

TEST REPORT

NON-LOADBEARING WALL

Name of sponsor:	Wood:UpHigh		
Product name:	Non loadbearing wall		
File no.:	PGA12343A	Revision no.:	1
Test date:	2023-09-18	Date:	15-02-2024
Pages:	11	Encl.:	67
Ref:	MMN / CHB		

Client information

Client: Wood:UpHigh
Address: Jernholmen 12
2650 Hvidovre
Denmark

The test is part of the project Wood:UpHigh. The project is partly sponsored by Uddannelses- og Forskningsstyrelsen through DBI's performance contract, Realdania and Grundejernes Investeringsfond. The project is headed by DBI, except for the construction of test specimens for the fire tests, which is headed by LOGIK&CO.

The results relate only to the items tested. The report should only be reproduced in extenso - in extracts only with a written agreement with this institute.

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Date of test

The test was conducted on 18-09-2023.

Purpose of test

Examination of the fire-resistance of two non-loadbearing walls.

The purpose of this test was to determine if there was a difference between using retention of the insulation inside the wall or not. The test was established by comparing two walls with and without retention. Each wall consisted of two types of wood insulation to observe the reaction of the insulation. The insulation in each wall was blown-in and batts.

The test specimen has been subjected to a standard fire test in following the principles standards:

EN 1363-1:2020 Fire resistance tests – General requirements

in conjunction with:

EN 1364-1:2015 Fire resistance tests for non-loadbearing elements Part 1: Walls

Test specimen

The trade name and sponsors identification mark are stated below:

Trade name:	Wood:UpHigh
Identification mark:	None

The components for the test specimen were delivered and mounted by the sponsor.

Drawings and description

Details of the construction are shown in the enclosed documentation as stated below:

Type	Drawing No.	Dated	Subject
Drawing	1.0	18-09-2023	Comparison test of retention of insulation
Drawing	1.1	18-09-2023	Comparison test of retention of insulation
Drawing	1.2	18-09-2023	Comparison test of retention of insulation

The documentation is supplied by the sponsor, and it is stamped by DBI - Danish Institute of Fire and Security Technology

Description

The test specimen consisted of the components described in the following. DBI inspected the components during mounting, the test and after the test.

The sponsor carried out the selection of the products for the test specimen as well as the mounting.

Test specimen A+B

External measures:	Height: 3100 mm	Width: 2550 mm	Thickness: 120 mm
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The specimen consisted of 2 types of walls. Wall-A and Wall-B

The specimen is a non-loadbearing wall.

The wall is a wood stud wall with 2 types of wood-based insulation. The outer layer of the wall consisted of gypsum boards.

Difference between the walls:

Wall-A had retention to hold the insulation.

Wall B had no retention.


The test specimen was symmetrical.

All measurements are written in by (Width x Length x thickness)

Wooden frame

Top and bottom rails: The top and bottom beams are 45 x 95 mm dry graded C24 construction spruce wood with a nominal density of 450 kg/m³. The top and bottom beams are fixed to each end of the studs.

Wood studs: A total of 14 studs were used in the wall construction, all 2910 mm tall. The studs are 45 x 95 mm dry graded C24 construction spruce wood with a nominal density of 450 kg/m³. The studs were spaced c/c 450 mm.

Fixation: 5,9 x 35 mm  screws. Used on the top and bottom of the studs 301 mm from frame with c/c 450 mm.

Insulation

Insulation: The insulation material used was a wood insulation designated [REDACTED] with a nominal thickness of 95 mm and nominal density of 40 kg/m³. The tested slab size was 570 x 1000 x 95 mm (width x length x thickness). The insulation was placed in layers between the wood studs.

Loose insulation: The blow-in insulation material used was a loose wood insulation designated [REDACTED] blown into the construction with a measured density of 60 kg/m³.

Retention: 2 mm steel wire fastened on each side of the wall. Steel wire was holding the insulation on wall-A. The distance between the wires in the vertical direction was 200 mm. Wall A consisted of approximately 15 rows of steel wire, on each side.

Fixings: 10 mm [REDACTED] galvanized staples were used to mount the steel wire to the frame and the studs. There was used 2 staples on each wooden stud, for each row of steel wire. 18 mm Tjep klammer staples were used to mount the steel wire to the frame and the studs. There was used 1 staple on each wooden stud, for each row of steel wire, few millimeters from the two rapid galvanized staples.

Outer layers

Outer boards: 900 x 2400 x 12.5 mm [REDACTED]. These gypsum boards are fastened on each side of the wall, on the studs. There were drilled holes in the gypsum boards with a diameter of 100 mm, to blow the loose insulation in the construction.

Inner boards: 60 x 125 x 12.7 mm plywood was used to close the holes made in the gypsum boards. They were screwed in behind the gypsum boards, so a small round board of gypsum could be fastened to it.

Fixings: 3.9 x 35 mm [REDACTED] gypsum screws were used to mount the gypsum boards to the studs by cc 155 mm. 3.5 x 41 mm [REDACTED] screws was used to mount the plywood to the gypsum boards. 4 screws were used at each hole.

Finish: There was made small round gypsum board pieces to close off after the insulation was blown in. Borup modelgips was used to close the gap left in the holes after the small gypsum board was mounted to the plywood. Droppen allround sandspartel was used as finish after the modelgips was smeared in the holes.

Measured by DBI

Product		Wood batt insulation	Wood Studs	Gypsum boards	Loose wood insulation
Density	kg/m ³	57	484	481	40
Thickness	mm	50.0	45.0	12.5	95.0
Moisture content	%	9.71	7.38	0.45	3.11
Sampling method		Extra material	Extra material	Extra material	Extra material
Drying temperature	°C	105	105	55	105

Test conditions

Conditioning

The test specimen was delivered on the 12-09-2023 to the DBI laboratory and stored under room temperature. On the day of the fire testing the condition of the test specimen was similar with respect to its moisture content as the test specimen would be in normal service.

Mounting

The test specimen was mounted in a wall frame with a clear opening of 5500 x 3100 mm (width x height). The frame was divided in two section with a 300 mm wide aerated concrete element in the middle resulting in two identical openings of 2600 x 3100 mm (width x height).

A free edge was established along one vertical edge of the test specimen (2 x 25 mm stone wool with alu-foil in each side) on both walls to allow for unrestrained deformation of the test specimen on the one side.

Fire test

Observations were made during the test on the general behavior of the test specimen.

Temperature observations were taken continually during the entire testing time.

The surface temperatures were measured on the unexposed surface of the test specimen as indicated on DBI drawing no. 1.3.

The furnace temperature was determined by means of plate thermocouples uniformly distributed at a distance of approximately 100 mm from the exposed side of the test specimen. The furnace temperature was continuously controlled so as to follow the standard time temperature curve within the accuracy specified in EN 1363-1:2020.

The thermocouples were constructed according to the description in EN 1363-1:2020.

Test results

Duration of the test was 49 minutes.

Measurement

The enclosed graphs and tables show:

Enclosures 2.0 and 2.1	Furnace temperatures The actual minimum-, average- and maximum furnace temperature in relation to the standard temperature. The table also shows the area under the actual time-temperature curve as well as the area under the standard time-temperature curve
Enclosures 3.0 and 3.1	Vertical furnace pressure The differential pressure in the furnace during the test, measured 3.3 m above notional floor level
Enclosures 4.0 and 4.1	Ambient temperature The ambient temperature in the laboratory during the test
Enclosures 5.0 and 5.1	Average temperature rise AB Measured with 5 thermocouples
Enclosures 6.0 and 6.1	Maximum temperature rise AB Maximum temperature rise on the unexposed side
Enclosures 7.0 and 7.1	Wall A B - indicative temperature - unexposed gypsum Maximum temperature rise inside the construction
Enclosures 8.0 and 8.1	Wall AB - indicative temperature - center studs Maximum temperature rise inside the construction
Enclosures 9.0 and 9.1	Wall AB - indicative temperature - exposed gypsum Maximum temperature rise inside the construction
Enclosures 10.0 and 10.1	Average temperature rise AL Measured with 5 thermocouples
Enclosures 11.0 and 11.1	Maximum temperature rise AL Maximum temperature rise on the unexposed side
Enclosures 12.0 and 12.1	Wall A L - indicative temperature - unexposed gypsum Maximum temperature rise inside the construction
Enclosures 13.0 and 13.1	Wall AL - indicative temperature - center studs Maximum temperature rise inside the construction
Enclosures 14.0 and 14.1	Wall AL - indicative temperature - exposed gypsum Maximum temperature rise inside the construction
Enclosures 15.0 and 15.1	Average temperature rise BB Measured with 5 thermocouples
Enclosures 16.0 and 16.1	Maximum temperature rise BB Maximum temperature rise on the unexposed side

Enclosures 17.0 and 17.1	Wall BB - indicative temperature - unexposed gypsum Maximum temperature rise inside the construction
Enclosures 18.0 and 18.1	Wall BB - indicative temperature - Center studs Maximum temperature rise inside the construction
Enclosures 19.0 and 19.1	Wall BB - indicative temperature - exposed gypsum Maximum temperature rise inside the construction
Enclosures 20.0 and 20.1	Average temperature rise BL Measured with 5 thermocouples
Enclosures 21.0 and 21.1	Maximum temperature rise BL Maximum temperature rise on the unexposed side
Enclosures 22.0 and 22.1	Wall BL - indicative temperature - unexposed gypsum Maximum temperature rise inside the construction
Enclosures 23.0 and 23.1	Wall BL - indicative temperature - Center studs Maximum temperature rise inside the construction
Enclosures 24.0 and 24.1	Wall BL - indicative temperature - exposed gypsum Maximum temperature rise inside the construction
Enclosures 25.0 and 25.1	Deformation Negative values indicate movement towards the furnace

Visual observations:

Time / Minutes	Visual observations:	U = Unexposed side E = Exposed side
0	Test commences	
1	Smoke form top of specimen A+B	U
2	Heavy smoke form all around edges of specimen A+B	U
3	Decrease of smoke	U
5	Smoke from right side specimen B	U
8	Smoke from near Thermocouple AB2.3	U
12	Heavy smoke from top left and right A+B	U
12	Wood burning sounds	E
15	Cracks vertical in gypsum boards	E
16	Flames from the top joints	E
18	Horizontal crack in gypsum boards	E
19	Wood burning sounds	E
20	Heavy smoke from sides A+B	U

23	Cotton pad test	U
25	Cotton pad test: top corner wall B: Nothing	U
26	Gypsum boards are still in place, more cracks.	E
29	Gypsum boards are still in place, more cracks.	E
30	Gypsum boards starting to hang.	E
33	Gypsum boards have fallen Top AB	E
35	Gypsum boards have fallen BB + BC	E
37	Most gypsum boards have fallen AB+AC	E
37	Insulation has fallen, Blown insulation BB	E
39	Smoke (vapor) from mid gypsum board.	U
41	Missing insulation AB top.	E
43	More insulation has fallen BL.	E
45	Cotton pad test over T joint, AB: Slight discoloration	U
47	Cotton pad test horizontal joint BL: nothing.	U
48	No changes on exposed side.	E
49	Test stopped due to safety reasons	

Note: see drawing enclosure 1.3 for thermocouple placement reference and naming.

The photographs on the attached photo sheets show the test specimen during the mounting, testing and after the test. See the description at each photo.

Conclusion

Fire resistance testing according to EN 1364-1:2015: of the construction described in this test report showed that failure according to the performance criteria stated in the test method occurred at the following time:

Integrity (E): **49 minutes**

- Sustained flaming did not occur during the test.
- The cotton pad was not ignited during the test.
- No through-going openings in the test specimen were created during the test.

Insulation (I): **49 minutes**

- Failure of insulation did not occur during the test.
- The average temperature rise on the unexposed surface of the test specimen did not exceed 140°C during the test.
- The maximum temperature rise on the unexposed surface of the test specimen did not exceed 180°C during the test.

Remarks

There is no field of direct application of the test results.

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 1363-1:2020, and where appropriate EN 1363-2:1999. 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 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.

This report has only been printed in a pdf-version. DBI has not issued a hard copy version.

All values mentioned in this report are nominal values, production tolerances are not considered.

The test was not performed accredited.

Danish Institute of Fire and Security Technology



Mads Møllgren

Resistance to fire engineer



Christian Basbøll

Resistance to Fire Engineer

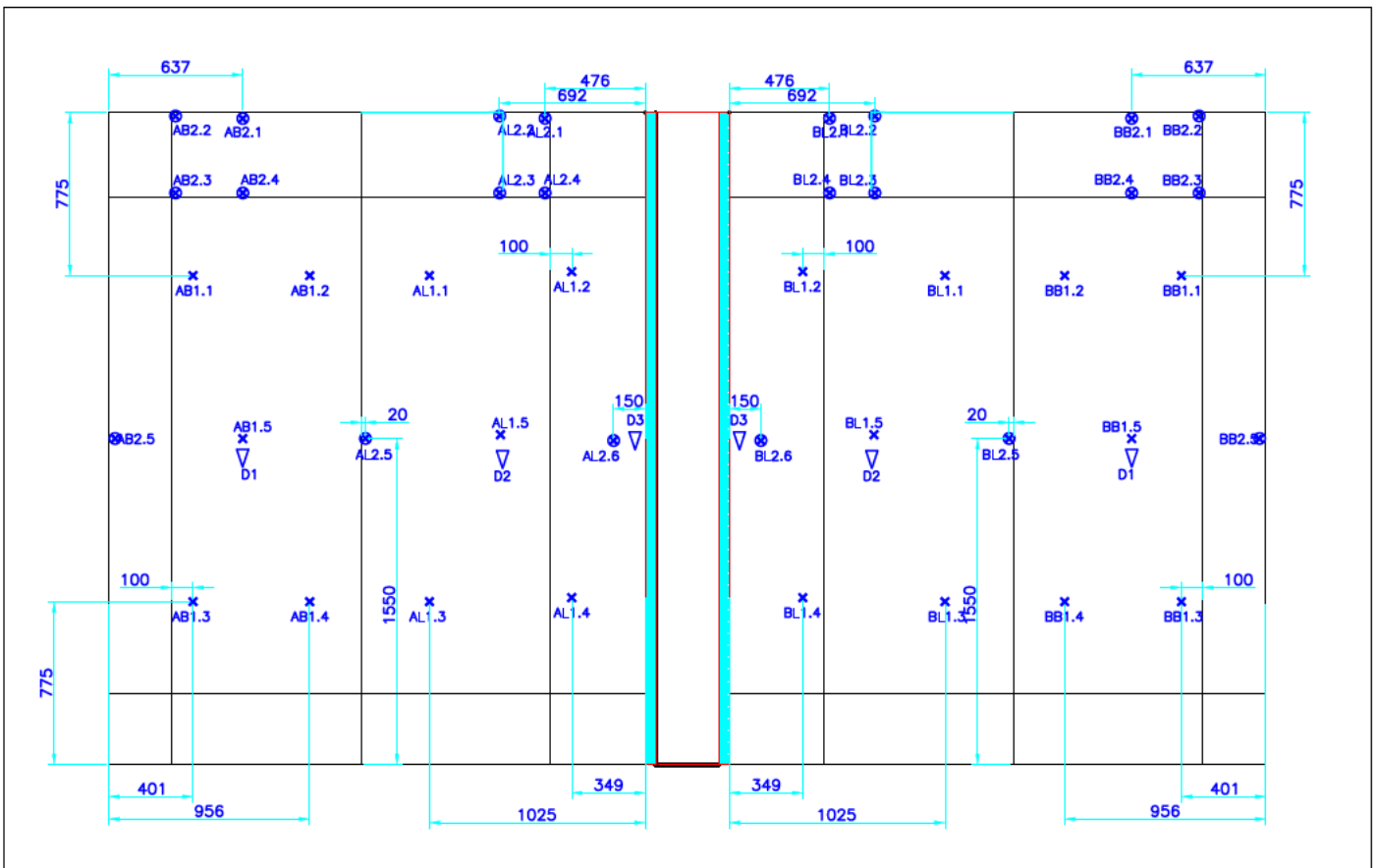
Wood:UpHigh

Jernholmen 12
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Enclosures:

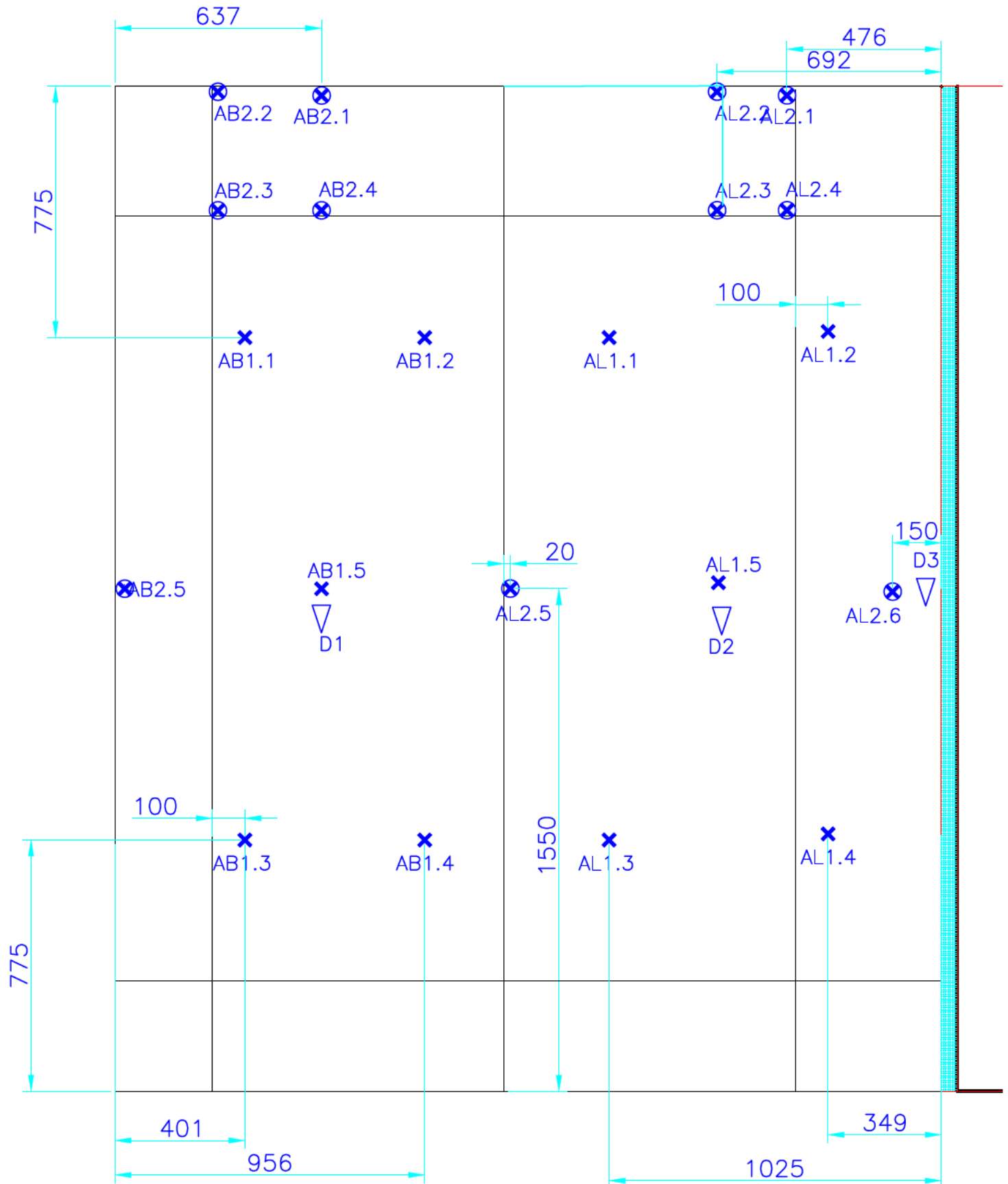
DBI drawings:	3
DBI graphs and tables:	48
Photo sheets:	13
Sponsors drawings:	3

