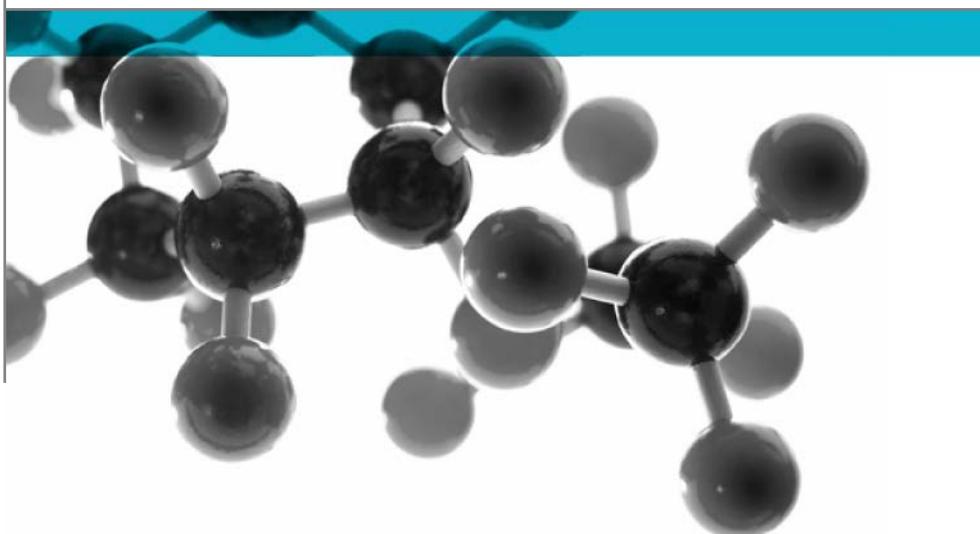


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NF X 70-100-1: 2006 & NF X 70-100-2: 2006



**Fire tests, Analysis of gaseous effluents. Part 1:
Methods for analysing gases produced by
thermal degradation. Part 2: Tubular furnace
thermal degradation method.**

Date: 28th July 2017

Issue No.: 1

Page 1

A Report To: Weidmüller Interface GmbH & Co. KG

Document Reference: Additional Test Report 386712

**Testing
Advising
Assuring**

Registered Office: Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian EH28 8PL United Kingdom. Reg No. SC 70429
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Executive Summary

Objective To determine the performance of the following product when tested in accordance with the procedure specified in NF X 70-100-1: 2006 & NF X 70-100-2: 2006.

| Generic Description | Product reference | Thickness | Density |
|---|--------------------|-----------|----------------------|
| Crosslinked ethylene vinyl acetate (EVA) heat shrink tubing | “HSS-HF” & “HS-HF” | 0.4-1mm | 1.4g/ml ³ |
| Please see page 5 of this test report for the full description of the product tested | | | |

Test Sponsor Weidmüller Interface GmbH & Co. KG, Klingenbergstraße 16, 32758 Detmold, Germany

Summary of Test Results: When tested in accordance with the procedure specified in NF X 70-100-1: 2006 & NF X 70-100-2: 2006 at a temperature of 600°C, the following results were obtained:

- C.I.T (NF F 16-101 (withdrawn)) = 4.24
- R value (BS 6853 Annex B.1 (withdrawn) / LUL S1085 Attachment A.1) = 0.32
- C.I.T_{NLP} (BS EN 45545-2:2013+A1:2015) = 0.06

Date of Test 23rd May 2016

This test report is additional to that issued as 364996 dated the 31st May 2016 and has been issued at the request of the sponsor. The original test report remains valid and is not replaced by this additional test report. The product referred to in the original report and this additional test report has not been re-tested since the original test and neither has a technical review of the original test report resulting in any technical changes been carried out.

The original product reference of the product has been removed and the reference “HSS-HF” & “HS-HF” has been inserted and the original sponsor name and address details have been removed and those of “Weidmüller Interface GmbH & Co. KG” have been inserted. The sponsor of the test has stated that the material described in this additional report is identical to the material which was tested. Both the original and the alternative trade names of the product and the original and alternative sponsor details have been documented and the documentation is maintained in the confidential file covering this investigation.

