भारतीय मानक IS/IEC 60695-2-11 : 2021

Indian Standard

अग्नि जोखिम परीक्षण

भाग 2 ग्लोइंग/हॉट-वायर आधारित परीक्षण विधियाँ

अनुभाग 11 चमकीला-तार ज्वलनशीलता परीक्षण विधि के लिए अंतिम उत्पाद (जी डब्ल्यू ई पी टी)

(पहला पुनरीक्षण)

Fire Hazard Testing

Part 2 Glowing/Hot-Wire Based Test Methods

Section 11 Glow-Wire Flammability Test Method for End Products (GWEPT)

(First Revision)

ICS 13.220.40; 29.020

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Environmental Testing Procedure Sectional Committee LITD 01

NATIONAL FOREWORD

This Indian Standard (Part 2/Section 11) (First Revision) which is identical with IEC 60695-2-11 : 2021 'Fire hazard testing — Part 2-11: Glowing/hot-wire based test methods — Glow-wire flammability test method for end products (GWEPT)' issued by the International Electrotechnical Commission was adopted by the Bureau of Indian Standards on the recommendation of the Environmental Testing Procedure Sectional Committee and approval of the Electronics and Information Technology Division Council.

This standard was originally published in 2019 and was identical with IEC 60695-2-11 : 2014. The first revision of this standard has been undertaken to align it with the latest version of IEC 60695-2-11 : 2021.

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' appears 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 certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their places, are listed below along with their degree of equivalence for editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60695-2-10 Fire hazard testing — Part 2-10: Glowing/hot-wire based test methods — Glow-wire apparatus and common test procedure	IS/IEC 60695-2-10 : 2021 Fire hazard testing: Part 2 Glowing/hot-wire based test methods, Section 10 Glow-wire apparatus and common test procedure	Identical with IEC 60695-2-10 : 2021
IEC 60695-4 : 2012 Fire hazard testing — Part 4: Terminology concerning fire tests for electrotechnical products	IS 1885 (Part 84) : 2022 Electrotechnical vocabulary: Part 84 Terminology concerning fire tests for electrotechnical products (*third revision*)	Identical with IEC 60695-4 : 2021
ISO 13943 : 2017 Fire safety — Vocabulary	IS 8757 : 2021 Glossary of terms associated with fire safety (*second revision*)	Identical

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 or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

CONTENTS

INTRODUCTION

In the design of any electrotechnical product, the risk of fire and the potential hazards associated with fire need to be considered. In this respect the objective within the design of component, circuit, and product design, as well as the choice of the materials, is to reduce to acceptable levels the potential risks of fire during normal operating conditions, reasonable foreseeable abnormal use, malfunction, and/or failure. IEC 60695-1-10 [1][1], together with its companion IEC 60695-1-11 [2], has been developed to provide guidance on how this is to be accomplished.

The primary aims of IEC 60695-1-10 and IEC 60695-1-11 are to provide guidance on how to:

a) prevent ignition caused by an electrically energized component part, and
b) confine any resulting fire within the bounds of the enclosure of the electrotechnical product in the event of ignition.

Secondary aims of IEC 60695-1-10 and IEC 60695-1-11 include the minimization of any flame spread beyond the product's enclosure and the minimization of harmful effects of fire effluents such as heat, smoke, toxicity and/or corrosivity.

Fires involving electrotechnical products can also be initiated from external non-electrical sources. Considerations of this nature are normally dealt with in the overall fire hazard assessment.

In electrotechnical equipment, overheated metal parts can act as ignition sources. In glow-wire tests, a glowing wire is used to simulate such an ignition source.

IEC 60695-2-10 describes a glow-wire test apparatus and common test procedure, IEC 60695-2-12 [3] describes a glow-wire flammability index (GWFI) test method for materials, and IEC 60695-2-13 [4] describes a glow-wire ignition temperature (GWIT) test method for materials.