67

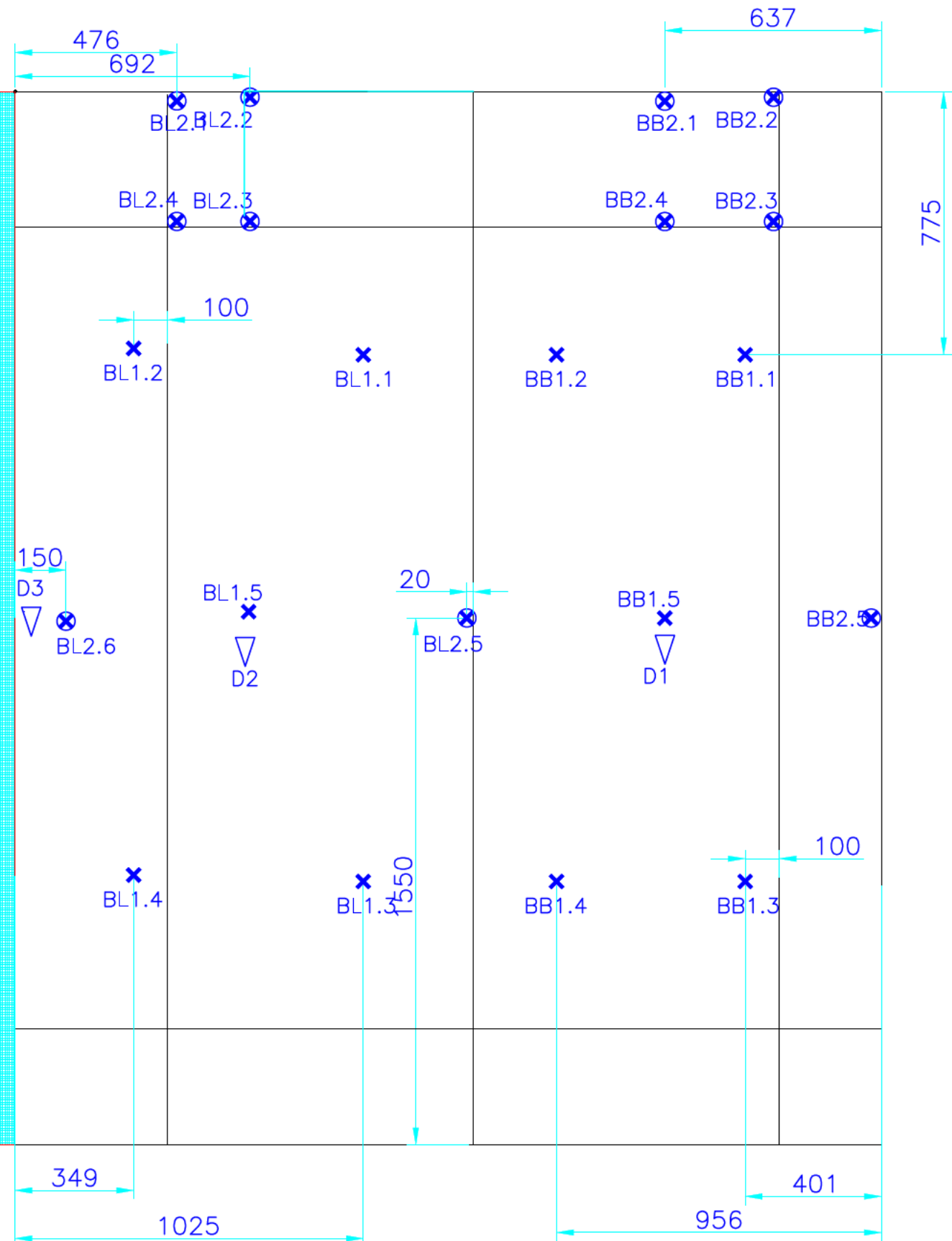


- ⊗ Thermocouple placed on the unexposed surface (average)
- ⊗ Thermocouple placed on the unexposed surface (maximum)
- ∇ Deflection measuring point

Subject: Non-load bearing wall
Enclosure: 1.3

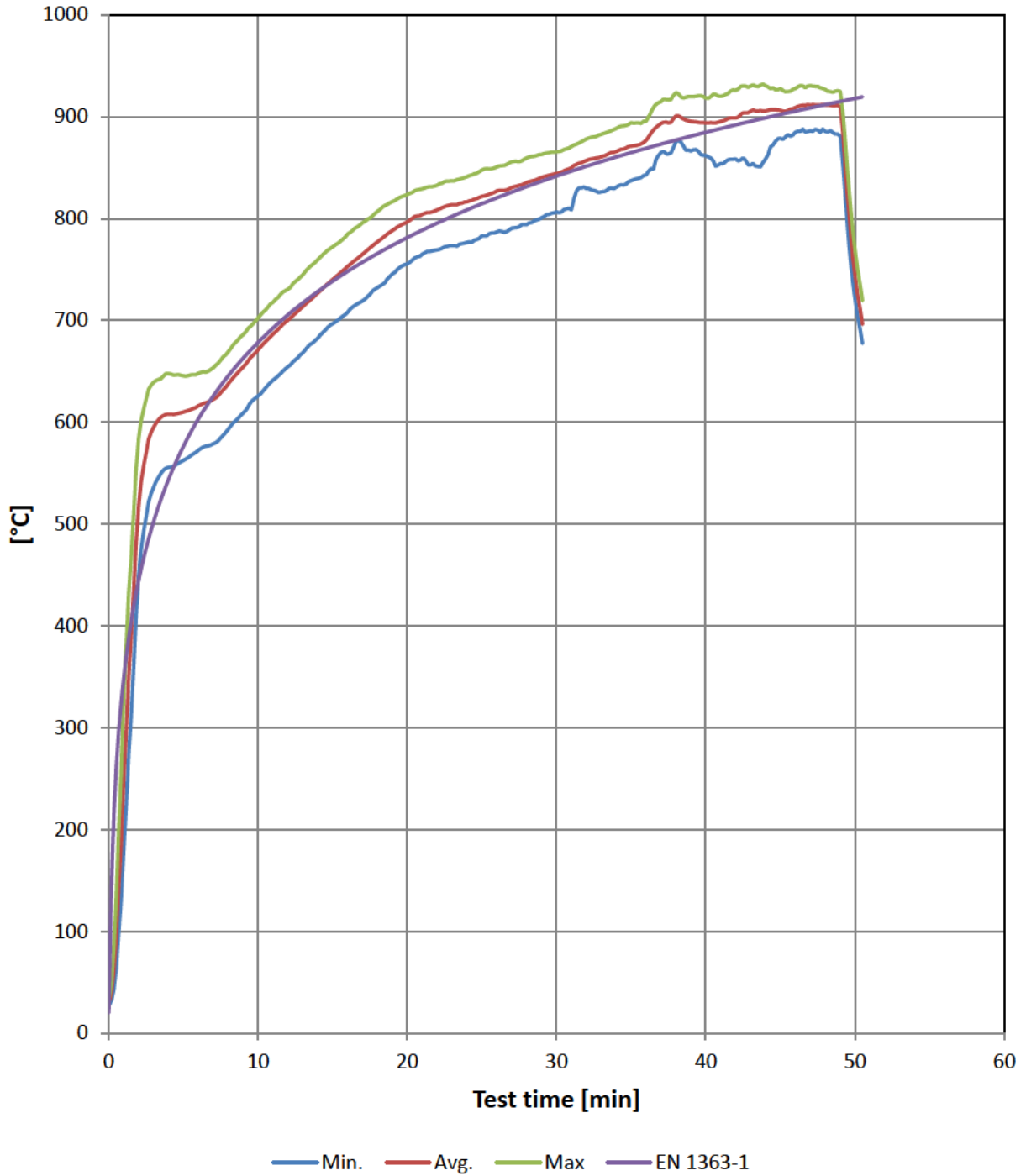


Subject: Non-load bearing wall
Enclosure: 1.4



Subject: Non-load bearing wall
Enclosure: 1.5

Furnace temperature

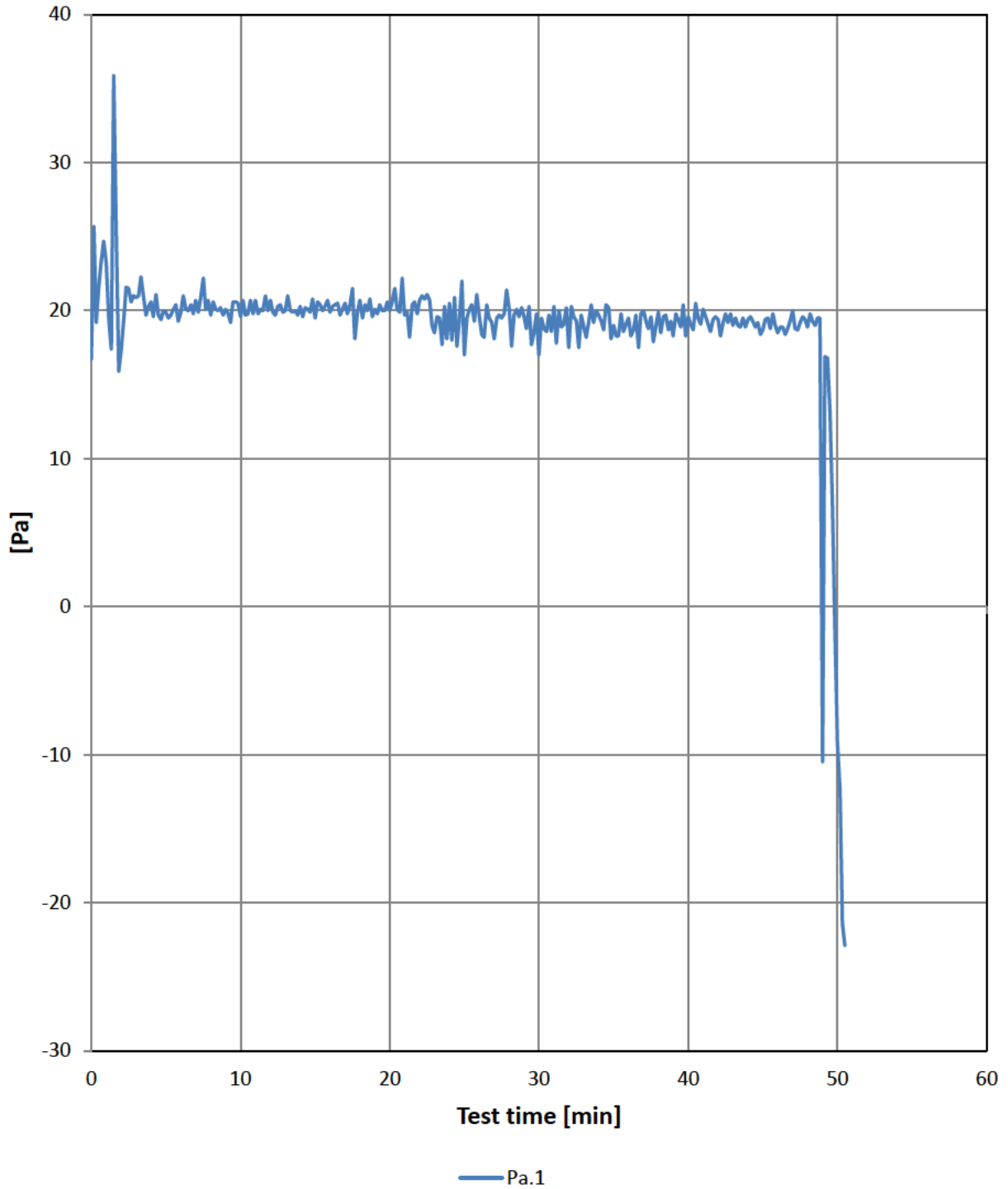


Furnace temperature

Time Minutes	Measured			Norm EN 1363-1	Area under curve		Dev. [%]	Limit [%]
	Minimum	Average	Maximum		Measured	EN 1363-1		
0	27	30	33	20	0	0	0.0	
2	449	517	584	445	500	640	-21.9	
4	556	608	648	544	1670	1639	1.9	
6	573	616	648	603	2891	2790	3.6	15
8	593	638	669	645	4140	4041	2.4	15
10	626	671	702	678	5449	5366	1.5	15
12	655	700	731	705	6821	6750	1.1	14
14	683	727	760	728	8248	8185	0.8	13
15	697	740	772	739	8982	8918	0.7	13
16	708	753	785	748	9729	9662	0.7	12
18	732	777	807	766	11259	11176	0.7	11
20	756	797	824	781	12834	12723	0.9	10
22	769	809	833	796	14442	14300	1.0	9
24	777	816	841	809	16068	15904	1.0	8
26	787	827	851	820	17711	17534	1.0	7
28	794	835	860	832	19372	19186	1.0	6
30	806	845	866	842	21052	20859	0.9	5
32	830	857	878	851	22753	22552	0.9	5
34	831	866	889	860	24476	24264	0.9	5
36	843	877	896	869	26217	25994	0.9	5
38	876	901	924	877	27999	27740	0.9	4
40	862	894	919	885	29792	29502	1.0	4
42	859	899	926	892	31584	31279	1.0	4
44	858	906	931	899	33392	33070	1.0	4
46	885	909	928	906	35206	34875	0.9	4
48	886	912	927	912	37028	36692	0.9	4
50	721	744	770	918	38764	38522	0.6	3

Vertical furnace pressure

The differential pressure in the furnace during the test, measured 3.3 m above notional floor level



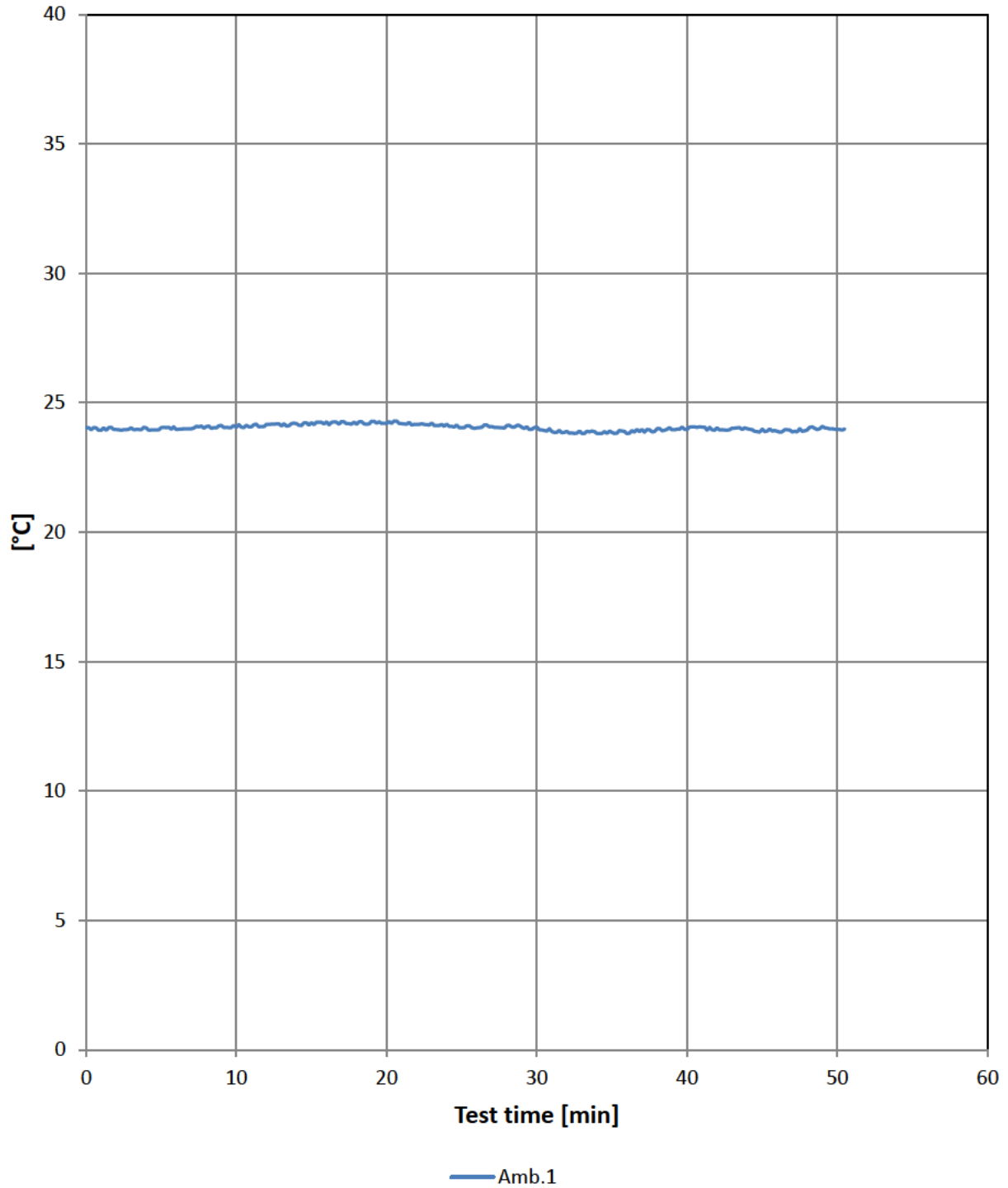
Vertical furnace pressure

The differential pressure in the furnace during the test, measured 3.3 m above notional floor level

Min. / Pa	Pa.1
0	16.7
2	17.3
4	20.6
6	19.9
8	19.7
10	19.6
12	20.7
14	20.3
15	19.5
16	19.9
18	20.7
20	20.0
22	20.7
24	20.5
26	19.6
28	20.1
30	17.0
32	17.5
34	19.7
36	19.5
38	19.9
40	19.6
42	19.4
44	19.4
46	18.5
48	18.9
50	-9.1

Ambient temperature

The ambient temperature in the laboratory during the test



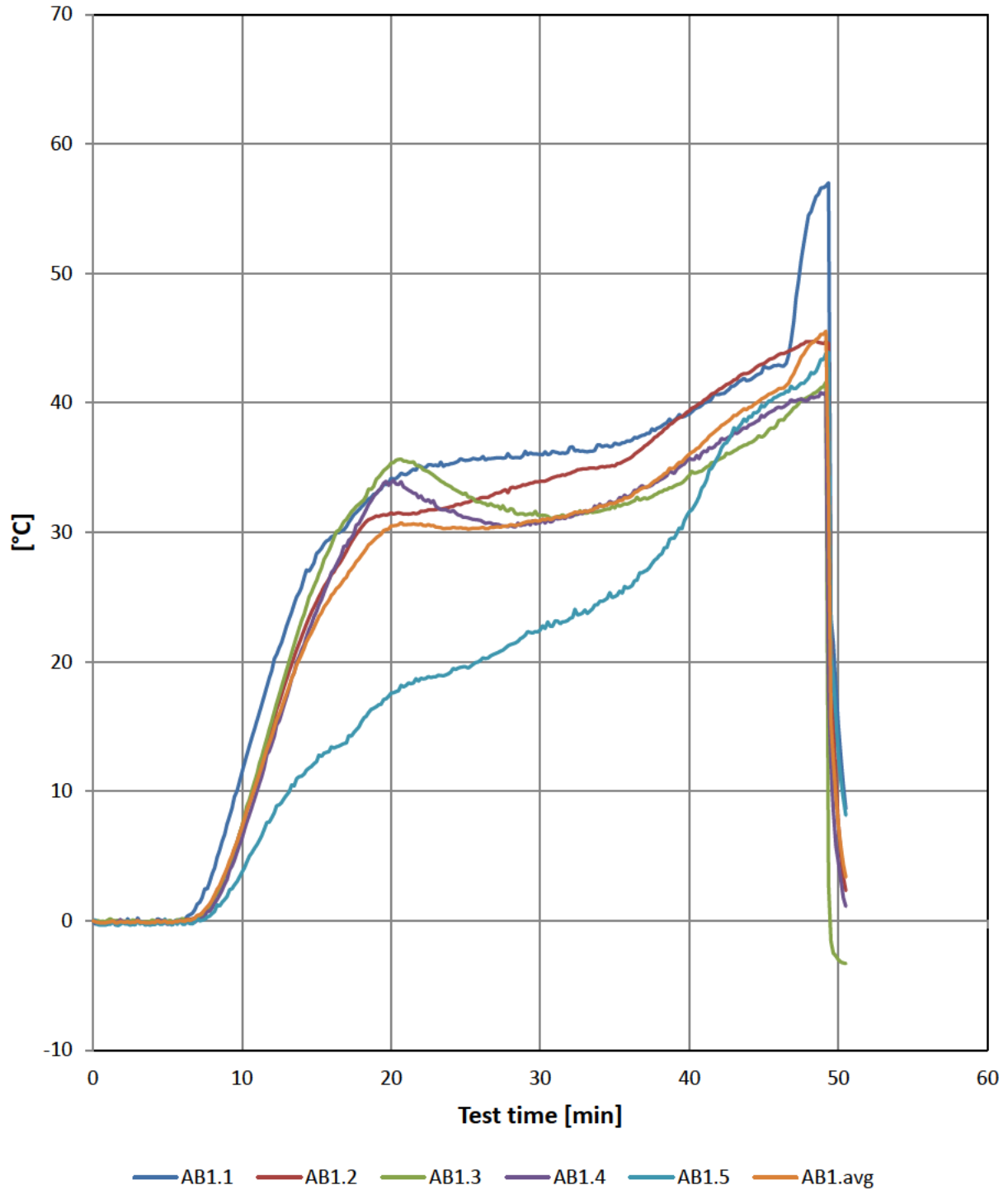
Ambient temperature

The ambient temperature in the laboratory during the test

Min. / °C	Amb.1
0	24
2	24
4	24
6	24
8	24
10	24
12	24
14	24
15	24
16	24
18	24
20	24
22	24
24	24
26	24
28	24
30	24
32	24
34	24
36	24
38	24
40	24
42	24
44	24
46	24
48	24
50	24