Signatories

| | |
|---|--|
|  |  |
| Responsible Officer T. Mort * Senior Technical Officer | Authorised S. Deeming * Business Unit Head |

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 28th July 2017

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| CONTENTS | PAGE NO. |
|------------------------------------|----------|
| EXECUTIVE SUMMARY | 2 |
| SIGNATORIES..... | 3 |
| TEST DETAILS..... | 5 |
| DESCRIPTION OF TEST SPECIMENS..... | 6 |
| TEST RESULTS | 7 |
| TABLE 1..... | 9 |
| OBSERVATIONS..... | 10 |
| REVISION HISTORY | 11 |

Test Details

| | |
|------------------------------------|---|
| Purpose of test | To determine the performance of specimens of a material when they are subjected to the conditions of test specified in NFX 70 - 100: 2006 "Analysis Of Gaseous effluents, Part 1: Methods for analysing gases produced by thermal degradation and Part 2: Tubular furnace thermal degradation method". The tests were performed in accordance with the procedure specified in NFX 70-100-1: 2006 and NF X 70-100-2: 2006 at a temperature of 600°C and this report should be read in conjunction with that Standard. |
| Scope of test | NFX 70-100-1: 2006 and NF X 70-100-2: 2006 specifies a method of test for carrying out quantitative analysis of certain gases produced under specified conditions of thermal degradation in the presence of air. |
| Fire test study group/EGOLF | Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group and EGOLF have identified a number of such areas and have agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Groups. Where such Resolutions are applicable to this test they have been followed. |
| Instruction to test | The test was conducted on the 23 rd May 2016 at the request of the original sponsor of the test. |
| Provision of test specimens | The specimens were supplied by the original sponsor of the test. Exova Warringtonfire was not involved in any selection or sampling procedure. |
| Conditioning of specimens | The specimens were received on the 9 th May 2016. Prior to test the specimens were conditioned to constant mass at temperatures of $23 \pm 2^\circ\text{C}$ and a relative humidity of $50 \pm 5\%$ RH, for a minimum period of 48 hours prior to testing. |

Description of Test Specimens

The description of the specimens given below has been prepared from information provided by the original sponsor of the test. All values quoted are nominal, unless tolerances are given.

| | |
|--|--|
| General description | Heat shrink tubing material |
| Generic type | Crosslinked ethylene-vinyl acetate (EVA) |
| Product reference | “HSS-HF” & “HS-HF” |
| Composition details | Moisture cross-linked polymer (40-50%, non-halogenated flame retardants and other fillers 50%) |
| Name of manufacturer | ECS cable protection |
| Thickness | Between 0.4 and 1mm (stated by sponsor) 0.92mm (determined by Exova Warringtonfire) |
| Density | 1.4g/ml ³ (stated by sponsor) 1.53g/cm ³ (determined by Exova Warringtonfire) |
| Colour reference | “Yellow” |
| Trade name of flame retardant | “HFX500P” |
| Generic type of flame retardant | Non-halogenated See Note 1 Below |
| Amount of flame retardant | See Note 1 Below |
| Brief description of manufacturing process | Extrusion process, crosslinking reaction in humid chamber, expansion |

Note 1: The sponsor was unwilling to provide this or further information.

Test Results

Applicability of test results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and will therefore invalidate the test results. It is the responsibility of the supplier of the product to ensure that the product, which is supplied, is identical with the specimens, which were tested.

Expression of Gas Content

C.C.I.T. calculation as described in NF F 16-101 (withdrawn)

The contents "ti" of gases (CO, CO₂, HCl, HBr, HF, HCN and SO₂) are expressed in milligrams of gas per gram of material. From these values of "ti", and the corresponding reference values "cc_i", a conventional index of toxicity, designated "C.I.T", is determined using the following equation:-

$$C.I.T = 100 \times \sum \frac{t_i}{cc_i}$$

R value calculation as described in BS 6853 Annex B.1 (withdrawn)

The contents of gases (CO, CO₂, HCl, HBr, HF, SO₂, HCN, NO₂) are expressed in milligrams of gas per gram of material. From these values of "cx" and the corresponding values of reference values "fx", a weighted summation of toxicity, designated "R", is determined using the following equation:-

$$Rx = cx/fx$$

$$R = \sum Rx$$

C.I.T._{NLP} calculation as described in (BS EN 45545-2:2013+A1:2015)

The contents "c_i" of gases (CO, CO₂, HCN, HCl, HBr, HF, SO₂ and NO_x) are expressed in milligrams of gas per gram of material. From these values of "c_i" and the corresponding values of reference values "C_i", a conventional index of toxicity, designated "C.I.T", is determined using the following equation:-

$$C.I.T = \sum \frac{c_i}{C_i}$$

Note, NF F 16-101 (withdrawn), BS 6853 (withdrawn) and (BS EN 45545-2:2013+A1:2015) utilised different reference values

The individual results obtained are given in table 1.