This document is used to assess the reaction of end products to heat caused by contact with an electrically heated wire under controlled laboratory conditions. This may be useful for the evaluation of end products that may be exposed to excess thermal stress such as a fault current flowing through a wire, overloading of components, and/or bad connections. It should not be used to solely describe or appraise the fire hazard or fire risk of products, or assemblies under actual fire conditions. However, results of this test can be used as elements of a fire hazard assessment which takes into account all of the factors which are pertinent to a particular end use.

This document may involve hazardous materials, operations, and equipment. It does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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1 Numbers in square brackets refer to the bibliography.

Indian Standard

FIRE HAZARD TESTING

PART 2 GLOWING/HOT-WIRE BASED TEST METHODS

SECTION 11 GLOW-WIRE FLAMMABILITY TEST METHOD FOR END PRODUCTS (GWEPT)

(First Revision)

1 Scope

This part of IEC 60695 specifies a test method on an end product. It is intended to simulate the effects of thermal stresses produced by an electrically heated source to represent a fire hazard.

This test method is used to check that, under defined test conditions, an end product exposed to an electrically heated source has either a limited ability to ignite or, if it ignites, a limited ability to propagate flame. However, the fire hazard analysis, the flammability aspects and the flame spreading to other products are not covered by this document.

This basic safety publication focusing on safety test method(s) is primarily intended for use by technical committees in the preparation of safety publications in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-4:2012, *Fire hazard testing – Part 4: Terminology concerning fire tests for electrotechnical products*

ISO 13943:2017, *Fire safety – Vocabulary*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 13943:2017 and IEC 60695-4:2012, some of which are reproduced below for the user's convenience, and in IEC 60695-2-10 regarding times and durations, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
burn, intransitive verb
undergo combustion

[SOURCE: ISO 13943:2017, 3.34]

3.2
combustible, adjective
capable of being ignited and burned

[SOURCE: ISO 13943:2017, 3.52]

3.3
combustion
exothermic reaction of a substance with an oxidizing agent

Note 1 to entry: Combustion generally emits fire effluent accompanied by flames and/or glowing.

[SOURCE: ISO 13943:2017, 3.55]

3.4
enclosure
<electrotechnical> external casing protecting the electrical and mechanical parts of apparatus

Note 1 to entry: The term excludes cables.

[SOURCE: ISO 13943:2017, 3.93]

3.5
end product
product that is ready for use without modification

Note 1 to entry: An end product can be a component of another end product.

[SOURCE: IEC 60695-4:2012, 3.2.7]

3.6
fire hazard
potential for harm associated with fire

Note 1 to entry: Alternatively, fire hazard can be a physical object or condition with a potential for an undesirable consequence from fire.

[SOURCE: ISO 13943:2017, 3.131]

3.7
fire hazard assessment
evaluation of the possible causes of fire, the possibility and nature of subsequent fire growth, and the possible consequences of fire

[SOURCE: IEC 60695-4:2012, 3.2.10]

3.8
fire risk
estimation of expected fire loss that combines the potential for harm in various fire scenarios that can occur with the probabilities of occurrence of those scenarios

Note 1 to entry: An alternative definition of fire risk is, "combination of the probability of a fire and a quantified measure of its consequence".

Note 2 to entry: Fire risk is often calculated as the product of probability and consequence.

[SOURCE: ISO 13943:2017, 3.145]

3.9
flame
rapid, self-sustaining, sub-sonic propagation of combustion in a gaseous medium, usually with emission of light

[SOURCE: ISO 13943:2017, 3.159]

3.10
flame spread
propagation of a flame front

[SOURCE: ISO 13943:2017, 3.168]

3.11
flammability
ability of a material or product to burn with a flame under specified conditions

[SOURCE: ISO 13943:2017, 3.178]

3.12
glowing, adjective
emitting light without flame from the combustion of a material in the solid phase

3.13
ignition
DEPRECATED: sustained ignition
<general> initiation of combustion

[SOURCE: ISO 13943:2017, 3.217]

3.14
insignificant mass
insufficient combustible material to constitute a fire hazard

Note 1 to entry: A default value is 2 g, but product TCs may assign a different value appropriate to the product type and scale.