Average temperature rise AB

Measured with 5 thermocouples



Average temperature rise AB

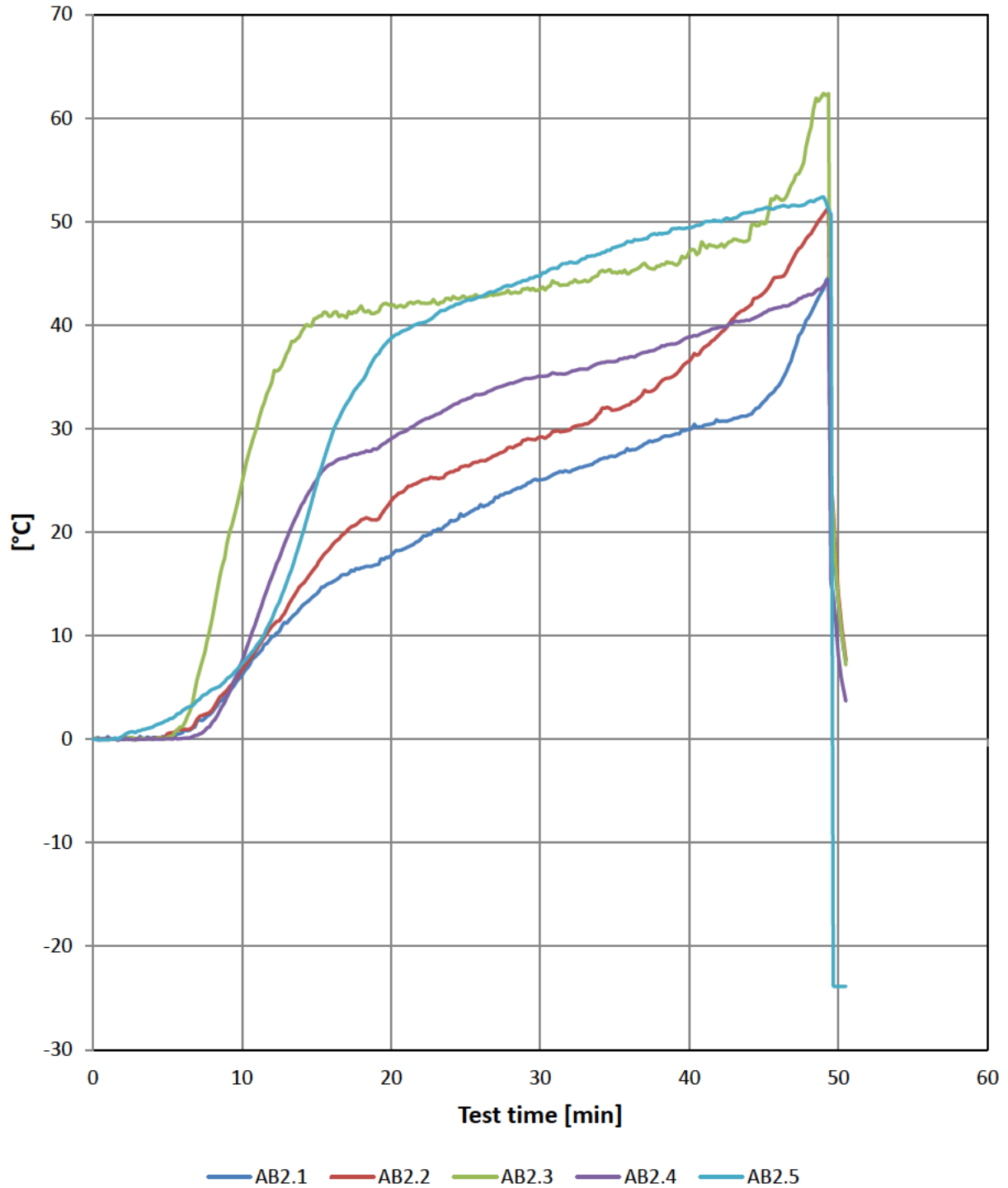
Measured with 5 thermocouples

Min. / °C	AB1.1	AB1.2	AB1.3	AB1.4	AB1.5	AB1.Avg	AB1.Max
0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
8	4	2	1	1	1	2	4
10	11	7	7	6	4	7	11
12	19	15	15	14	8	14	19
14	26	22	23	21	11	21	26
15	28	25	26	24	12	23	28
16	30	27	29	27	13	25	30
18	32	30	32	31	15	28	32
20	34	32	35	34	18	30	35
22	35	32	35	33	19	31	35
24	35	32	34	32	19	30	35
26	36	33	32	31	20	30	36
28	36	33	32	31	21	31	36
30	36	34	31	31	22	31	36
32	37	35	31	31	23	31	37
34	37	35	32	32	25	32	37
36	37	36	32	33	26	33	37
38	38	38	33	34	28	34	38
40	39	39	34	36	32	36	39
42	41	41	36	37	36	38	41
44	42	42	37	38	39	40	42
46	43	44	39	40	41	41	44
48	54	45	40	40	42	44	54
50	15	8	-3	5	13	7	15

Failure [min]	-	-	-	-	-	-	-
Failure °C	180	180	180	180	180	140	180

Maximum temperature rise AB

Maximum temperature rise on the unexposed side



Maximum temperature rise AB

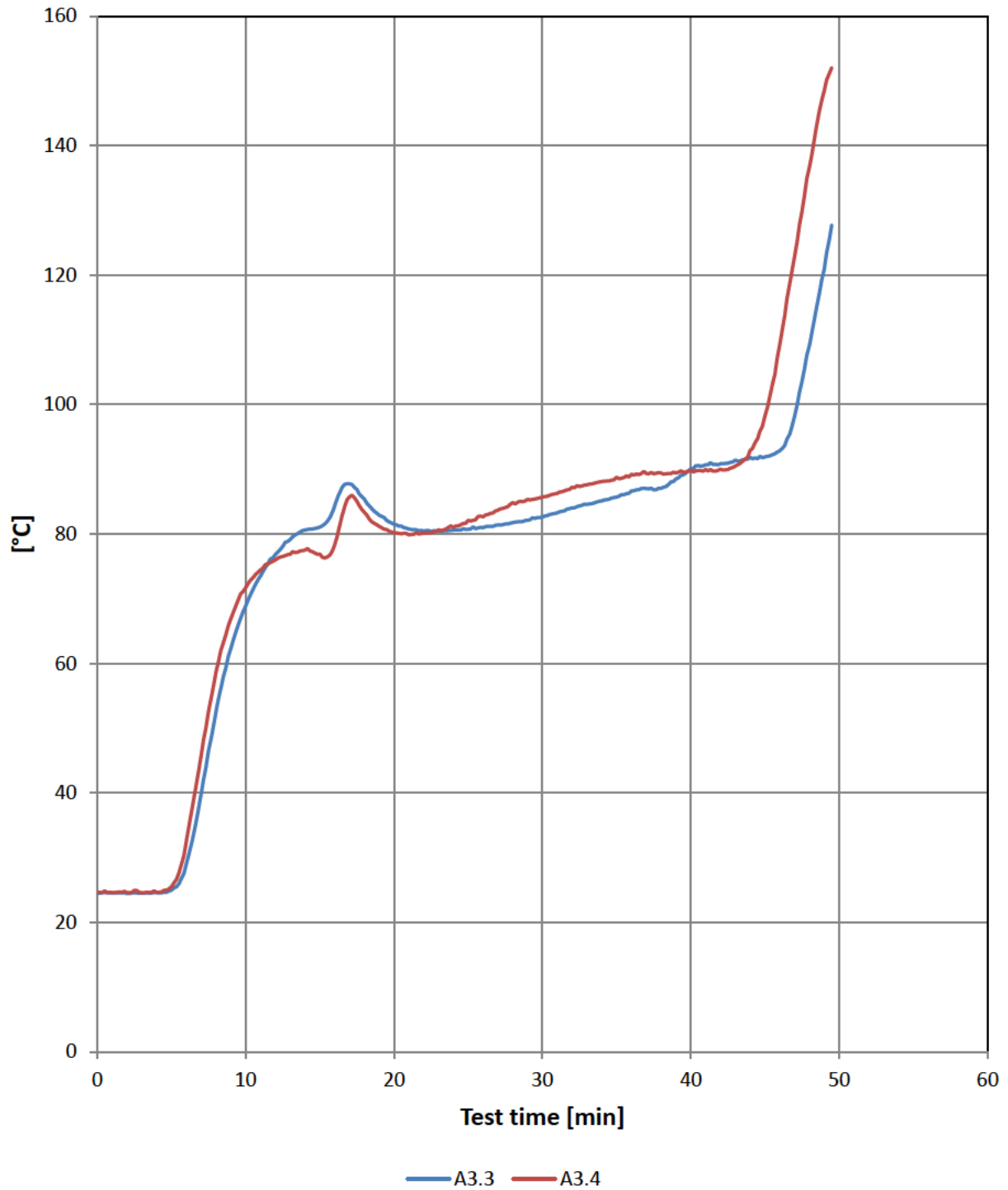
Maximum temperature rise on the unexposed side

Min. / °C	AB2.1	AB2.2	AB2.3	AB2.4	AB2.5	AB2.Max
0	0	0	0	0	0	0
2	0	0	0	0	0	0
4	0	0	0	0	1	1
6	1	1	1	0	3	3
8	3	3	12	2	5	12
10	6	7	25	8	7	25
12	10	11	35	16	12	35
14	13	15	39	23	20	39
15	14	17	41	25	25	41
16	15	19	41	27	29	41
18	17	21	42	28	35	42
20	18	23	42	29	39	42
22	19	25	42	31	40	42
24	21	26	42	32	42	42
26	23	27	43	33	43	43
28	24	28	43	34	44	44
30	25	29	43	35	45	45
32	26	30	44	35	46	46
34	27	32	45	36	47	47
36	28	32	45	37	48	48
38	29	34	46	38	49	49
40	30	37	47	39	49	49
42	31	39	48	40	50	50
44	31	42	48	40	51	51
46	34	45	52	42	51	52
48	41	49	58	43	52	58
50	13	14	13	8	-24	14

Failure [min]	-	-	-	-	-	-
Failure °C	180	180	180	180	180	180

Wall A B - indicative temperature - unexposed gypsum

Maximum temperature rise inside the construction



Wall A B - indicative temperature - unexposed gypsum

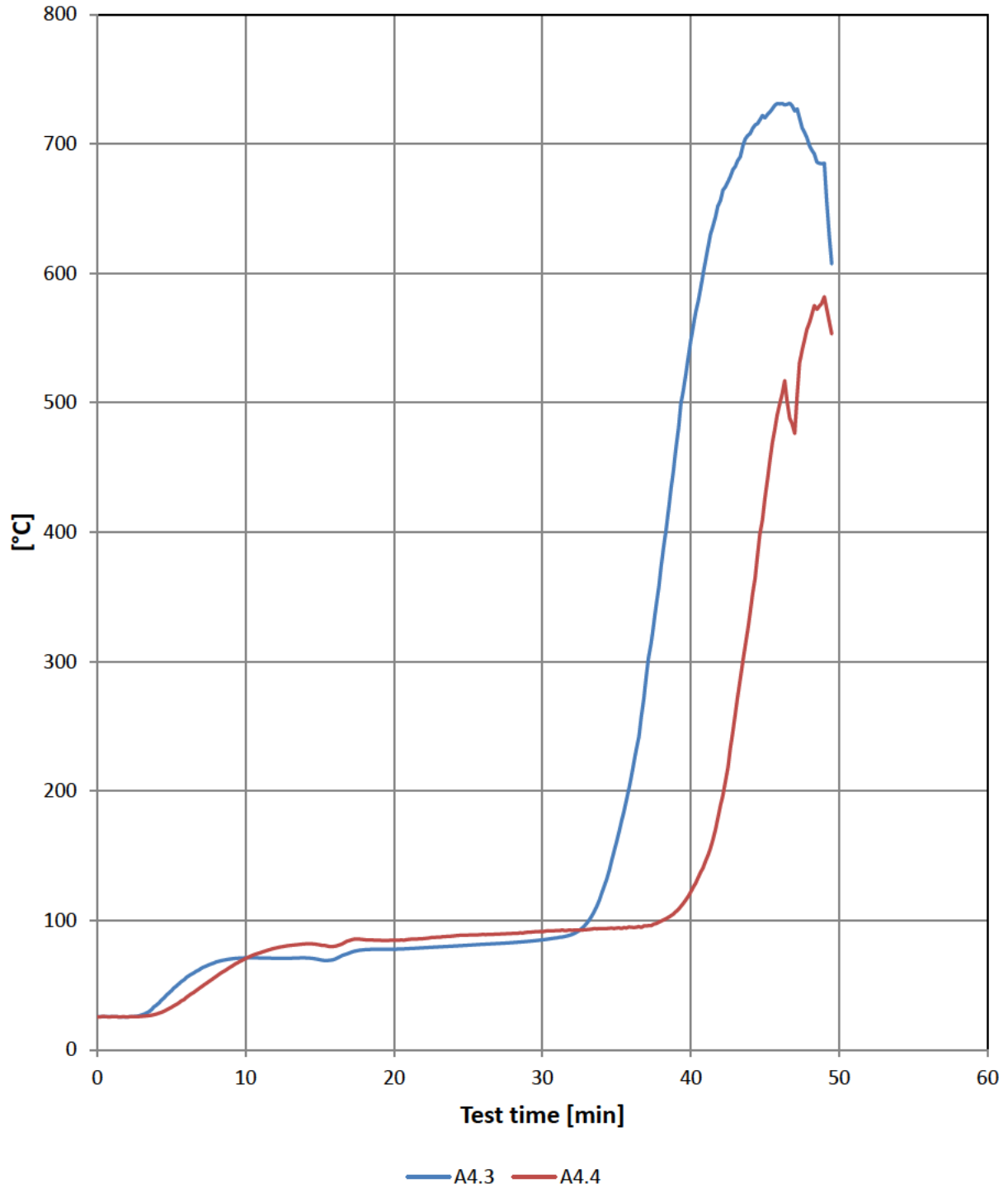
Maximum temperature rise inside the construction

Min. / °C	A3.3	A3.4	A3.Max
0	25	25	25
2	24	25	25
4	25	25	25
6	29	33	33
8	53	59	59
10	69	72	72
12	77	76	77
14	81	78	81
15	81	77	81
16	84	78	84
18	85	83	85
20	82	80	82
22	80	80	80
24	81	81	81
26	81	83	83
28	82	85	85
30	83	86	86
32	84	87	87
34	85	88	88
36	87	89	89
38	87	89	89
40	90	90	90
42	91	90	91
44	92	93	93
46	93	109	109
48	109	137	137
50	0	0	0

Failure [min]	-	-	-
Failure °C	180	180	180

Wall AB - indicative temperature - center studs

Maximum temperature rise inside the construction



Wall AB - indicative temperature - center studs

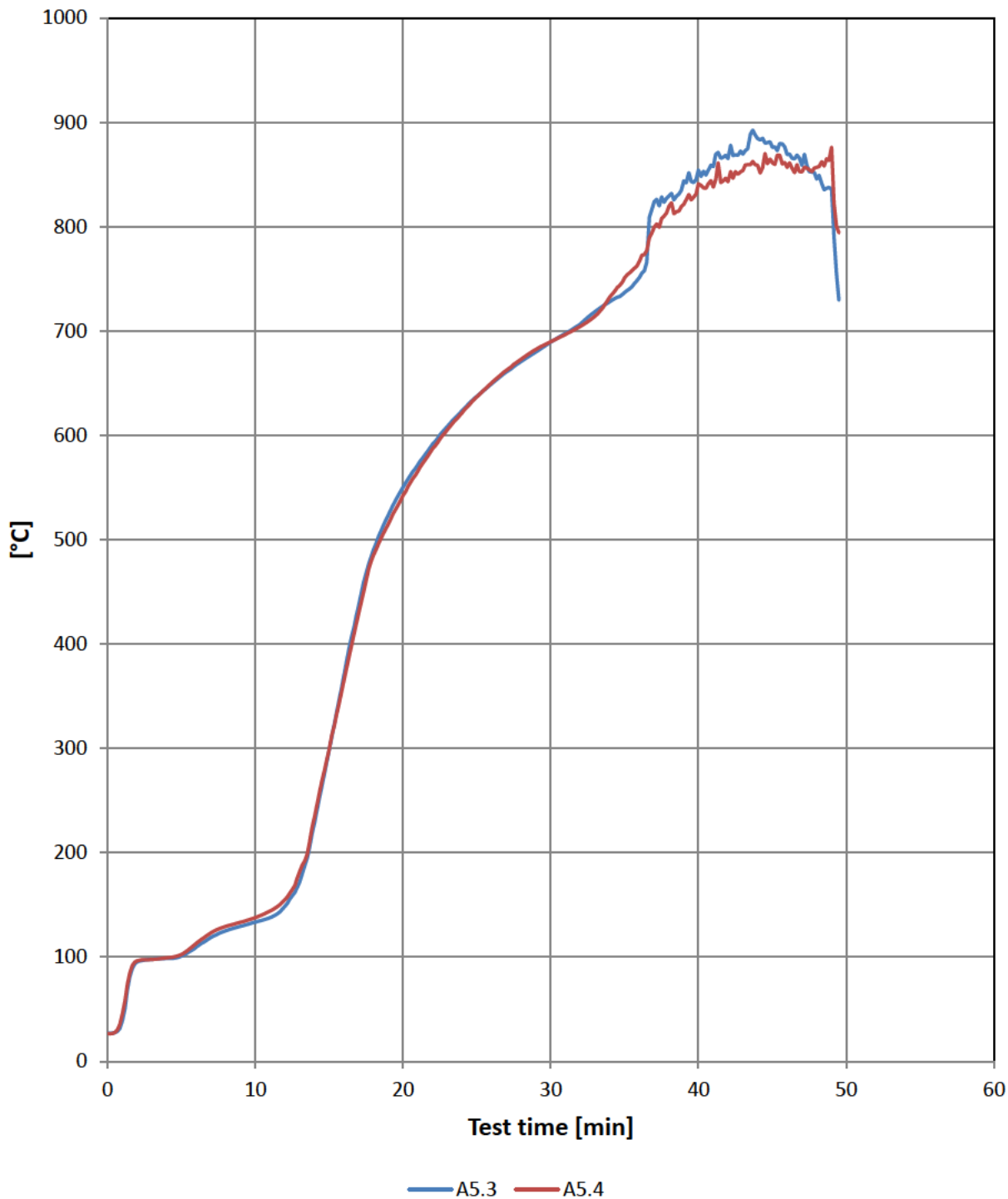
Maximum temperature rise inside the construction

Min. / °C	A4.3	A4.4	A4.Max
0	26	26	26
2	26	25	26
4	35	28	35
6	56	41	56
8	68	57	68
10	71	71	71
12	71	79	79
14	71	82	82
15	70	81	81
16	70	80	80
18	77	85	85
20	78	85	85
22	79	86	86
24	80	88	88
26	82	89	89
28	83	90	90
30	85	91	91
32	89	92	92
34	121	94	121
36	212	95	212
38	373	99	373
40	548	122	548
42	656	189	656
44	708	337	708
46	731	499	731
48	699	562	699
50	0	0	0

Failure [min]	35.33	41.83	35.33
Failure °C	180	180	180

Wall AB - indicative temperature - exposed gypsum

Maximum temperature rise inside the construction



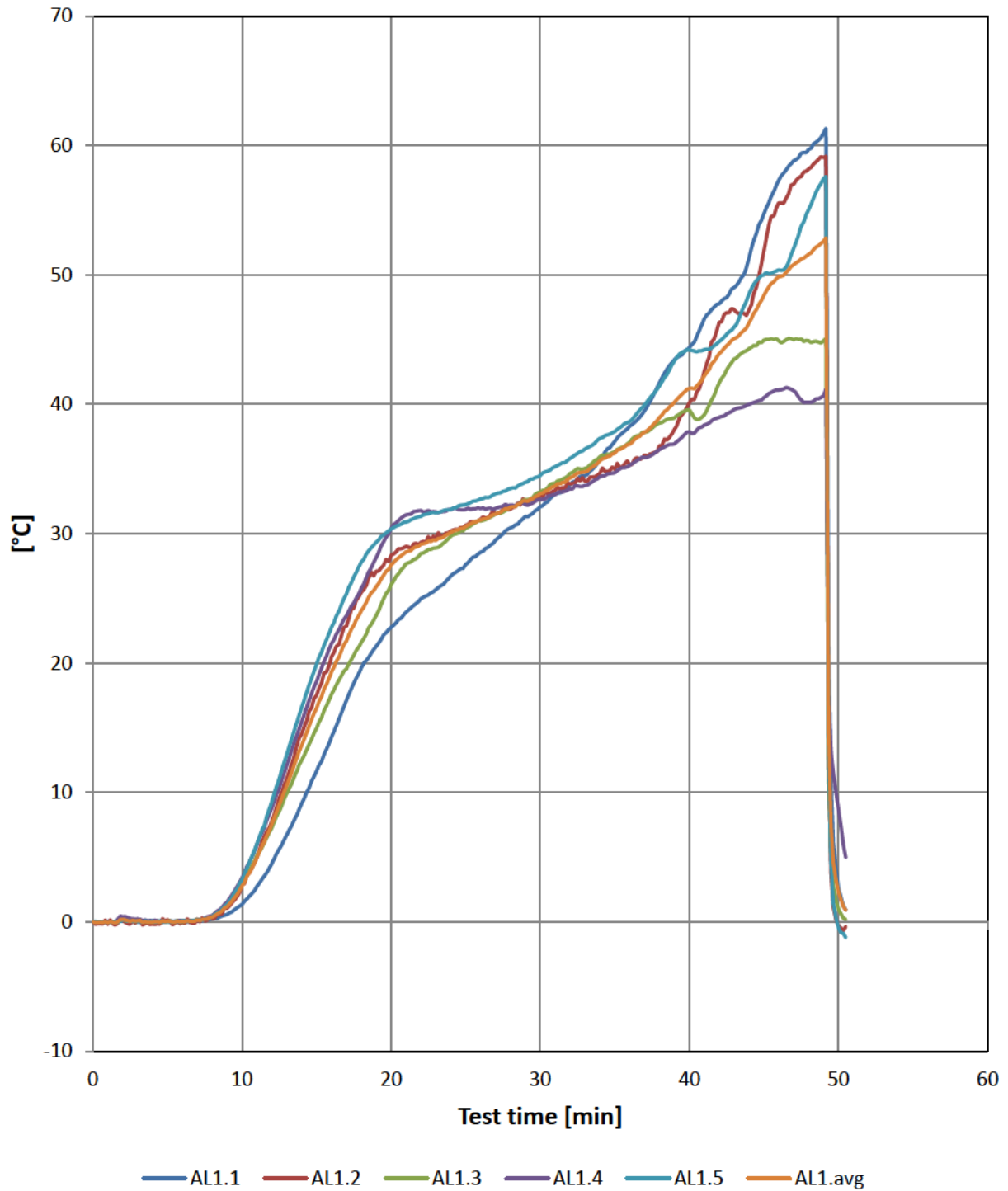
Wall AB - indicative temperature - exposed gypsum*Maximum temperature rise inside the construction*

