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IS 13585-2 (2013): Shunt Power Capacitors Of The Non -Self Healing Type For ac Systems Having A Rated Voltage up to and Including 1 000 V, PART 2: Aging Test and Destruction Test [ETD 29: Power Capacitors]
Indian Standard

SHUNT POWER CAPACITORS OF THE
NON-SELF-HEALING TYPE FOR a.c. SYSTEMS
HAVING A RATED VOLTAGE UP TO AND
INCLUDING 1 000 V

PART 2 AGEING TEST AND DESTRUCTION TEST

ICS 29.120.99;31.060.70
NATIONAL FOREWORD

This Indian Standard (Part 2) which is identical with IEC 60931-2 : 1995 ‘Shunt power capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1 000 V — Part 2: Ageing test and destruction test’ issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Power Capacitors Sectional Committee and approval of the Electrotechnical Division Council.

This standard is published in three parts. Other parts in this series are:

Part 1 General — Performance, testing and rating — Safety requirements — Guide for installation and operation
Part 3 Internal fuses

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appear, referring to this standard, they should be read as ‘Indian Standard’.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to the following International Standard for which Indian Standard also exists. The corresponding Indian Standard, which is to be substituted in its place is listed below along with its degree of equivalence for the edition indicated:

<table>
<thead>
<tr>
<th>International Standard</th>
<th>Corresponding Indian Standard</th>
<th>Degree of Equivalence</th>
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<tbody>
<tr>
<td>IEC 60931-1 : 1989 Shunt power capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1 000 V — Part 1: General – Performance, testing and rating — Safety requirements — Guide for installation and operation</td>
<td>IS 13585 (Part 1) : 2012 Shunt power capacitors of the non-self-healing type for a.c. systems having a rated voltage up to and including 1 000 V: Part 1 General — Performance, testing and rating — Safety requirements — Guide for installation and operation (first revision)</td>
<td>Identical to IEC 60931-1 : 1996</td>
</tr>
</tbody>
</table>

The technical committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard        Title
IEC 60241 : 1968               Fuses for domestic and similar purposes
IEC 60593 : 1977               Internal fuses and internal overpressure disconnectors for shunt capacitors

Only the English language text has been retained while adopting it in this Indian Standard and as such the page numbers given here are not the same as in the IEC Publication.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
1 Scope

This part of IEC 931 applies to capacitors according to IEC 931-1 and gives the requirements for the ageing test and destruction test for these capacitors.

NOTE – The numbering of the clauses and subclauses in this part corresponds to that of IEC 931-1.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 931. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 931 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 241: 1968, Fuses for domestic and similar purposes

IEC 593: 1977, Internal fuses and internal overpressure disconnectors for shunt capacitors

IEC 931-1: 1989, Shunt power capacitors of the non-self-healing type for a.c. system having a rated voltage up to and including 660 V – Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation and operation
Amendment No. 1 (1991)

Section 2: Quality requirements and tests

17 Ageing test

17.1 Conditioning

The temperature of the case during the ageing test shall be the highest mean temperature in 24 h (see IEC 931-1, table 1) plus the difference between the measured temperature of the case and the cooling air temperature recorded at the end of the thermal stability test carried out on an identical unit.
The two test methods indicated below are intended to ensure that the capacitor case temperature is maintained constant during the test.

The two methods are considered as being equivalent.

The units that are not sealed shall be tested in air, with forced circulation.

17.1.1 Testing in air with forced circulation

The capacitor unit is mounted in an enclosure in which heated air is circulated with an air velocity such that temperature variations at any point of the enclosure do not exceed \( \pm 2 \, ^\circ C \). The sensitive element of the thermostat regulating the temperature in the capacitor enclosure shall be located on the surface of the capacitor container, three-quarters of the way up.

The capacitor shall be placed in a vertical position with the terminals upright.

When many capacitors are tested together, they shall be placed with sufficient clearance between them in order to have sufficient temperature uniformity.