[SOURCE: IEC 60695-4:2012, 3.2.16]

3.15
small part
part with a dimension less than the minimum specified for the relevant test method

[SOURCE: IEC 60695-4:2012, 3.2.25]

4 Test specimens

4.1 General

It is not necessary to test **end products** or parts of **end products** which have **insignificant mass**. Additionally, this test method is not suitable for testing **small parts** (see 4.4).

4.2 Complete end product

Whenever possible, the test specimen should be a complete **end product** as opposed to a partial **end product** (see 4.3). The test specimen shall be chosen so that the conditions of the test will not be significantly different from those occurring in normal use with regard to shape,

ventilation, effect of thermal stresses, and eventually, the effects of burning or **glowing** particles falling from the test specimen.

4.3 Partial end product (alternative)

If the test cannot be made on a complete **end product** then, unless otherwise specified by the relevant product standard, it is acceptable to

a) cut a piece containing the part under examination from a complete and assembled **end product**, or

b) cut an aperture in the complete **end product** to allow the glow-wire access, or

c) remove the part under examination in its entirety and test it separately.

Technical committees should define in their relevant product standards what may be removed to achieve access. So far as possible, these product standards should strive to replicate actual service locations and conditions.

4.4 Test considerations and limitations associated with the specimen configuration

When cutting an opening for access purposes, a small aperture may affect the results by leading to the **ignition** of the surroundings and/or reducing the temperature of the tip of the glow-wire. The opening should be large enough to allow an adequate supply of air for **combustion**.

If, during the test, any part of the end product containing the test specimen is ignited by extraneous heat from the glow-wire which in turn influences the thermal conditions at the test specimen, the test is invalid.

The glow-wire **flammability** test method for **end products** shall not be used for testing **small parts**. This is because such parts cannot be effectively supported to avoid heat losses (see IEC 60695-2-10), and they are not able to accommodate the penetration of the glow-wire.

The following are considered to be **small parts**:

a) where each surface lies completely within a circle of 15 mm in diameter; or

b) where it is not possible to fit a circle of 8 mm in diameter completely on at least one of the surfaces while, at least one part dimension is > 15 mm.

See Figure 1.

When checking a surface,

1) projections on the surface are disregarded, and

2) holes or recesses which are not greater than 2 mm in any dimension are disregarded.

