Cable tray systems and cable ladder systems for cable management

The European Standard EN 61537:2001 has the status of a British Standard

ICS 29.120.10
National foreword

This British Standard is the official English language version of EN 61537:2001. It is identical with IEC 61537:2001.

The UK participation in its preparation was entrusted to Technical Committee PEL/213, Cable management, which has the responsibility to:

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— 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.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 62, an inside back cover and a back cover.

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Amendments issued since publication

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Cable tray systems and cable ladder systems
for cable management
(IEC 61537:2001)

Systèmes de chemin de câbles et
systèmes d'échelle à câbles pour
systèmes de câblage
(CEI 61537:2001)

Kabelträgersysteme zum Führen von
Leitungen für elektrische Energie und
Informationen
(IEC 61537:2001)
**Foreword**

The text of document 23A/365/FDIS, future edition 1 of IEC 61537, prepared by SC 23A, Cable management systems, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61537 on 2001-10-01.

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) 2002-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn: (dow) 2004-10-01

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given for information only.

In this standard, annexes D and ZA are normative and annexes A, B, C, E, F, G, H and I are informative.

Annex ZA has been added by CENELEC.

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**Endorsement notice**

The text of the International Standard IEC 61537:2001 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

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<td>NOTE</td>
<td>HD 429 S1:1983 (not modified).</td>
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<tr>
<td>IEC 60364-5-54</td>
<td>NOTE</td>
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CABLE TRAY SYSTEMS AND CABLE LADDER SYSTEMS
FOR CABLE MANAGEMENT

1 Scope

This International Standard specifies requirements and tests for cable tray systems and cable ladder systems intended for the support and accommodation of cables and possibly other electrical equipment in electrical and/or communication systems installations. Where necessary, cable tray systems and cable ladder systems may be used for the segregation of cables.

This standard does not apply to conduit systems, cable trunking systems and cable ducting systems or any current-carrying parts.

NOTE Cable tray systems and cable ladder systems are designed for use as supports for cables and not as enclosures.

2 Normative references

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.


ISO 4046:1978, Paper, board, pulp and related terms – Vocabulary

3 Definitions

For the purpose of this International Standard, the following definitions apply.

3.1 cable tray system or cable ladder system
assembly of cable supports consisting of cable tray lengths or cable ladder lengths and other system components
3.2 **system component**
part used within the system. System components are as follows:

a) cable tray length or cable ladder length  
b) cable tray fitting or cable ladder fitting  
c) support device  
d) mounting device  
e) system accessory  

NOTE System components may not necessarily be included together in a system. Different combinations of system components may be used.

3.3 **cable tray length**  
system component used for cable support consisting of a base with integrated side members or a base connected to side members  

NOTE Typical examples of cable tray types are shown in figures A.1 to A.3.

3.4 **cable ladder length**  
system component used for cable support consisting of supporting side members, fixed to each other by means of rungs  

NOTE Typical examples of cable ladder types are shown in figure A.4.

3.5 **fitting**  
system component used to join, change direction, change dimension or terminate cable tray lengths or cable ladder lengths  

NOTE Typical examples are couplers, bends, tees, crosses.

3.6 **cable runway**  
assembly comprised of cable tray lengths or cable ladder lengths and fittings only

3.7 **support device**  
device designed to provide mechanical support and which may limit movement of a cable runway  

NOTE Typical examples of support devices are shown in annex B.

3.8 **mounting device**  
system component used to attach or fix other devices to the cable runway  

NOTE A typical example is an apparatus mounting device.

3.9 **apparatus mounting device**  
component used to accommodate electrical apparatus like switches, socket outlets, circuit-breakers, telephone outlets, etc. which can be an integral part of the electrical apparatus and which is not part of the cable tray system and cable ladder system.
3.10  
**system accessory**

system component used for a supplementary function such as cable segregation, cable retention, and covers, etc.

3.11  
**cable segregation**

under consideration

3.12  
**metallic system component**

system component which consists of metal only. Screws for connections and other fasteners are not considered

3.13  
**non-metallic system component**

system component which consists of non-metallic material only. Screws for connections and other fasteners are not considered

3.14  
**composite system component**

system component which consists of both metallic and non-metallic materials. Screws for connections and other fasteners are not considered

3.15  
**non-flame propagating system component**

system component which is liable to catch fire as a result of an applied flame, along which the flame does not propagate and which extinguishes itself within a limited time after the flame is removed

3.16  
**external influence**

presence of water, oil, building materials, corrosive and polluting substances, and external mechanical forces such as snow, wind, and other environmental hazards

3.17  
**safe working load (SWL)**

maximum load that can be applied safely in normal use

3.18  
**uniformly distributed load (UDL)**

load applied evenly over a given area

NOTE  Methods of applying uniformly distributed loads are shown in annexes D and E.

3.19  
**span**

distance between the centres of two adjacent support devices

3.20  
**internal fixing device**

device for joining and/or fixing system components to other system components. This device is part of the system but not a system component

NOTE  Typical examples are nuts and bolts.
3.21 external fixing device
device used for fixing a support device to walls, ceilings or other structural parts. This device is not part of the system

NOTE Typical examples are anchor bolts.

3.22 base area of cable tray length or cable ladder length
plan area available for cables

3.23 free base area
part of the base area which is open to the flow of the air. Holes in cable ladder rungs are included in the free base area

3.24 load plate
rigid means through which a load is applied to the sample for testing purposes

3.25 product type
group of system components which vary in the case of
- cable runways in the width only
- cantilever brackets in the length only
- pendants in the length only

NOTE Different jointing methods and position constitute different product types.

