

TEST REPORT No. 17580A

Sponsor

KNAUF DANOLINE A/S
Kløvermarksvej 6
9500 Hobro
Denmark

Test specimen

A suspended ceiling – type: KNAUF DANOLINE XTRA, fixed to steel beams, underneath an unloaded aerated concrete floor.

Nature of the tests

Test to determine the contribution to the fire resistance of this horizontal protective membrane in accordance with the European standard EN 13381-1:2014.

On the premises of the laboratory and under its control, the company Knauf Danoline A/S, Kløvermarksvej 6, 9500 Hobro, Denmark set up, on 11 January 2016 a suspended ceiling fixed to steel beams, underneath a loadbearing aerated concrete floor, for a fire resistance test.

This test specimen was prepared in accordance with the requirements of the standard stated hereinafter.

1 DESCRIPTION OF THE TEST SPECIMEN

1.1 Name and address of the sponsor of the fire resistance test:

Knauf Danoline A/S
Kløvermarksvej 6
9500 Hobro
Denmark

1.2 Name and address of the manufacturer:

Knauf Danoline A/S
Kløvermarksvej 6
9500 Hobro
Denmark

1.3 Description of the test specimen (annexes 1 and 2)

In the following description, all dimensions and material properties are the nominal values communicated by the sponsor.

The conformity of the test specimen with these communicated values was verified by the laboratory insofar as the structure of the test specimen and the form in which it was delivered allowed this verification.

The present test specimen has been fully assembled in the laboratory so that all the dimensions could be verified.

The measured values (MV) are only mentioned if they differ significantly from the nominal values (NV).

In this description, the numbers of the parts between rectangular brackets [] refer to the numbering in the drawings. Listed in the description are the dimensions and material properties of the components of the test specimen.

1.3.1 Composition of the test specimen

The test specimen is a suspended ceiling, type: KNAUF DANOLINE XTRA. The ceiling is suspended from steel beams, underneath an aerated concrete floor.

Outer dimensions of the test specimen:

- length: 4000 mm;
- width: 3000 mm;
- height plenum: 420 mm;
- span: 4200 mm.

1.3.1.1 Standard supporting construction

[1] Steel beam – type: IPE 140 – outer dimensions: 140 mm x 73 mm – length: 4400 mm – yield strength: 327 N/mm² (MV).

- number: 5;
- position: resting on the rolling element bearings at the transversal ends of the furnace frame,;
- orientation: in longitudinal direction of the furnace frame;
- c/c distance: 625 mm;
- span: 4200 mm.

- [2] Aerated concrete slab – section dimensions: 600 mm x 150 mm – length: 2950 mm – volumetric mass: 650 kg/m³ (NV).
- number: 7;
 - position: on top of the steel beams [1];
 - orientation: perpendicular to the steel beams.

1.3.1.2 Ceiling

1.3.1.2.1 Suspension structure

- [3] Hammer-on Flange Clip – brand and type: Erico 4H58 P21 (170030) – material: steel.
- position: connection between the beams [1] and the hangers [4];
 - fixing: slid over the lower flanges of the beam.
- [4] Quick hanger with 2 hooks – brand and type: DONN SB 50/10/30.
- composition: upper and lower part [4a] and a butterfly clip [4b];
 - position: connection between the flange clip [3] and the main profile [7];
 - c/c distance: 600 mm x 600 mm.
- [4a] Hook – material: steel – diameter: 4.0 mm – length: 80 mm – hooked length: 25 mm.
- [4b] Butterfly clip – material: steel – outer dimensions: 24 mm x 54 mm – steel thickness: 0.6 mm – number: 1 per hanger.
- position: connection between the upper part and the lower part.
- [5] Wall angle – L-shape – brand and type: DONN Wall angle 20/24 – material: steel – steel thickness: 0.5 mm – dimensions: 20 mm x 24 mm – length: 3000 mm.
- position: around the test specimen, against the concrete furnace frame, at the corners a clearance is provided: 10 mm;
 - orientation: the 24 mm flange horizontally;
 - fixing:
 - to the concrete furnace frame;
 - by means of a tension sleeves [6];
 - c/c distance: 350 mm - 400 mm.

