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Product Guideline No.2

Factory-made expanded polystyrene products

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1 Purpose

This Product Guideline supplements the measures in the General Guidelines.

This Product Guideline concerns panels and rolls of expanded polystyrene, in accordance with harmonised European standard NF EN 13163.

2 Additional elements of the certificate application technical file

The technical file defined in paragraph 2.2 of the General Guidelines does not require any additional elements.

3 Characteristics which can be certified

The characteristics which can be certified are the characteristics listed in paragraph 4 of standard NF EN 13163, supplemented by the following characteristics:

- Service compression strength, normal service deformation
- Class of insulating underlayers beneath screed or floating slab and under tiles
- Emissivity
- Specific heat capacity

4 Methods of determination of the certified characteristics by the pilot laboratories

The test methods applied by the pilot laboratory for each of the characteristics are defined in paragraph 5 of standard NF EN 13163, supplemented by the following measures.

4.1 Thermal conductivity

The measures of paragraph 1.1 of Technical Specification No.1 apply, supplemented by the following elements.

4.1.1 Conditioning of the test specimens

Test specimens intended for thermal resistance measurements must be conditioned beforehand in the normal dry state. This dry state is deemed to be achieved after 8 days of conditioning at

50 ± 5°C in an oven, the air used for ventilation being taken from a stabilised atmosphere at 23 ± 2°C, 50 ± 5%RH.

Expanded polystyrene moulded in blocks, continuously or in slabs using the wet method contain a certain amount of water when they come off the production line. After 8 days' storage, the humidity level by weight may still be between 5 and 10%, i.e. 0.1 to 0.3% of the volume. In practical terms, this humidity level has very little effect on thermal conductivity, which justifies the definition of thermal resistance given below. However, to ensure that all the values measured are strictly comparable, measurements of thermal resistance shall be made on test specimens previously conditioned in the normal dry state.

4.1.2 Specific measures for elasticised EPS

The test specimens are dried at a temperature of 50 ± 5°C in a ventilated oven until constant weight is achieved, the air used for ventilation being taken from the standard laboratory atmosphere. This dry state is deemed to have been achieved after 8 days of conditioning.

To check that this method of drying does not affect the result, the test specimens are dried again after the thermal measurement has been performed at a temperature of 70 ± 5°C in a ventilated oven until constant weight is reached, the air used for ventilation being taken from the standard laboratory atmosphere and the weights thus obtained are compared.

4.2 Thermal resistance

Certified thermal resistance is defined according to the procedures in Technical Specification No.2.

4.3 Reaction to fire

The measures in Technical Specification No.3 apply.

4.4 Service compression strength, normal service deformation

The measures in Technical Specification No.5 apply.

4.5 Class of insulating underlayers beneath screed or floating slab and under tiles

If the class of insulating underlayers beneath screed or floating slab and under tiles defined in the DTU guideline NF DTU 52.10 P1.2 is certified, the procedures in Technical Specification No.6 apply.

4.6 Emissivity

If the product has a surface coating for which the emissivity is certified, the procedures in Technical Specification No.7 apply.

4.7 Specific heat capacity

The measures in Technical Specification No.10 apply.

5 Factory production control

Production control in the production unit satisfies the requirements of appendix B of European standard NF EN 13163.

In addition to these measures, for the following certified characteristics for the purposes of these regulations and described in detail in the various Technical Specifications, the procedures (methods and minimum test frequencies) provided for in this Technical Specification apply:

- Reaction to fire
- Service resistance and normal service deformation
- Class of insulating underlayers beneath screed or floating slab and under tiles
- Emissivity
- Specific heat capacity

In addition, the following specific measures must be complied with.

5.1 Thickness, length and width

The acceptable limits concern slabs in the dry state, but measurements may commonly be made on non-dried products (slabs, blocks, etc.). Therefore, correlations between the dimensions of dry slabs and non-dried slabs must be established beforehand.

The length and width measurements are performed in accordance with standard NF EN 822. These measurements are made on the full-sized product (slab) using a tape measure. Controls are performed at least once after adjusting the machine or cutting settings per production batch.