3.26 topological shape
group of product types which varies in thickness and height only

4 General requirements

Cable tray systems and cable ladder systems shall be so designed and so constructed that in normal use, when installed according to the manufacturer’s or responsible vendor's instructions, they ensure reliable support to the cables contained therein. They shall not impose any unreasonable hazard to the user or cables.

The system components shall be designed to withstand the stresses likely to occur during recommended transport and storage.

Cable tray systems and cable ladder systems according to this standard are not intended to be used as walkways.

Compliance is checked by carrying out all the relevant tests specified in this standard.
5 General conditions for tests

5.1 Tests according to this standard are type tests.

5.2 Unless otherwise specified, tests shall be carried out with cable tray system components or cable ladder system components assembled and installed as in normal use according to the manufacturer's or responsible vendor's instructions.

5.3 Tests on non-metallic system components or composite system components shall not commence earlier than 168 h after manufacture.

5.4 Unless otherwise specified, tests shall be carried out at an ambient temperature of 20 °C ± 5 °C.

Unless otherwise specified, all tests are carried out on new samples.

5.5 When toxic or hazardous processes are used, precautions should be taken to safeguard the person performing the test.

5.6 Unless otherwise specified, three samples are subjected to the tests and the requirements are satisfied if all the tests are met.

If only one of the samples does not satisfy a test due to an assembly or a manufacturing fault, that test and any preceding one which may have influenced the results of the test shall be repeated and also the tests which follow shall be made in the required sequence on another full set of samples, all of which shall comply with the requirements.

NOTE The applicant, when submitting a set of samples, may also submit an additional set of samples which may be necessary, should one sample fail. The testing station will then, without further request, test the additional set of samples and will reject only if a further failure occurs. If the additional set of samples is not submitted at the same time, the failure of one sample will entail rejection.

5.7 If the relative humidity of the atmosphere has a significant effect on the classified properties of the samples under test, the manufacturer or responsible vendor shall declare this information.

5.8 If a system component or system is coated in paint or any other substance which is likely to affect its classified properties, then the relevant tests in this standard shall be performed on the coated sample.

6 Classification

6.1 According to material

6.1.1 Metallic system component

6.1.2 Non-metallic system component

6.1.3 Composite system component

6.2 According to resistance to flame propagation

6.2.1 Flame propagating system component

6.2.2 Non-flame propagating system component

6.3 According to electrical continuity characteristics

6.3.1 Cable tray system or cable ladder system without electrical continuity characteristics
6.3.2 Cable tray system or cable ladder system with electrical continuity characteristics
NOTE For cable tray systems and cable ladder systems with PE function, see annex C.

6.4 According to electrical conductivity

6.4.1 Electrically conductive system component

6.4.2 Electrically non-conductive system component

6.5 According to material coating

6.5.1 Non-coated system component
NOTE Examples of non-coated materials are stainless steel, aluminium alloy, PVC and glass reinforced plastic (GRP).

6.5.2 System component with metallic coating
NOTE Examples of metallic coatings are zinc-galvanized and aluminium-electroplated.

6.5.3 System component with organic coating
NOTE Examples of organic coatings are epoxy powder and PVC.

6.5.4 System component with metallic and organic coating

6.6 According to temperature

6.6.1 Minimum temperature as given in table 1

Table 1 – Minimum temperature classification

<table>
<thead>
<tr>
<th>Minimum transport, storage, installation and application temperature (°C)</th>
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<tbody>
<tr>
<td>+20</td>
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<tr>
<td>+5</td>
</tr>
<tr>
<td>–5</td>
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<tr>
<td>–15</td>
</tr>
<tr>
<td>–20</td>
</tr>
<tr>
<td>–40</td>
</tr>
<tr>
<td>–50</td>
</tr>
</tbody>
</table>

6.6.2 Maximum temperature as given in table 2

Table 2 – Maximum temperature classification

<table>
<thead>
<tr>
<th>Maximum transport, storage, installation and application temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+20</td>
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<td>+40</td>
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<td>+90</td>
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</tr>
<tr>
<td>+120</td>
</tr>
<tr>
<td>+150</td>
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6.7 According to the perforation in the base area of the cable tray length as given in table 3

<table>
<thead>
<tr>
<th>Classification</th>
<th>Perforation in the base area</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Up to 2 %</td>
</tr>
<tr>
<td>B</td>
<td>Over 2 % and up to 15 %</td>
</tr>
<tr>
<td>C</td>
<td>Over 15 % and up to 30 %</td>
</tr>
<tr>
<td>D</td>
<td>More than 30 %</td>
</tr>
</tbody>
</table>

NOTE For the purpose of ventilation, classification D relates to IEC 60364-5-523, subclause 523.8.2, third paragraph.

6.8 According to the free base area of cable ladder length as given in table 4

<table>
<thead>
<tr>
<th>Classification</th>
<th>Free base area</th>
</tr>
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<tbody>
<tr>
<td>X</td>
<td>Up to 80 %</td>
</tr>
<tr>
<td>Y</td>
<td>Over 80 % and up to 90 %</td>
</tr>
<tr>
<td>Z</td>
<td>More than 90 %</td>
</tr>
</tbody>
</table>

NOTE For the purpose of ventilation, classification Z relates to IEC 60364-5-523, subclause 523.8.2, fourth paragraph.