Min. / °C	A5.3	A5.4	A5.Max
0	27	27	27
2	95	97	97
4	99	99	99
6	110	113	113
8	125	130	130
10	133	138	138
12	149	155	155
14	229	235	235
15	298	299	299
16	371	366	371
18	490	485	490
20	551	542	551
22	592	587	592
24	624	622	624
26	650	651	651
28	671	673	673
30	690	690	690
32	707	705	707
34	729	733	733
36	752	767	767
38	830	820	830
40	854	841	854
42	865	843	865
44	885	859	885
46	869	857	869
48	846	857	857
50	0	0	0

Failure [min]	13.17	12.83	12.83
Failure °C	180	180	180

Average temperature rise AL

Measured with 5 thermocouples



Average temperature rise AL

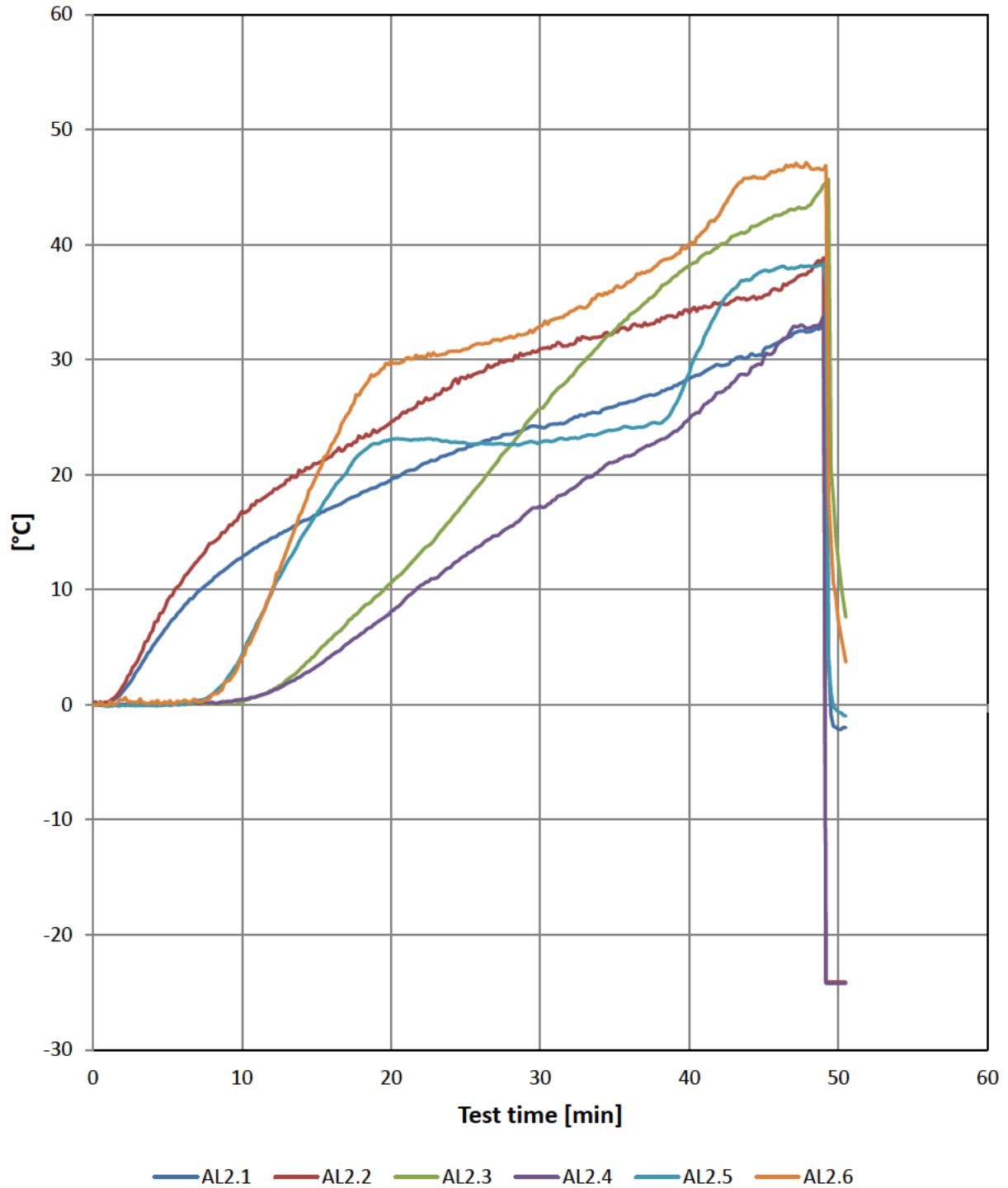
Measured with 5 thermocouples

Min. / °C	AL1.1	AL1.2	AL1.3	AL1.4	AL1.5	AL1.Avg	AL1.Max
0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
10	1	3	3	3	3	3	3
12	5	8	7	9	9	8	9
14	9	15	12	15	17	14	17
15	12	18	15	19	20	17	20
16	14	20	18	21	23	19	23
18	20	25	22	26	28	24	28
20	23	28	26	30	30	28	30
22	25	29	28	32	31	29	32
24	27	30	30	32	32	30	32
26	29	31	31	32	33	31	33
28	30	32	32	32	34	32	34
30	32	33	33	33	34	33	34
32	34	34	35	33	36	34	36
34	36	35	36	34	37	36	37
36	38	35	37	35	39	37	39
38	42	37	39	36	41	39	42
40	44	40	40	38	44	41	44
42	48	46	42	39	45	44	48
44	51	47	44	40	49	46	51
46	57	56	45	41	50	50	57
48	60	58	45	40	55	52	60
50	3	0	1	9	0	2	9

Failure [min]	-	-	-	-	-	-	-
Failure °C	180	180	180	180	180	140	180

Maximum temperature rise AL

Maximum temperature rise on the unexposed side



Maximum temperature rise AL

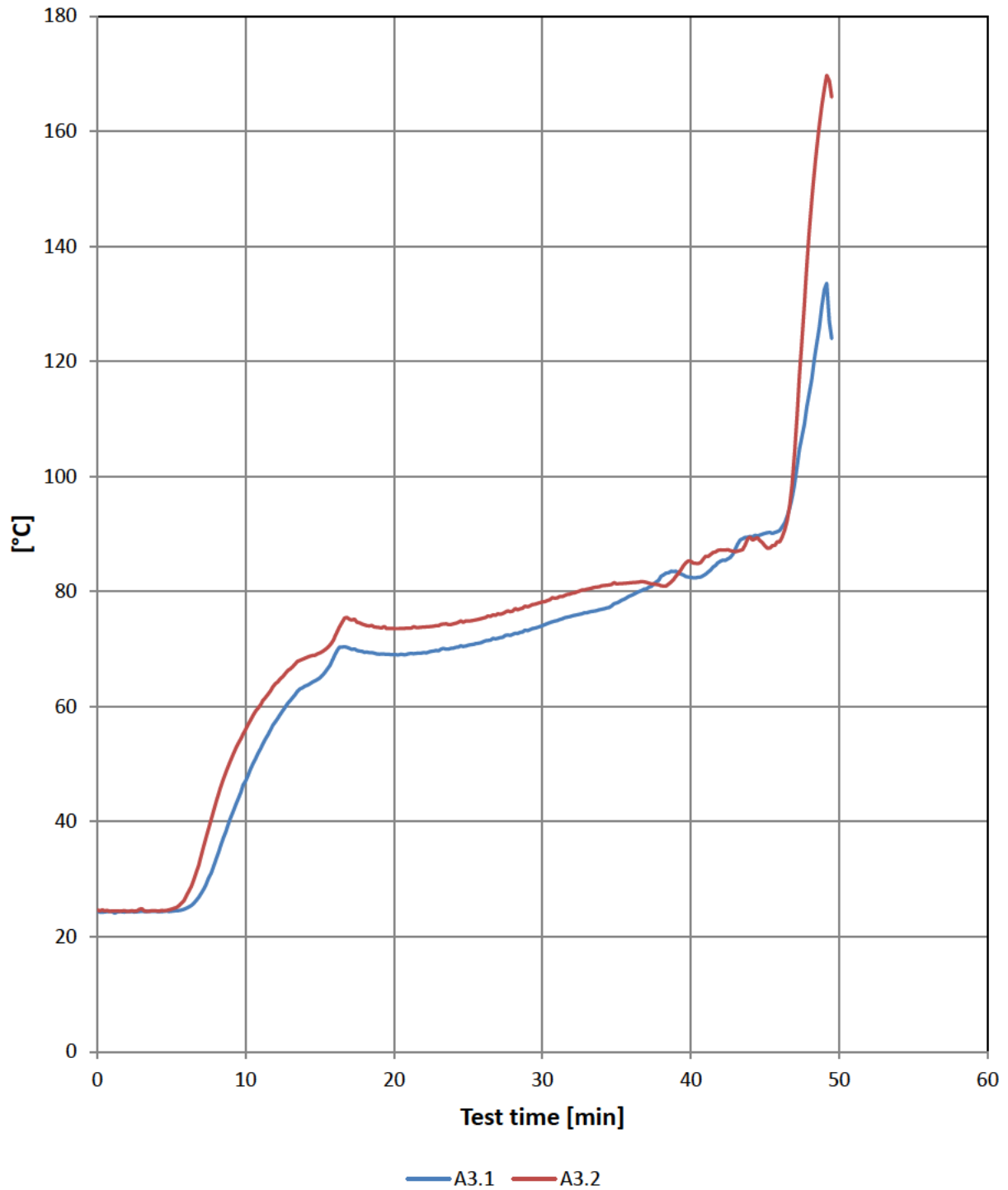
Maximum temperature rise on the unexposed side

Min. / °C	AL2.1	AL2.2	AL2.3	AL2.4	AL2.5	AL2.6	AL2.Max
0	0	0	0	0	0	0	0
2	1	2	0	0	0	0	2
4	5	6	0	0	0	0	6
6	8	11	0	0	0	0	11
8	11	14	0	0	1	1	14
10	13	17	0	0	4	4	17
12	15	18	1	1	10	10	18
14	16	20	3	3	15	17	20
15	16	21	4	3	17	20	21
16	17	22	6	4	19	23	23
18	18	23	8	6	22	27	27
20	20	25	11	8	23	30	30
22	21	26	13	10	23	30	30
24	22	28	16	12	23	31	31
26	23	29	19	14	23	31	31
28	24	30	23	16	23	32	32
30	24	31	26	17	23	33	33
32	25	31	28	19	23	34	34
34	25	32	31	20	24	36	36
36	26	33	34	22	24	37	37
38	27	33	36	23	24	38	38
40	28	34	38	25	29	40	40
42	30	35	40	27	35	43	43
44	30	35	41	29	37	46	46
46	32	36	43	31	38	46	46
48	32	38	43	33	38	47	47
50	-2	-24	12	-24	-1	7	12

Failure [min]	-	-	-	-	-	-	-
Failure °C	180	180	180	180	180	180	180

Wall A L - indicative temperature - unexposed gypsum

Maximum temperature rise inside the construction



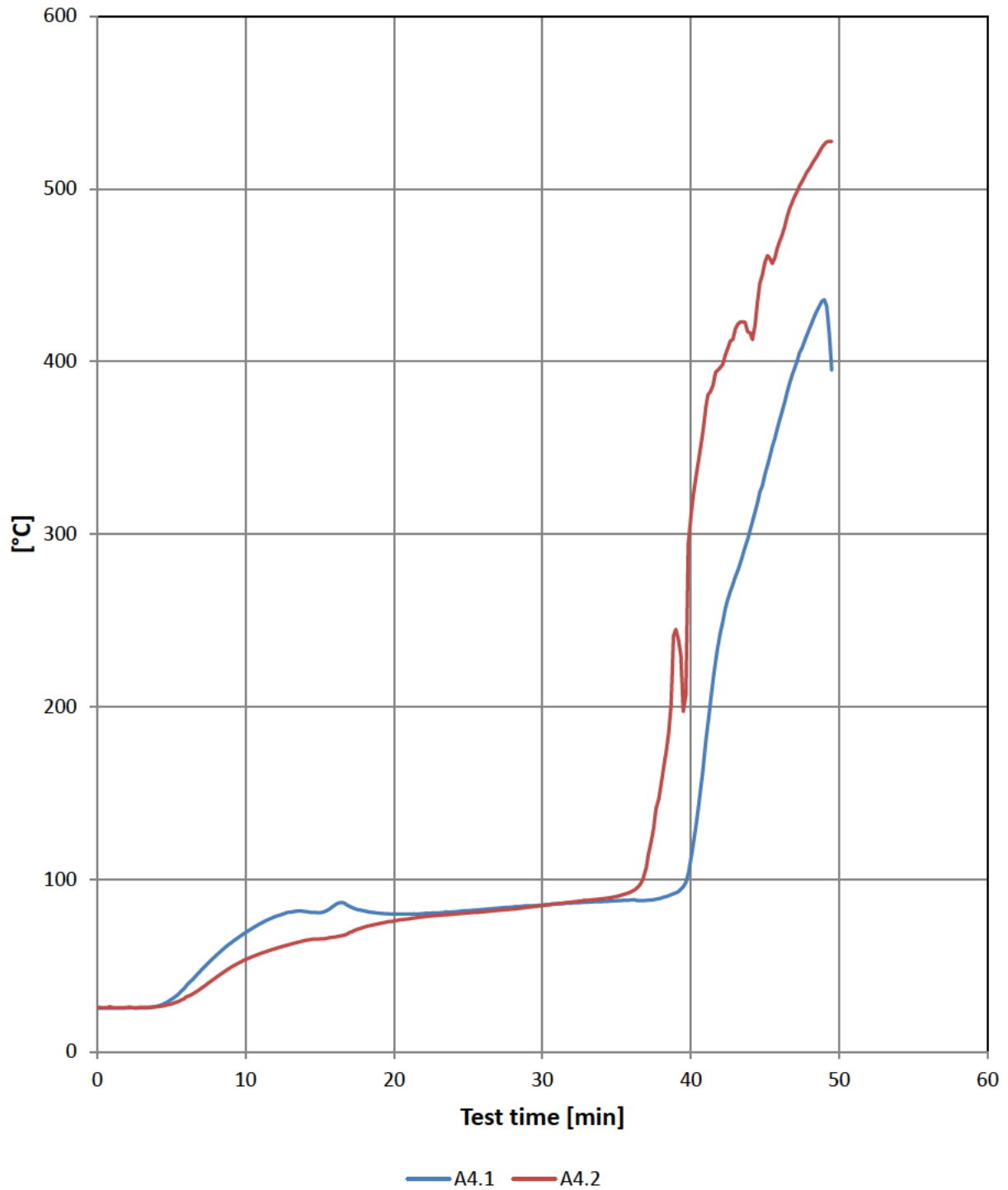
Wall A L - indicative temperature - unexposed gypsum*Maximum temperature rise inside the construction*

Min. / °C	A3.1	A3.2	A3.Max
0	24	25	25
2	24	24	24
4	24	25	25
6	25	27	27
8	33	43	43
10	47	56	56
12	57	64	64
14	64	68	68
15	65	69	69
16	69	72	72
18	69	74	74
20	69	74	74
22	69	74	74
24	70	74	74
26	71	75	75
28	73	77	77
30	74	78	78
32	76	80	80
34	77	81	81
36	79	82	82
38	83	81	83
40	82	85	85
42	85	87	87
44	90	89	90
46	91	89	91
48	115	143	143
50	0	0	0

Failure [min]	-	-	-
Failure °C	180	180	180

Wall AL - indicative temperature - center studs

Maximum temperature rise inside the construction



Wall AL - indicative temperature - center studs

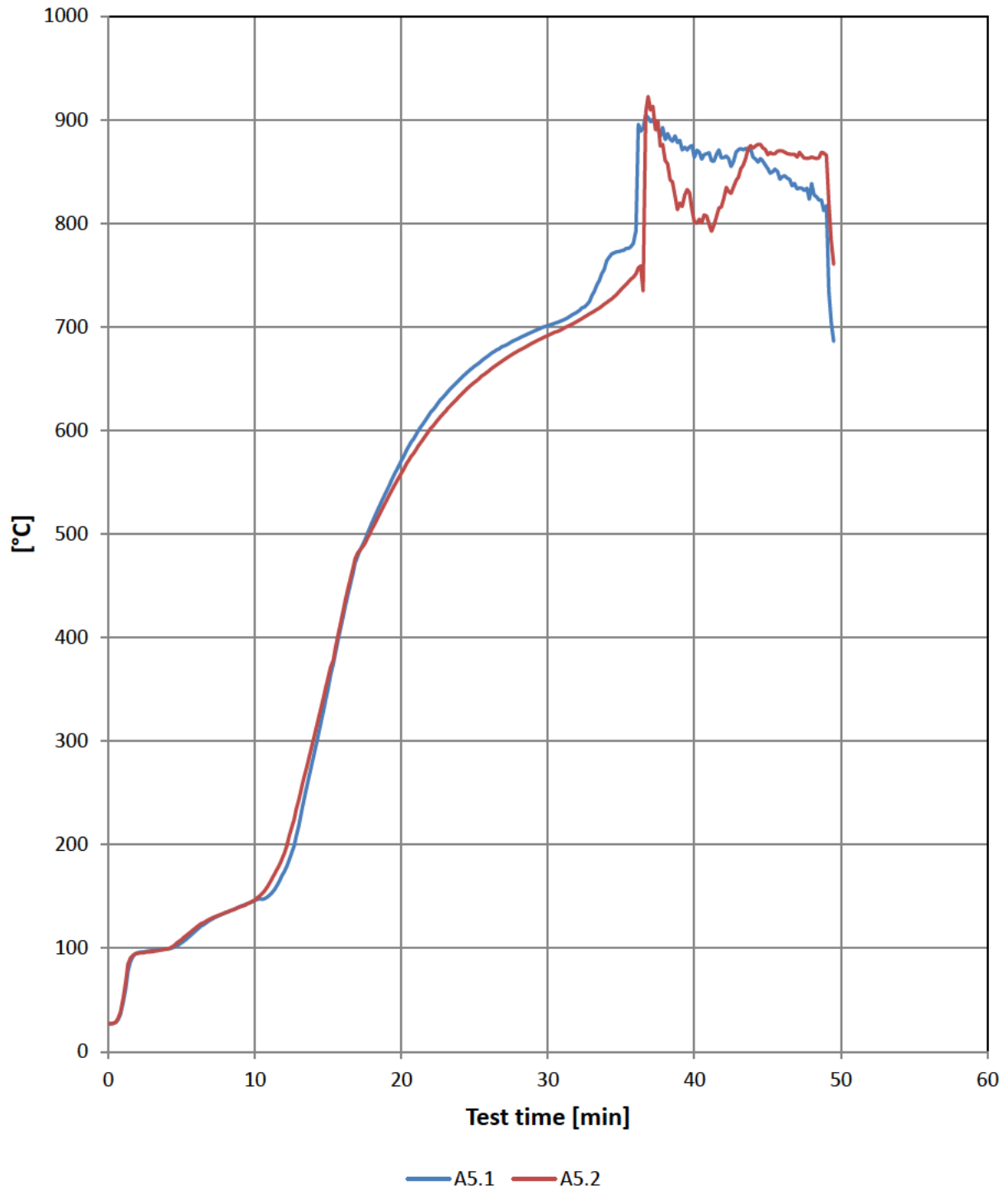
Maximum temperature rise inside the construction

Min. / °C	A4.1	A4.2	A4.Max
0	25	26	26
2	25	26	26
4	26	26	26
6	38	32	38
8	56	43	56
10	69	53	69
12	78	60	78
14	81	65	81
15	81	65	81
16	85	67	85
18	82	72	82
20	80	76	80
22	80	78	80
24	81	80	81
26	83	81	83
28	84	83	84
30	85	85	85
32	86	87	87
34	87	89	89
36	88	93	93
38	89	155	155
40	112	308	308
42	243	397	397
44	302	417	417
46	366	470	470
48	419	512	512
50	0	0	0

