BRITISH STANDARD

BS EN 60652:2004

Incorporating Amendment No. 1 to BS IEC 60652:2002 (renumbers the BS IEC as BS EN 60652:2004)

Loading tests on overhead line structures

The European Standard EN 60652:2004 has the status of a British Standard

ICS 29.240.20

BSI British Standards

National foreword

This British Standard is the official English language version of EN 60652:2004. It is identical with IEC 60652:2002.

The UK participation in its preparation was entrusted to Technical Committee PEL/11, Overhead lines, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Summary of pages

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EUROPEAN STANDARD **EN 60652**

NORME EUROPÉENNE

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English version

Loading tests on overhead line structures
(IEC 60652:2002)

Essais mécaniques des structures de lignes aériennes
(CEI 60652:2002)

Belastungsprüfungen an Freileitungstragwerken
(IEC 60652:2002)

This European Standard was approved by CENELEC on 2004-02-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 60652:2004 E

Foreword

The text of the International Standard IEC 60652:2002, prepared by IEC TC 11, Overhead lines, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60652 on 2004-02-01 without any modification.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop) 2005-02-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow) 2007-02-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60652:2002 was approved by CENELEC as a European Standard without any modification.

CONTENTS

LOADING TESTS ON OVERHEAD LINE STRUCTURES

1 Scope

This International Standard codifies the methods of testing supports for overhead lines.

It is applicable to the testing of supports and structures of overhead lines for voltages above 45 kV; it can also serve as reference to the testing of lower voltage supports.

There is no restriction on the type of material used in the fabrication of the supports which may include, but not be limited to, metallic alloys, concrete, timber, laminated wood and composite materials. If required by the client, this standard may also be applied to the testing of telecommunication supports, railway/tramway overhead electrification supports, electrical substation gantries, street lighting columns, wind turbine towers, ski-lift supports, etc.

Tests on reduced scale models of supports are not covered by this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050(466):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 466: Overhead lines*

ISO/IEC 17025:1999, *General requirements for the competence of testing and calibration laboratories*

3 Definitions

For the purposes of this International Standard, the following definitions apply. The definitions listed below supplement those given in IEC 60050(466).

3.1
client
organization which contracts with the testing station and provides the test specification

3.2
design load
load for which the support has been designed

3.3
failure load
point at which the support cannot carry any additional load

NOTE It is also known as the limit state failure load and is determined during a destruction test on the support.

3.4
test report
document summarizing all the relevant aspects of the tests

4 Categories of tests

With respect to the purpose of the test, the level of instrumentation and the method of execution, this standard refers to two categories of tests:

a) design tests;

b) sample tests.

4.1 Design tests

Design tests are normally carried out on prototype supports, with one or more of the following objectives:

a) as part of a research and/or development programme in the design of an innovative support;

b) to verify compliance of the support design with the specifications (also known as type tests);

c) to develop and/or validate a new design standard or methodology;

d) to develop and/or validate new fabrication processes.

When tests are carried out to verify design parameters, the test support shall be identical as far as possible to the production supports (see clause 5, first paragraph). Tests on full scale sections or part of the support may also be undertaken.

Design tests shall be carried out to at least the design load or to failure, especially when testing according to 4.1b) and/or 4.1c).

4.2 Sample tests

These are intended for use either prior to or during the fabrication of the production of a batch of supports to act as a check on the quality of the fabrication, or on the materials being used. The support may be taken at random from the production supports during manufacture.

Sample tests are taken to a specific percentage of the design load (usually 100 %), as stipulated in the test specification.

5 General test criteria

For a design test (according to 4.1b) or 4.1c)), the material(s) and the manufacturing processes used in the fabrication of the prototype support shall be to the same specifications as those used during the fabrication of the production supports. These specifications shall include the member sectional properties, connection details, e.g. bolt or weld sizes, material grades and fabrication processes. Prior to the commencement of the prototype support fabrication, agreement shall be made with regard to the surface coating of the support.

Agreement shall also be made with respect to the organization responsible for the checking of the support prior to the testing.

If a sample test is required on a production support, the components may be chosen at random from the batch.

Whether it is for the design test (according to 4.1b)) or the sample test, the support shall successfully withstand the loads specified by the client.

If required by the client, the testing station shall be accredited by an external organization to perform this type of test according to the procedures of quality assurance defined by ISO/IEC 17025.