6.9 According to impact resistance

6.9.1 System component offering impact resistance up to 2 J

6.9.2 System component offering impact resistance up to 5 J

6.9.3 System component offering impact resistance up to 10 J

6.9.4 System component offering impact resistance up to 20 J

6.9.5 System component offering impact resistance up to 50 J

7 Marking and documentation

7.1 Each system component shall be durably and legibly marked with
  - the manufacturer's or responsible vendor's name or trade mark or identification mark;
  - a product identification mark which may be, for example, a catalogue number, a symbol, or the like.

When system components other than cable tray lengths and cable ladder lengths are supplied in a package, the product identification mark may be, as an alternative, marked on the package only.

NOTE 1 The necessity to mark flame propagating system components is under consideration.

Compliance is checked by inspection and, for marking on the product, by rubbing by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with petroleum spirit.
After the test, the marking shall be legible.

NOTE 2 Petroleum spirit is defined as the aliphatic solvent hexane with a content of aromatics of maximum 0.1% volume, a kaurnbutanol value of 29, an initial boiling point of 65 °C, a dry point of 69 °C and a specific gravity of approximately 0.68 kg/l.

NOTE 3 Marking may be applied, for example, by moulding, pressing, engraving, printing, adhesive labels, or water slide transfers.

NOTE 4 Marking made by moulding, pressing, or engraving is not subjected to the rubbing test.

7.2 If a system component can, by taking precautions, be stored and transported at a temperature outside the declared temperatures according to tables 1 and 2, the manufacturer or responsible vendor shall declare the precautions and the alternative temperature limits.

Compliance is checked by inspection.

7.3 The manufacturer or responsible vendor shall provide in his literature all information necessary for the proper and safe installation and use. The SWL and impact resistance is valid for the whole temperature classification declared. The information shall include

a) instructions for the assembly and installation of system components and for the precautions required to avoid excessive transverse deflection, which could cause damage to the cables (see 5.2, 9.2, 10.3, 10.7, 10.8, and 14.1),

b) thermal expansion properties and precautions to be taken, if necessary,

c) classification according to clause 6,

d) relative humidity if it affects the classifications (see 5.7),

e) information on holes or devices when provided for equipotential bonding (see 6.3.2) in particular when a specific electrical connection device is necessary,

f) precautions for transport and storage outside the declared temperature classification, where applicable (see 7.2),

l) fixing method for installing cable tray or cable ladder to the supports when declared for the test (see 10.3, 10.4 and 10.8.1),

m) SWL in N/m for the cable tray lengths or cable ladder lengths including joints, where applicable for one or more of the following installation methods (see 10.1):

   i) mounted in the horizontal plane running horizontally on multiple spans (see 10.3)

   ii) mounted in the horizontal plane running horizontally on a single span (see 10.4)

   iii) mounted in the vertical plane running horizontally (see 10.5)

   iv) mounted in the vertical plane running vertically (see 10.6),

n) SWL in N for cantilever brackets and if used for cable tray only (see 10.8.1),

o) SWL for pendants as a bending moment in Nm and/or as a force in N (see 10.8.2),
p) the appropriate material specification and environmental conditions, chemical environments or aggressive agents for which the product is suitable (see 14.2).

NOTE SWL information can be given in the form of a diagram, table, or similar.

Compliance is checked by inspection.

8 Dimensions

The manufacturer or responsible vendor shall give the following information:

- the overall envelope of the cross-section of the cable tray length or cable ladder length;
- the base width of the cable tray length or cable ladder length available for the accommodation of cables;
- the height of the cable tray length or cable ladder length available for the accommodation of cables when a cover is fitted;
- the minimum internal radius of fittings available for the accommodation of cables;
- the dimensions of the perforations, and their arrangements on the cable tray lengths;
- the dimensions of the rungs including perforations, if any, and the centre line spacing of the rungs.

NOTE System components, such as fittings, when used as part of the system, may change the effective area available for the accommodation of cables.

Compliance is checked by inspection.

9 Construction

The same sample may be used for all the tests in this clause.

9.1 Surfaces of system components which are likely to come into contact with cables during installation or use shall not cause damage to the cables when installed according to the manufacturer's or responsible vendor's instructions.

Compliance is checked by inspection and, if necessary, by manual test.

9.2 Surfaces of system components which do not come into contact with cables during installation or use and where the manufacturer or responsible vendor does not require the use of gloves for installation purposes shall ensure safe handling.

Compliance is checked by inspection and, if necessary, by manual test.

9.3 Screwed connections and other internal fixing devices shall be so designed to withstand the mechanical stresses occurring during installations according to the manufacturer's or responsible vendor's instructions and normal use. They shall not cause damage to the cable when correctly inserted.

Screwed connections can be either

a) ISO metric threads, or
b) a thread forming type, or
c) a thread cutting type if suitable design provisions are made, or
9.3.1 Sudden or jerky motions shall not be used to tighten reusable screwed connections. To test the screwed connection, it shall be tightened and removed

- 10 times for metal screwed connections in engagement with a thread of non-metallic material and for screwed connections of non-metallic material,

or

- 5 times in all other cases.

The test is carried out using a suitable screwdriver or spanner to apply the torque as specified by the manufacturer or responsible vendor.

After the test, there shall be no breakage or damage, that will impair the further use of the screwed connection.

9.3.2 Reusable connections other than screwed connections, for example push-on and clamping connections, shall be tightened and removed 10 times.

After the test, there shall be no damage to impair the further use of the reusable connections.

9.3.3 Non-reusable connections are checked by inspection and, if necessary, by manual test.

10 Mechanical properties

10.1 Mechanical strength

Cable tray systems and cable ladder systems shall provide adequate mechanical strength.