Failure [min]	41.00	38.33	38.33
Failure °C	180	180	180

Wall AL - indicative temperature - exposed gypsum

Maximum temperature rise inside the construction



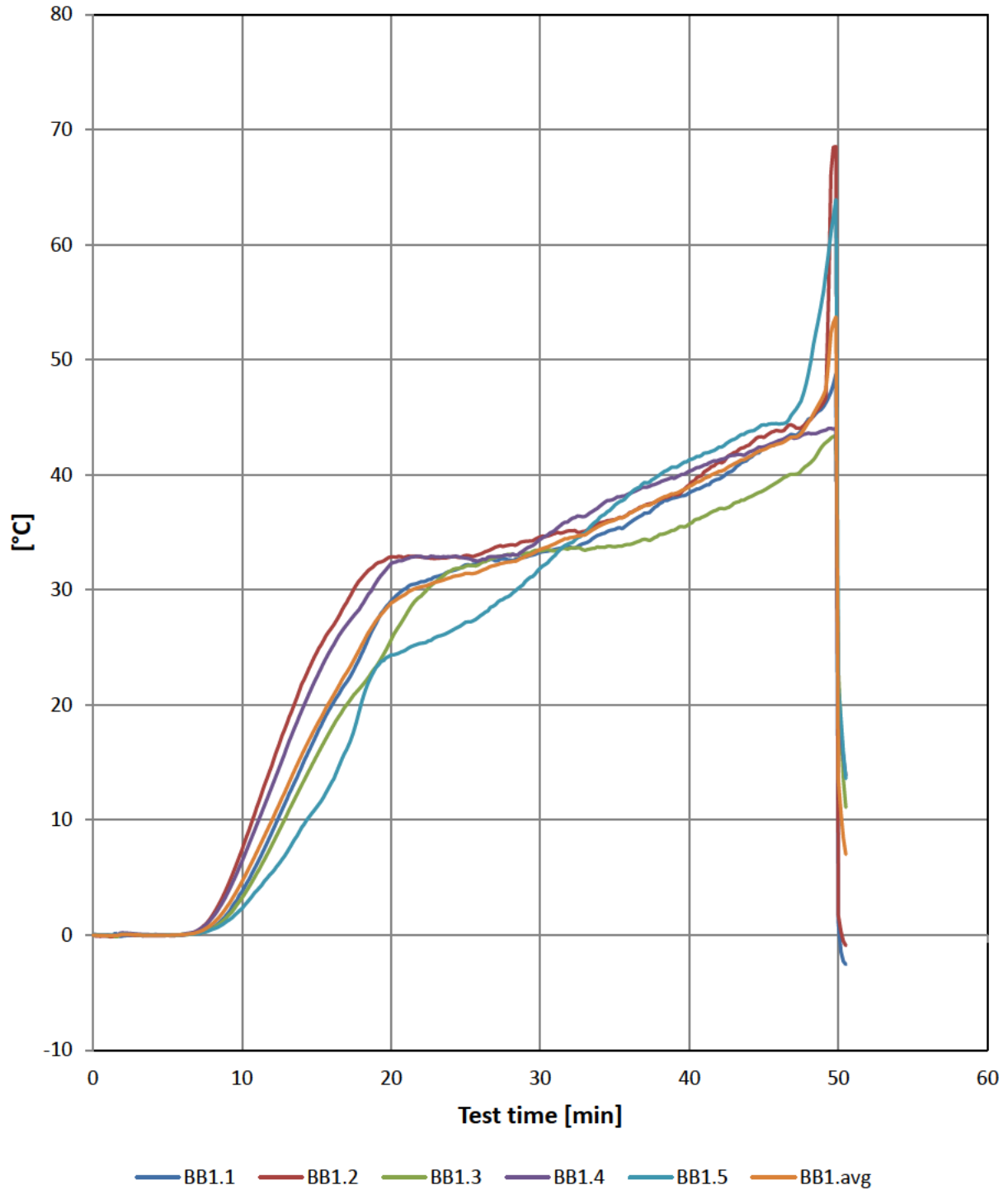
Wall AL - indicative temperature - exposed gypsum*Maximum temperature rise inside the construction*

Min. / °C	A5.1	A5.2	A5.Max
0	27	27	27
2	96	95	96
4	99	99	99
6	118	121	121
8	134	135	135
10	146	147	147
12	174	192	192
14	285	302	302
15	351	361	361
16	420	425	425
18	511	505	511
20	571	559	571
22	618	602	618
24	650	634	650
26	673	658	673
28	689	677	689
30	701	692	701
32	715	705	715
34	764	724	764
36	793	751	793
38	881	860	881
40	864	801	864
42	864	824	864
44	864	873	873
46	845	870	870
48	839	864	864
50	0	0	0

Failure [min]	12.17	11.67	11.67
Failure °C	180	180	180

Average temperature rise BB

Measured with 5 thermocouples



Average temperature rise BB

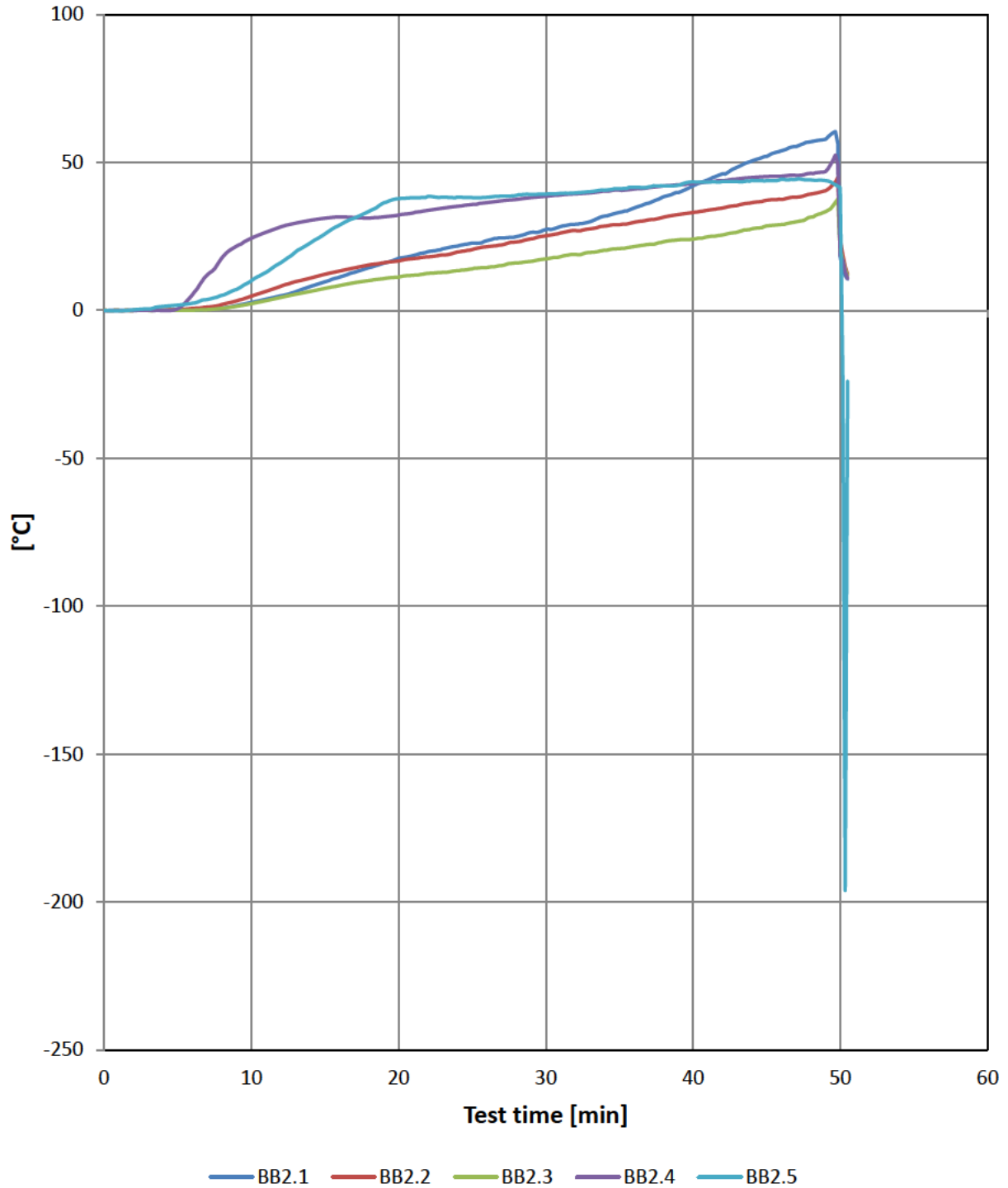
Measured with 5 thermocouples

Min. / °C	BB1.1	BB1.2	BB1.3	BB1.4	BB1.5	BB1.Avg	BB1.Max
0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
8	1	2	1	2	0	1	2
10	4	7	3	6	2	5	7
12	9	15	8	13	5	10	15
14	15	22	13	19	9	16	22
15	17	25	16	22	11	18	25
16	20	27	18	25	13	21	27
18	24	31	22	29	20	25	31
20	29	33	26	32	24	29	33
22	31	33	29	33	25	30	33
24	32	33	32	33	26	31	33
26	32	33	32	33	28	32	33
28	33	34	33	33	30	32	34
30	33	35	33	34	32	34	35
32	34	35	34	36	34	35	36
34	35	36	34	37	36	36	37
36	36	37	34	38	38	37	38
38	38	38	35	39	40	38	40
40	38	39	36	40	41	39	41
42	40	41	37	41	42	40	42
44	41	43	38	42	44	42	44
46	43	44	39	43	44	43	44
48	45	45	41	44	49	45	49
50	1	2	23	20	22	14	23

Failure [min]	-	-	-	-	-	-	-
Failure °C	180	180	180	180	180	140	180

Maximum temperature rise BB

Maximum temperature rise on the unexposed side



Maximum temperature rise BB

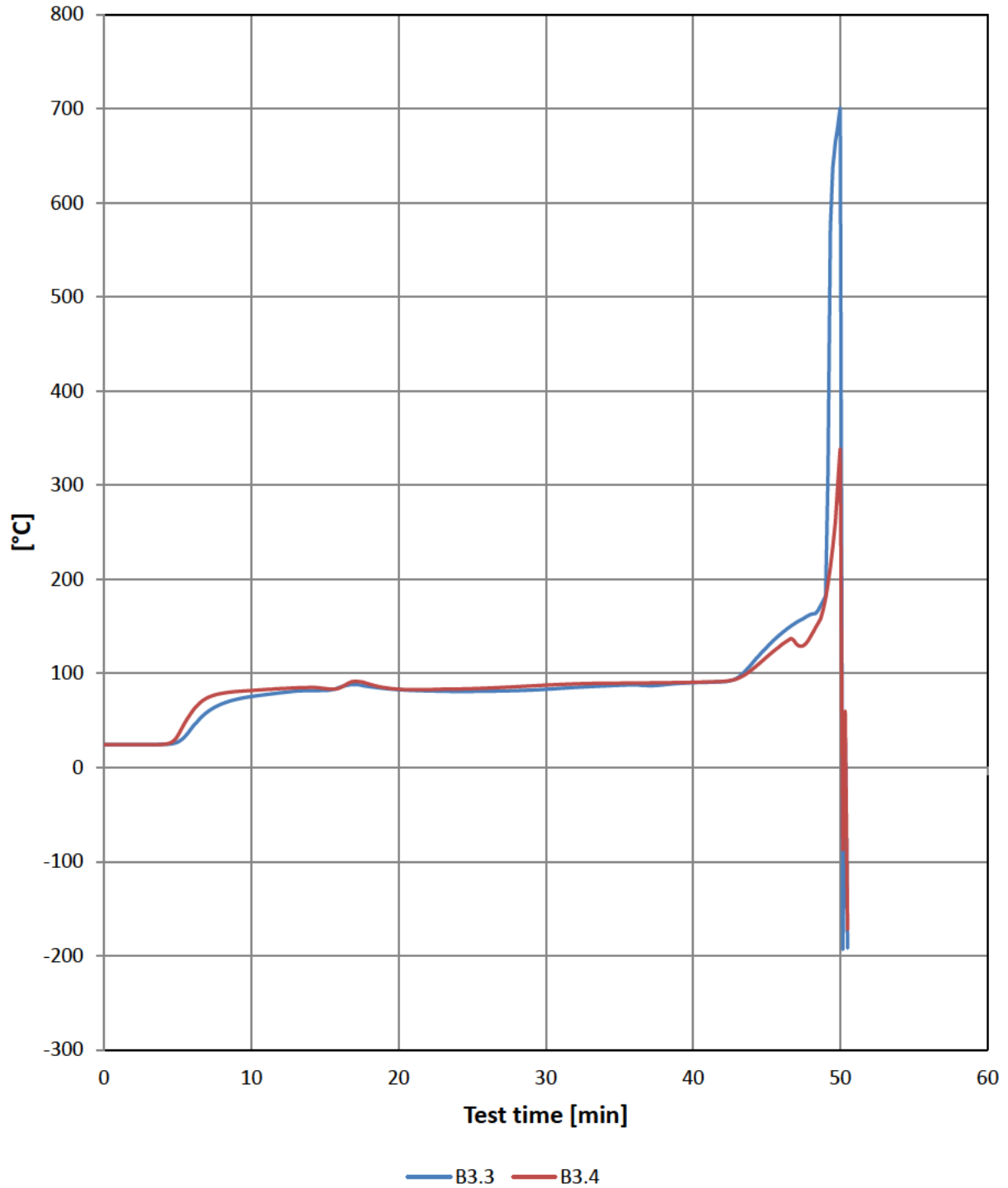
Maximum temperature rise on the unexposed side

Min. / °C	BB2.1	BB2.2	BB2.3	BB2.4	BB2.5	BB2.Max
0	0	0	0	0	0	0
2	0	0	0	0	0	0
4	0	0	0	0	1	1
6	0	1	0	5	2	5
8	1	2	1	18	5	18
10	3	5	2	24	10	24
12	5	8	4	28	16	28
14	8	11	6	30	23	30
15	10	12	7	31	26	31
16	11	13	8	32	29	32
18	14	15	10	31	34	34
20	18	17	11	32	38	38
22	20	18	13	34	39	39
24	22	20	13	35	38	38
26	24	22	15	36	38	38
28	25	23	16	38	39	39
30	27	25	17	39	39	39
32	29	27	19	39	40	40
34	32	28	20	40	41	41
36	35	30	22	41	42	42
38	38	32	23	42	42	42
40	42	33	24	43	43	43
42	46	35	26	44	44	46
44	51	36	28	45	44	51
46	54	38	29	45	44	54
48	57	39	32	46	44	57
50	18	24	20	19	42	42

Failure [min]	-	-	-	-	-	-
Failure °C	180	180	180	180	180	180

Wall BB - indicative temperature - unexposed gypsum

Maximum temperature rise inside the construction



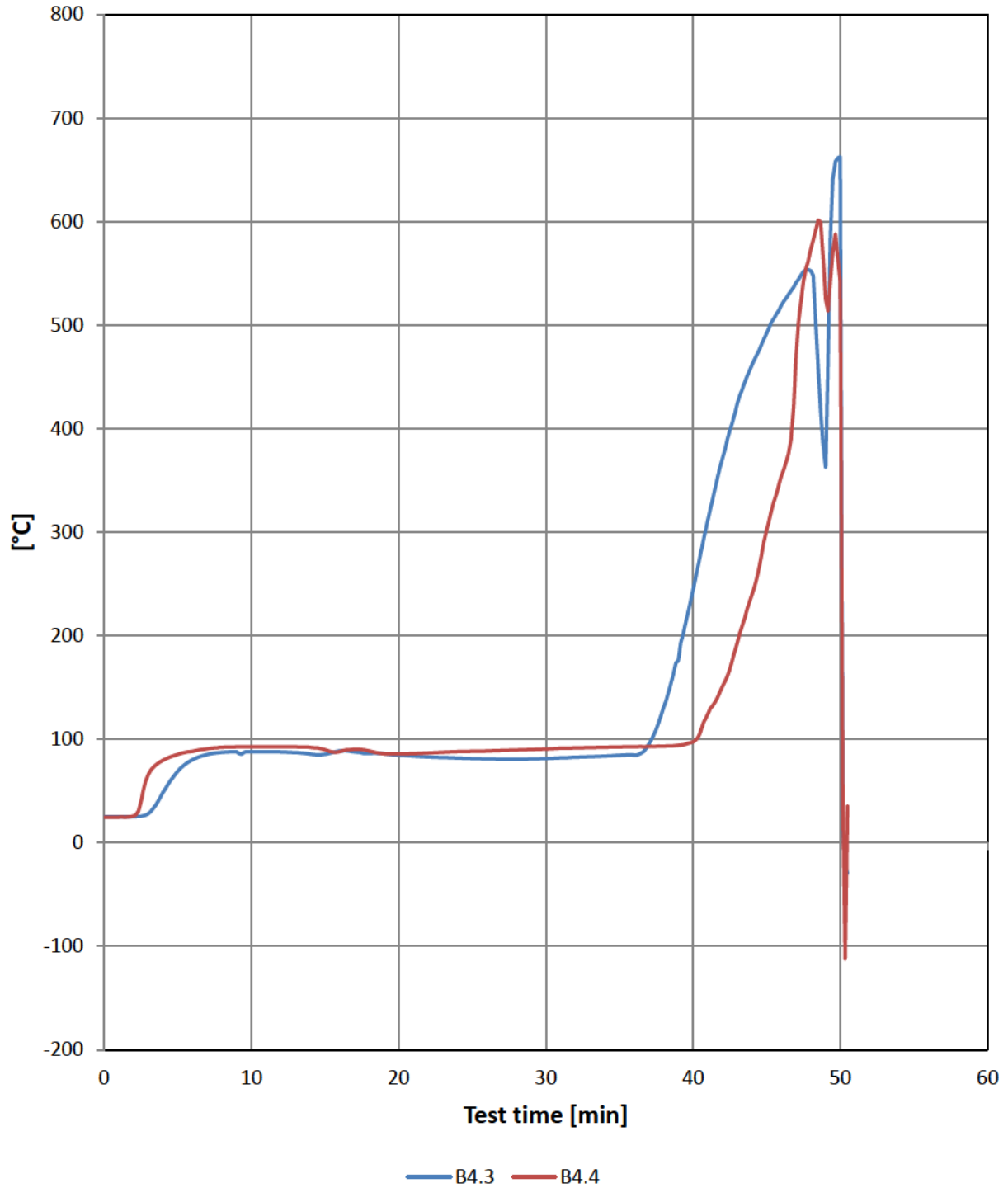
Wall BB - indicative temperature - unexposed gypsum*Maximum temperature rise inside the construction*

Min. / °C	B3.3	B3.4	B3.Max
0	24	24	24
2	24	24	24
4	25	25	25
6	43	60	60
8	68	79	79
10	75	82	82
12	80	84	84
14	82	85	85
15	82	84	84
16	85	85	85
18	86	89	89
20	83	83	83
22	81	83	83
24	81	84	84
26	81	84	84
28	82	86	86
30	83	88	88
32	85	89	89
34	87	90	90
36	88	90	90
38	88	90	90
40	90	91	91
42	91	92	92
44	110	104	110
46	142	130	142
48	163	139	163
50	701	339	701

Failure [min]	48.83	49.00	48.83
Failure °C	180	180	180

Wall BB - indicative temperature - Center studs

Maximum temperature rise inside the construction



Wall BB - indicative temperature - Center studs

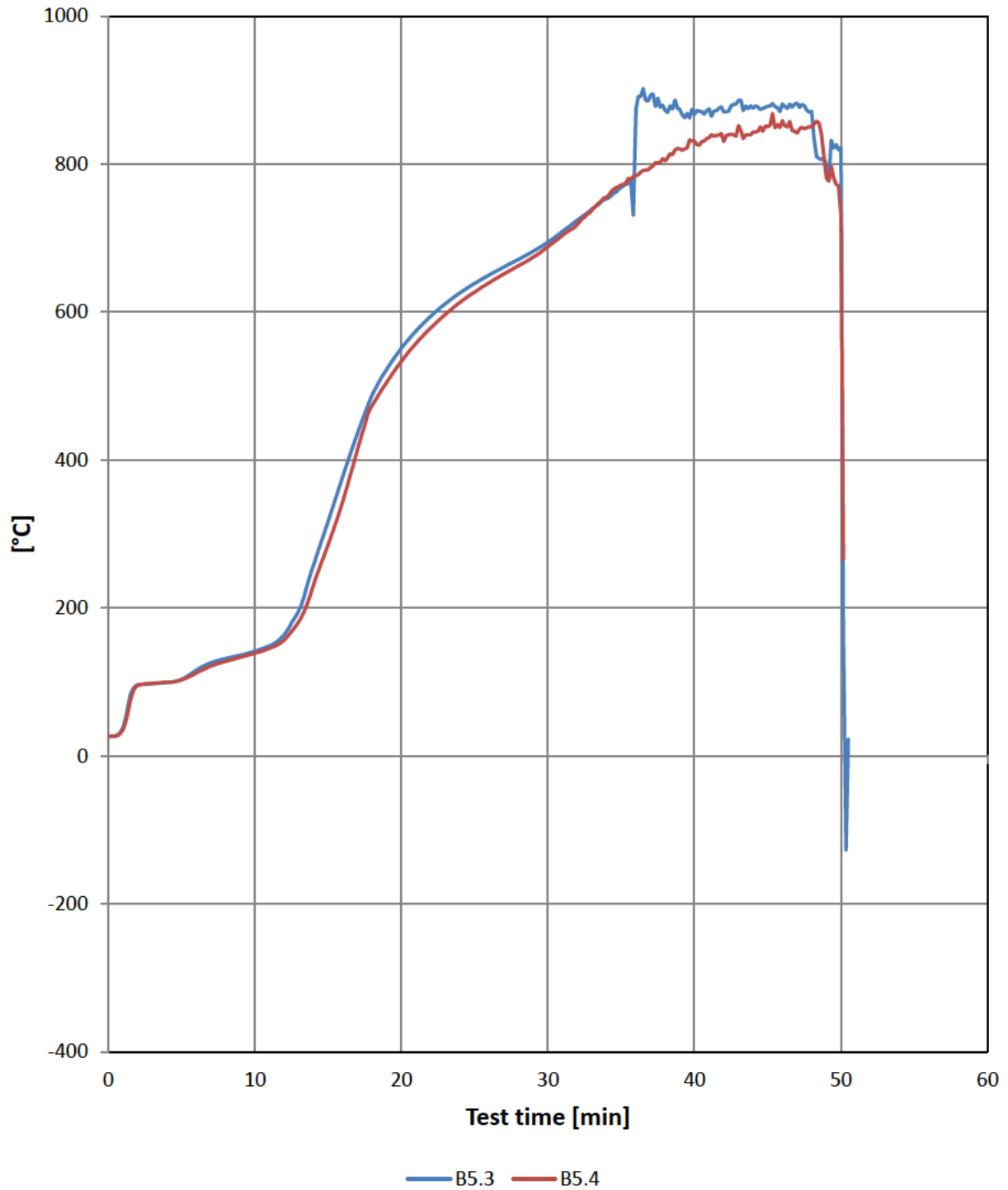
Maximum temperature rise inside the construction

Min. / °C	B4.3	B4.4	B4.Max
0	25	25	25
2	25	26	26
4	48	80	80
6	80	88	88
8	87	92	92
10	88	93	93
12	88	93	93
14	86	92	92
15	86	90	90
16	89	88	89
18	86	89	89
20	85	86	86
22	83	87	87
24	82	88	88
26	81	89	89
28	81	90	90
30	82	91	91
32	83	92	92
34	84	92	92
36	85	93	93
38	131	93	131
40	244	98	244
42	371	151	371
44	462	240	462
46	519	354	519
48	553	574	574
50	663	543	663

