm for lamps failures

4.8.1 *Parallel wiring*

To control and monitor a CCR, the standard source voltages shall be: 24 V or 48 V DC nominal, the common being at 0 V, or at + 24 V or + 48 V.

If relays are used for switching on and setting the intensities, they shall be low-consumption relays so that they shall be operational from a control element located at a distance of 3 000 m, through a 0,8 mm diameter cable. The capacity of voltage free contacts shall not be less than 70 V DC, 0,25 A and 10 W.

To monitor CCR data dry contacts shall be used in order to limit the risk of tripping of the CCR to avoid disturbance of the functional control part of the CCR in case of breakdown of the monitoring part.

4.8.2 *Serial interfaces*

All these controls and output functions may be optionally available via a serial interface. In that case, at least the same data as in Table 2 shall be optionally available on a serial interface of a EIA RS 485 type, using a protocol allowing to use at least layers one and two of the ISO/OSI reference model.

The communication rate shall be adjustable between any standard value from at least 1 200 baud.

4.9 Control response and output current limitation

Switching the CCR on or off, changing the intensity or varying the load shall not lead to transients liable to damage the incandescent lamps.

These transients shall be limited as follows:

— Changes of intensity due to switching of brightness steps in local or remote control shall progress smoothly from the actual step value to the new step value without over- or undershoots. The new value shall be stabilised within the limits of table 1 within less than 0,5 s.

— For a sudden load variation, the duration of the possible overcurrent shall be limited to one half-wave. If the peak current reaches twice the max. peak current in normal operation (= peak current in short circuit at maximum brightness and maximum input voltage) current shall block immediately after the half sine wave in progress. The current blocking shall remain blocked from 1 to 4 periods and than restored within the limits of Table 1 within less than 0,5 s.

4.10 Circuit isolation

The power input circuit shall be electrically isolated from the output circuit. With the open circuit protection disabled, the output voltage of an open-circuited CCR shall not exceed 1,3 times the rated wattage divided by the rated current.

4.11 Wiring and connections

Conductors shall be marked for identification. The marking shall be in agreement with the indications on wiring diagrams and drawings. This indication may be limited to the end of the conductors.

All cabling and small wiring shall be securely cleared in systematic runs and coded where terminated. Power cabling shall be terminated with lugs or eyes and terminals shall be clearly and appropriately coded. Cabling and wiring passing through metal work shall be protected by bush, gland or grommets.

The protective conductor shall be readily distinguishable by shape, location, and marking. When identification by colour is used, it shall be green and yellow (twin-coloured). When the protective conductor is an insulated single core cable, this colour identification shall be used throughout the whole length.

Insulated conductors shall be rated for at least the maximum voltage of the circuit concerned.

Cables between two connecting devices shall have no intermediate splices or soldered joints. Connections shall, as far as practicable, be made at fixed terminals. Only one conductor should be connected to a terminal. The connection of two or more conductors to one terminal is permissible only in those cases where the terminals are designed for this purpose.

Supply leads to apparatus and measuring instruments in covers or doors shall be so installed that no mechanical damage can occur to the conductors as a result of movement of these covers or doors.

4.12 Protective devices

4.12.1 *On serie circuit loop*

4.12.1.1 *Open circuit protection*

The CCR shall be protected against output circuit opening at CCR terminals within 0,1 s, by a device acting on the primary circuit and switching off the power supply. The CCR shall be latched in the "OFF"-position until manual restart.

4.12.1.2 *Secondary overcurrent protection*

The CCR shall protect the secondary loop against overcurrent exceeding 1,05 × In (6,93 A).

The device shall switch off the primary power supply in less than 5 s at 1,05 × In, and in less than 1 s at 1,25 × In.

The CCR shall be latched in the "OFF"-position until manual restart.

4.12.1.3 *Short circuit protection*

It shall be possible to start the CCR into a short circuit load and leave it running at any brilliancy for five minutes without any sustaining damage.

In that case, the CCR should be able to activate an alarm on the front panel or on the remote system.

4.12.1.4 *Lightning arresters*

Lightning arresters shall be connected between the output terminals and earth to protect the CCR against induced over voltages on the series circuit. The lightning arresters may be provided as part of the CCR assembly or as separate installation items (installed outside the CCR).

The lightning arresters shall have characteristics given in Table 3.