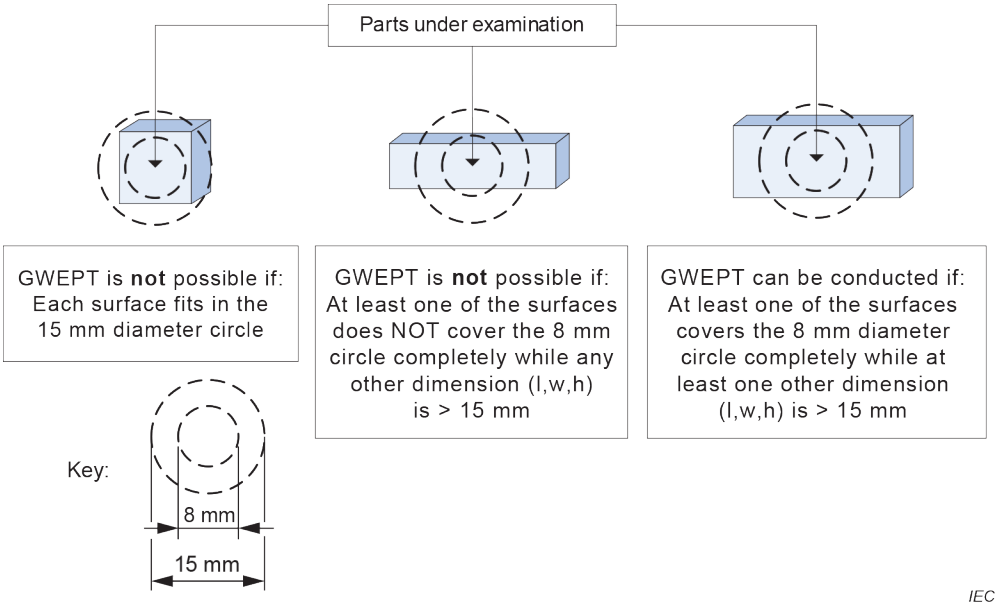


Figure 1 – Small parts

5 Test apparatus

The test apparatus of IEC 60695-2-10 shall be used except that the reference to a specified layer may not apply.

To evaluate the possibility of the spread of fire, for example by burning or **glowing** particles falling from the test specimen, a specified layer as described in IEC 60695-2-10, or the material or components normally surrounding or situated underneath the test specimen, are placed underneath the test specimen. The distance between the test specimen and the specified layer representing the surrounding material or components shall be equal to that which occurs in end use. If the test specimen is a component such that surrounding materials and distances are unknown, then the specified layer described in IEC 60695-2-10 shall be placed 200 mm ± 5 mm below the glow-wire point of contact.

If the test specimen is a complete free-standing equipment, it is placed in its normal position of use on the specified layer as described in IEC 60695-2-10 extending for at least 100 mm outside the base of the equipment in all directions.

If the test specimen is a complete wall-mounted equipment, it is fixed in its normal position of use 200 mm ± 5 mm above the specified layer as described in IEC 60695-2-10.

6 Verification of the temperature measuring system

The temperature measuring system shall be verified as specified in IEC 60695-2-10.

7 Conditioning

7.1 Conditioning of test specimens

Unless otherwise specified in the relevant product standard, the test specimens shall be conditioned for 24 h in an atmosphere having a temperature between 15 °C and 35 °C and a relative humidity between 45 % and 75 %.

7.2 Conditioning of specified layers

If the wrapping tissue or wooden board is used as specified layer, the conditioning shall be carried out according to IEC 60695-2-10. If the material or components normally surrounding or situated underneath the test specimen is used, the material or components shall be conditioned in the same way as the test specimen (see 7.1).

7.3 Testing conditions

The test specimens shall be tested in a laboratory atmosphere having a temperature between 15 °C and 35 °C and a relative humidity less than or equal to 75 %. Testing shall be completed within 30 minutes after the specimens and the specified layers (if any) are removed from the conditions specified in 7.1 and 7.2, respectively.

8 Test procedure

8.1 General

In addition to the common test procedure specified in IEC 60695-2-10, if not otherwise specified, the test specimen shall be so arranged that the tip of the glow-wire is applied to the part of the surface of the test specimen which is likely to be subjected to thermal stresses in normal use. The glow-wire shall be maintained as close to the horizontal as is practicable.

In cases where the test shall be made at more than one point on the same test specimen, ensure that any deterioration caused by previous tests does not affect the result. In this case, the test shall be made at a minimum distance from the edges of the previous burnt area of 30 mm (two times the size of **small parts**).

In cases where the areas subjected to thermal stresses during normal use of the equipment are not specified in detail, the tip of the glow-wire is applied at a place where the section is thinnest, but if possible not less than 15 mm from the upper edge of the test specimen.

Clamping the test specimen onto the test apparatus shall not introduce excessive internal mechanical stresses in the test specimen during the test.

8.2 Test temperatures

The glow-wire is heated to the test temperature specified in the relevant product standard. This temperature should preferably be one of the temperatures shown in Table 1.

Table 1 – Test temperatures

Test temperatures °C	**Tolerances** °C
550	±10
600	±10
650	±10
700	±10
750	±10
800	±15
850	±15
900	±15
960	±15

When selecting test temperatures, product committees should consider Annex A and its Figure A.1, which gives suggested glow-wire **end product** test (GWEPT) temperatures.