The main criterion for the SWL is safety in use of the product.
For the declared application, the manufacturer or responsible vendor shall declare the SWL to be tested:

- in N/m for each type of cable tray length or cable ladder length at specified distances, preferably in spans of 0,5 m increments, between the support devices,
- in N/m for each type of fitting which is not directly supported by a support device,
- in N or N/m for each type of support device.

NOTE This information can be given in the form of a diagram or table or similar.

Compliance for cable runways is checked by carrying out the relevant tests according to the manufacturer’s or responsible vendor's declaration as specified in 10.3, 10.4, 10.5, 10.6 and 10.7 on samples of the widest and narrowest width for each product type. For the intermediate widths the SWLs shall then be determined by interpolation of the test results. The alternative is to test only the widest product. For the tests specified in 10.3, 10.4 and 10.7, the SWL of an untested narrower width may be derived by multiplying the SWL of the tested widest width by the factor of the narrower width divided by the widest (tested) width.

Compliance for support devices is checked by carrying out the tests specified in 10.8.

Cable tray system components and cable ladder system components shall withstand impacts occurring during transport, storage and installation.

Compliance is checked by the test specified in 10.9.

10.2 SWL test procedure

Deflection measurements shall be used only as a method of assessing the SWL, if no clear indication of failure occurs, i.e. where the product continues to deflect greatly without collapse.

Tests shall be carried out at the maximum and minimum temperature declared according to the classification in tables 1 and 2. During the test, the spatio-temporal uniformity of the temperature shall be within the range of ±5 °C, 0,25 m around the sample. Alternatively, tests can be carried out

- at any temperature within the declared range if documentation is available which states that the relevant mechanical property values of the materials as used within the sample do not differ by more than ±5 % of the average between the maximum and minimum property values due to temperature change within the declared temperature range,

or

- only at the maximum temperature within the range, if documentation is available, which states that the relevant mechanical property values of the materials, as used within the sample, improve when the temperature is decreasing,

or

- at the maximum and minimum temperature within the range only for the smallest and largest size of cable tray lengths or cable ladder lengths, having the same material, joint and topological shape. The other sizes can be tested at ambient temperature only.

This procedure can only be used if the percentage of the difference between the TDF (SWL temperature dependence factor) of the smallest size and the largest size is less than 10 % using the following formula for the calculation:

\[
\frac{\text{TDF smallest size} - \text{TDF largest size}}{\text{maximum value of the TDF either of the smallest size or the largest size}} < \frac{10}{100}
\]
The TDF for these sizes is obtained by testing at minimum, ambient, and maximum temperature to determine the loads which provide the maximum allowed deflection. The loads for each temperature are averaged. Then the TDF is calculated by dividing the minimum of these averaged loads by the averaged load at ambient temperature.

If documentation is available which states that the relevant mechanical property values of the materials, as used within the system, improve when the temperature is decreasing, then testing at minimum temperature is not needed and the TDF can be calculated by dividing the averaged loads at maximum temperature by the averaged loads at ambient temperature.

Other sizes with the same topological shape can be tested at ambient temperature but increasing the declared load for the maximum or minimum temperature within the range by dividing it by the TDF for the range tested \((TDF_R)\), where \(TDF_R\) is the arithmetic mean of the TDF for the smallest size and TDF for the largest size, in order to simulate the worst case within the temperature range. For an example of how to determine the \(TDF_R\), see annex F.

All loads shall be uniformly distributed over the length and width of the samples as shown in annex D.

The load shall be applied in such a way that a UDL (uniformly distributed load) is ensured even in the case of extreme deformation of the samples.

Typical methods of applying a UDL are shown in annex E.

To allow for settlement of the samples, a pre-load of 10 % of the SWL, unless otherwise specified, shall be applied and removed after 5 min. At this time, the measurement apparatus shall be calibrated to zero.

The load shall then be increased evenly longitudinally and transversely up to the SWL continuously or, when a continuous increase is impractical, the load shall be increased by increments, these increments not being heavier than a quarter of the SWL. The load increments shall be distributed through the load plates as evenly longitudinally and transversely as is practical.

After loading, the deflection shall be measured at the points specified for each test arrangement.

For the tests in 10.3, 10.4, 10.5, 10.6, and 10.7, the mid span deflection is the arithmetic mean of the deflections at the two measuring points near the side members as shown in figure 1, key 8.

Where necessary, a third measurement of deflection shall be taken in the centre of the cable tray base or cable ladder base at mid-span as shown in figure 1, key 7, or figure 5, point s, for fittings. The transverse deflection shall be calculated by subtracting the mid-span deflection from the third reading.

The samples shall be left and the deflections measured every 5 min until the difference between two consecutive sets of readings is less than 2 % with regard to the first set of the two consecutive sets of readings. The first set of readings measured at this point are the deflections measured at the SWL. For an example see annex G.

When subjected to the SWL, the samples, their joints and internal fixing devices shall show no damage or crack visible to normal view or corrected vision without magnification and the deflections shall not exceed the values specified in 10.3, 10.4, 10.5, 10.6, 10.7, and 10.8.
The load shall then be increased to 1.7 times the SWL.

The samples shall be left and the deflections measured every 5 min until the difference between two consecutive sets of readings is less than 2 % with regard to the first set of the two consecutive sets of readings.

The samples shall sustain the increased loading without collapsing. Buckling and deformation of the samples is permissible at this loading.

10.3 Test for SWL of cable tray lengths and cable ladder lengths mounted in the horizontal plane running horizontally on multiple spans

The test is carried out on cable tray lengths and joints or cable ladder lengths and joints to verify the declared SWL when mounted over multiple spans with the cable tray or cable ladder in the flat and horizontal plane.

