

TEST REPORT

Sponsor : NORRES SCHLAUTECHNIK GmbH & Co.KG
Am Stadthafen 12-18
45881 GELSENKIRCHEN
GERMANY

Reference of order : Mail dated on the April 20th, 2011

Test specification : Test of fire reaction for F classification

Specification document : Standard NF F 16-101 (October 1988)
Standard NF F 16-102 (April 1992)
STM-S-001 Index C (October 2006)

Material trademark : AIR DUC PUR 352 SE

Identification of samples : Fire-retarded polyurethane profiled hose, reinforced with a steel wire spiral, transparent coloured and about 0,85 mm thick

Tested face : Profiled face

Description of samples : page 2

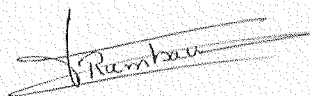
CLASSIFICATION : F2

This classification has been specified according to the above mentioned standards from analysis of the gases generated by the combustion and smoke opacity, the results of which are in appendices 1 and 2.

The mentioned results are only applicable to the samples, products or materials submitted to LNE, such as they are defined in this document.

Trappes, the June 23th, 2011

**The Head of Fire Behaviour
and Fire Safety Department**



Valérie RUMBAU



Accréditation
N° 1-0606
Portée disponible
sur www.cofrac.fr



**Test officer
Michael DE ABREU**

Responsible for test



Luc NOBLANC

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Laboratoire national de métrologie et d'essais

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1. IDENTIFICATION OF SAMPLES

The applicant supplied on the May 6th, 2011 to the LABORATOIRE NATIONAL DE METROLOGIE ET D'ESSAIS samples referenced "AIRDUC PUR 352 SE" and gave the following informations.

Manufacturer : NORRES SCHLAUTECHNIK GmbH & Co.KG
Am Stadthafen 12-18
45881 GELSENKIRCHEN
GERMANY

Composition : Polyurethane + steel wire

Colour : Transparent

Tested thickness : 0,85 mm

Mass : About 2,95 kg/m² (determined by LNE)

End use : Hoses.

Tests have been carried out from the May 26th, 2011 to the June 9th, 2011.

2. DETERMINATION OF F CLASSIFICATION

The materials are classified from F0 to F5 according to the value of smoke index called I.F.

$$I.F. = \frac{D_{max}}{100} + \frac{VOF4}{30} + \frac{I.T.C.}{2}$$

Clt.F	I.F.
F0	I.F. ≤ 5
F1	I.F. ≤ 20
F2	I.F. ≤ 40
F3	I.F. ≤ 80
F4	I.F. ≤ 120
F5	I.F. > 120

D_{max} : maximum specific optical density determined with the average of 3 tests whose results are given in appendix 2.

VOF4 : smoke obscuration value during the first 4 minutes determined with the average of 3 tests whose results are given in appendix 2.

I.T.C. : conventional toxicity index determined with the concentration of the different gases to the average of 3 tests whose results are given in appendix 1.

Result of the measurements

$$I.F. = \frac{340.93}{100} + \frac{742.10}{30} + \frac{17.75}{2}$$

I.F. = 37 therefore **F2 Class**

APPENDIX 1

TOXIC GAS SPECIES ANALYSIS

- TESTS PROCEDURE

The tests have been carried out in a tubular furnace at 600°C on a sample of about 1 g of combustible mass, according to the NF X 70-100 standard (April 2006). Each representative piece has been cut in the thickness of the material.

- Carbon monoxide and carbon dioxide (CO et CO₂), are systematically measured in continuous by non dispersive infra-red spectrophotometry.
- Fluoride ion has been researched by ion liquid chromatography (qualitative analysis). According to the result, hydrogen fluoride (HF) is measured by ionometry.

Moreover, a preliminary analysis has been conducted. According to the results, the gases analysed are :

- Hydrogen chloride (HCl), hydrogen bromide (HBr), sulfur dioxide (SO₂), measured by ion liquid chromatography.
- Hydrogen cyanide (HCN), measured by visible spectrophotometry.

- RESULTS

The ignition occurred at about 1 min and the extinguishing at about 2 min.
The mass loss is 100 %.

	Test n°1	Test n°2	Test n°3	Mean value
CO (mg/g)	89.03	96.96	87.88	91.29
CO ₂ (mg/g)	404.01	409.91	405.88	406.60
HBr (mg/g)	N.M.	/	/	N.M.
HCl (mg/g)	N.M.	/	/	N.M.
HCN (mg/g)	6.91	6.62	6.41	6.65
SO ₂ (mg/g)	N.M.	/	/	N.M.
HF (mg/g)	N.Det.	/	/	N.Det.

N.M. : Not Measurable

N.Det. : Not Detected during the qualitative analysis

DETERMINATION OF CONVENTIONAL TOXICITY INDEX

$$I.T.C = 100 \times \sum \frac{t_i}{cci} \quad \text{with } t_i = \text{average contents of the "i" gas generated}$$

cci = critical concentration of the "i" gas

$$I.T.C. = 100 \times \left[\frac{91.29}{1750} + \frac{406.60}{90000} + \frac{6.65}{55} \right]$$

$$I.T.C. = 17.75$$

APPENDIX 2

SMOKE OPACITY MEASUREMENT

- TESTS PROCEDURE

The tests have been carried out in a smoke chamber according to the specification of the standard NF X 10-702 Part 1 (November 1995) and Parts 2 to 5 (September 1994).

A preliminary test is carried out : one without pilot flames and one with pilot flames. According to the application document STM-S-001 index C (October 2006), the highest partial smoke index ($IF_{\text{partiel}} = VOF4/30 + D_{\text{max}}/100$) determines the exposure mode for the 2 following tests. In case any of the IF_{partiel} is lower than the IF_{partiel} of the initially not chosen mode, 2 complementary tests are carried out in that mode. Then, the finally chosen mode is the mode leading to the highest mean value for the 3 IF_{partiel} s.

