EPAQ European Quality Assurance Association for Panels and Profiles

Testing Rules for Profiles

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European Quality Assurance Association for Panels and Profiles

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1 Resistance to concentrated forces

1.1 Principle

The aim of this test method is to determine the resistance to concentrated forces of self-supporting profiled metal sheet for roofing products, in accordance with EN 14782, 4.3.2.

The requirement for this test does not apply for

- ceiling and soffit products,
- internal lining and
- external cladding and
- cassettes.

Products intended for use at a span less than or equal to 400 mm, e. g. some tile profiles, are deemed to satisfy this requirement without the need of testing.

NOTE: In this case, the supporting structure will determine the resistance to imposed forces.

The test has to be carried out on a single profiled sheet of full width. The tested span shall be the largest quoted as suitable for use on a roof by the profiled sheet manufacturer.

The profiled sheets have to resist a concentrated force of 1,2 kN applied at mid-span near the centre line of the sheet.

It is not necessary to determine the ultimate span for a profiled sheet to resist a concentrated force of 1,2 kN.

1.2 General references for technically correct recording of test results

The requirements of EN 14782 need to be considered and followed essentially:

For each ITT test series a formal documentation (test report) that contains all relevant data needs to be developed, so that the test series can be reproduced accurately. In addition to test results, the specimens need to be described fully and accurately, particularly in terms of dimensions and material properties. Furthermore, any observations during testing must be recorded.

The following information shall be recorded in all ITT test reports:

1. date and time of production;
2. manufacturer's product name and/or designation;
3. quality of metal;
4. specified yield strength of metal
   (inspection certificate 3.1 according EN 10204);
5. nominal thickness of product;

6. measured dimensions of the product;
7. date of test;
8. span at which the product was tested (in mm);
9. method of loading and details of testing;
10. support conditions;
11. orientation of profiles during testing;
12. maximum force supported without global collapse at the test span;
13. mode of failure (if possible with photo documentation);
14. rate of application of the force from the point where the imposed force starts to increase until either 1,2 kN has been applied or until the maximum supported force is reached;
15. mean measured thickness of tested product from a minimum of three positions across product width;
16. measured yield strength of metal, determined by inspection certificate 3.1 according to EN 10204 or by test (see 1.3.3);
17. force supported without global collapse at the test span corrected to nominal thickness and yield strength in accordance with equations in B.5 of EN 14782;
18. confirmation that the test has been completed in accordance with the method defined in annex B in EN 14782 .

1.3 Presentation and explanation of tests in detail

1.3.1 Resistance of roofing products to concentrated forces

The resistance of roofing products to concentrated forces shall be evaluated according to annex B in EN 14782 when subject to regulatory requirements and may be evaluated when not subjected to such requirements.

1.3.2 Sampling for ITT

The choice of the method of sampling is defined in a) or b)

a) Random sampling

Whenever practicable, the random sampling method shall be used, in which every base material or finished product of the same type in a delivery batch has an equal chance of being selected for the sample.

b) Representative sampling

When random sampling is impracticable, e. g. when the products form a large stack or stacks with ready access to only a limited number of products, a representative sampling procedure shall be used.

1.3.3 Mechanical properties of metal faces

Based on: EN 14782, 4.3.1, Table 2 and EN 10002-1

Comments:

According to Table 2 of EN 14782 the mechanical properties of the metal faces can be proved by inspection documents from the manufacturer (inspection certificate 3.1 according EN 10204) or have to be tested as follows:

1. Test specimen:

Metallic bright flat test pieces according to EN 10002-1 type 1 or type 2 depending on the material.

The coating must be removed either in part or totally before taking the core thickness. For galvanized steel, the removal must be in accordance with EN 10326 annex A.

2. Test procedure:

The test procedure is exactly defined in EN 10002-1. Specific details of the delivery standard have to be considered.

3. Number of tests:

For each coil 3 tests are sufficient. Two of the samples must be taken from the edge area (with a minimum distance of 50 mm from the edge) and one sample must be taken from the centre of the width. All samples must be oriented parallel to the lengthwise direction of the profile.

4. Important test results:

Metal sheet thickness t_{obs} (accuracy 1/100 mm), yield stress $f_{y,obs}$, ultimate stress $f_{u,obs}$ and elongation A determined on test specimen. The values are necessary for interpretation of test results.

1.3.4 Test spans

Support the profiled sheeting under test by rigid flat supports at least 50 mm wide.

The span can be:

- the maximum span intended by the manufacturer for the profiled sheet when used on a roof
- a proposed span due to previous calculation
- a span determined from previous experience or by pre-testing

NOTE It is not necessary to search for the maximum span that carries 1,2 kN.

The profiled sheet shall not be fixed to the supports.

Measure the span, defined by the distance between inner sides of the supports to an accuracy of ±3 mm, as shown in Figure B.1. The maximum length of profiled sheet extending past the supports shall be 300 mm at both ends.