The test is carried out with the samples consisting of two or more cable tray lengths or cable ladder lengths. These shall be coupled, as shown in figure 1 to form two full spans plus a cantilever. Joints are to be positioned as required for each test type following the manufacturer’s or responsible vendor’s instructions.

The samples shall be placed on fixed, rigid supports a, b and c which shall be horizontal and level with a width of 45 mm ± 5 mm. The samples shall not be fixed to the supports unless a fixing method is declared by the manufacturer or responsible vendor in which case this fixing method shall be used.

For all test types, full standard cable tray lengths or cable ladder lengths shall be used for all intermediate lengths. Cut lengths shall only be used at the end positions required.

The cantilever of 0.4L can be increased slightly in length as described in annex D, if necessary, to ensure a UDL on the cantilever.

Depending on the installation method(s) declared by the manufacturer or responsible vendor, one or more of the following test types shall be used.

10.3.1 Test type I

Test type I shall be used when the manufacturer or responsible vendor does not declare any end span limitations and where the joints shall be placed on all installations. In this case, joints can occur anywhere on an installation. The test arrangement shall be as shown in figure 2a.

10.3.2 Test type II

Test type II shall be used when the manufacturer or responsible vendor declares that on all installations there shall be no joints in the end span. The test arrangement shall be as shown in figure 2b.

If the manufacturer or responsible vendor declares that on all installations the end span shall be reduced in length, the end span X shall then be declared.
10.3.3 Test type III

Test type III shall be used when the standard cable tray length or cable ladder length is equal to the span or multiples of the span and the manufacturer or responsible vendor declares the joint position, relative to the end support, to be used on all installations. The test arrangement shall be as shown in figure 2c.

If the manufacturer or responsible vendor declares that on all installations the end span shall be reduced in length, the end span \( X \) shall then be declared.

10.3.4 Test type IV

Test type IV shall be used for products with localized weakness. In this case, the localized weakness is positioned over support \( b \) as shown in figure 3. If this can be achieved by modifying test type I or II by moving the joint by up to \( \pm 10 \% \) of \( L \) from its specified position, then this shall be done.

10.3.5 Test type V

Test type V may be used as an alternative to test type I to IV if the span is greater than 4 m. In this case, subclause 10.4 shall be used to check the SWL with a joint positioned at mid-span or as declared by the manufacturer or responsible vendor. The test arrangement shall be as shown in figure 4.

The test shall be carried out in accordance with 10.2.

The practical mid-span deflection of either span at the SWL shall not exceed 1/100th of the span.

The transverse deflection at the SWL shall not exceed 1/20th of the width of the sample and the samples shall still ensure reliable support to any cables that would normally be contained therein without imposing any unreasonable hazard or danger to the user or cables.

10.4 Test for SWL of cable tray lengths and cable ladder lengths mounted in the horizontal plane running horizontally on a single span installation

The test is carried out on cable tray lengths or cable ladder lengths to verify the declared SWL when used as a single beam over a single span with the cable tray or cable ladder in the flat and horizontal plane.

The samples shall be placed on fixed, rigid supports \( a \) and \( b \) which shall be horizontal and level with a width of 45 mm \( \pm 5 \) mm as shown in figure 4. The samples shall not be fixed to the supports unless a fixing method is declared by the manufacturer or responsible vendor, in which case this fixing method shall be used.

If the span is greater than the cable tray length or cable ladder length and the manufacturer or responsible vendor does not declare where the joints shall be placed, they shall be at mid-span position as shown in figure 4. This does not apply to test type V of 10.3.

The test shall be carried out in accordance with 10.2.

The practical mid-span deflection at the SWL shall not exceed 1/100th of the span.
The transverse deflection at the SWL shall not exceed 1/20th of the width of the samples and the samples shall still ensure reliable support to any cables that would normally be contained therein without imposing any unreasonable hazard or danger to the user or cables.

For products with localized weakness, a test is required with the localized weakness positioned over support a and b, as shown in figure 4.

If this can be achieved by moving the joint by up to ±10 % of span L from its specific position, this shall be done.

If the manufacturer or responsible vendor does not declare where the joints shall be placed, then this additional test shall be done, independent of the joint location.

This test is carried out identically to the standard test as described in 10.3 using the same SWL as the standard test.

10.5 Test for SWL of cable tray lengths and cable ladder lengths mounted in the vertical plane running horizontally

Under consideration.

10.6 Test for SWL of cable tray lengths and cable ladder lengths mounted in the vertical plane running vertically

Under consideration.

10.7 Test for SWL of cable tray fittings and cable ladder fittings mounted in the horizontal plane running horizontally

The test is carried out on the largest unsupported 90° bends, equal tees, and equal crosses of each product type to verify the declared SWL when mounted in the horizontal plane running horizontally. Other fittings are not considered.

Fittings which, according to the manufacturer’s or responsible vendor’s instructions, shall be installed with an additional support directly to it, are not tested.

A change in fitting radius, as shown in figure 5a, figure 5b and figure 5c, constitutes another product type.

Each fitting shall be fixed with the recommended coupling device to a cable tray length or cable ladder length of the same product type. Supports shall be at equal distance Y from the fitting as shown in figure 5a, figure 5b and figure 5c. The UDL to be applied on the fitting shall be as follows:

\[ Q = q \times L_m \]

where

- \( Q \) is the UDL to be applied on the fitting;
- \( q \) is the SWL declared by the manufacturer or responsible vendor in N/m;
- \( L_m \) is the length of mid-line of the fitting shown in figure 5d as a dotted line(s). Where there are two dotted lines, \( L_m \) is the summation of the length of the two dotted lines.