- [6] Tension sleeve – material: steel – diameter: 5.5 mm – length: 35 mm.
- [7] Main profile – brand and type: Donn DX24 XH 60 W – material: steel – steel thickness: 0.3 mm – outer section dimensions: 23.8 mm x 37.9 mm (MW) – initial length: 3425 mm – applied lengths: 2665 mm – weight per unit length: 0.34 kg/m (MV).
- total length: 4000 mm;
 - orientation: in longitudinal direction of the concrete furnace frame;
 - c/c distance: 1200 mm;
 - fixing to the wall profiles [5]:
 - resting on the lower flange of the wall profiles [5];
 - clearance: 0 - 10 mm.
 - fixing to the hangers [3]:
 - the lower part [4a] of the hanger is hooked in the main profile.
- [8] Short cross tee – brand: Donn DX24 XH 60 W – material: idem main profile [7].
- position: perpendicular between the main profiles [7];
 - c/c distance: 600 mm;
 - fixing to the main profiles [7]:
 - clicked into the slots provided in the long cross tees;
 - fixing to the wall profiles [5]:
 - resting on the lower flange of the wall profiles.

1.3.1.2.2 Ceiling tiles

- [9] Ceiling tile – brand and type: Knauf Danotile Xtra White – material: glassfibre reinforced gypsum board, both sides foil-covered with pre-impregnated paper (PVC-free, Non-toxic foil faced + PE) – total thickness: 12.4 mm (MV) – dimensions: 600 mm x 600 mm – surface weight: 6.8 kg/m² (MV).
- position: resting on the main profiles [7] and the cross tees [9] and [10].

1.4 Drawings

The present drawings are not to scale.

Annex 1: Top view (unexposed side) – sections A-A and B-B – observations – thermocouples.

Annex 2: Top view – sections A-A and B-B – dimensions.

1.5 Trade name of the test specimen

KNAUF DANOLINE XTRA.

1.6 Number of test specimens received by the laboratory

One.

2 TEST PROCEDURE

2.1 Sampling done by

The sponsor.

2.2 Date of the delivery of the test specimen

11 January 2016.

2.3 Set-up date of the test specimen

11 January 2016.

2.4 Set-up conditions for the test specimen

On a horizontal concrete frame with inner dimensions 4000 mm x 3000 mm, five IPE 140 profiles have been applied on rolling element bearings – span: 4200 mm. On top of the IPE 140 profiles, a floor of aerated concrete slabs has been applied – thickness 150 mm.

The ceiling is suspended from the IPE 140 profiles and rests on the wall profiles that have been fixed to the concrete frame. The dimensions of the concrete frame are invariable regardless of the actions of the test specimens during the test.

2.5 Conditioning

From the moment the test specimen was delivered until the test itself, the test specimen is kept, with due care, in the laboratory under normal ambient conditions.

2.6 Date of the test

11 January 2016.

2.7 Loading

During the test, no additional load was applied to the floor. A bending moment of 6.3 % of the maximum bending moment in cold condition (25.28 kN.m, based on the measured steel strength) has been applied to the IPE 140 profiles, generated by the own weight of the test specimen.

The detailed calculations of the bending moment and the load are retained in the lab archives.

2.8 Test method

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in EN 13381-1:2014, EN 1363-1:2012, and where appropriate EN 1363-2:1999. Except for the loading, there has not been deviated from these standards.

Deviation from EN 13381-1:2014: The maximum bending moment in the IPE 140 profiles was 6.3% instead of the prescribed 60% of the ultimate cold condition limit state value of the design moment resistance of the IPE 140 profiles.