- RESULTS

For the test without pilot flames,

VOF4 = 95.0 , $D_{\text{max}} = 271.9$ and $IF_{\text{partiel}} = 5.89$

For the test with pilot flames,

VOF4 = 857.3 , $D_{\text{max}} = 393.6$ and $IF_{\text{partiel}} = 32.52$

Consequently, the tests have been carried out with pilot flames.

The results and curves obtained for each test are given in appendix 3.

	Test n°1	Test n°2	Test n°3	Mean Value
VOF4	857.3	699.8	669.2	742.10
Dmax	393.6	314.3	314.9	340.93

- OBSERVATIONS DURING THE TESTS

The material chars and ignites immediately, then smokes at about 15 s.

At about 1 min 30 s, flames reach a height of about 20 cm.

During the test, the material melts.

At the end of the test, the surface of the material is molten and partially destroyed.

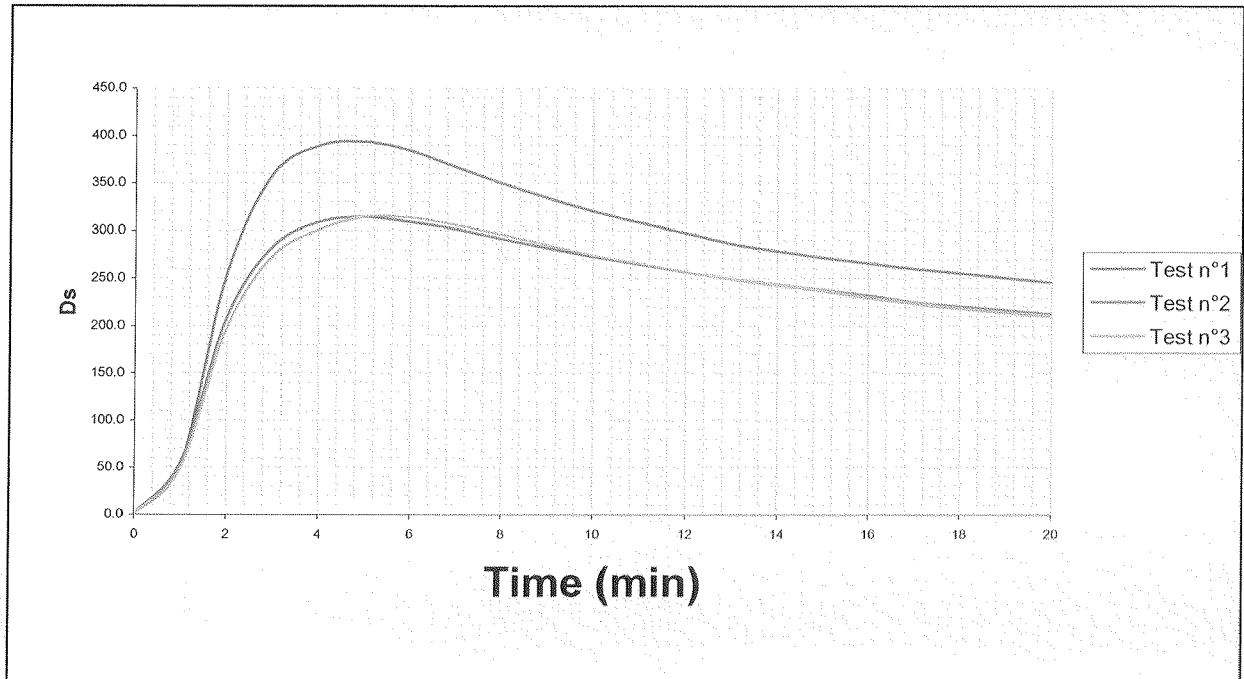
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APPENDIX 3

CURVES OF TESTS WITH PILOT FLAMES

AIRDUC PUR 352 SE

Thickness : 0,85 mm



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DEFINITIONS OF PARAMETERS GIVEN IN PAGE 7

Dmax : maximum specific optical density reached during the test.

T (Dmax) : time in minutes to reach Dmax.

$$VOF4 = D1 + D2 + D3 + \frac{D4}{2}$$

Dc : specific optical density at the end of the test after smoke has been exhausted .

Mass (g) : mass of the sample tested, in grams.

Thickness (mm) : average thickness of the sample in millimeters.

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RESULTS OF THE TESTS WITH PILOT FLAMES

AIRDUC PUR 352 SE

Thickness : 0,85 mm

Time in minutes	Specifique Optical Density		
	Test n°1	Test n°2	Test n°3
0	0.0	0.0	0.0
1	50.8	54.6	48.8
2	253.3	208.0	196.8
3	358.5	283.0	273.0
4	389.3	308.4	301.2
5	393.6	314.3	314.7
6	384.3	308.8	313.8
7	366.9	301.4	306.1
8	350.1	291.3	296.5
9	334.8	282.0	285.5
10	320.6	272.7	274.2
11	308.4	264.5	265.7
12	297.9	256.4	256.9
13	286.7	249.3	249.1
14	279.0	243.3	242.8
15	272.1	238.1	237.1
16	266.2	232.1	229.4
17	260.4	224.8	223.4
18	255.6	220.5	218.5
19	251.0	216.3	214.1
20	245.6	212.2	210.4

Dmax	393.6	314.3	314.9
T(Dmax) (min)	4 min 57 s	4 min 59 s	5 min 31
VOF4	857.3	699.8	669.2
Dc	12.7	8.2	8.7
Mass (g)	16.7727	16.5726	16.3738
Thickness (mm)	0.9	0.9	0.9