L.S.FIRE TESTING INSTITUTE S.R.L.- Via Bonifica, 4 - 64010 CONTROGUERRA (TE) ITALY

# Classification according to standard prEN 45545 part 2 (2010)

Railway application – Fire protection on railway vehicles –
Part 2: Requirements for fire behaviour of materials and components

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**Applicant:** **3M TILTON**
1 Paper Trail
USA - Tilton, N.H.

**Product:** **THERMA VOLT**

**Product description:** high temperature paper
thickness: 0.127 mm; weight: 186 g/m$^2$; density: 1506 kg/m$^3$.

**Listed Item:** electrical insulation

**Requirements** **R 23**

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## Tables of results:

| EN ISO 4589-2<br>Report LSFire 02242<br>Oxygen Index | | EN ISO 5659-2<br>25 kW/m$^2$ + PF<br>Report LSFire 02243<br>Smoke | | EN ISO 5659-2<br>25 kW/m$^2$ + PF<br>Report LSFire 02243<br>Toxicity | |
|---|---|---|---|---|---|
| % (V/V) | Class | Ds max | Class | $CIT_C$ | Class |
| 93.4 | HL 3 | 2.54 | HL 3 | 0.0045 | HL 3 |

**Remarks**: The value of CIT index was calculated using the test method EN ISO 5659-2 instead of NF X 70-100-1/2 according to prEN 45545-2.

## Final classification

**HL3**

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Controguerra, 04-05-2012

**LABORATORY DIRECTOR**
*Maddalena Pezzani*

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L.S.FIRE TESTING INSTITUTE S.R.L.- Via Bonifica, 4 - 64010 CONTROGUERRA (TE) ITALY

TEST REPORT
according to :

LSFIRE/NC02242
Date: 24-04-2012

# EN ISO 4589 - 2

Determination of burning behaviour by oxygen index

**for**

**prEN 45545-2** Fire protection of railway vehicle
Part 2 - Requirements for fire behaviour of materials and components

Applicant: **3M TILTON**
1 Paper Trail
USA - Tilton, N.H.

Denomination of the product : **THERMA VOLT**

Description and characteristics : high temperature paper
thickness: 0.127 mm; weight: 186 g/m$^2$; density: 1506 kg/m$^3$.

Use : electrical insulation

Conditioning: T = (23 ± 2)°C and R.H. = (50 ± 5)% for 88h minimum

## SUMMARY OF RESULTS

| Characteristics | Units | Value |
|---|---|---|
| Type of test specimen | - | V |
| Test specimen dimensions | (mm) | 140 × 52 × 0.127 |
| Ignition procedure used | - | B |
| Used $O_2$ concentration increment | % (V/V) | 0.2 |
| Final value of $O_2$ concentration - $c_f$ | % (V/V) | 93.2 |
| **k** factor | - | 0.95 |
| Standard deviation | σ | 0.15 |
| **Measured Oxygen Index - OI** | **% (V/V)** | **93.4** |
| **Note:** | | |

These results relate only to the behaviour of the product under the conditions of test method.
They are not intended to be the sole criterion for the assessment of the performance under real fire conditions.

Controguerra, 04-05-2012

**LABORATORY DIRECTOR**
*Maddalena Pezzani*

**TEST OPERATOR**
*Pio Acciarri*

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TEST REPORT
according to :

LSFIRE/NC02243
Date: 20-04-2012

# ISO 5659-2 + FTIR

Plastics – Smoke generation – Part 2 : Determination of optical density by a single-chamber test

**for**

**prEN 45545-2** Fire protection of railway vehicle
Part 2 - Requirements for fire behaviour of materials and components

Applicant: **3M TILTON**
1 Paper Trail
USA - Tilton, N.H.

Denomination of the product : **THERMA VOLT**

Description and characteristics : high temperature paper
thickness: 0.127 mm; weight: 186 g/m$^2$; density: 1506 kg/m$^3$.