Failure [min]	39.00	42.67	39.00
Failure °C	180	180	180

Wall BB - indicative temperature - exposed gypsum

Maximum temperature rise inside the construction



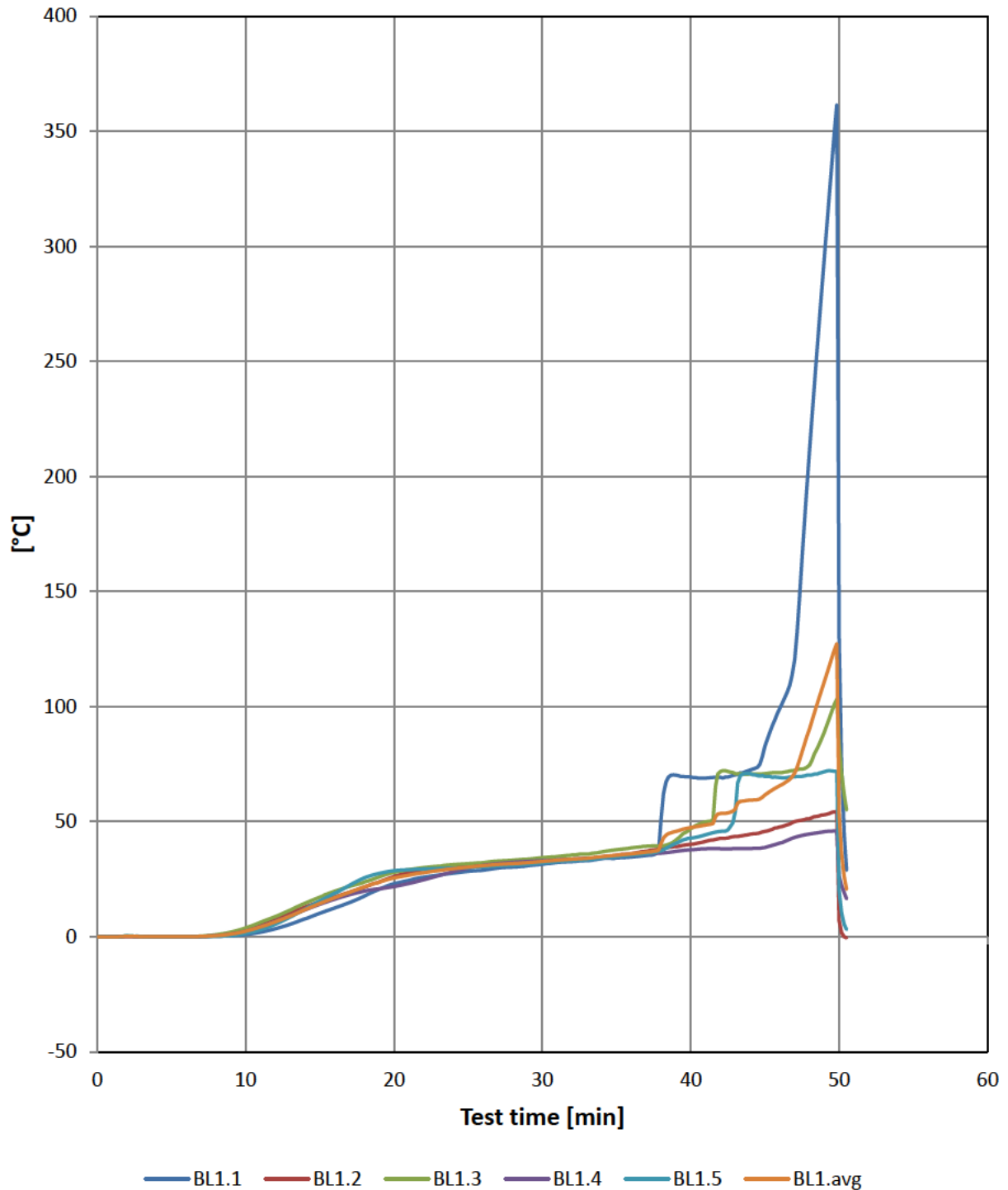
Wall BB - indicative temperature - exposed gypsum*Maximum temperature rise inside the construction*

Min. / °C	B5.3	B5.4	B5.Max
0	27	27	27
2	96	96	96
4	99	100	100
6	116	112	116
8	132	128	132
10	142	139	142
12	164	157	164
14	258	231	258
15	318	286	318
16	378	345	378
18	488	474	488
20	551	534	551
22	595	579	595
24	626	613	626
26	651	640	651
28	672	663	672
30	695	689	695
32	724	719	724
34	753	755	755
36	875	785	875
38	873	805	873
40	867	832	867
42	871	831	871
44	876	843	876
46	882	859	882
48	871	850	871
50	823	731	823

Failure [min]	12.50	12.83	12.50
Failure °C	180	180	180

Average temperature rise BL

Measured with 5 thermocouples



Average temperature rise BL

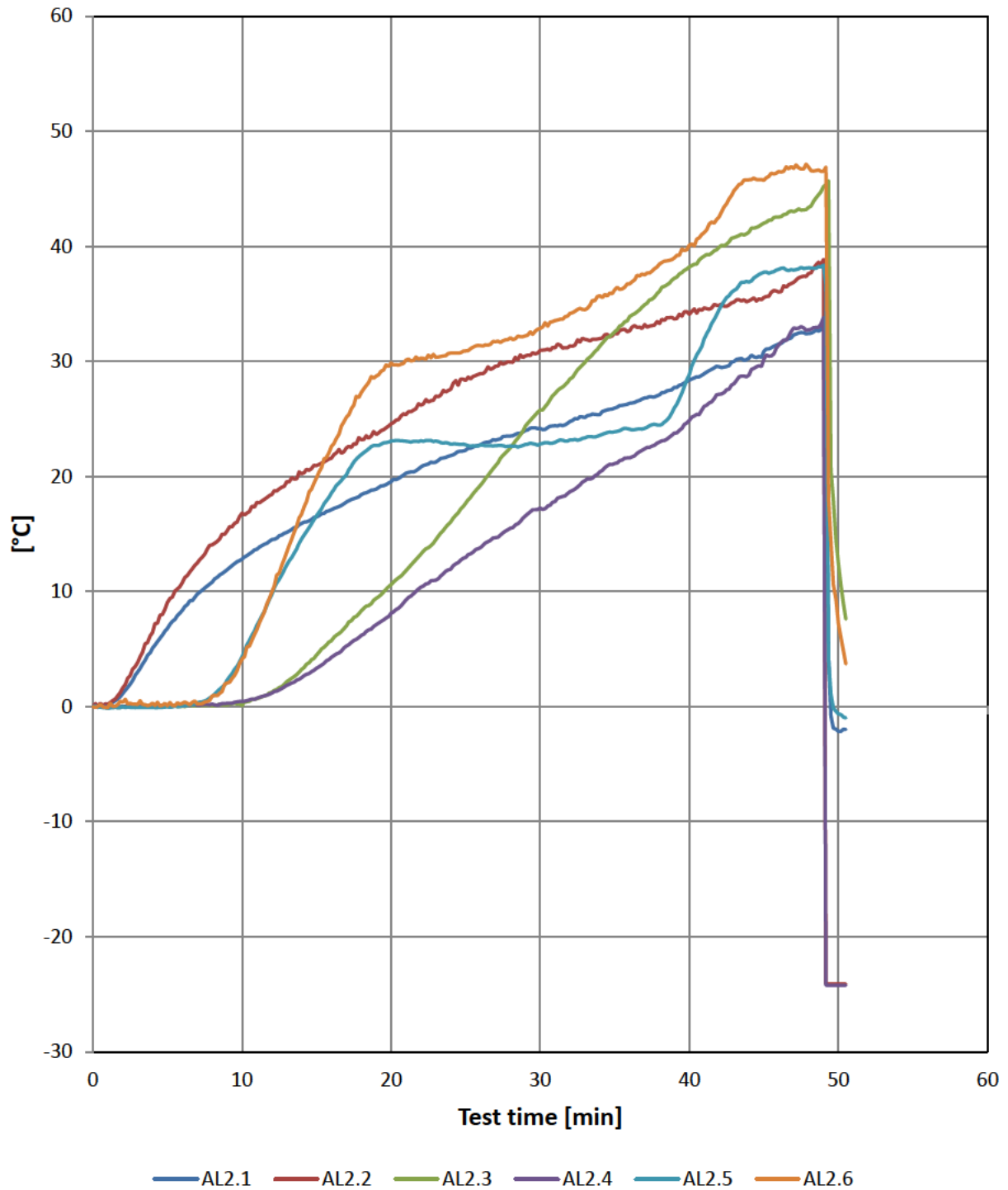
Measured with 5 thermocouples

Min. / °C	BL1.1	BL1.2	BL1.3	BL1.4	BL1.5	BL1.Avg	BL1.Max
0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
8	0	1	1	0	0	0	1
10	1	3	4	2	1	2	4
12	3	8	9	7	5	6	9
14	8	13	15	12	12	12	15
15	10	15	17	14	16	14	17
16	13	17	20	16	19	17	20
18	18	22	24	20	26	22	26
20	23	26	28	22	29	26	29
22	26	29	30	25	29	28	30
24	28	31	31	28	30	30	31
26	29	32	32	31	30	31	32
28	30	32	33	32	31	32	33
30	32	33	34	33	32	33	34
32	33	34	36	34	33	34	36
34	34	35	37	34	34	35	37
36	35	36	39	35	35	36	39
38	51	38	39	36	37	41	51
40	69	40	47	38	43	47	69
42	69	43	72	38	46	54	72
44	72	45	71	38	71	59	72
46	99	48	71	41	69	66	99
48	211	51	75	45	70	90	211
50	131	7	84	27	20	54	131

Failure [min]	47.50	-	-	-	-	-	47.50
Failure °C	180	180	180	180	180	140	180

Maximum temperature rise BL

Maximum temperature rise on the unexposed side



Maximum temperature rise BL

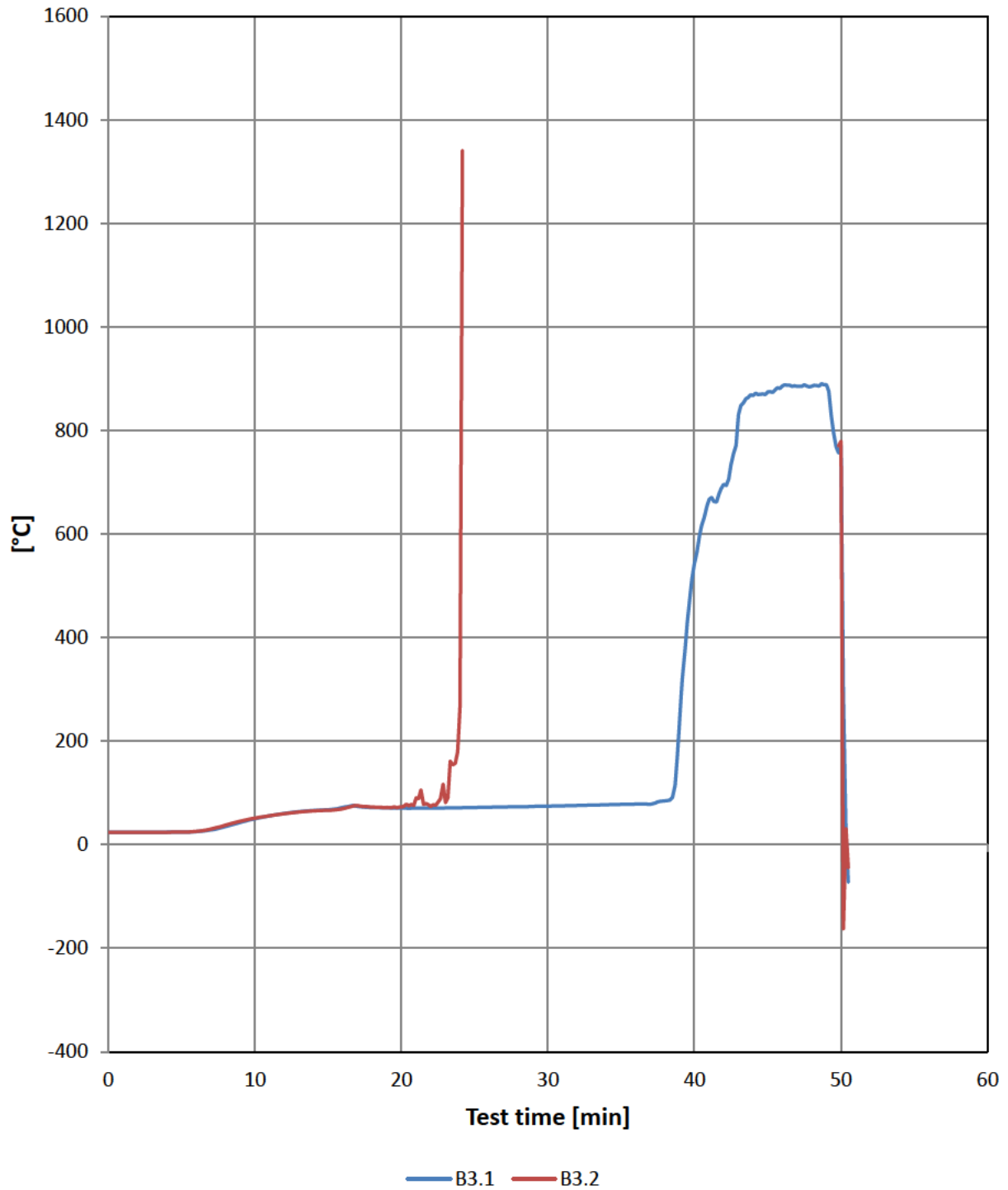
Maximum temperature rise on the unexposed side

Min. / °C	AL2.1	AL2.2	AL2.3	AL2.4	AL2.5	AL2.6	AL2.Max
0	0	0	0	0	0	0	0
2	1	2	0	0	0	0	2
4	5	6	0	0	0	0	6
6	8	11	0	0	0	0	11
8	11	14	0	0	1	1	14
10	13	17	0	0	4	4	17
12	15	18	1	1	10	10	18
14	16	20	3	3	15	17	20
15	16	21	4	3	17	20	21
16	17	22	6	4	19	23	23
18	18	23	8	6	22	27	27
20	20	25	11	8	23	30	30
22	21	26	13	10	23	30	30
24	22	28	16	12	23	31	31
26	23	29	19	14	23	31	31
28	24	30	23	16	23	32	32
30	24	31	26	17	23	33	33
32	25	31	28	19	23	34	34
34	25	32	31	20	24	36	36
36	26	33	34	22	24	37	37
38	27	33	36	23	24	38	38
40	28	34	38	25	29	40	40
42	30	35	40	27	35	43	43
44	30	35	41	29	37	46	46
46	32	36	43	31	38	46	46
48	32	38	43	33	38	47	47
50	-2	-24	12	-24	-1	7	12

Failure [min]	-	-	-	-	-	-	-
Failure °C	180	180	180	180	180	180	180

Wall BL - indicative temperature - unexposed gypsum

Maximum temperature rise inside the construction



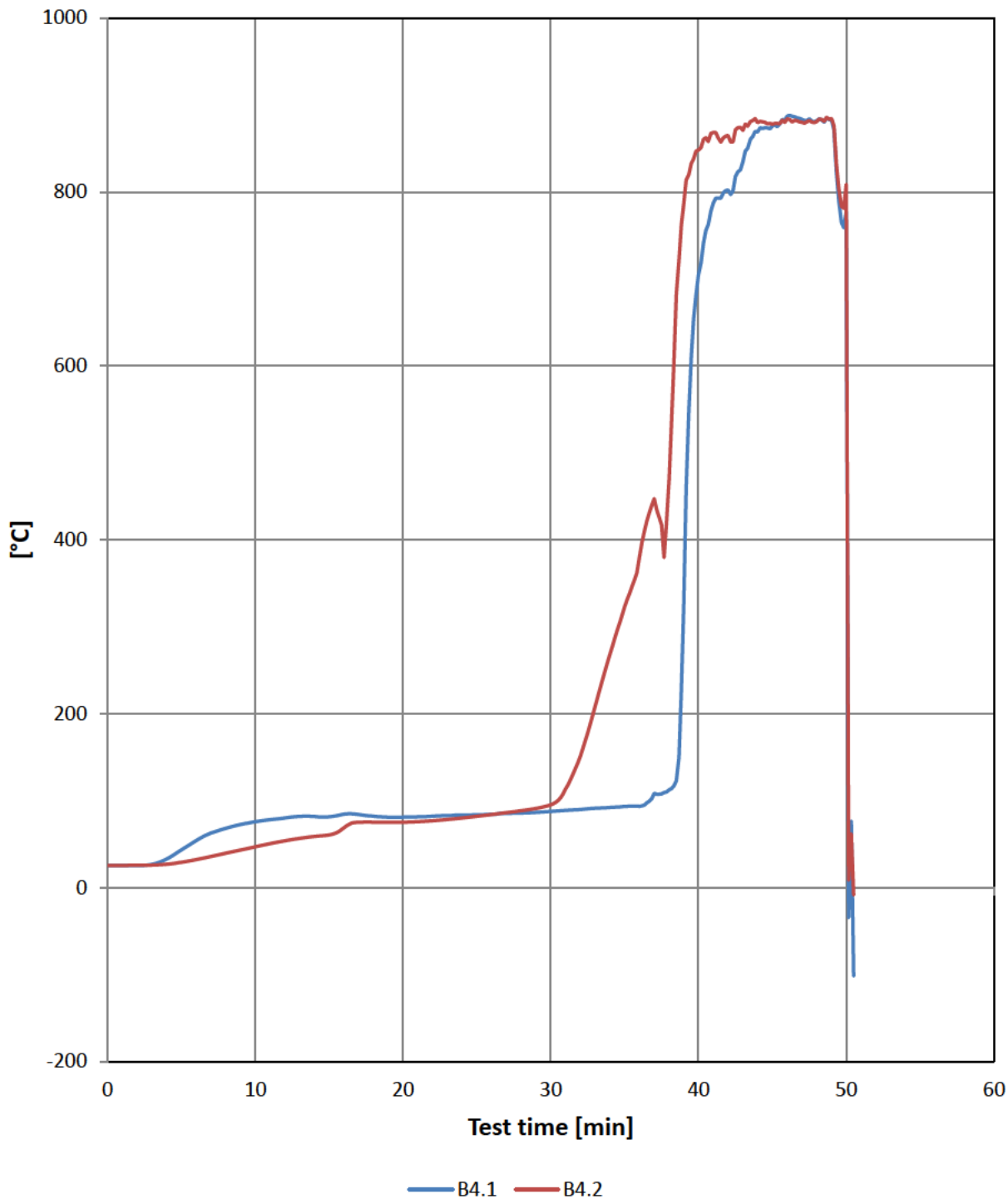
Wall BL - indicative temperature - unexposed gypsum*Maximum temperature rise inside the construction*

Min. / °C	B3.1	B3.2	B3.Max
0	24	24	24
2	24	24	24
4	24	24	24
6	25	26	26
8	35	38	38
10	50	51	51
12	60	60	60
14	66	66	66
15	68	66	68
16	72	70	72
18	72	73	73
20	71	73	73
22	71	74	74
24	71	267	267
26	73	0	73
28	74	0	74
30	75	0	75
32	76	0	76
34	77	0	77
36	79	0	79
38	85	0	85
40	543	0	543
42	696	0	696
44	868	0	868
46	886	0	886
48	885	0	885
50	771	779	779

Failure [min]	38.83	23.83	23.83
Failure °C	180	180	180

Wall BL - indicative temperature - Center studs

Maximum temperature rise inside the construction



Wall BL - indicative temperature - Center studs

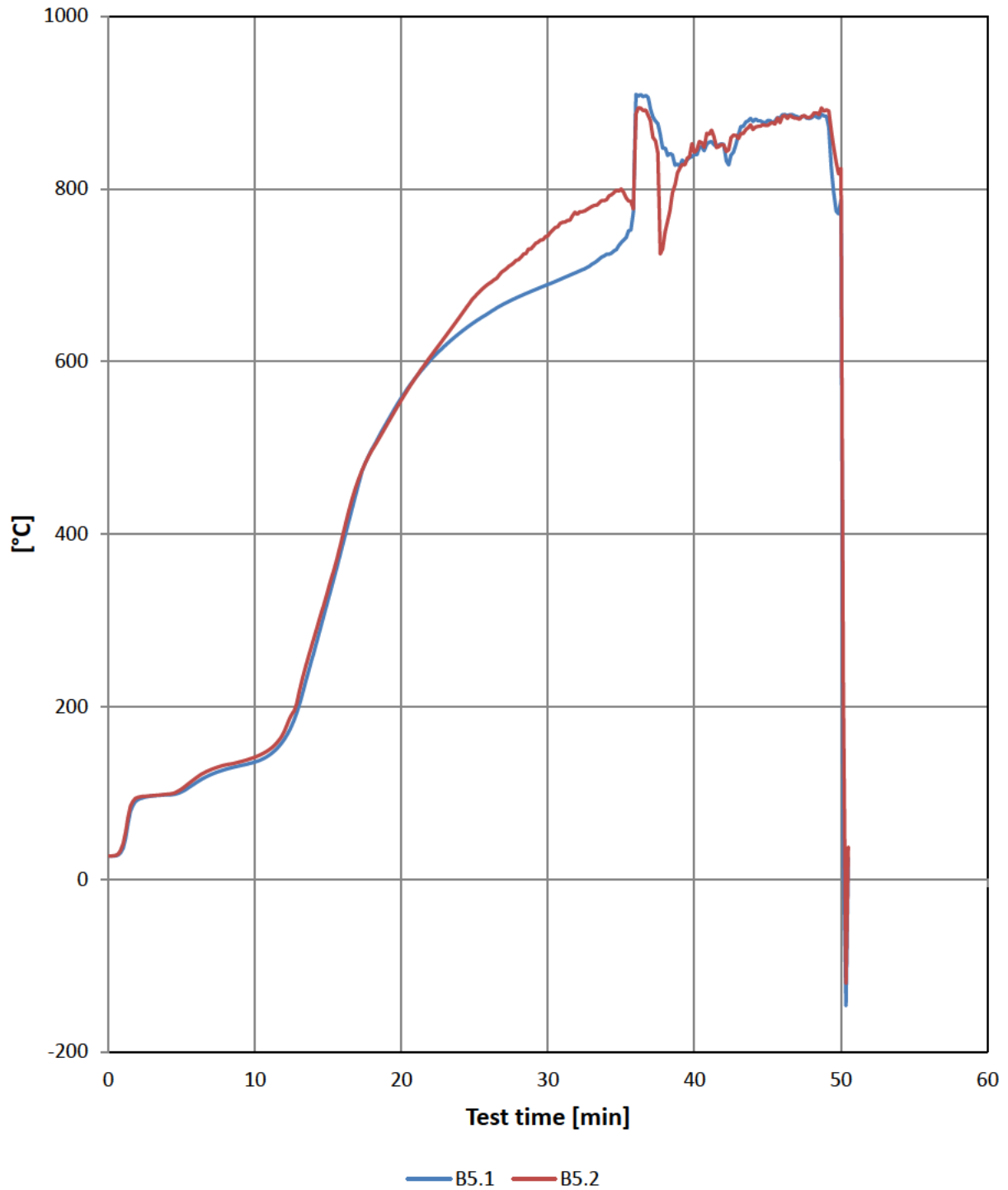
Maximum temperature rise inside the construction