6 Test specification

The client shall prepare and transmit to the testing station, at an agreed time prior to the delivery of the support, the following appropriate information:

- Workshop and/or erection drawings of the support.
- The mass of each section of the support.
- Precautions to be observed during the unloading and unpacking.
- Requirements for the support assembly or disassembly, including if necessary details for lifting the support from the horizontal.
- Bolt tightening requirements.
- The tensions for any guys.
- Nominal force to be applied during slip-joining of sections and/or slip-joint length and their respective tolerances.
- Foundation setting tolerances and verticality tolerances of the support.
- The category of the test (design or sample).
- The exact position of the load application points for each loading case.
- The design loads to be applied on the support for each loading case.
- All reactions induced on the foundations of the test support for each loading case.
- If the support is to be realigned between individual tests.
- The location of the deflection measuring points for each loading case.
- The position and the orientation of strain gauges.
- The areas of the test support to be filmed during the test.

7 Test programme

The test programme shall be submitted to the client at an agreed date before the test. This document shall be approved by the client and returned to the testing station within an agreed period.

The test programme shall include but not be limited to the following information:

- The expected test date.
- A description of the proposed foundations for the test support.
- The method of load application.
- A drawing of the test rigging arrangement and attachment details.
- The position of the dynamometers and/or load cells and the position of angle transducers in the case of resultant load applications.
- The position of deflection measurement points.
- The position and orientation of strain gauges if appropriate.
- The tolerances (loads, resultant angles, deflections, strain gauges).
- Details of applied loads for each test load case, load increment and holding period.
- Holding period for the final level.
- Loading rate for elastic-plastic materials and creep-sensitive materials.
- The category of the test (design or sample).

8 Assembly of support

The test support shall be erected on a footing that simulates the design assumption.

The testing station shall proceed with the assembly of the support in accordance with the instructions provided by the client.

In the case where the testing station encounters a difficulty in the assembly or erection of the support, the client shall be informed and shall decide on the modifications required.

If requested by the client, a report of assembly shall be provided by the testing station. This report may include a video of the different phases of the assembly and any particular difficulty encountered.

9 Load application

Loading cases (loads, directions, and load application points) are stated by the client in the test specification.

9.1 Combined loads

If, for practical purposes, certain loads (e.g. due to wind on the support) have to be combined, the value of the resultant, its direction, and its application point shall be shown in the test programme.

9.2 Precautions for load application

The dynamometer/load cells shall be located in the test rigging as close as practical to the load application point on the support.

Similarly, it is recommended that the test rigging should be arranged so as to minimize any load eccentricity.

The testing station shall minimize the influence of any contact between the test rigging and the support; where this is not practical, this shall be drawn to the client's attention.

Unless otherwise agreed, it is recommended that the difference between the required load and the measured load at any individual load application point and at any time during the test should not exceed 5 %.

Loads shall be applied in such a way as to avoid any dynamic effect. However, joint slippage during the support test shall be accepted.

9.3 Load levels

The test loads shall be applied in increments to 50 %, 75 %, 90 %, 95 % and 100 % of the specified loads.

If required by the client, additional load levels may be considered.

9.4 Tolerances on applied loads

For each load level, the applied load measurements shall be considered acceptable if they are within the limits shown in table 1 below:

Table 1 – Load tolerances

Load level %	**Acceptable range** %
50	49 to 51
75	74 to 76
90	89 to 91
95	94 to 96
100	100 to102

9.5 Loading rate and holding period

For each load increment, the time taken for the load application depends upon the facilities of the testing station and the time needed for the loads to be adjusted in accordance with 9.4.

For the final 100 % level, the loads shall be maintained for a minimum of 1 min and for a maximum of 5 min. The holding period chosen for the final level shall be included in the test programme.

For supports made of creep-sensitive materials, different loading rates and holding periods may apply.

10 Measurements

10.1 Load and angle measurements

The accuracy of the dynamometers and/or load cells and/or angle transducers shall be such that errors in measurement are not greater than 1 % at full scale (including the effect of the test rigging). The accuracy specified assumes a standard deviation of 3 σ.

All dynamometers and/or load cells and/or angle transducers shall be calibrated before and after every test series. The calibration instruments shall be certified at least once a year.

All applied loads and/or resultant angles shall be recorded.

10.2 Deflection measurements

At each load level and when the support is stable, support deflection shall be measured in accordance with the test specification. The accuracy of measurements shall be 25 mm. The accuracy specified assumes a standard deviation of 3 σ.