Table 3 — Lightning arresters

Output current	Output power	Nominal output voltage	Output dielectric test voltage
A	kVA	V r.m.s.	V r.m.s. one minute
6,6	2,5	379	1 900
6,6	5	758	3 800
6,6	7,5	1 136	5 700
6,6	10	1 515	7 600
6,6	15	2 273	11 400
6,6	20	3 030	15 200
6,6	25	3 788	19 000
6,6	30	4 545	22 700

In any case the manufacturer shall supply all the characteristics of the needed equipment and this for each type of CCR.

4.12.2 ***On power supply***

4.12.2.1 *Main isolator switch*

The CCR shall be provided with an isolating device. The purpose is to trip and lock mechanically out the CCR for maintenance purposes.

The isolator switch shall meet the requirements specified in applicable sections of EN 60947.

4.12.2.2 *Over load protection*

The CCR shall be protected on the primary circuit by an overcurrent protective device appropriate to the current level.

This function could be included in the previous device.

4.12.2.3 *High voltage protection*

Access without using tools or keys shall not be possible on any part of the CCR, where a voltage above 650 V is present.

4.13 Electromagnetic compatibility

The equipment shall comply with the following requirements.

4.13.1 ***Emission***

The CCR shall not cause radiated or conducted electromagnetic interference to other equipment such as information technology equipment (ITE), or radio navigational aids that may be located on or near the aerodrome, or that may use the same power supply.

The CCR shall comply with the requirements specified in EN 50081-2.

4.13.2 ***Immunity***

The CCR shall comply with the requirements of EN 50082-2.

4.13.3 ***Harmonics***

The CCR shall generate the minimum amount of harmonics on power supply feeder.

Especially ranked three harmonics shall be reduced as far as possible.

4.14 Temporary losses of power source

If the main power supply source disappears during less than one second then the CCR shall be able to deliver the previous intensity in less than 0,5 s. If the duration of the loss exceeds one second then the CCR shall return to the current level preceding its disappearance in the same conditions as specified in **4.9**.

4.15 Control and monitoring panel

4.15.1 ***Local command and indication***

For maintenance purpose, the CCR shall be equipped on its front panel with one or two switches giving the following positions:

— "on/off";

— "remote control" position;

— each proposed intensity steps.

Facilities shall be incorporated for separately indicating on the front panel the following conditions:

1 — a dedicated warning signal shall appear when any of the following events occurs

— tripping by open circuit,

— tripping by overcurrent protection,

— regulation fault (divergence between requested current intensity setting and true current intensity),

2. CCR ON

3. Earth fault detection when provided (see **4.17.1**).

4. Lamp out indication when provided (see **4.17.3**).

4.15.2 *Control ammeter*

A true r.m.s, value ammeter, preferably digital, shall be installed on the front panel of the CCR. It shall be used to read and adjust the CCR output current. The accuracy shall be better than or equal to ± 1 %. If not, a measurement socket shall be available.

4.16 Design and construction: HV/LV separation — Safety

The low and extra low voltage parts (control, regulation) shall be separated from the high voltage part (transformer, etc.) either by construction when they are in the same envelope, or by installation in two different locations.

Insulated cover plates are to be fitted to all components wherever live parts could present a voltage of 650 V or above in case the CCR is opened by a hinged door.

The access plates are to be fitted with the appropriate IEC label with the words DANGER HIGH VOLTAGE, SWITCH OFF BEFORE REMOVING THIS PLATE. This inscription should be produced in the national language of the country were the CCR is supposed to be installed.

The ELV could be accessible when the CCR is in operation for adjustment and checks.

The CCR subassemblies shall be placed either in the same cabinet, or in different racks.

The regulation and remote control part (LV and ELV) shall be protected by an IP 21 class enveloppe.

When the HV is in the same cabinet the envelope shall be an IP 21 class enveloppe.

Regulator cabinets shall be designed for installation with rollers and or lifting rings. They shall have an additional earthing terminal to which the cable shielding, if any, shall be connected.

4.17 Optional auxiliaries

4.17.1 *Earth fault indicator*

The control apparatus could be built into the CCR or could be global for many loops and in that case be external to the CCR. When this apparatus is inside the CCR, it shall be designed to apply a permanent DC voltage of 500 V max. on the CCR secondary circuit versus the earth.

The earth fault indicator shall be able to detect any insulation resistance fault ranging *from 10 kΩ to 50 kΩ*.

