Technical Specification No.7

Determination of emissivity

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1 Preamble

Emissivity, symbolised by ε, is the intrinsic property of a material to absorb and emit infra-red radiation. A reflective product is therefore a product with very low emissivity. It does not absorb radiation, it reflects it.

Certification of emissivity ε is based on verification of the declared emissivity value ε_D.

2 Determination of declared emissivity

The declared emissivity ε_D of the external reflective surfaces of the product must be determined. If the surfaces are not identical, the declared emissivity must be determined for each external surface.

The value of ε_D must be determined taking into account influencing factors such as manufacturing dispersion and ageing, and even the "primer" appearance.

2.1 Test specimens

Emissivity must be measured for at least 4 manufacturing dates. These dates must be sufficiently far apart to properly cover manufacture and measurements shall be made by an external notified laboratory.

2.2 Measurement of mean initial emissivity

Emissivity must be measured for the four dates of manufacture in the initial state, according to the procedure described in paragraph 3 of this Technical Specification.

The mean initial emissivity ε_m is determined by calculation as being the mean of all the results of tests carried out before ageing treatment.

2.3 Statistical emissivity

Statistical emissivity ε_S is a fractile value and a limit value accounting for at least 90% of the production with a confidence limit of 90%.

Statistical emissivity ε_S shall be determined by using the results of the initial emissivity tests in a notified laboratory (before ageing) and by self-checks, according to the calculations described in the following paragraphs, considering the standard deviation σ_ε:

$\sigma_\varepsilon = \sqrt{\frac{\sum_{i=1}^{n}(\varepsilon_i - \varepsilon_m)^2}{n-1}}$ with n the number of test results

And using the following values for factor k:

Number *n* of test results	k
4	2.6
6	2.4
10	2.07
11	2.01
12	1.97
13	1.93
14	1.9
15	1.87
16	1.84
17	1.82
18	1.8
19	1.78

Number *n* of test results	k
20	1.77
22	1.74
24	1.71
25	1.7
30	1.66
35	1.62
40	1.6
50	1.56
100	1.47
300	1.39
17	1.82

2.3.1 In the case of a weekly emissivity check by the manufacturer

The static emissivity ε_S is determined by the following formula:

$$\varepsilon_S = \varepsilon_m + k \cdot \sigma_\varepsilon$$

2.3.2 If there is no weekly emissivity check by the manufacturer

The static emissivity ε_S is determined by the following formula:

$$\varepsilon_S = \varepsilon_m + k \cdot \sigma_\varepsilon + \Delta\varepsilon$$

Using the correction factor $\Delta\varepsilon = \begin{cases} 0.02 & si \quad \varepsilon_m \leq 0.10 \\ 0.05 & si \quad 0.10 < \varepsilon_m \leq 0.30 \\ 0.10 & si \quad \varepsilon_m > 0.30 \end{cases}$

2.4 Declared emissivity

Based on the static emissivity value ε_S, the declared emissivity ε_D is determined by applying the following correction factors.

2.4.1 Ageing factor

The ageing factor is determined by comparing the emissivity measured on 4 series of test specimens after 4 different treatments:

1. Emissivity ε_1 is the mean of the emissivity measured on 4 test specimens without ageing (initial state, see previous paragraphs);
2. Emissivity ε_2 is obtained by measurement on 4 test specimens subjected to UV radiation then kept in a dry atmosphere at 70°C for 200 hours. In the case of ageing with fluorescent tube bench, this will be carried out in the UVA range (315nm-400nm) with either UVA-340 tubes (centred on 340nm), BL tubes (centred on 368nm) or UVA-351nm. The irradiance at the surface of the films on the range 315-400nm will be 30W/m^2. The films will be positioned 50mm form the centre of the tubes. Ageing will be performed on 1date of manufacture.

   The duration of exposure to UV radiation depends on the nature of the product packaging:

   - If the packaging protects the product from UV radiation (UVB 290-320 nm), the product must be subjected to UV radiation for 200 hours at 45° C and 90 % RH,
   - Otherwise, the product must be subjected to UV radiation for 500 hours at 45° C and 90 % HR.

   ε_2 is the arithmetic mean of the 4 results;
3. Emissivity ε_3 is obtained by measurement on 4 test specimens after treatment for 28 days at 70 ° C and 90 % RH.

   ε_3 is the arithmetic mean of the 4 results;
4. Emissivity ε_4 is obtained by measurement on 4 test specimens after treatment for 60 days at 70 ° C and 90 % RH.

   ε_4 is the arithmetic mean of the 4 results.

Correction factor F_a is defined by the following formula:

$$F_a = \max_{1 \le i \le 4} \left(\frac{\varepsilon_i}{\varepsilon_1} \right)$$

The declared emissivity is therefore calculated as follows:

$$\varepsilon_D = \varepsilon_S \cdot F_a$$

2.4.2 Dust factor

If one of the surfaces of the product is intended for use in contact with highly ventilated airspaces after its installation, according to the definition in EN ISO 6946, declared emissivity shall be defined by a specific study. In the absence of such study: ε_D = 0.9.

If the surfaces of the product are intended to work in both conditions, emissivity shall be respectively declared for each product surface. This is the case when one surface is in contact with a ventilated airspace and the other with a non-ventilated airspace.

2.4.3 Print factor

If more than 5% of the surface of the product is covered by the product trade name or any other information, the emissivity of the product is calculated as the mean surface area of the printed parts and non-printed parts, considering that the emissivity of the printed part is equal to 0.9.

$$\varepsilon_D = 0{,}9 \cdot \%\ de\ surface\ imprimée + (\varepsilon_S \cdot F_c) \cdot \%\ de\ surface\ non\ imprimée$$

2.4.4 Expression of the result

The declared emissivity must be:

- between 0 and 1,
- rounded up to the nearest 0.01.

3 Measuring method

Emissivity is measured in accordance with appendix D of standard NF EN 16012.