8.3 Number of test specimens

If not otherwise specified by the relevant product standard, the test is made on one test specimen.

NOTE More test specimens can be required.

9 Observations and measurements

During the time of application of the glow-wire, t_{APP} (30 s ± 1 s), and during a further period of 30 s, time of observation t_{OBS}, the test specimen, the parts surrounding the test specimen or the specified layer placed below it shall be observed and the following shall be recorded:

a) whether there is no **ignition**; or, if there is **ignition**, the time of **ignition**, t_I for the test specimen;

b) the time of extinguishment t_E; and

c) whether there is any **ignition** of the specified layer placed underneath the test specimen.

10 Evaluation of test results

The test specimen is considered to have passed the GWEPT test if the following criteria have been met:

a) there is no **ignition**, or

b) all of the following situations apply when **ignition** has occurred:

   i) **flames** or **glowing combustion** of the test specimen extinguish within 30 s after removal of the glow-wire, i.e. t_R 30 s; and

   ii) the specified layer placed underneath the test specimen does not ignite.

11 Test report

The test report shall include the following information:

a) a reference to IEC 60695-2-11;

b) a description of the test specimen including type and manufacturer (see Clause 4);

c) a description of the method for preparation of the test specimen (see Clause 4);

d) the conditioning of the test specimens and the specified layers (see Clause 7);

e) the number of test specimens tested (see 8.3);

f) the surface tested and the points of application of the glow-wire (see 8.1);

g) the specified layer used to evaluate the effect of flaming particles and its vertical distance to the glow wire point of application (see Clause 5);

h) the test temperature (see 8.2);

i) all applicable observations and measurements from Clause 9; and

j) the GWEPT as determined in Clause 10 shall be reported in the following manner, for example, for a test specimen tested at 850 °C:

GWEPT: 850

12 Information to be given in the relevant product standard

When referencing this method, technical committees shall indicate the following details:

a) the type and description of the test specimen (see Clause 4);

b) the method of preparation (see Clause 4);

c) any conditioning of the test specimens and the specified layers (see Clause 7);

d) the number of test specimens (see 8.3);

e) the surface to be tested and the points of application of the glow-wire (see 8.1);

f) the specified layer to be used to evaluate the effect of flaming particles (see Clause 5);

g) the GWEPT (see Clause 10) and test temperature (see 8.2), for example, "GWEPT of 850 °C in accordance with IEC 60695-2-11";

h) the relevant part(s) or zone(s) of the end product subjected to the test on the same test specimen (see 8.1);

i) whether the criteria specified are sufficient to check compliance with the safety requirements, or whether other criteria should be used (see Clause 9); and