Use : electrical insulation

Conditioning: T = (23 ± 2)°C and R.H. = (50 ± 5)% for 88h minimum

Test Methods :

- Determination of optical density by a single chamber test
  Operating conditions according to ISO Standard 5659-2 (2006)
- Toxicity of fire effluents measured in a single chamber test
  Operating conditions according to Annex C method 1 of prEN 45545-2 : 2010: Testing procedure for analysis of toxic gases

## MAIN TEST RESULTS (*)

| Description | 25 kW/m2 with pilot flame | | | |
|---|---|---|---|---|
| | Test n° 1 | Test n° 2 | Test n° 3 | **Average** |
| Maximum specific optical density (Ds max) | 2.34 | 2.81 | 2.47 | ***2.54*** |
| Specific optical density at 4 min ($D_s$ 4) | 2.34 | 1.98 | 2.26 | ***2.19*** |
| VOF4 | 3.23 | 4.39 | 3.20 | ***3.60*** |
| $CIT_G$ at 4 min | 0.0025 | 0.0026 | 0.0025 | ***0.0025*** |
| $CIT_G$ at 8 min | 0.0044 | 0.0046 | 0.0044 | ***0.0045*** |

(*) For the other test results see the attached Smoke density and Toxicity reports.

These results relate only to the behaviour of the product under the conditions of test method.
They are not intended to be the sole criterion for the assessment of the performance under real fire conditions.