Any significant deviation with respect to size, constructional details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

3 OBSERVATIONS DURING THE TEST

Time in minutes	Observations
0	Start of the test.
1	At the exposed side, flames are visible over the full surface of the ceiling. Black discoloration is visible. Burned paper is flaking and falling.
3	Glowing is visible over the full surface of the ceiling.
12	Light deformations of the main runners.
23	Light deflection of the cross tees.
28	Black discoloration at the corners of the ceiling tiles
46	Light deflection of the ceiling tile in zone 1
60	The ceiling tile in zone 2 detaches.
61	The ceiling tile in zone 2 falls.
64	The ceiling tile in zone 3 falls.
67	No part of the steel suspension system has fallen. End of the test in consultation with the sponsor.

Remark: The ambient temperature during the test was 15°C.

4 MEASUREMENTS DURING THE TEST

Annex 3: shows the deflection of the test specimen on the positions indicated in annex 1, in relation to time.

The following annexes show the rise in temperature of the thermocouples in the places indicated in annex 1, in relation to time.

Annex 4: at mid-height in the plenum (Th1-Th9) + average.

Annex 5: average, maximum and characteristic plenum temperature.

Annex 6: at the bottom side of the aerated concrete floor (Th10-Th14).

Annex 7: at the bottom flange of the IPE 140 profile (Th15-Th29).

Annex 8: average, maximum and characteristic surface temperature (measured on the IPE 140 profiles).

Annex 9: at the unexposed side of the suspended ceiling (Th30-Th34).

The following annexes show the rise in temperature of the thermocouples in the places indicated in annex 1 till 3, in relation to time.

Annex 10: at the unexposed side of the aerated concrete floor (Th35-Th39).

The following annexes show absolute temperatures, the deviation and the overpressure in the furnace, in relation to time.

Annex 11: shows the temperature of the plate thermometers in the furnace and the standard curve T (°C), in accordance with EN 1363-1:2012.

Annex 12: shows the deviation of the mean furnace temperature with respect to the standard curve, in accordance with EN 1363-1:2012.

Annex 13: shows the overpressure in the furnace, measured at 100 mm under the ceiling. It was set to $(20 \pm 3) \text{ N/m}^2$.

5 PHOTOS OF THE TEST SPECIMEN BEFORE, DURING AND AFTER THE TEST

Annexes 14 till 19.

6 EVALUATION OF THE LOADBEARING CAPACITY

6.1 Evaluation method

The contribution of the ceiling to the fire protection of the overlying structural floor is determined on the basis of the evaluation of the temperatures measured in the plenum between the floor and the ceiling and measured on the steel IPE 140 profiles during the test.


6.1 Results

Results for the unloaded floor with a maximum bending moment of 6.3% of the ultimate cold condition limit state value of the design moment resistance of the IPE 140 profiles:

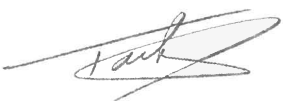
Floor type	Reference temperature in the plenum (°C)	Time to reach reference temperature in the plenum (minutes)	Corresponding loadbearing capacity (minutes)
Concrete	600	60	60
Steel beams / concrete slabs	530	48	48
Prestressed concrete	450	36	36
Composite steel-concrete slabs	400	30	30
Cold welded steel construction elements	370	27	27
Timber	300	20	20
Beams type	Reference temperature IPE 140 profile (°C)	Time to reach reference temperature IPE 140 profile (minutes)	Corresponding loadbearing capacity (minutes)
Steel beams / concrete slabs	510	48	48
Composite steel-concrete slabs	350	30	30
Cold welded steel construction elements	350	30	30

(1) Not reached during the test. The test was stopped after 67 minutes.

SIGNED


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APPROVED


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This document is the original version of the test report and is written in English.

In case of doubt, the most recent version prevails, originally issued in English.

The present report includes: 12 pages;
 19 annexes, 6 of which contain photos.

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