The insulation resistance reading shall be independent of the intensity setting, and of the location of the fault. The fault shall be measured permanently as soon as the local switch is on "remote control" position or on an intensity setting. When the position "OFF" is selected this control device, even if external, shall be automatically switched off.

At least, two alarm thresholds, determined in relation with the local operational requirement of the airport, shall be offered with a local information available on a lamp indication and a remote information (dry contact or series datas).

The CCR manufacturer shall be able to offer this option as a inset extension card or in a separate cabinet.

4.17.2 *Load indicator*

A load indicator graduated in percentage of the nominal load or in kVA should be located on the front panel of the CCR accessible via a connector on the front panel, when the transformer of the CCR is fitted with load matching taps.

In that case this device could be useful to adjust the nominal load close to the 100 % value, which should optimise the thyristor conducting curve and the efficiency at 6,6 A.

4.17.3 *Lamps fault indicator*

The indication shall be capable of detecting the number of burnt out lamps as specified in Annex 14. The precision shall be better than ± 1 lamp up to 10 burnt lamps and ± 2 lamps up to 30 burnt lamps.

This apparatus could be manually adjustable according to the power of the type of lamps used in the loop from 45 W to 200 W.

At least one threshold for the number of lamps out of service shall be available in order to allow authorised people to determine whether a specific part of a visual aid is working in degraded mode or not.

Detection shall operate for all brightness levels and for all loads between 1/4 and 4/4 nominal load.

The thresholds shall be adjustable and trigger an alarm in local and remote mode. In the remote signalling, a dry contact shall be used.

5 Type and production tests

5.1 Safety prescription

During the constant CCR's tests, lethal voltages and high energy levels are developed. Every protective measure shall be implemented to avoid any risk to personnel or property.

It is essential to inform the operators and witnesses of the safety provisions and that personnel schooled in resuscitation techniques be available on the test site.

5.2 Type tests

The type tests aim at ensuring that the design of the product is able to comply with this specification.

Type tests shall be witnessed as defined and certified by an approval organisation. The certification report shall mention compliance to this specification and to any applicable standard.

All the following tests shall be run for at least the smallest and the largest CCR rating in each construction size:

The manufacturer shall be requested to submit type test certificates from an approved independent testing organisation that the following requirements have been complied with:

a) — Type tests (see **6.1**)

Ambient temperature tests (see **6.2**)

- Visual inspection (see **6.2.1**)
- Safety (see **6.2.2**)
- Operation (see **6.2.3**)
- Performance (see **6.2.4**)
- Mechanical operation (see **6.2.5**)
- EMC (see **6.2.6**)

b) — Environmental tests (see **6.3**)

- Low temperature (see **6.3.1**)
- High temperature (see **6.3.2**)
- Altitude test (see **6.3.3**)

In case the CCR is made of several subassemblies, the type test shall be run on a complete assemblies of all subassembly wired per manufacturer's instruction manual the global properties and each subassemblies properties shall be recorded.

Additional tests may be requested by the certifying authority to ensure compliance to other applicable standards.

5.3 Routine production tests

The following production tests shall be carried out at the factory on every CCR ASSEMBLY when they are assembled in accordance with a previous accepted type or by the exclusive use of parts and accessories specified or supplied by the manufacturer for this purpose and already approved.

The following are the minimum routine production tests:

- Visual inspection: inspection of the CCR ASSEMBLY
- Safety: dielectric test, checking of protective measures and of the electrical continuity of the protective circuits
- Performance
- Operation: checking of the control and monitoring system
- Contract compliance

The routine tests may be carried out in any order.

NOTE The performance of the routine tests at the factory does not relieve the contractor installing the CCR from the duty of checking it after transport and installation.

5.4 Requalification tests

In order to ascertain that initial product properties are maintained throughout the life of the product, every year, the "ambient temperature tests" of the type tests shall be run and results recorded and checked for compliance to the original type tests results.

In case the manufacturing plant is ISO 9001 certified, these requalification tests shall be run by the manufacturers Quality Assurance-department.

When the manufacturer is not ISO 9001 certified, the same third party which has proceeded with the original certificate shall run the tests.

6 Tests description

6.1 Type tests

When a variation from the following tests description is applicable in the corresponding re qualification or routine production tests, the variation is explicitly described in **6.4** and **6.5** respectively.