Controguerra, 04-05-2012

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*Claudio Baiocchi*

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# Smoke density

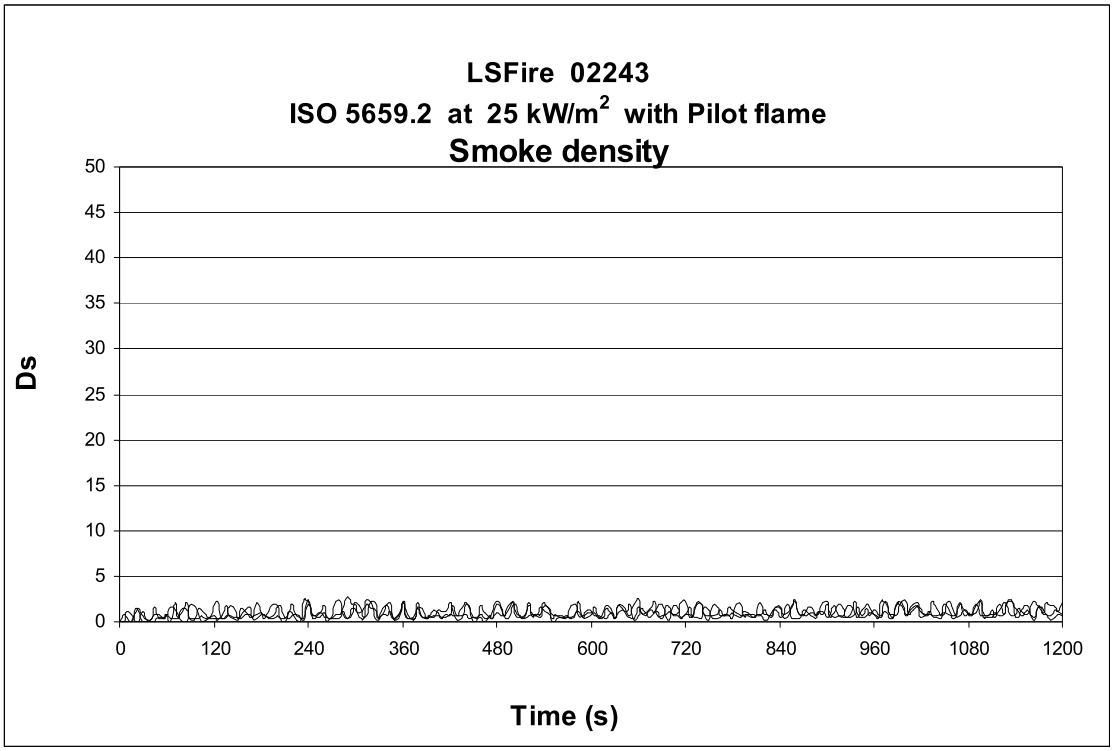
*Report according to:*

**ISO 5659-2**

Determination of smoke density by a single chamber test

| | TEST CONDITIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Parameter*** | 25 kW/m$^2$ no pilot flame | | | | 25 kW/m$^2$ with pilot flame | | | | 50 kW/m$^2$ no pilot flame | | | |
| | Test 1 | Test 2 | Test 3 | *Average* | Test 1 | Test 2 | Test 3 | *Average* | Test 1 | Test 2 | Test 3 | *Average* |
| **T min (%)** | | | | | 96.0040 | 95.2196 | 95.7910 | *95.6716* | | | | |
| **Ds max** | | | | | 2.34 | 2.81 | 2.54 | *2.54* | | | | |
| **Time Tmin (s)** | | | | | 240 | 290 | 315 | *282* | | | | |
| **Ds 10min** | | | | | 1.11 | 0.93 | 0.80 | *0.95* | | | | |
| **Ds 4min** | | | | | 2.34 | 1.98 | 2.26 | *2.19* | | | | |
| **VOF4** | | | | | 3.23 | 4.39 | 3.20 | *3.60* | | | | |
| **Tr residual (%)** | | | | | 99.9 | 99.9 | 99.9 | *99.9* | | | | |
| **Dsm corr.** | | | | | 2.28 | 2.75 | 2.41 | *2.48* | | | | |
| **Ds averaged** | | | | | 0.91 | 1.05 | 0.90 | *0.95* | | | | |
| **T ignition (s)** | | | | | NI | NI | NI | *NI* | | | | |
| **End of flame (s)** | | | | | - | - | - | - | | | | |
| **Test duration (min)** | | | | | 20 | 20 | 20 | *20* | | | | |
| **Sample mass (g)** | | | | | 1.189 | 1.149 | 1.162 | *1.167* | | | | |
| **Initial mass (g)** | | | | | 1.454 | 1.431 | 1.427 | *1.437* | | | | |
| **Final mass (g)** | | | | | 1.372 | 1.350 | 1.337 | *1.353* | | | | |
| **Mass loss (g)** | | | | | 0.082 | 0.081 | 0.090 | *0.084* | | | | |
| **Tini chamber (°C)** | | | | | 36.0 | 43.0 | 42.5 | *40.5* | | | | |
| **Tfin chamber (°C)** | | | | | 45.6 | 49.0 | 49.9 | *48.2* | | | | |

Remarks: NI : No Ignition

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# Toxicity

*Report according to:*

**ISO 5659-2 + FTIR**

Toxicity of fire effluents measured in single chamber test

## Qualitative analysis

### *Gas species detected*

| TEST CONDITIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 25 kW/m² no pilot flame | | | 25 kW/m² with pilot flame | | | 50 kW/m² no pilot flame | | |
| Test 1 | Test 2 | Test 3 | Test 1 | Test 2 | Test 3 | Test 1 | Test 2 | Test 3 |
| | | | *Carbon monoxide (CO)*<br>*Carbon dioxide ($CO_2$)* | | | | | |

## Quantitative analysis of carbon monoxide (CO)

| | TEST CONDITIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Parameter*** | 25 kW/m² no pilot flame | | | | 25 kW/m² with pilot flame | | | | 50 kW/m² no pilot flame | | | |
| | Test 1 | Test 2 | Test 3 | *Average* | Test 1 | Test 2 | Test 3 | *Average* | Test 1 | Test 2 | Test 3 | *Average* |
| **CITG at 4min** | | | | | 20.1 | 20.9 | 18.6 | *19.9* | | | | |
| **CITG at 8min** | | | | | 25.9 | 28.9 | 27.8 | *27.5* | | | | |

## Quantitative analysis of carbon dioxide ($CO_2$)

| | TEST CONDITIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Parameter*** | 25 kW/m² no pilot flame | | | | 25 kW/m² with pilot flame | | | | 50 kW/m² no pilot flame | | | |
| | Test 1 | Test 2 | Test 3 | *Average* | Test 1 | Test 2 | Test 3 | *Average* | Test 1 | Test 2 | Test 3 | *Average* |
| **CITG at 4min** | | | | | 1151.3 | 1222.2 | 1232.8 | *1202.1* | | | | |
| **CITG at 8min** | | | | | 2586.8 | 2638.5 | 2529.3 | *2584.9* | | | | |

## Conventional Index of Toxicity according to prEN 45545-2

| | TEST CONDITIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Parameter*** | 25 kW/m² no pilot flame | | | | 25 kW/m² with pilot flame | | | | 50 kW/m² no pilot flame | | | |
| | Test 1 | Test 2 | Test 3 | *Average* | Test 1 | Test 2 | Test 3 | *Average* | Test 1 | Test 2 | Test 3 | *Average* |
| **$CIT_G$ at 4min** | | | | | 0.0025 | 0.0026 | 0.0025 | *0.0025* | | | | |
| **$CIT_G$ at 8min** | | | | | 0.0044 | 0.0046 | 0.004 | *0.0045* | | | | |

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