For the application of the UDL, see annexes D and E.
10.7.1 Test for SWL of 90° bend

The test shall be carried out in accordance with 10.2.

The test load shall be the load \( Q \) as calculated from the declared SWL.

The practical mid-span deflection at the test load shall not exceed 1/100th of the curved span between supports a and b as indicated in figure 5a.

The transverse deflection at the test load shall not exceed 1/20th of the width of the samples, and the samples shall still ensure reliable support to any cables that would normally be contained therein without imposing any unreasonable hazard or danger to the user or cables.

10.7.2 Test for SWL of equal tee and equal cross

The test shall be carried out in accordance with 10.2.

The test load shall be the load \( Q \) as calculated from the declared SWL.

The practical mid-span deflection at the test load shall not exceed 1/100th of the span between supports a and b as shown in figure 5b and figure 5c.

The transverse deflection at the test load shall not exceed 1/20th of the distance between measuring points r and t as shown in figure 5b and figure 5c and the samples shall still ensure reliable support to any cables that would normally be contained therein without imposing any unreasonable hazard or danger to the user or cables.

10.8 Test for SWL of support devices

10.8.1 Test for SWL of cantilever brackets

The test shall be carried out on samples of the longest and shortest length of each product type. Intermediate SWLs can be determined by interpolation of the test results. Alternatively, if the shortest length has not been tested, the manufacturer or responsible vendor shall declare that the SWL applicable to the longest length shall also be applied to the shorter lengths.

When the cantilever bracket is intended to be used on walls, the samples shall be fixed to a rigid support. When the cantilever bracket is intended to be used on pendants, the samples shall be fixed to a short length of the pendant profile, which shall be fixed to a rigid support as shown in figure 6a.

The declared SWL of a cantilever bracket shall be based on the use of the maximum width of the cable runway for which the cantilever bracket is designed. For different loading conditions, the manufacturer or responsible vendor should be consulted.

The load is not to be fixed to the cantilever bracket to give the worst case for the test.

A test for the case where the manufacturer or responsible vendor declares that the cable runway is to be fixed to the cantilever bracket is under consideration.
The load shall be placed at two points on cantilever brackets designed for cable tray or cable ladder as shown in figure 6b. Cantilever brackets designed for cable tray lengths and cable tray fittings only can be loaded on more than two points as shown in figure 6c. For the purpose of the test, unless otherwise declared by the manufacturer or responsible vendor, the cable runway is positioned as near as possible to the free end of the cantilever bracket.

The test shall be carried out in accordance with 10.2 but with a pre-load of 50% of the SWL applied.

The measurement of the deflection shall be carried out using a rigid light arm, to be positioned as shown in figure 6d and to be used as a measuring support means.

The maximum deflection at the SWL shall not exceed 1/20th of the overall length $L$ of the cantilever bracket from the support.

10.8.2 Test for SWL of pendants

The test setup for pendants is shown in figure 7.

The sample shall be fixed to a rigid support. When the manufacturer or responsible vendor declares that the cable runway is to be fixed to the bracket, the test shall be carried out with the relevant cable runway fixed to the bracket and the load applied to the cable runway.

The SWL for each product type shall be declared by the manufacturer or responsible vendor and the load applied as shown in figure 7.

The tests shall be carried out according to 10.2 with the exception that a pre-load of 50% of the SWL shall be applied.

The maximum deflection at the SWL shall not exceed 1/20th of the length $L$ of the pendant or the width $W$ of the cantilever bracket.

The test set-ups for a pendant for cantilever brackets are shown in figures 7a, 7b and 7c.

10.8.2.1 Test for bending moment of the pendant at the ceiling plate

Figure 7a shows the test setup for the bending moment at the ceiling plate. The manufacturer or responsible vendor shall declare the SWL as a bending moment $M_1$ in Nm.

The test shall be carried out on a pendant length $L$, of preferably 800 mm, applying a force $F$, calculated from $F = \frac{M_1}{L}$. Where only shorter pendants exist, the test shall be carried out on the longest one available.

10.8.2.2 Test for pendant tensile strength

Figure 7b shows the test setup for tensile strength. The manufacturer or responsible vendor shall declare the SWL as a force in Newtons.

The test can be carried out at any pendant length.
10.8.2.3 Test for the bending moment of the pendant at the cantilever bracket

Figure 7c shows the test set-up for the bending moment, which indicates the deflection of the pendant. The manufacturer or responsible vendor shall declare the SWL as a bending moment $M_2$ in Nm.

The SWL shall be applied at lengths $L$ equal to 500 mm, 1 000 mm and 1 500 mm, as far as is available, using the strongest of the largest cantilever bracket recommended by the manufacturer or responsible vendor for each pendant type. The force $F$ is calculated from

$$F = \frac{2 M_2}{A_1 + A_2}$$

where $A_1$ and $A_2$ are shown in figure 7c.

NOTE The strongest cantilever bracket can be determined from the test results from 10.8.1.

Information for a safe installation of a pendant with cantilever brackets is given in annex H.

10.8.3 Test of SWL for the pendant with bracket

10.8.3.1 Test for SWL of the pendant with mid-supported bracket

The SWL test set-up for a pendant with a mid-supported bracket is shown in figure 7d.

10.8.3.2 Test for SWL of the pendant with end-supported bracket

The SWL test set-up for a pendant with an end-supported bracket is shown in figure 7e.

10.8.4 Test for SWL of the fixing brackets when used to support cable tray lengths and cable ladder lengths vertically

Under consideration.