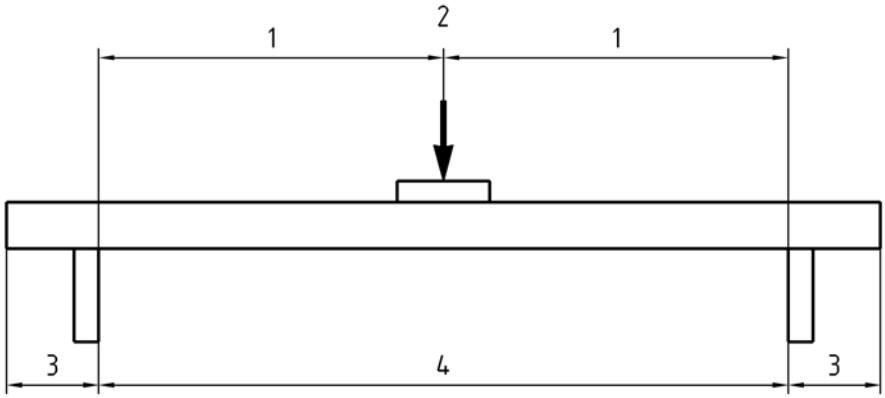
1.3.5 Test sheets

Test a single sheet without any additional side support.

The thickness of each specimen and if required the yield strength of the specimen shall be measured after test.

1.3.6 Test procedure

Profiled sheets with a trough width exceeding 130 mm shall be tested with the force applied to the trough at the centre line. The force shall be applied through a flat timber block measuring 125 mm x 125 mm x 80 mm minimum thickness.



Key
1 Half span
2 Applied force
3 Maximum overhang of sheet 300 mm
4 Span length between sides of the supports

Figure 1: Test layout and measurement of span

Profiled sheets with a rib along the centre line shall be tested with the force applied through a bridge to timber blocks in the troughs on either side of the rib. The timber blocks shall be 125 mm long x 125 mm wide unless the profile trough is less than 130 mm wide. Where the trough width is less than 130 mm the width of the block shall be equal to the trough width minus 5 mm.

NOTE Profiles with more than 6 ribs generally shall be tested with the force applied through a bridge to timber blocks placed on the troughs on either side of the central rib.

The thickness of the blocks has to exceed the nominal profile depth by at least 15 mm.

In order to avoid local stress, a layer of rubber of Shore hardness A 20-30 determined according to EN ISO 868, 10 to 15 mm thick, may be placed between the timber block and the test metal sheet.

Tile profiles with steps and sinusoidal profiled sheets shall be tested with timber blocks shaped to the nominal profile radius and/or step.

When loading with a mechanical or hydraulic actuator, a ball joint or other means to ensure the timber block remains parallel to the surface of the test metal sheet shall be used.

The test force shall be gradually applied (not dropped) at a mean rate of (150 ± 50) N/s.

NOTE It is proposed to perform the test with a constant speed of the test rig. The speed has to be evaluated in a preloading procedure at the beginning of the tests with maximum forces not exceeding 80% of the first peak.

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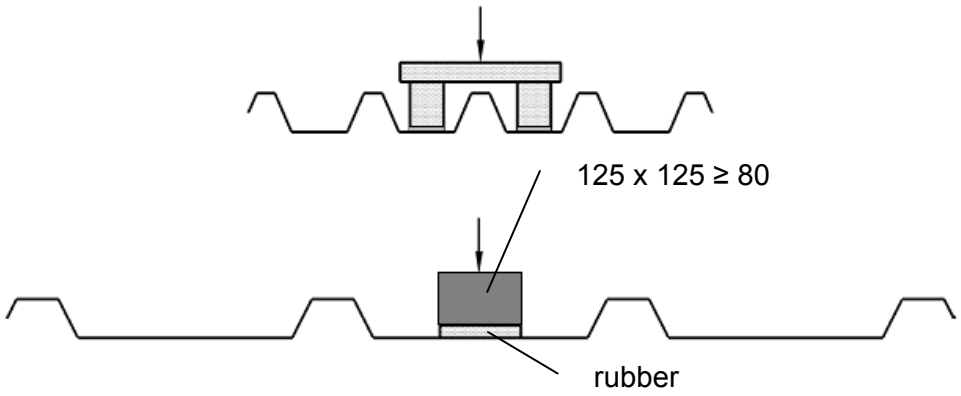

Figure 2: Application of the concentrated forces

The force applied shall be measured to an accuracy of ± 25 N.

Record the maximum force and the time when the imposed load starts to increase until the time when the maximum force supported by the profiled sheet is applied.

NOTE The test force applied may reach a peak and then drop before increasing again, the maximum force supported without global collapse by the profiled sheets should be recorded. Because of the application of these profiles, it is recommended to use the first peak load for further calculation and labelling and not the maximum force.