10.3 Strain measurements

If requested by the client, strain measurement shall be obtained in accordance with accepted industry standards. The testing station shall provide the accuracy of measurement of the strain gauges and/or the instrumented members and synchronize the measurements with applied loads.

11 Sequence of test loading cases

The sequence of test loading cases shall be determined by the client and stated in the test specification. It is recommended to choose first those tests having the least influence on the results of the successive tests. If agreed by the client, the testing station may adjust the test sequence to simplify the test operations or to reduce the cost of the test.

12 Video documentation

It is recommended that the entire test should be video recorded and the video cross-referenced with the measurements.

13 Acceptance criteria

The performance of the support shall be considered acceptable if it resists the specified design loads (at 100 %) for 1 min without failure of any components or assemblies even though a longer holding period may have been specified.

Permanent local deformations such as bowing or twisting of secondary members and components are acceptable. Ovalization of holes and permanent deformation of bolts shall be accepted.

Additionally, the requirement of clause 15 shall be fulfilled.

14 Premature failure

14.1 Design tests

In the event of failure at less than 95 % of the specified design load, the failed component(s) may be replaced by other component(s). The modified structure shall be retested to resist 100 % of the specified design loads.

In the event of failure between 95 % and less than 100 % of the specified design loads, with the exception of the final load case (frequently the destruction load case), the support shall be modified and retested. If failure occurs in the final load case, the client may elect not to retest the modified support.

In the event of failure at 100 % of the specified design loads but at less than 1 min into the holding period, the client may accept the support without modification.

14.2 Sample tests

In the event of a failure at less than 100 % of the specified design load, the failed component(s) shall be replaced by identical components and the support retested. In the event of a subsequent failure, the client may reject the batch of supports from which the test support has been drawn.

In the event of a failure at 100 % of the specified design load but at less than 1 min into the holding period, the client may accept the batch of supports from which the test support has been drawn.

14.3 Replacement of components

The partial or complete replacement or modification of elements, assemblies and complete sections of the support is the responsibility of the client.

15 Material specification

The selection of materials, manufacturing tolerances and engineering properties (i.e. geometrical and mechanical characteristics) for the support are the responsibility of the client.

The materials used for the fabrication of a prototype support shall be representative of the materials used in production structures and within the appropriate industry specification.

On completion of the test series, it is recommended to take samples from the prototype support in order to verify the compliance of the material with the specifications.

The number and location of samples are the responsibility of the client.

If the components of the support do not fulfil the requirements of the applicable industry standards, the client may declare the test invalid and reject the support.

16 Test report

The testing station shall document all relevant test information and data.

The test report shall include the following data:

a) Indication of the applicable standard for testing supports (IEC 60652)
b) Designation, type, and description of the support.
c) Name of the support manufacturer.
d) Name of the support designer.
e) Name of the client.
f) Dates and location of testing.
g) Names of the persons present during the tests.
h) List of workshop and/or erection drawings of the test support, including any modifications.
i) Methods and measurements of the joints assembly.
j) Description of all anomalies and difficulties met during the assembly as well as corrective measures adopted by the client.
k) Rigging drawing used to apply the test loads.
l) Brief description of the test facility including the number, location, range and calibration charts or tables of every load and angle transducer or other load measuring devices, as well as the accuracy of the equipment used to measure the test loads.
m) Loads required at the various points on the support and at each load level.
n) Holding period for the final level.
o) Calibration records
p) Deflection measurements.
q) Strain gauge measurements if appropriate.
r) In case of failure:
   - maximum loads applied to the support prior to failure;
   - a description of the failure;
   - when required by the client, engineering properties of the failed component(s);
   - if required by the client, a video film of the failure.
s) Photographs showing the whole support before, during and after tests and, where appropriate, details of any failure.
t) Local meteorological data during the tests series (e.g. wind speed and direction, temperature, etc.).
u) If required by the client, observations of noticeable permanent deformations during the dismantling.
v) When applicable, the number of the certificate of quality assurance of the station according to ISO/IEC 17025.
w) If required by the client, the engineering properties of component samples taken from the support.

17 Record and traceability

The testing station shall keep a record of all relevant information for a time period of at least 10 years or as required by the client. Relevant information includes the test report, calibration and test data, deflection and load time histories, rigging drawings and available video and still images.

The disposition or storage of the test support is the responsibility of the client.

———————

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60050-466	1990	International electrotechnical vocabulary (IEV) Chapter 466: Overhead lines	-	-
ISO/IEC 17025	1999	General requirements for the competence of testing and calibration laboratories	EN ISO/IEC 17025	2000

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