10.9 Test for impact resistance

The test is performed according to IEC 60068-2-75 using the pendulum hammer.

The test is carried out on samples of cable tray lengths or cable ladder lengths, 250 mm ± 5 mm long.

Samples of ladder shall consist of two side members with two rungs positioned centrally, and the sample length has to be increased accordingly. Samples of mesh trays shall be prepared in such a way that there will be a wire in the centre.

Before the test, non-metallic and composite components are aged at a temperature of 60 °C ± 2 °C for 240 h continuously.

The samples shall be mounted on a wooden fibreboard of thickness 20 mm ± 2 mm. The samples to be tested shall be placed in a refrigerator, the temperature within is maintained at the declared temperature according to table 1, with a tolerance of ±2 °C.
After 2 h, the samples shall, in turn, be removed from the refrigerator and immediately placed in the test apparatus.

At 10 s ± 1 s after removal of each sample from the refrigerator, the hammer shall be allowed to fall with the declared impact energy according to 6.9. The mass of the hammer and the fall height shall be as given in table 5 and shall be applied as shown in figure 8.

The impact shall be applied to the base, or respectively a rung, in the first sample, to one of the side members in the second sample, and to the other side member in the third sample.

In each case, the impact is applied to the centre of the face being tested.

After the test, the samples shall show no signs of disintegration and/or deformation that impairs safety.

<table>
<thead>
<tr>
<th>Table 5 – Impact test values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate energy J</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

11 Electrical properties

11.1 Electrical continuity

Cable tray systems and cable ladder systems declared according to 6.3.2 shall have adequate electrical continuity to ensure equipotential bonding and connection(s) to earth if required according to the application of the cable tray system or of the cable ladder system.

After treatment according to 11.1.1, compliance is checked by the test according to 11.1.2.

The samples and test set-up shall be as shown in figure 9. If different types of coupling exist within the system, then they shall be tested separately.

11.1.1 All grease is removed from the parts to be tested, by cleaning with white spirit with a kauributanol value of 35 ± 5.

The parts shall then be dried, after which they are assembled and tested according to 11.1.2.

11.1.2 A current of 25 A ± 1 A a.c. having a frequency of 50 Hz to 60 Hz supplied by a source with a no-load voltage not exceeding 12 V shall be passed through the length of the samples. The voltage drop shall be measured between two points 50 mm each side of the coupler or integral coupling and again between two points 500 mm apart on one side of the joint as shown in figure 9, and the impedances are calculated from the current and the voltage drops.

The calculated impedances shall not exceed 50 mΩ across the joint and 5 mΩ per metre without the joint.
11.2 Electrical non-conductivity

Cable tray system components and cable ladder system components declared according to 6.4.2 shall be deemed non-conductive at surface resistivity levels of $10^8 \, \Omega$ or greater and volume resistivity levels of $10^5 \, \Omega \cdot \text{m}$ or greater.

Compliance is checked immediately after the humidity treatment according to 11.2.1 and followed by

- the test according to 11.2.2 followed by 11.2.3 for systems components according to 6.1.3;
- the test according to 11.2.3 for system components according to 6.1.2.

Each sample shall be a flat smooth disk or sheet extracted from a significant part of the system component and sufficiently larger so that the guard ring used to conduct the test does not reach the outer edges of the samples.

11.2.1 Humidity treatment

The humidity treatment shall be carried out in a humidity cabinet with a relative humidity between 91 % and 95 % at a temperature $t$, maintained within ±1 °C of any convenient value between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the samples are brought to a temperature between $t$ and $t + 4$ °C. This may be achieved by keeping them at this temperature for at least 4 h before the humidity treatment.

The samples are kept in the humidity cabinet for 24 h.

A relative humidity between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate ($\text{Na}_2\text{SO}_4$) or potassium nitrate ($\text{KNO}_3$) in water having a substantially large contact surface with air.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

11.2.2 Surface resistivity

Under consideration

11.2.3 Volume resistivity

Under consideration

12 Thermal properties

Under consideration

13 Fire hazards

13.1 Reaction to fire

13.1.1 Initiation of fire

This item is not relevant for cable tray systems and cable ladder systems.
13.1.2 Contribution to fire

System components declared according to 6.1.2 and 6.1.3 which might be exposed to abnormal heat due to an electrical fault shall have limited ignitability.

NOTE Only parts that can be in contact with electrical cables should be considered.

Compliance is checked by the test according to IEC 60695-2-1/1, clauses 4 to 10, with a glow-wire temperature of 650 °C.

Small parts, such as washers, are not subject to the test of this subclause.

The test is not carried out on parts made of ceramic or metallic material.

The test is carried out on one sample, which may be tested at more than one point.

The test is carried out applying the glow-wire once for 30 s.

The sample is regarded as having passed the glow-wire test if

– there is no visible flame and no substantial glowing,

or

– flames and glowing at the sample extinguish within 30 s after removal of the glow-wire.

There shall be no ignition of the tissue paper or scorching of the board.

In case of doubt, the test shall be repeated on two further samples.

NOTE Requirements for the rate of heat release are under consideration.

13.1.3 Spread of fire

Non-flame propagating systems components shall either not ignite or, if ignited, shall have a limited spread of fire.

Compliance is checked as follows:

– for system components of non-metallic or composite material other than cable tray lengths or cable ladder lengths by the test of 13.1.2 at a glow wire temperature of 650 °C. Parts that have already been tested in accordance with 13.1.2 are not tested again;

– for cable tray lengths or cable ladder lengths of non-metallic or composite material, by the following flame test.