After placing the capacitor in the unheated enclosure, the thermostat shall be set at a temperature equal to that indicated in 17.1.

Then, without energizing the capacitor, the enclosure shall be brought to thermal stability, which shall be deemed to have been reached when the container temperature of the capacitor has reached the stated temperature with a tolerance of \( \pm 2 \, ^\circ C \).

The capacitor shall then be energized at the voltage stated in 17.2 a).

17.1.2 Testing in a liquid bath

The capacitor unit is immersed in a container filled with a liquid which, by appropriate heating, is kept at the temperature indicated in 17.1 during the whole test.

This temperature is maintained with a permissible change of \( \pm 2 \, ^\circ C \).

Care shall be taken to ensure that the temperature in the neighbourhood of the capacitor is within these limits.

The capacitor is not energized until it has reached the temperature of the liquid bath.

The capacitor shall then be energized at the voltage stated in 17.2 a).

NOTE — Where the terminal insulation, or the insulation of cables permanently attached to the capacitor, is of material that might be damaged by the heating liquid, it is permissible for the capacitors to be positioned in such a manner that these terminals or cables are just above the surface of the liquid.

17.2 Test sequence

Before the test, the capacitance shall be measured as prescribed in 7.1 (IEC 931-1).
The test sequence is in three parts as follows:

a) The capacitor shall be energized at a voltage equal to 1.25 $U_N$ for 750 h.

b) The capacitor shall then be subjected to 1 000 discharge cycles consisting of:
   - charging the capacitor to a d.c. voltage of 2 $U_N$;
   - discharging the capacitor through an inductance of:
     $$ L = \frac{1000}{C} \pm 20\% \text{ in microhenrys (µH)} $$
     in which $C$ is the measured capacitance in microfarads (µF)

   The cables used for the external circuit and the inductance shall have a cross-section appropriate to the maximum permissible current (see IEC 931-1, clause 21).

   The duration of each cycle shall be 30 s minimum.

   c) Repetition of item a).

During the whole test sequence the temperature of the case shall be maintained equal to that indicated in 17.1.

In the case of three-phase capacitors, the first and the third parts of the test sequence (items a) and c)) shall be carried out with all the phases energized at 1.25 $U_N$. This can be obtained either by using a three-phase source, or by using a monophase source and modifying the internal capacitor connections.

The second part (item b)) of the test sequence, however, shall be carried out on two phases only. In the case of a star connection, modification of the internal connections are necessary or the charging voltage shall be increased from 2 $U_N$ up to 2.31 $U_N$.

17.3 Test requirements

During the test no permanent breakdown, interruption or flashover shall occur.

At the end of the test the capacitor shall cool down freely to the ambient temperature and the capacitance shall then be measured under the same conditions as before the test.

The maximum permitted variation of capacitance compared to the values measured before the test shall be 3 % averaged over all the phases and 5 % on one phase.

The voltage test between terminals and container shall be carried out with the same procedures as prescribed in 10.1 of IEC 931-1.

The sealing test shall be repeated as prescribed in clause 12 of IEC 931-1.

18 Self-healing test

Not applicable.

19 Destruction test

This test is performed to evaluate the behaviour of the capacitor at the end of its life.
If the capacitor is protected by internal fuses, these fuses shall comply with IEC 593.

If no internal fuses are provided, the destruction test shall be carried out according to the following procedure.

19.1 Test sequence

The test shall be carried out on a capacitor unit. If necessary the discharge resistors shall be disconnected in order to avoid burning.

A capacitor which has passed the ageing test may be used.

For polyphase units the test shall be carried out between two terminals only. In the case of three-phase delta connection two terminals shall be short-circuited. For star connection no terminals shall be short-circuited.

The principle of the test is to promote failure in the elements by d.c. voltage and subsequently to check the behaviour of the capacitor when an a.c. voltage is applied.