Conclusion

When tested in accordance with the procedure specified in NF X 70-100-1: 2006 & NF X 70-100-2: 2006 at a temperature of 600°C, the results obtained were

- C.I.T calculated in accordance with NF F 16-101 (withdrawn) = 4.24
- R value calculated in accordance with BS 6853 Annex B.1 (withdrawn) / LUL S1085 Attachment A.1 = 0.32
It must be noted that the following applies to BS 6853 (withdrawn): this R value must only be used to demonstrate compliance against the requirements specified in Tables 7 & 8 (minor use materials), Table 11 (textiles) and Tables 13 & 14 (cables) of BS 6853: 1999 (withdrawn). Should an R value be required to demonstrate compliance against any other table in BS 6853: 1999 (withdrawn), then a test in accordance with BS 6853: 1999: Annex B.2 (withdrawn) must be performed.
- C.I.T_{NLP} calculated in accordance with BS EN 45545-2:2013+A1:2015 = 0.06

It must be noted that this C.I.T value must only be used to demonstrate compliance of non-listed products. Should a C.I.T value be required to demonstrate compliance of a general product or cable product, then a CIT_G or C.I.T_C must be calculated.

Validity

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

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Table 1

| GASES | Concentration (mg/g) | NF F 16-101 (withdrawn) reference values, c_c (mg/m ³) | BS 6853 (withdrawn) reference values, F_x (mg/g) | (BS EN 45545-2) reference values, C_i (mg/m ³) | CIT (NF F 16-101 (withdrawn)) | r value (BS 6853 Annex B.1 (withdrawn)) | CIT _{NLP} (BS EN 45545-2) |
|-------------------|----------------------|--|--|--|-------------------------------|---|------------------------------------|
| CARBON MONOXIDE | 53.04 | 1750 | 280 | 1380 | 3.03 | 0.19 | 0.04 |
| CARBON DIOXIDE | 679.80 | 90000 | 14000 | 72000 | 0.76 | 0.05 | 0.01 |
| HYDROGEN CHLORIDE | 0.36 | 150 | 15 | 75 | 0.24 | 0.02 | 0.00 |
| HYDROGEN BROMIDE | ND | 170 | 20 | 99 | 0.00 | 0.00 | 0.00 |
| HYDROGEN CYANIDE | 0.12 | 55 | 11 | 55 | 0.21 | 0.01 | 0.00 |
| HYDROGEN FLUORIDE | ND | 17 | 4.9 | 25 | 0.00 | 0.00 | 0.00 |
| SULPHUR DIOXIDE | ND | 260 | 53 | 262 | 0.00 | 0.00 | 0.00 |
| NITROUS OXIDES | 0.38 | N/A | 7.6 | 38 | N/A | 0.05 | 0.01 |

Where ND indicates non-detected
N/A indicates not applicable

Observations

In the case of each specimen the test duration was 40 minutes and the volume of the gas sampled was 80 litres. In each case the air was circulated using a suction method.

In the case of each specimen a nominally 1g sample was obtained which was representative of the substance or material as used in practice.

| Specimen No. | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
|--|--------|--------|--------|-----------------------------|--------|--------|--------|-----|-----|-----------------|--------|--------|
| Gases | HCN | | | HCl / HBr / SO ₂ | | | HF | | | NO _x | | |
| Mass (g) | 1.0000 | 1.0000 | 0.9970 | 1.0020 | 0.9990 | 1.0010 | 1.0010 | N/A | N/A | 1.0000 | 1.0020 | 1.0020 |
| Mass loss (g) | 0.5420 | 0.5460 | 0.5610 | 0.5380 | 0.5480 | 0.5510 | 0.5470 | N/A | N/A | 0.5500 | 0.5700 | 0.5660 |
| Mass loss (%) | 54.20 | 54.60 | 56.27 | 53.69 | 54.85 | 55.04 | 54.65 | N/A | N/A | 55.00 | 56.89 | 56.49 |
| Ignition time (min:secs) (if applicable) | 00:50 | 00:50 | 00:59 | 00:50 | 00:46 | 00:52 | 01:02 | N/A | N/A | 00:51 | 00:53 | 00:45 |
| Extinction time (min:secs) (if applicable) | 02:12 | 02:17 | 02:14 | 02:10 | 02:16 | 02:05 | 02:20 | N/A | N/A | 02:08 | 02:14 | 02:18 |
| Key: | | | | | | | | | | | | |
| N/A = Not applicable | | | | | | | | | | | | |

Revision History

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|----------------------|--------------|
| Issue No : | Issue Date: |
| Revised By: | Approved By: |
| Reason for Revision: | |