The flame test is carried out on samples that have a length of 675 mm ± 10 mm.

The test is performed using the burner specified in IEC 60695-2-4/1.

The samples shall be placed as shown in figure 10 in a rectangular metal enclosure with one open face as shown in figure 11 in an area substantially free from draughts. Each sample shall be clamped at both ends, in order to prevent distortion or movement of the sample itself under flame application conditions. In the case of cable ladder lengths, the top face of the rung shall be positioned 100 mm from the upper extremity of the lower clamp.
The burner is positioned as shown in figure 10 with the flame applied
- to the middle of the side rail of the inside face of the cable ladder length,
- to the inside face at the junction between the base and the side flange of the cable tray length.

The internal lower surface of the enclosure shall be covered with a piece of pine or particle board, approximately 10 mm thick, covered with a single layer of tissue paper of a density between 12 g/m² and 30 g/m², in accordance with ISO 4046.

The samples shall be subjected to the exposure of the flame for 60 s ± 2 s.

The sample shall be regarded to have passed the test if
- it does not ignite, or if
- in the case of ignition, the following three conditions are fulfilled:
  a) the flame extinguishes within 30 s after removal of the test flame,
  b) there is no ignition of the tissue paper or scorching of the board,
  c) there is no evidence of burning or charring above 50 mm below the lower extremity of the upper clamp.

NOTE If perforated system components are made from unperforated system components, the unperforated system component need not be tested.

13.1.4 Additional reaction to fire characteristics
Under consideration.

13.2 Resistance to fire
Under consideration.

14 External influences

14.1 Resistance against environmental forces
Snow, wind loading and other environmental forces are not considered to be the responsibility of the manufacturer or responsible vendor.

NOTE The designer of the installation should take into consideration the effects of snow, wind and other environmental forces where necessary.

14.2 Resistance against corrosion
In development.*

14.2.1 Non-coated system components
Under consideration.

14.2.2 System components with metallic coating
Under consideration.

* In an advanced stage of development by IEC/SC23A/MT12 to be incorporated in amendment 1 of this International Standard.
14.2.3  System components with organic coating

Under consideration.

15  Electromagnetic compatibility (EMC)

Products covered by this standard are, in normal use, passive in respect of electromagnetic influences, emission and immunity.

NOTE  When products covered by this standard are installed as part of a wiring installation, the installation may emit or may be influenced by electromagnetic signals. The degree of influence will depend on the nature of the installation within its operating environment and the apparatus connected by the wiring.
Figure 1a

Figure 1b

Figure 1c

Key
1 Symbol to indicate a uniformly distributed load (UDL)
2 Joint
3 Extension of cantilever only permitted when required to support loading media (see annex D)
4 End span = L
5 Intermediate span = L
6 Maximum unloaded length = 500 mm
7 Deflection measuring point at mid width
8 Deflection measuring point within 30 mm of product edge
9 Cantilever = 0.4L
10 Symbol to indicate a support position
11 Symbol to indicate a deflection measurement point
a Support
b Support
c Support
d End of load
L Distance between supports on lengths as declared by the manufacturer

All dimensions are in millimetres

Figure 1 – Safe working load test – General arrangement
Key
1 Joint at the mid-point of span a-b
2 Product standard length; this may be reduced for test purposes to avoid that a joint causes a premature failure due to the cantilever
3 One or more joints may be required depending upon the product length and span
4 End span = \( L \)
5 Intermediate span = \( L \)
6 Cantilever = 0.4\( L \)
a, b and c Support positions
b End of load
\( L \) Distance between supports on lengths as declared by the manufacturer

Figure 2a – Test type I (see 10.3.1)

Key
1 For test purposes, a joint may be required in span a-b because the joint in span b-c shall always be at the mid-span position
2 Product standard length; this may be reduced for test purposes to avoid premature failure due to the joint at the end span
3 Joint at the mid-point of span b-c
4 End span = \( L \) or \( X \)
5 Intermediate span = \( L \)
6 Cantilever = 0.4\( L \)
a, b and c Support positions
b End of load
\( L \) Distance between supports on lengths as declared by the manufacturer

Figure 2b – Test types II (see 10.3.2)
Key
1 Joint position within each span
2 Product standard length
3 End span = L or X
4 Intermediate span = L
5 Cantilever = 0.4L
a, b and c Support positions
d End of load
L Distance between supports on lengths as declared by the manufacturer

NOTE If the product standard length is equal to two or more times the span, and the manufacturer or responsible vendor states the joint position to be used on all spans for all installations with no end span joints, this test may be used with no joints in the end span, i.e. one joint only in the intermediate span.

Figure 2c – Test type III (see 10.3.3)

Figure 2 – Safe working load test types I, II and III (see 10.3.1 to 10.3.3)
Key
1 Joint positioned as required in test type I or II, but offset by the minimum distance necessary so that support b is directly underneath any point of local weakness
2 Product standard length
3 End span = L or X
4 Intermediate span = L
5 Cantilever = 0.4L
6 Localized weakness
a, b and c Support positions
d End of load
L Distance between supports on lengths as declared by the manufacturer

Figure 3 – Safe working load test IV (see 10.3.4)

Key
1 Unloaded overhang length 0.4L but no more than 1 000 mm
2 Joint may be required at the position declared by the manufacturer
3 Span = L
4 Localized weakness
a, b Support positions
L Distance between supports on lengths as declared by the manufacturer

NOTE  Figure 4 also applies to 10.4.

Figure 4 – Safe working load test type V (see 10.3.5)