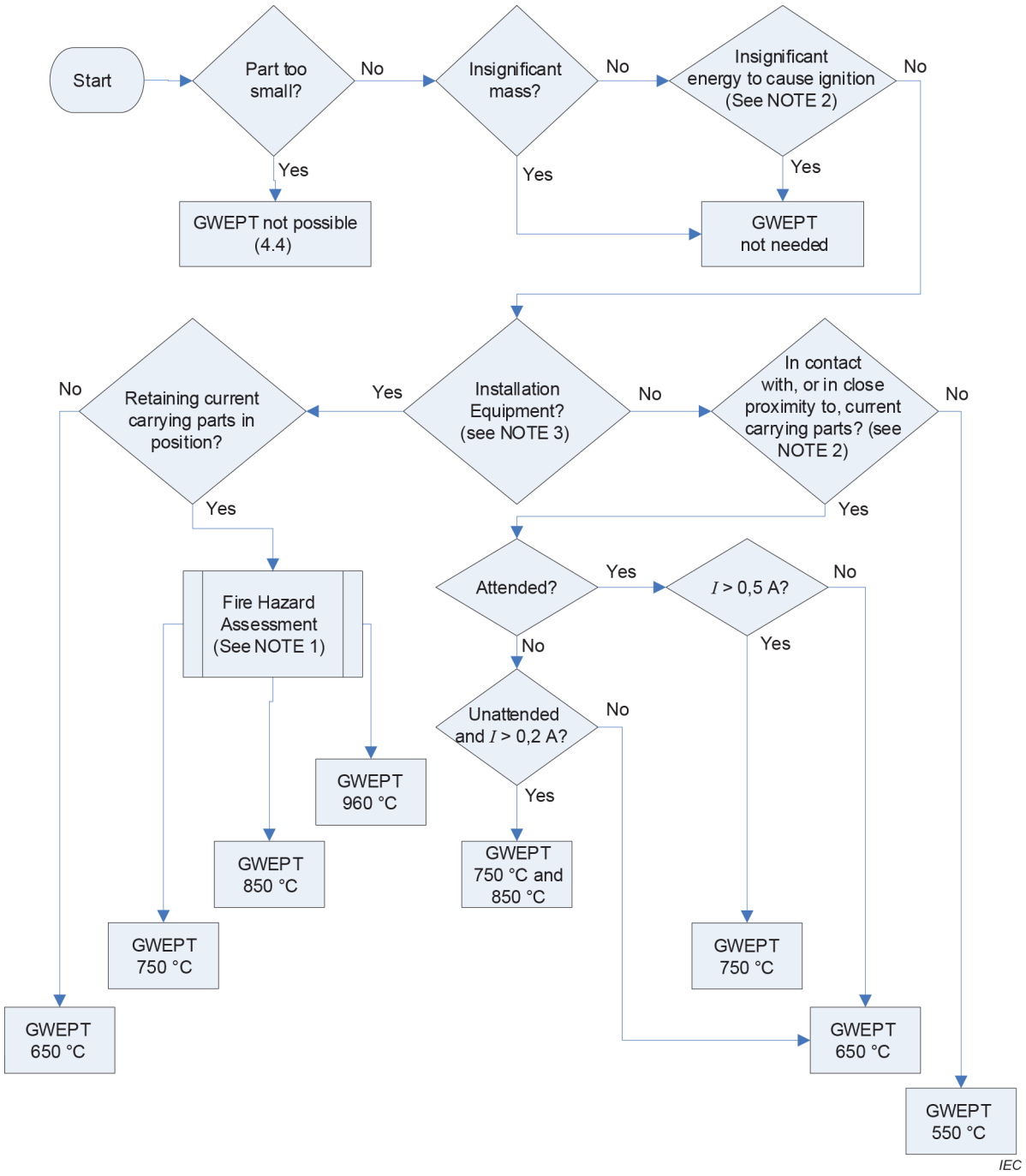
j) whether consequential testing needs to be considered to cover residual risks and, if so, which test method and what requirements should be specified.

NOTE See IEC 60695-1-11 [2] for additional guidance on consequential testing.

Annex A
(informative)

Suggested GWEPT temperatures

Figure A.1 demonstrates suggested GWEPT temperatures.



Key

I	rated current
A	ampere
GWEPT	glow-wire flammability test method for end products

NOTE 1 A separate fire hazard assessment (FHA) as determined by the relevant product standard will dictate the appropriate GWEPT temperature.

NOTE 2 The phrases "insufficient energy" and "close proximity" are defined by the relevant product committee. It is dependent upon a number of factors (for example, the severity of the hazard).

NOTE 3 Examples of installation equipment include socket outlets, circuit protection devices, and LV switchgear.

NOTE 4 The right side of the flow chart (Installation equipment = no) is intended to partially represent the limited application of the GWEPT as currently used by IEC 60335-1 [5]. Refer to IEC 60335-1 for other considerations.

Figure A.1 – Suggested GWEPT temperatures

Bibliography

[1] IEC 60695-1-10, *Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines*

[2] IEC 60695-1-11, *Fire hazard testing – Part 1-11: Guidance for assessing the fire hazard of electrotechnical products – Fire hazard assessment*

[3] IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

[4] IEC 60695-2-13, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

[5] IEC 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

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