The thickness measurements are made in accordance with standard NF EN 823 (or by any other method leading to the same results) in line with the following minimum provisions:

- measuring equipment: the accuracy of the instrument used must be compatible with the stated thickness tolerances. The tape measure should be avoided as the sole means of measurement for thickness controls.
- sampling: the measurements are made on a full-sized slab or having a minimum length of 1 m. If it is impossible to measure such dimensions, the minimum dimensions may be reduced, with the agreement of the lead member, based on specific proof that the sample for thickness measurements is representative.
- measurement plan and frequency of controls:
    - For continuous manufacturing,
        - the thickness is measured according to the measurement plan in standard NF EN 823, at least at 3 points distributed along the edges of the slab, where required.
        - the thickness is controlled each time the machine settings are adjusted at least once per manufactured tonne as it leaves the machine. The thickness of the wadding measured in the factory laboratory during other tests.
    - For manufacturing in blocks,

- the thickness is measured according to the measurement plan in standard NF EN 823, at least at 4 points, 3 of which are distributed along the edges of the slab and 1 in the centre, where required (this measurement may be obtained after cutting the sample in two). Based on specific proof (for each cutting line) of the evenness of the thickness between the edges and the centre of the slabs, the thickness checks may be made on the edges of the slab only. Thickness in the centre of the slab shall be verified periodically (e.g. during the follow-up audits).
- the thickness is measured each time the cutting settings are adjusted and in the factory laboratory during other tests.

For productions of single moulded slabs, the controls are identical to those for continuous production.

5.2 Density

The acceptable limits generally concern products in the dry state whereas measurements are commonly performed on non-dried products. A coefficient (α) is therefore used to convert the acceptance limits on dry products for wet products. The α coefficient and the manufacturer's internal control process are established as follows, according to whether a correlation has been established (case 2 and 3) or not (case 1).

5.2.1 Case 1: Control without prior correlation

The test is carried out on the wet product just after moulding with comparison of the weight of a block or set of slabs with a minimum threshold to be reached. If this is not satisfactory, the corresponding volume of product is declassified (the block, volume produced continuously since the last weigh-in, the slabs manufactured in the unit since the last weigh-in, etc.).

The minimum threshold by weight (S) is determined based on the weighed volume (V) and the wet density obtained from the minimum dry set point guaranteed by the slab (ρ_{so}) using an all-in coefficient (α) for each type of product.

$$V \times \rho_h > S$$

With: $S = V \times \alpha \times \rho_{so}$

ρ_h being the wet density of the sample.

The α coefficient takes into account particularly:

- the weight of water in the EPS when it is weighed,
- the reduction in dispersion when going from individual values for the slabs to values obtained in a greater volume of sample (block or package of slabs).

The α coefficients are equal to:

Density	Blocks	Continuous or slabs
for $\rho_{so} \geq 25$ kg/m^3	1.10	1.10
for $13 \leq \rho_{so} < 25$ kg/m^3	1.15	1.12

for ρ_{so} < 13 kg/m^3	1.20	1.15

The values of α are lower for continuous production or in slabs, to take into account a lower volume of weighed sample than for blocks (3 m^2 minimum at least once an hour) and the lower spatial dispersion.

For manufacturing in blocks, if it appears that the weight of surface water when the block is weighed is not negligible, it must be taken into account by adopting higher α values.

In addition, the following should be recorded on each block:

- the product reference (or that of the product in the class below in case of declassification),
- the date of moulding,
- the batch number,
- the weight of the block.

For each batch, a sheet containing the weight of each of the blocks or packages with the date of manufacture and indication of any declassification. The following information is recorded on the product registers: the batch number, the batch tonnage, the moulding date(s), the number of blocks or the volume manufactured. In addition, the mean value and standard deviation, plus the number of declassified blocks or the corresponding quantity shall also be calculated and recorded. However, for the purposes of these calculations, random sampling may be carried out for the product the most manufactured in each centre, without going below 25% of the number of blocks manufactured.

It is important that the batch number should follow the products right through to their labelling.

5.2.2 Case 2: Control after study of the correlation between the wet and dry slabs

If, for a specific production, the manufacturer wishes to apply a α coefficient less than those defined for Case 1, it must justify this on the basis of a study of the correlation between the wet weight and the dry weight of the slab.