6.2 Ambient temperature tests

The following tests shall be performed at an ambient temperature of 20 °C ± 5 °C and at normal outdoor atmosphere pressure, in still air (air velocity lower than 0,1 m/s).

The CCR shall be installed and wired per manufacturer's instruction manual.

The most unfavourable combination of optional features shall be implemented on the CCR under test. The clearances around the CCR shall be at the minimum specified by the instruction manual. The wiring cross section shall be the lowest allowable per instruction manual.

6.2.1 *Visual Inspection*

Visually inspect the equipment for compliance to:

— manufacturer's data sheet;

— manufacturer's drawings;

— manufacturer's instruction manual;

— this standard regarding name plate position and content;

— presence of the safety warnings;

— clearance between live pans and enclosure;

— presence and size of power, earthing and control terminals;

— compliance to the EN 60529 standard regarding IP21 protection level;

— compliance of equipment (rolling castors, lifting rings, ...) specified in this prestandard.

6.2.2 ***Safety***

The cross section and connection of the earth wiring shall be checked for compliance to EN 60204 and EN 60950, check for continuity to all parts of the enclosure.

The test report of the power transformer shall be checked for compliance to HD 398.

The clearances shall be checked in accordance to EN 60240 and EN 60950, between live parts and enclosures, between HV, LV and control circuitry (including on PCB's).

The dielectric strength shall be checked for a 1 minute period as follows:

a) Output terminals and earth at 5 times the nominal output voltage (nominal power rating divided by nominal full brightness output ...), the test voltage may not be less than 2 kV r.m.s.

b) During this test the control terminals and LV circuitry shall be earthed. LV input terminals and earth (output and control terminals being earthed) in accordance to EN 60950, for reinforced insulation level.

c) Control terminals and earth (LV and output circuitry being earthed) in accordance with EN 60950, for reinforced insulation level.

d) Connect the constant CCR to a nominal power source and a nominal resistive load.

Adjust the CCR for supplying a nominal output current until the temperature has stabilised (no variation in excess of 1 °C for a period of one hour). Record the highest temperature spot of the enclosure. If this temperature is in excess of 25 °C above the ambient temperature, check that the maximum enclosure temperature is mentioned on the name plate and is at least 55 °C plus the recorded maximum temperature rise.

e) Connect a milliammeter having an impedance of less than 1 Ω in the earthing connection.

Change the output current level and record the maximum milliammeter reading. In case this reading is in excess of 3,5 mA, check that adequate warning is displayed and that the maximum earthing leakage current is mentioned in the nameplate.

f) Select the highest brightness setting. Select a load resistance for an output current equal to one fifth of the nominal value. Check that the power to the output transformer is switched off within 0,5 s of the load increase.

Run the same test starting from the lowest brightness setting.

g) Switch a current attenuator by 1,05 in series with the current feedback circuitry and check that the power to the output transformer is cut off within 5 s.

Restore normal current sensing and restart the CCR.

Switch in a current attenuator by 1,25 In series with the current feedback circuitry in.

Check that power to the output transformer is cut off within one (1) second. The voltage peaks on the open circuit before operation of the protection should not exceed 1,5 Pn/In, r.m.s. value.

h) Check that overcurrent protecting devices (circuit breakers, fuses, ...) are suitably rated in comparison to the wiring cross section they are protecting.

6.2.3 ***Operation test***

By applying a nominal supply voltage and control signals, check that the CCR is fully responding to the signals and that remote signalling follows the actual operation.

In order of precedence, reference shall be made to this prestandard, then to the CCR data sheet, then to the instruction manual.

The following procedure shall be carried out;

a) Protective devices operation (circuit breakers, fuses, safety switches, ...) shall be checked.

b) Local ON/OFF and brightness selection shall be checked.

c) Remote ON/OFF and brightness selection shall be checked.

d) Non response to any state of the remote control shall be checked, when in local control mode.

e) Level, state and capacity of remote signalling lines shall be checked.

f) Re-check per point C above with a 215 Ω resistor in series with the common line of the remote control circuitry.

6.2.4 ***Performance test***

The following equipment shall be available upon starting of the tests:

— Measuring equipment with an accuracy class at least 5 times better than the specified accuracy for the parameter to be measured. The equipment shall be equipped with a calibration traceable. Care shall be exercised to take into account the effect of cast factors and harmonics on actual accuracy reading.