Min. / °C	B4.1	B4.2	B4.Max
0	25	26	26
2	25	26	26
4	33	27	33
6	54	32	54
8	68	39	68
10	76	47	76
12	80	54	80
14	82	59	82
15	81	60	81
16	84	69	84
18	82	75	82
20	81	75	81
22	82	77	82
24	83	80	83
26	84	84	84
28	86	88	88
30	87	95	95
32	90	151	151
34	92	268	268
36	93	381	381
38	112	469	469
40	704	848	848
42	802	865	865
44	869	880	880
46	887	884	887
48	882	881	882
50	777	809	809

Failure [min]	38.67	32.50	32.50
Failure °C	180	180	180

Wall BL - indicative temperature - exposed gypsum

Maximum temperature rise inside the construction



Wall BL - indicative temperature - exposed gypsum

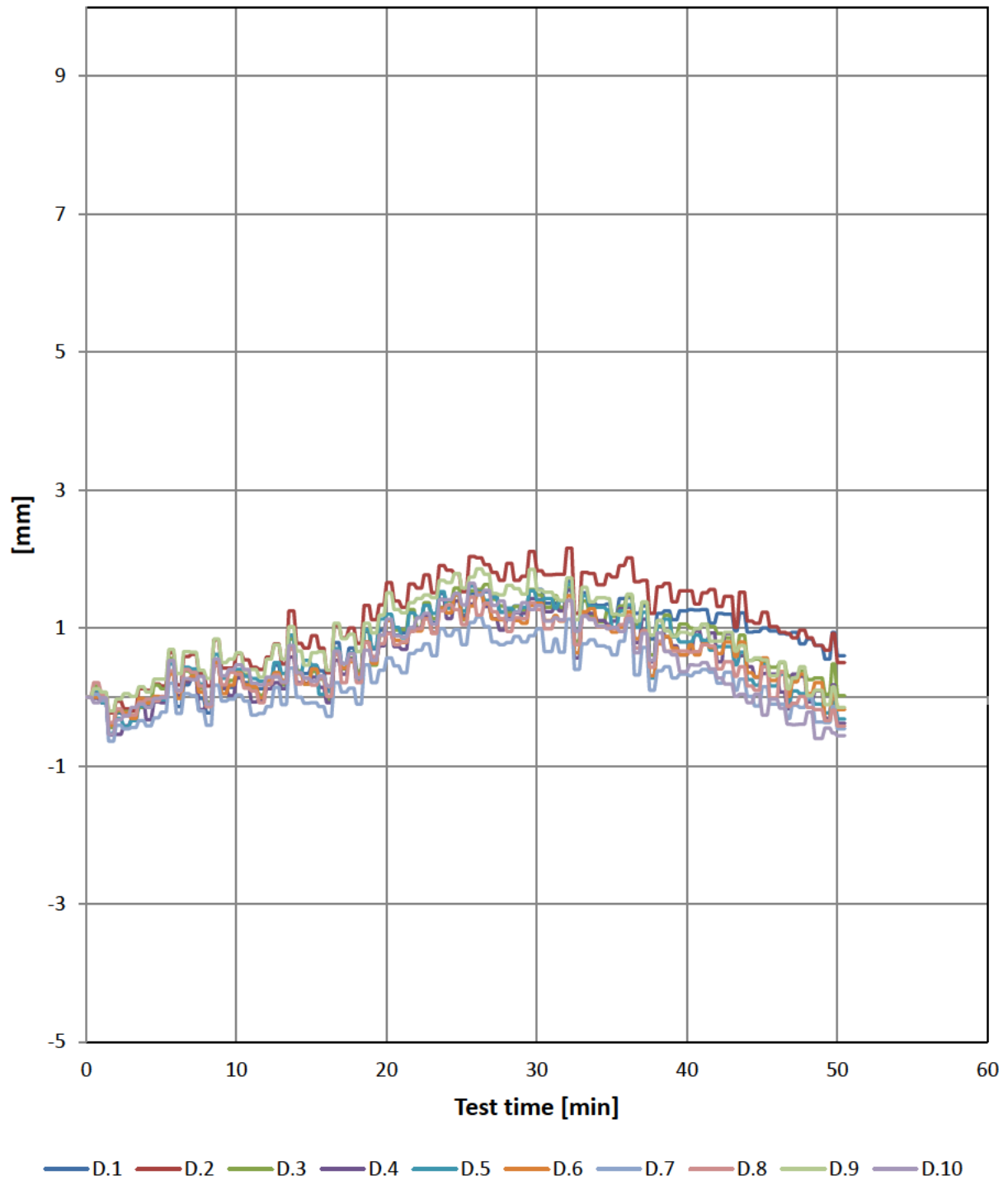
Maximum temperature rise inside the construction

Min. / °C	B5.1	B5.2	B5.Max
0	27	27	27
2	92	95	95
4	98	98	98
6	112	118	118
8	127	133	133
10	136	141	141
12	162	171	171
14	262	278	278
15	324	336	336
16	388	399	399
18	499	497	499
20	558	556	558
22	602	606	606
24	633	652	652
26	657	691	691
28	675	718	718
30	689	746	746
32	704	771	771
34	724	788	788
36	910	887	910
38	847	751	847
40	840	842	842
42	852	851	852
44	878	869	878
46	886	884	886
48	883	884	884
50	787	824	824

Failure [min]	12.50	12.17	12.17
Failure °C	180	180	180

Deformation

Negative values indicate movement towards the furnace



Deformation

Negative values indicate movement towards the furnace

Min. / mm	D.1	D.2	D.3	D.4	D.5	D.6	D.7	D.8	D.9	D.10
0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	-1	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
10	0	1	0	0	0	0	0	0	1	0
12	0	1	0	0	0	0	0	0	1	0
14	0	1	0	0	0	0	0	0	1	0
15	0	1	0	0	0	0	0	0	1	0
16	0	0	0	0	0	0	0	0	0	0
18	0	1	0	0	0	0	0	0	1	0
20	1	2	1	1	1	1	1	1	2	1
22	1	2	1	1	1	1	1	1	1	1
24	1	2	1	1	1	1	1	1	2	1
26	2	2	2	2	2	2	1	1	2	1
28	1	2	1	1	1	1	1	1	2	1
30	2	2	1	1	1	1	1	1	2	1
32	2	2	2	2	2	1	1	1	2	1
34	1	2	1	1	1	1	1	1	1	1
36	1	2	1	1	1	1	1	1	1	1
38	1	2	1	1	1	1	0	1	1	1
40	1	2	1	1	1	1	0	1	1	0
42	1	1	1	1	1	1	0	0	1	0
44	1	1	1	0	0	0	0	0	1	0
46	1	1	0	0	0	0	0	0	0	0
48	1	1	0	0	0	0	0	0	0	0
50	1	1	0	0	0	0	0	0	0	-1



Photo No. 1 Mounting of timber studs in the testing frame.



Photo No. 2 Mounting of wiring on timber studs.



Photo No. 3 Wire fastened to stud.

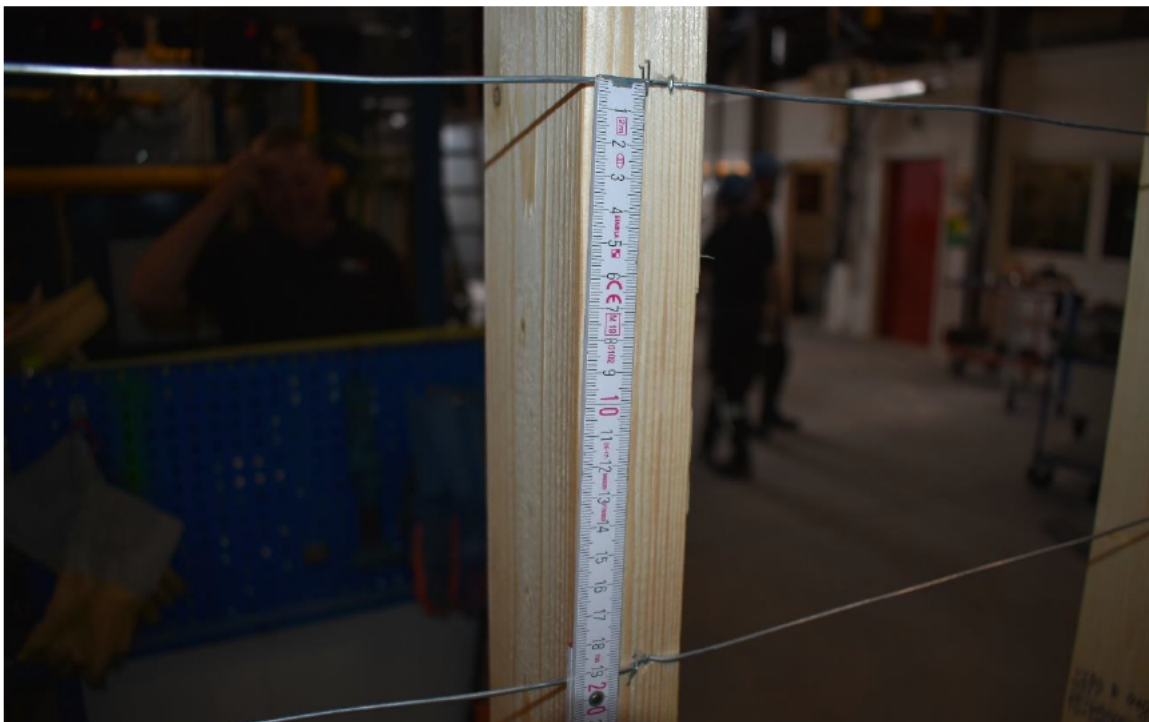


Photo No. 4 Distance between wire.



Photo No. 5 Gypsum cladding mounted to studs.



Photo No. 6 Insulation slabs being mounted on the side with the wire.



Photo No. 7 Side without wire, insulation slab installed.



Photo No. 8 Test specimen seen from exposed side.



Photo No. 9 Woodfibre insulation being blown in test specimen.



Photo No. 10 Woodfibre insulation.



Photo No. 11 Mounting holes for wood fibre insulation.

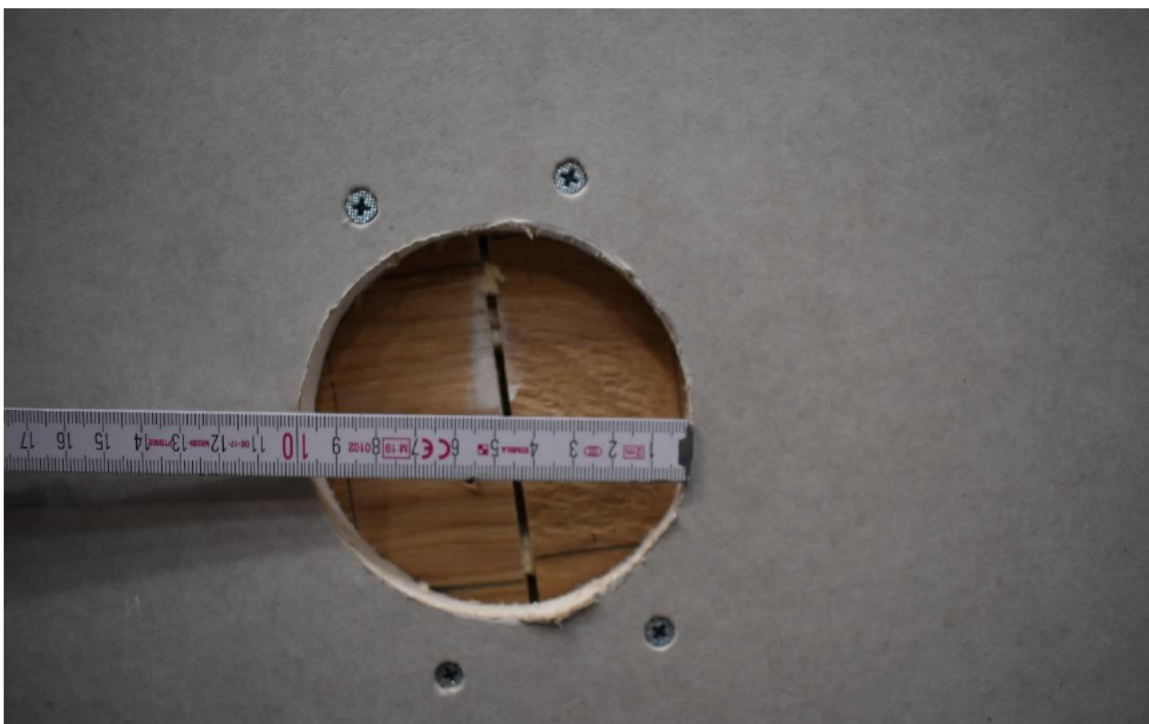


Photo No. 12 Hole opening for insulation.

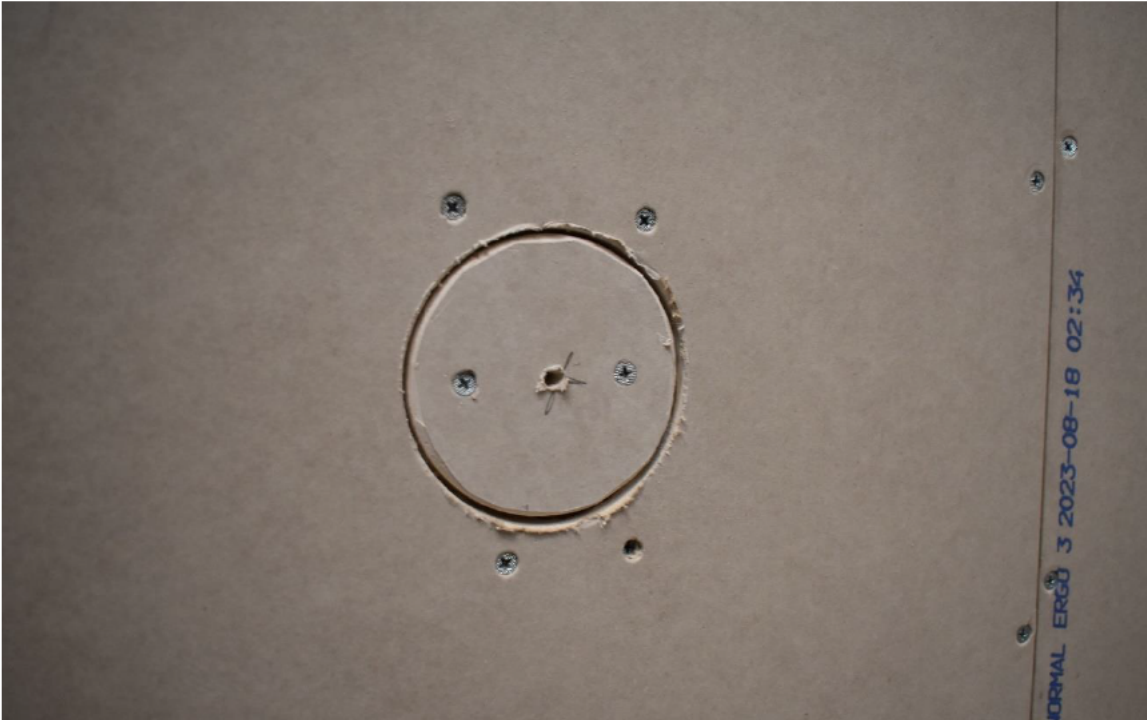


Photo No. 13 Sealing for insulation hole.

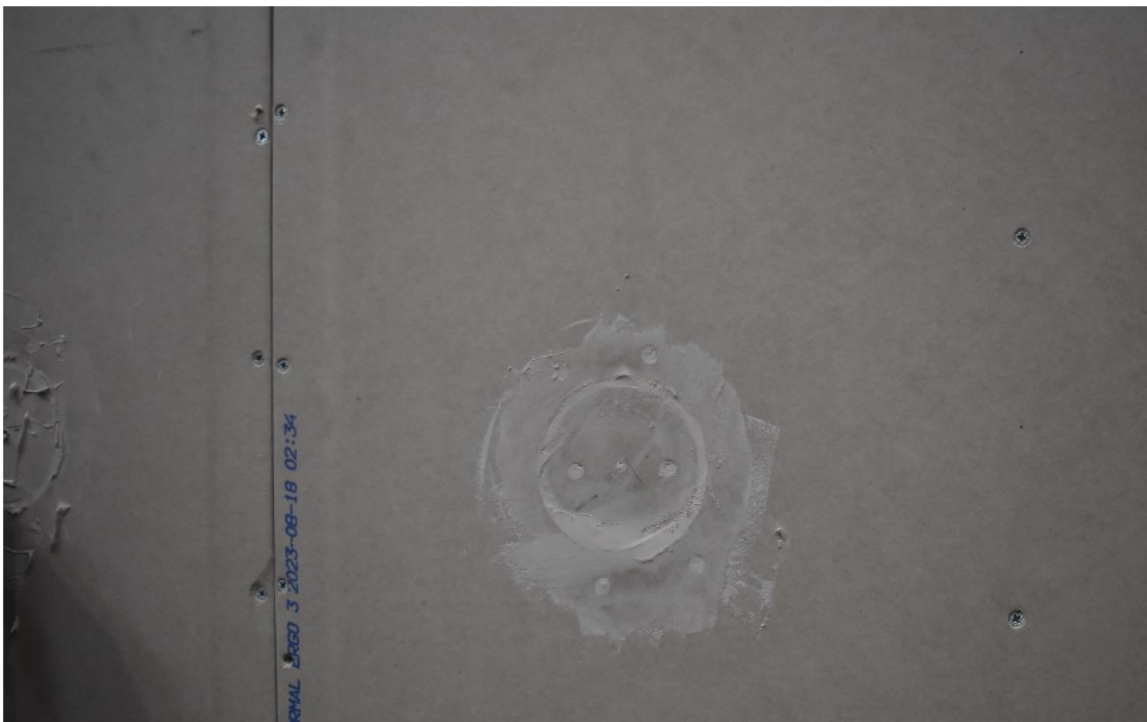


Photo No. 14 Sealed with gypsum mortar.



Photo No. 15 Sealed with gypsum mortar.



Photo No. 16 Start of test.

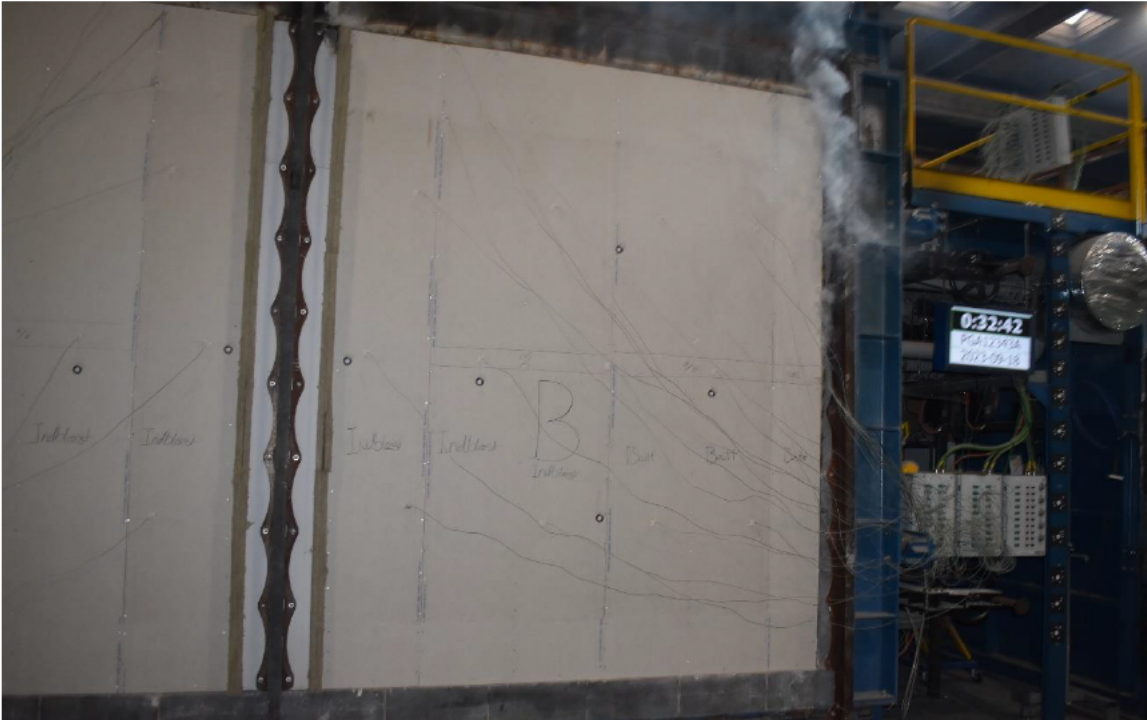


Photo No. 17 Test specimen after 30 min.