The study must take into account the spatial dispersion (especially blocks) and the main parameters affecting this correlation. The procedure is as follows:

1. Sampling: ½ block (or equivalent for continuous productions or production in slabs for each batch of 1 or 2 tonnes, two ½ blocks for each batch of 3 or 4 tonnes.
2. Weighing: all the slabs of the sample in the wet state then the dry state. If the α coefficient is established, weighing in the dry state shall be limited to 2 slabs per ½ block (edge and centre of the block). Subsequently, the frequency of sampling may be reduced based on justification, taking into account the experience acquired and the quantities produced.
3. Determination of α: based on 3 bar charts (at least 25 pairs of dry and wet values per bar chart) by comparison of the 95% fractiles in dry and wet state, with analysis of the spatial and temporal dispersions obtained.

4. Proof
    - Tonnage and dates corresponding to the batches studied, and the densities of the pre-expanded beads.
    - Weight of each block (or package of slabs) weighed, bar chart, mean and standard deviation per batch.
    - Wet and dry density for each sample slab.
    - Bar charts, means, standard deviations and references of the corresponding batches.

5.2.3 Case 3: Control after study of the correlation according to a specific plan

A different control plan may be established for a specific production, e.g. based on a correlation between the dry density of the slabs and the density of the beads at a specific stage. The equivalence must then be established between this plan and those presented in Cases 1 and 2.

The density is determined in accordance with standard EN 1602 on a full-sized slab or of a minimum length of 1 m. If it is impossible to perform the control using these dimensions, samples of a smaller size may be used, on condition that they are representative, and by agreement with the lead member.

Density controls are performed for each product and each thickness at least once for each production batch.

5.3 Class of insulating underlayers beneath screed or floating slab and under tiles

In addition to the procedures defined in Technical Specification No.6, the following frequencies are applied in factory production control.

The minimum test frequencies according to the levels and densities in the dry state are as follows:

Level I1 Level I2	$\rho_{so} \geq 12$ kg/m^3	no test
Level I2 Level I3	$\rho_{so} < 12$ kg/m^3 $\rho_{so} \geq 15$ kg/m^3	cross-check at least 2 twice a year
Level I3 kg/m^3 Level I4 Level I5	$13 < \rho_{so} < 15$	periodic control

In the case of periodic controls, the minimum frequency corresponds to one test per production batch (4 tonnes at most) and for a volume of 250 m^3 at most. If the simplified test is used, one test in four must be doubled by a test using test method NF P75-301.

5.4 Dimensional stability

For certain levels, a stabilisation period may be required. It is therefore necessary to indicate the moulding dates on the storage locations (blocks or spaces) then on the product labels.

5.5 Water absorption in the short term by partial immersion

A test of water absorption in the short term by partial immersion is performed for each production campaign (4 tonnes at most). Perform a new test in case of localised low-level failure.

5.6 Tensile strength

Levels L3 and L4: Periodical test with traction, with correlation.

5.6.1 Case 1: Control without prior correlation

In the absence of a study of correlation, the minimum thresholds σ_m to be satisfied are obtained based on σ_o thresholds by multiplying them by a coefficient β:

$$\sigma_m = \beta \times \sigma_o$$

with:

$\beta = 1$ if the test is conducted with tensile force in compliance with the EN standard at a speed of 10 mm/minute.

$\beta = 1.10$ if the test is conducted with tensile force at approximate constant speed which is always below 100 mm/minute.

$\beta = 1.30$ if the test is performed:

- either with tensile force at an undefined speed,
- or with bending force with a pitch of 450 mm (bar 500 mm long, 100 mm wide, and thickness equal to that of the slab and a speed of bending variation of 10 mm/minute).

$\beta = 1.50$ if the test is conducted with bending force with a pitch lower than 450 mm and/or undefined speed.

N.B.: For bending tests, the method mentioned above is applied to equivalent cohesion strength σ (this does not involve tensile strength given the characteristics of the material) calculated by the standard formula:

$$\sigma = \frac{3\,k\,F_1}{2\,b\,h^2}$$

F_1: breaking force

K: pitch

B: width of the test specimen

H: height of the test specimen.