— A power source adjustable between 70 % and 120 % of the rated input voltage.

— A remote control system complying to this standard.

— A 215 Ω/10 W resistor.

— A 0,3 μF/6 000 VAC capacitor.

— Isolating transformers having in total a nominal wattage corresponding to 30 % of the nominal CCR output power rating.

— A load able to carry the full output current + 25 % and to sustain the full output voltage 25 % (+ 125 % versus earth from and adjustable/switchable between short circuit and full load).

— A milli/micro-ohmmeter for temperature rise measurement.

6.2.4.1 *Regulation test*

After having warned up at nominal input voltage and full load until thermal stabilisation (less than 1 °C temperature variation in one hour), proceed to measurement of the output current with voltage source and load according to Table 4 for each brightness.

The controls and signals obtained on the control and monitoring output shall individually be tested

6.2.4.2 *Efficiency testing*

Immediately after the test described in **6.2.4.1**, the efficiency shall be computed as follows:

$$\eta = \frac{AOP}{AIP}$$

where η *is the efficiency*

AOP is the Active output power

AIP is the Active input power

The efficiency shall be computed at full resistive load, full brightness and for input voltage of 95 %, 100 % and 110 % of nominal input voltage.

6.2.4.3 *Power factor*

Immediately after the test described in **6.2.4.2**, the power factor shall be computed as follows:

$$PF = \frac{AIP}{A_PIP}$$

where PF is the power factor

AIP the Active input power in watts;

ApIP is the Apparent input power in volts amperes.

The measurement and calculation shall be made at same load and input voltages as **6.2.4.2**.

6.2.4.4 *Dynamic behaviour*

The settling time of the output current in the test conditions as given in Table 5, at switch on and brightness changes shall be tested.

Table 4

Load Supply	Short circuit	Half rating + 30 % Open/Circuit Isolating Transformer	Half rating + 30 % Open/Circuit Isolating Transformer with capacitor	Full resistive load
– 5 %	x	No test	x	x
NOMINAL	x	No test	No test	No test
+ 10 %	x	x	x	x

Table 5

Load → Input Voltage ↓	Short circuit	Half load resistive	Half resistive +30 % Open/Circuit Isolating Transformer	Full load resistive
95 %	No test	No test	x	x
NOMINAL	x	No test	x	x
110 %	x	x	x	x

It shall be tested that the output current reaches the specification within 0,5 s from switch on or brightness change and that no overshoot above 105 % of the maximum load current occurs.

6.2.4.5 *Changing power supply sources*

Check that when the power supply source is changed, the CCR continues to operate or, if a power supply break has occurred, returns to the previous current step. For this test, power supply breaks of multiples of 1/10 s, up to a maximum of 1 s, shall be carried out.

When the power supply source is restored, check that the sum of the response time of the CCR and the time needed by the current to reach the previous step ± 0,10 A should be less than 0,5 s.

6.2.5 ***Mechanical operation test***

- Check for the correct operation of all controls of the CCR.
- Check for the effective interlocks per instruction manual and drawings.
- Check for effective operation of the safety devices an opening of doors giving access to compartments containing dangerous voltages, as applicable.
- Check for effective operation of the door/panel locks and that the keys can be removed in the locked position.

6.2.6 ***Electromagnetic compatibility (EMC)***

Check that the CCR complies with **4.13**.

The test shall be limited to the highest and the lowest power rating per constructive size, and this for the lowest available power supply voltage par catalogue/specification sheet.

6.3 Environmental tests

6.3.1 ***Low temperature***

The CCR (or set of interconnected subassemblies in case the CCR is mounted in several racks) shall be installed in a low temperature chamber in which the temperature shall be adjusted to – 20 °C ± 5 °C and left there for a period not less than 4 h after temperature stabilisation, the CCR being un-energised.

The CCR is then started, with its output terminals short circuited, and the output current checked for compliance to the specification table.

At switch on, the CCR is started on the highest brightness for 15 min, then switched to the second highest brightness for 15 min and so on, until the lowest brightness step has been checked.

The r.m.s. output current shall be checked and recorded for each brightness step.

6.3.2 ***High temperature***

The CCR (or set of interconnected subassemblies in case the CCR is mounted in several racks) shall be installed in a high temperature room in which the ambient temperature is stabilised at + 55 °C and left there for a period of 12 h, the CCR being un-energised.