The capacitor shall be mounted in a circulating air oven having a temperature equal to the maximum ambient air temperature of the temperature category of the capacitor.

When all the parts of the capacitor have reached the temperature of the oven the following test sequence shall be performed with the circuit given in figure 1:

a) With the selector switches H and K in position 1 and a respectively, the a.c. voltage source is set to $1.3U_N$ and the capacitor current is recorded.

b) The d.c. source is set to $10U_N$. The switch H is then set to position 2 and the variable resistor is adjusted to give a d.c. short-circuit current of 300 mA.

c) Switch H is set to position 3 and switch K to position b in order to apply the d.c. test voltage to the capacitor which is maintained until the voltmeter indicates approximately zero for 3 s to 5 s.

d) Switch K is then set to position a again in order to apply the a.c. test voltage to the capacitor for a period of 3 min when the current is again noted.

The following conditions may be obtained:

- the ammeter I and the voltmeter U both indicate zero. In this case the fuse shall be checked. If it has blown it shall be replaced. Then the a.c. voltage is applied to the capacitor and if the fuse blows again the procedure is interrupted. If the fuse does not blow, the procedure consisting in the application to the capacitor of d.c. and a.c. voltage as prescribed in items c) and d) continues using only the switch K;
- the current indicated by the ammeter I is lower than 66 % of the initial value and the voltmeter U indicates $1.3 U_N$. In this case the procedure is interrupted;
- the current indicated by the ammeter I is higher than 66 % of the initial value. In this case the procedure (d.c. - a.c.) continues.

When the procedure is interrupted the capacitor is cooled to the ambient temperature, and the voltage test between terminals and container is carried out according to 10.1 of IEC 931-1 applying an a.c. voltage of 1 500 V.

![Figure 1 - Circuit to perform the destruction test](image)

The minimum short-circuit current of the a.c. generator shall be 2 000 A at the capacitor terminals.

A time-lag fuse complying with IEC 241 shall be used.

The rated current $I_F$ of the fuse shall be obtained by the formula:

$$I_F = K I \pm 10 \% \text{ in amperes (A)}$$

where:

$K = \frac{100}{Q}$

$Q = Q_N$ in kilovars (kvar), in the case of a single-phase capacitor;

$Q = 2/3 Q_N$ in kilovars (kvar), in the case of a three-phase delta-connected capacitor with two terminals connected together or three-phase star-connected capacitor with two terminals connected only. (This because the testing voltage has to be adjusted as per additional note when performing the test; see following note.);

$I = I_N$ in amperes (A), in the case of a single-phase or star-connected three-phase capacitor;

$I = 2\sqrt{3}(=1,155) I_N$ in amperes (A), in the case of a three-phase delta-connected capacitor with two terminals connected together.
In any case, K shall be not less than two and not greater than ten.

NOTE – For three-phase star-connected capacitors, the single-phase test voltage applied to any two terminals is adjusted by a single factor of $\frac{2}{\sqrt{3}}$. For a test voltage level of $1.3 \, U_N$ the adjusted voltage in this case will be $2/\sqrt{3} \times 1.3 \, U_N$ (about $1.5 \, U_N$).

19.2 Test requirements

At the conclusion of the test the enclosure of each capacitor shall be intact except that normal operation of a vent, or minor damage of a case (e.g. cracks) is permitted provided the following conditions are met.

a) Escaping liquid material may wet the outer surface of the capacitor but shall not fall in drops.

b) The container of the capacitor may be deformed and damaged but not broken.

c) Flames and/or fiery particles shall not be emitted from the openings.

This may be checked by enclosing the capacitor in gauze (cheesecloth). Burning or scorching of the gauze is then considered to be a criterion of failure.

d) The result of a dielectric test between terminals and container with 1 500 V for 10 s shall be satisfactory.

NOTE – Excessive emanation of fumes during the test could be dangerous.
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Amendments Issued Since Publication

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