Application:

To satisfy levels L3 and L4, it is therefore necessary to obtain cohesions or equivalent cohesions greater than:

β	L3	L4
1	0.050 MPa	0.180 MPa
1.10	0.055 MPa	0.200 MPa
1.3	0.065 MPa	0.235 MPa
1.5	0.075 MPa	0.270 MPa

The minimum thresholds above must be satisfied by 80% of the test specimens (i.e. 4 specimens out of the series of 5 tested), and the lowest value must not be lower by more than 20% of these thresholds.

The testing frequencies according to the quantities produced are respectively:

Level L3: 1 test (5 test specimens) for each production of a maximum of 1000 m^3 at least once a week.

Level L4: 1 test (5 test specimens) for each batch (of a maximum of 250 m^3).

If the above criteria are not satisfied, a second series of 5 test specimens is taken. The minimum threshold must be achieved for these 5 specimens. If not, the corresponding batch is declassified.

5.6.2 Case 2: Control after correlation

The β coefficients indicated above may be reduced based on a correlation study for a factory's production determined with control by testing according to a clearly defined and reproducible method.

The correlation study concerns at least 20 series of 5 test specimens tested with the exact method of the Technical Regulations (tensile force at a speed of 10 mm/minute) and 20 series of 5 test specimens taken from the same slabs, tested according to the method for correlation, specifying in the case of bending tests, the operating procedure and the direction of cutting (with deviations of 0 to 15% being possible between the various directions). The test specimens are taken from products from at least 5 different batches (e.g. 4 series of 5 test specimens per batch), and the batches and densities corresponding to the samples are recorded.

The results are only valid for one direction of cutting the blocks and one direction of cutting the samples. The study must be repeated if these directions of cutting are changed.

5.7 Permeability

No test for products with clearly defined densities and which are subjected to inspection of their mechanical properties (welding of the beads).

6 Tests performed during follow-up

For characteristics requiring monitoring, random tests are conducted at least once a year according to the table below when relevant to the relevant product.

The tests are conducted in accordance with the measures in European standard NF EN 13163, supplemented if applicable by the procedures described in the Technical Specifications corresponding to the characteristics tested.

Characteristics (NF EN 13163))	**Test methods**	**Place of performance of the tests**
Thermal resistance – Thermal conductivity	NF EN 12667 NF EN 12939	Pilot laboratory
Length and width	NF EN 822	Production unit and pilot laboratory
Thickness	NF EN 823 or NF EN 12431	Production unit and pilot laboratory
Squaring	NF EN 824	Production unit
Flatness	NF EN 825	Production unit
Reaction to fire[1]	NF EN 13501-1	Pilot laboratory
Traction perpendicular to the surfaces	NF EN 1607	Production unit and if not compliant at the pilot laboratory
Other characteristics or criteria	**Test methods**	**Place of performance of the tests**
Emissivity	Technical Specification No.7	Pilot laboratory
Service resistance (R_{CS})	Technical Specification No.5	Production unit and if not compliant, at the pilot laboratory
Density	NF EN 1602	Pilot laboratory

[1] The reaction to fire classification is monitored by conducting random tests once every two years.

The certifying body may also perform verification tests to verify other characteristics not listed in the table below, in particular if there is any doubt as to the compliance of the certified values.

Random testing is performed for reaction to fire in the case of products coming under conformity certificate system 1 for CE marking, in the case of the key-mark or at the manufacturer's request. In addition, for the follow-up tests, the following measures apply: one SBI test for each expansion agent on the worst case according to the initial type testing (class C).

7 Certificate maintenance rules

The certificate maintenance rules are defined in paragraph 4 of the General Guidelines.

Based on the results of the tests performed by the pilot body, product compliance is verified:

- For the dimensional characteristics according to the requirements of paragraph 4 of European standard NF EN 13163;
- For thermal performance according to paragraphs 2.1 or 2.2 of Technical Specification E;
- For the following characteristics certified under these regulations and described in detail in the various Technical Specifications, according to the conditions stipulated in these Technical Specifications:
    - Reaction to fire
    - Service compression strength and normal service deformation
    - Emissivity

8 Marking Rules

The marking rules laid out in Technical Specification D apply.

In particular, the information label complies with the measures in paragraph 3.1.1 of this Technical Specification.