During the duration of the tests, the air of the test chamber shall be moved at a speed of less than 0,5 m^3/min, in order to avoid having cold/hot spots in the test chamber. The temperature sensors for the test chamber shall be placed at the level and close to the air intake off the CCR.

The CCR is then started, delivering its full rated output (secondary) power onto a load external to the test chamber. The CCR shall remain at the + 55 °C ambient temperature while delivering its full rated load power for a period of 24 h.

After this period, the regulation is tested according to **6.2.4.1**, it shall comply with the specification.

After this check, the CCR is allowed to cool down to a 20 °C ± 5 °C, with the power supply removed from the CCR.

After having cooled down, the CCR is visually inspected in detail, inside and outside for:

— any component (part showing a trace of overheating);

— any trace of blister, crack, deformation of any component, part of the enclosure, control;

— any discoloration, fading or true change visible with the naked eye;

— compliance to **6.2.5**;

— legibility of all markings, warnings, labels.

Any failure to meet the above shall be a cause for rejection.

6.3.3 ***Altitude test***

The CCR, connected to its nominal power supply, rated full load on its maximum brightness level shall be installed in a closed room where the temperature shall be kept under one of the following constant value 40 °C, 50 °C.

The barometric pressure in the room shall be lowered in order to match the level mentioned in the ICAO Standard Atmosphere Manual for the measured temperature at the CCR air intake.

The CCR is left in this situation for a period of at least 6 h. After this period, the atmospheric pressure is restored, the CCR is switched off.

The CCR is then visually inspected as described in **6.3.2**.

Special attention shall be paid to components containing a gel or liquid (such as coolants, lubricants, electrolytes, oils, ...): no leakage, deformation nor crack is allowed.

6.4 Requalification test description

Refer to **4.2** and **6.2**.

6.5 Routine production tests

The routine production tests are run at ambient temperature.

The tests per following articles shall be performed:

— Visual inspection		: **6.2.1**
— Safety		: **6.2.2**
— Performance test	Regulation	: **6.2.4.1**
	Efficiency	: **6.2.4.2**
	power factor	: **6.2.4.3**
— Mechanical operation		: **6.2.5**

Additionally, the CCR shall be checked for compliance with the particular requirements of the purchase order/contract. This check shall at least comprise, but not be-limited to, specific controls, signalling and/or marking.

The results of the routine production tests shall be recorded in the test protocol.

7 Classification and designation

7.1 Classification

CCRs are classified according to electrical ratings, type of cooling system. A CCR may be classified as an N X CCR as defined below:

— N: Electrical ratings as specified in Table 6.

Table 6

Class	Power Ratings kVA	Test Insulation Voltage kV a.c.(r.m.s.)
I	*less than or equal to 5 kVA*	3
II	*more than 5 k VA and less than 20 k VA*	10
III	*equal to or above 20 kVA*	20

— X: Type of transformer

1 Dry-type transformer, cooled by natural convection.

2 Oil immersed transformer.

7.2 Marking, labelling, packaging

A label giving the following information shall be fixed to the CCR front panel:

— Type and name of manufacturer

— Constant Current Regulator

— Class: N X.

— Input: _____ V, _____ Hz

— Remote control: _____ V DC or derial interface characteristics

— Output: _____ kVA at 6,6 A

— Current steps:

— Serial No.: _____

— Production date

7.3 Manual

A wiring diagram and a diagram explaining the brightness adjustment process shall be included with the equipment and shall be accessible during installation.

The manual shall include the following parts:

— Operating principle;

— Installation;

— Maintenance;

— Faults and repairs;

— Wiring and component layout diagrams;

— Parts list giving the manufacturers of subassemblies and components.

The maintenance and operating manuals shall include:

— Theory of operation;

— Comprehensive instructions for the switching on, operation, switching off and isolation, and for dealing with emergency conditions;

— Instructions for any safety and precautionary measures necessary;

— Instructions for servicing, including frequency, materials and special tools or procedure to be used to maintain the equipment in good and safe conditions;

— Trouble-shooting charts.

Copies of manufacturer's data sheets may be incorporated to supplement the descriptions and instructions but shall not replace them. Only data relevant to the supplied equipment shall be included; where non-relevant data appears on the same sheet it shall be clearly marked to show that it is not applicable.

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