The recorded maximum force applied shall include the weight of the timber block and other test components supported by the test metal sheet, plus the maximum measured applied force but not the self-weight.

Remove the applied force and record any observations.

1.3.7 Number of tests and analysis of results

A minimum of one test has to be made on a sheet profiled from the thinnest metal and nominal grade of yield stress and in the position, intended by the manufacturer for the profiled sheet when used on a roof.

NOTE The resistance to concentrated force is only valid for the tested position. If the profile is used in both positions the tests have to be performed on both sides. Then it is allowed, to label both values with reference to the position or the minimum value for both positions.

The thickness of the test sheet shall be determined as the mean thickness (t_a) in millimetres, determined from measurements at three points across its width excluding the thickness of any organic coating, i. e. one measurement near the centre and one near both sides of the sheet.

All three measurements shall not deviate more than ±5 % of the nominal sheet thickness, t_n.

If this limit is exceeded the sheet shall be rejected.

If only one single profiled sheet is tested, to allow for variations in test methods and measurement errors the declared force shall be reduced by

a factor of 0,9 applied to the measured force corrected for thickness if $t_a > t_n$ and yield strength if $f_{y,obs} > f_{y,nom}$. This means, that the profiled sheet has to carry more than 1,2 kN to fulfil the requirements. In this case, the minimum force for the profile to carry is:

$$F_{min} = 1{,}2\ kN\ /\ 0{,}9 \cdot (f_{y,obs}/f_{y,nom}) \cdot (t_a/t_n) \quad (1)$$

If the recorded maximum force is lower than F_{min} the test has to be repeated with a different span or if the shortfall is less than 10%, two more tests with the same span can be performed.

When three or more profiled sheets of identical nominal thickness and nominal yield strength are tested with the same span, the mean measured force corrected for thickness if $t_a > t_n$ and yield strength if $f_{y,obs} > f_{y,nom}$, has to exceed 1,2 kN.

$$F_{mean} = \sum_{i=1}^{n} F_i \cdot \left(\frac{t_{n,i}}{t_{a,i}} \right) \cdot \left(\frac{f_{nom,i}}{f_{obs,i}} \right) \geq 1{,}2kN \quad (2)$$

If the force is lower than the required force, the tests have to be repeated with a briefer span. If the force is much higher than the required force the tests can be repeated with a larger span.

The maximum force may be extrapolated for thicker metal sheets of nominal thickness (t_2) not exceeding 1,75 x t_n using (3):

$$F_{t2} = F_{tn} \cdot (t_2/t_n) \quad (3)$$

where

F_{t2} is the maximum force for the nominal thickness t_2;

F_{tn} is the maximum force corrected to t_n and is equal to the measured maximum force x (t_n/t_a).

The maximum force may be extrapolated for higher yield strength steel metal sheets not exceeding 1,15 x f_{yn} using (4):

$$F_{fy2} = F_{fyn} \cdot (f_{y2}/f_{yn}) \quad (4)$$

where

F_{fyn} is the maximum force for the specified yield strength f_{yn} of the tested sheet

F_{fy2} is the maximum force for a specified yield strength f_{y2} , not exceeding 1,15 x f_{yn}

Other metals may not have accepted correction factors, for these tests the measured yield strength should be quoted.

According to the requirements in annex ZA and chapter 6.2, table 3 for each roofing profile the manufacturer has to state a value for a span

compatible with a force of 1,2 kN. This leads to the need for an equation for extrapolation of the span instead of the force. The main internal force variable is the maximum bending moment capacity of the profile. Under consideration of the self-weight the extrapolation can be performed according (5):

$$L_i = \frac{-B \pm \sqrt{B^2 - 4 \cdot A \cdot C}}{2 \cdot A} \tag{5}$$

with

$$A = \frac{g_0 \cdot t_2}{8 \cdot t_N}$$

$$B = \frac{F}{4}$$

$$C = -\frac{t_2}{t_N} \cdot \left(\frac{g_0 \cdot L_0^2}{8} + \frac{F \cdot L_0}{4} \right)$$

and g_0 self-weight per length of the tested profile (nominal thickness t_n)

F maximum Force of the tested sheet, corrected to nominal thickness t_n and nominal yield strength f_{yn}

L_0 test-span

L_i extrapolated span of the profile with the nominal thickness t_i

It is allowed to test the profiled sheets with higher thickness and higher yield strength.

It is allowed to declare the maximum span of the profiled sheet with the minimum thickness and the minimum yield strength also for profiled sheets with higher thickness and higher yield strength.

1.3.8 Acceptance criteria

The profile manufacturer shall declare that the designated profile of metal type, nominal thickness and nominal grade of yield strength will support without global collapse a concentrated force of at least 1,2 kN at the declared maximum span determined in accordance with this test method.