Photo No. 18 Gypsum seen from exposed side.

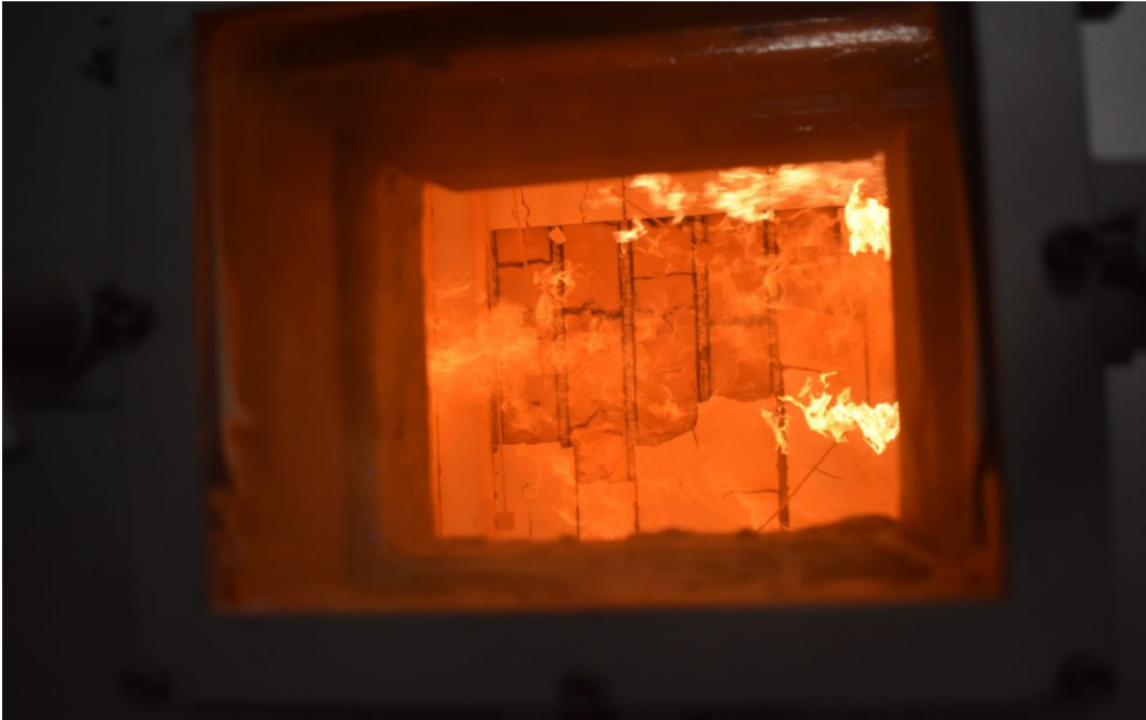


Photo No. 19 Most of the gypsum boards fallen off from the exposed side.

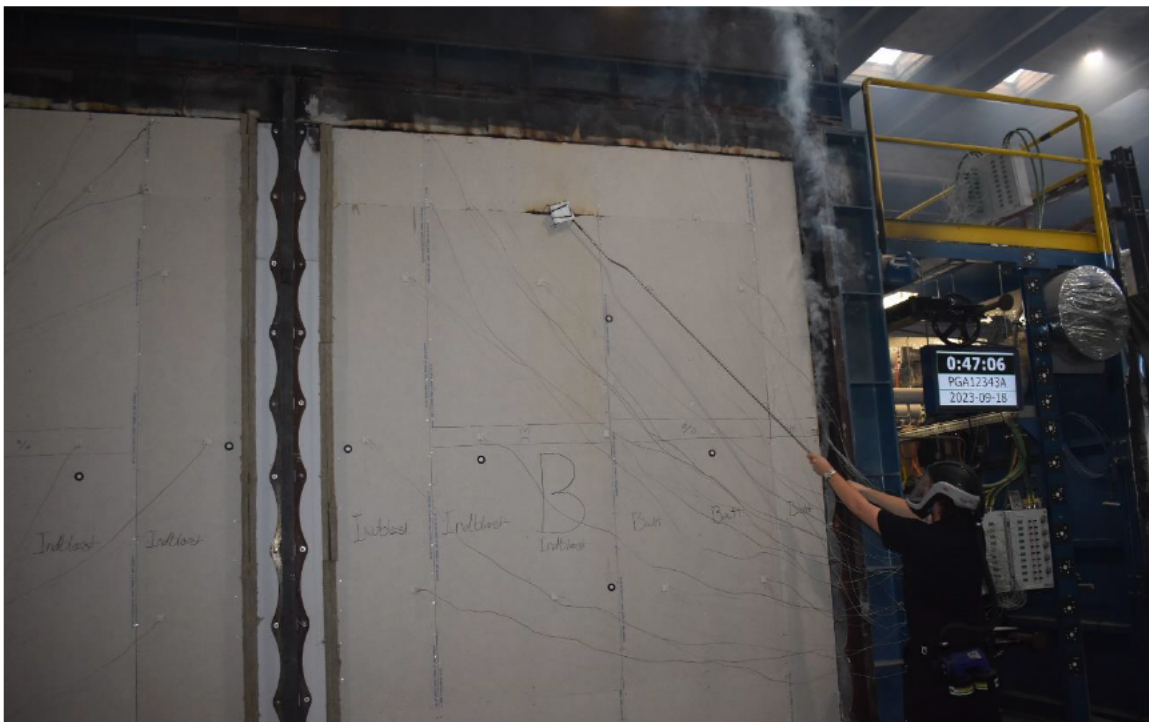


Photo No. 20 Cotton pad test at 47 min.

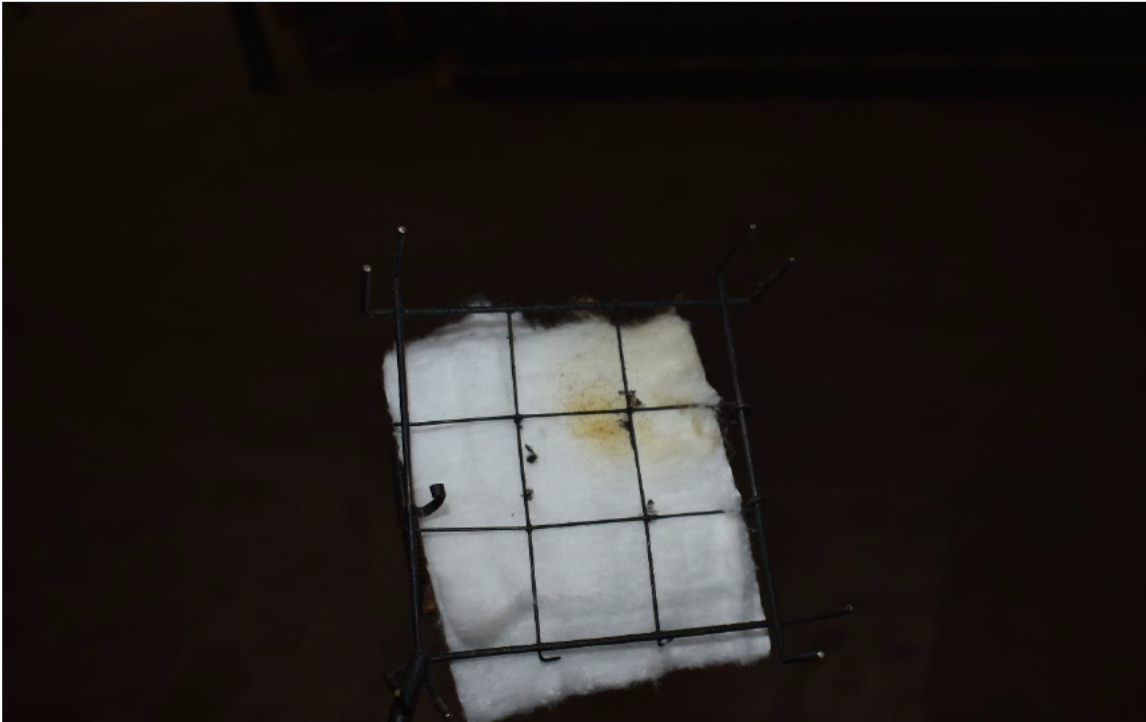


Photo No. 19 Cotton after first cotton pad test. Slight discoloration.

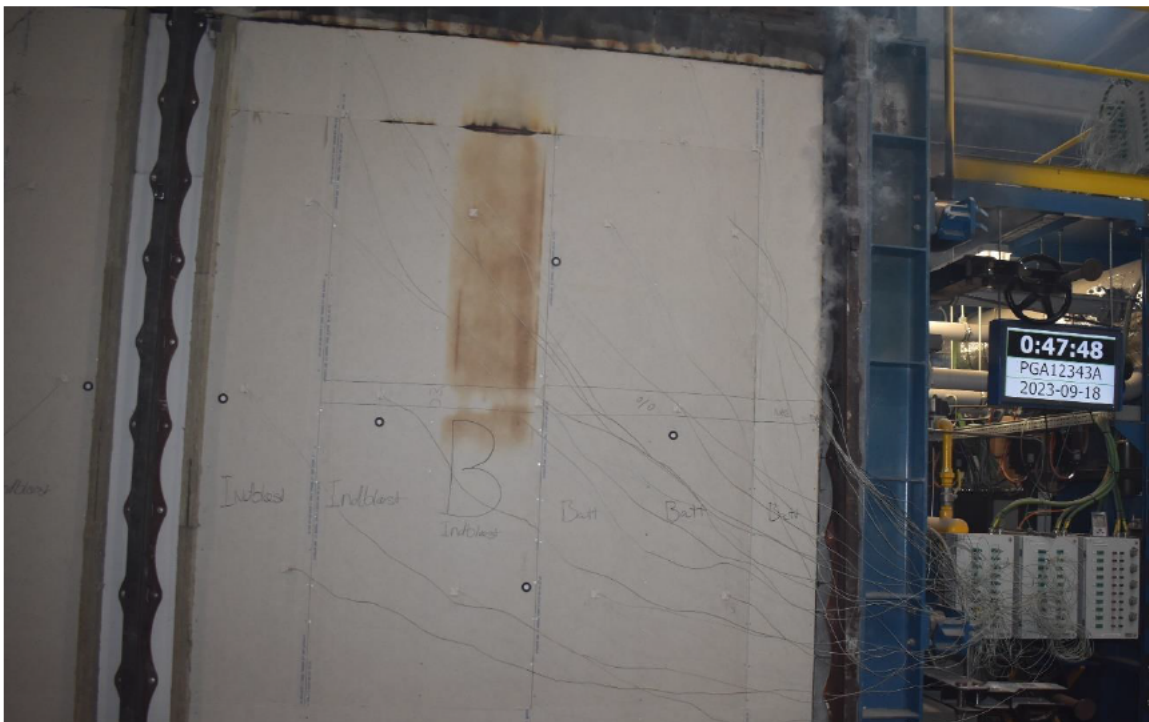


Photo No. 20 Gypsum board starting to show discoloration. On side B



Photo No. 19 Gypsum board with heavy discoloration. On side B

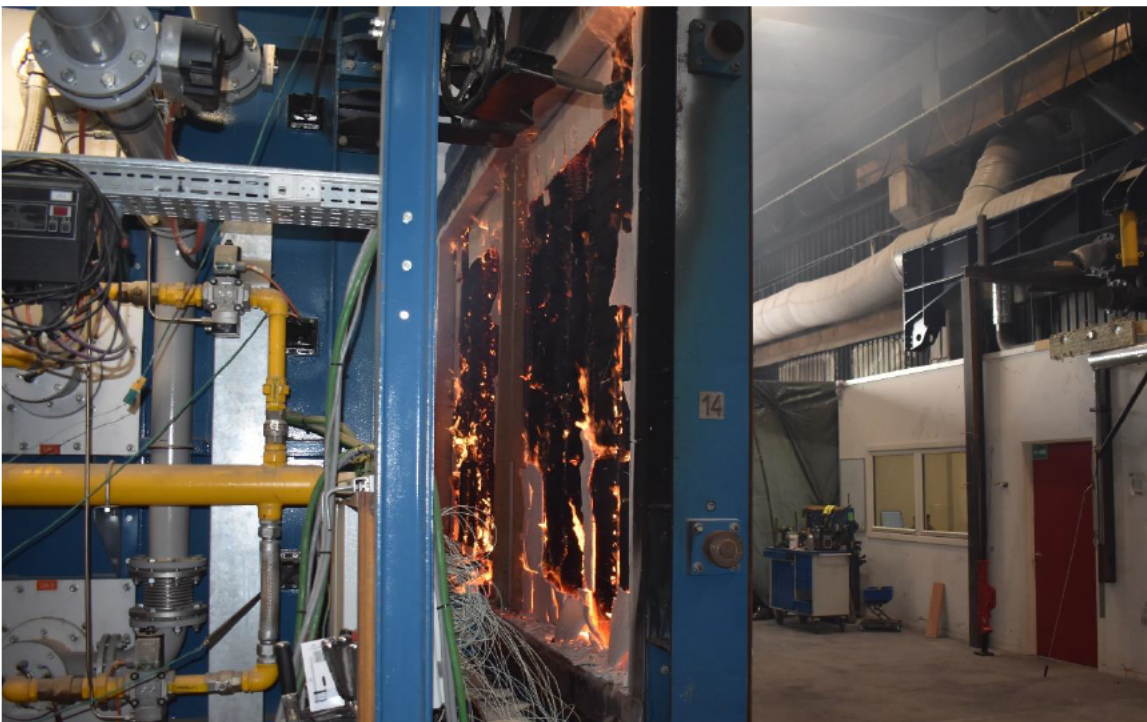


Photo No. 20 Test specimen after test.

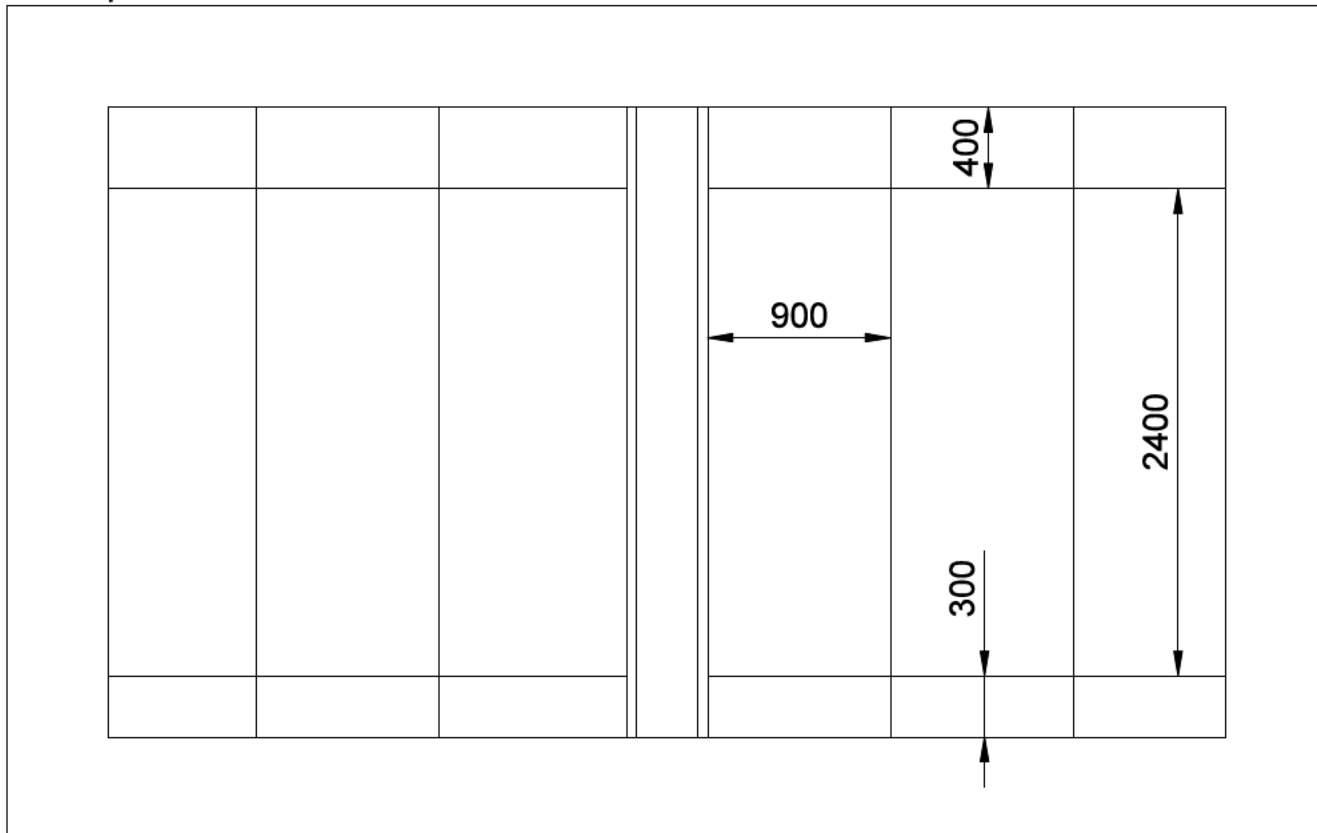


Photo No. 19 Test specimen after test seen from exposed side.

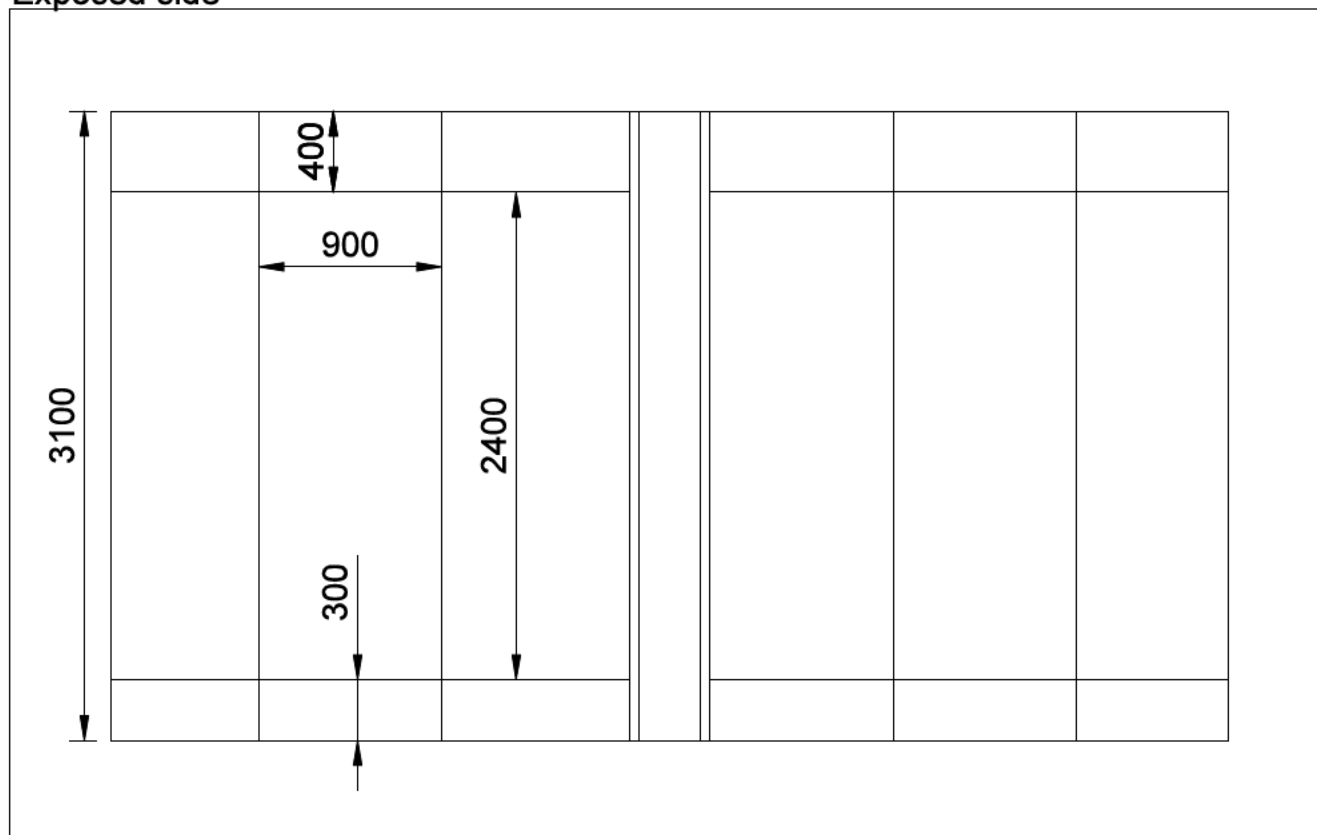


Photo No. 20 Test specimen after test seen from unexposed side.

Unexposed side



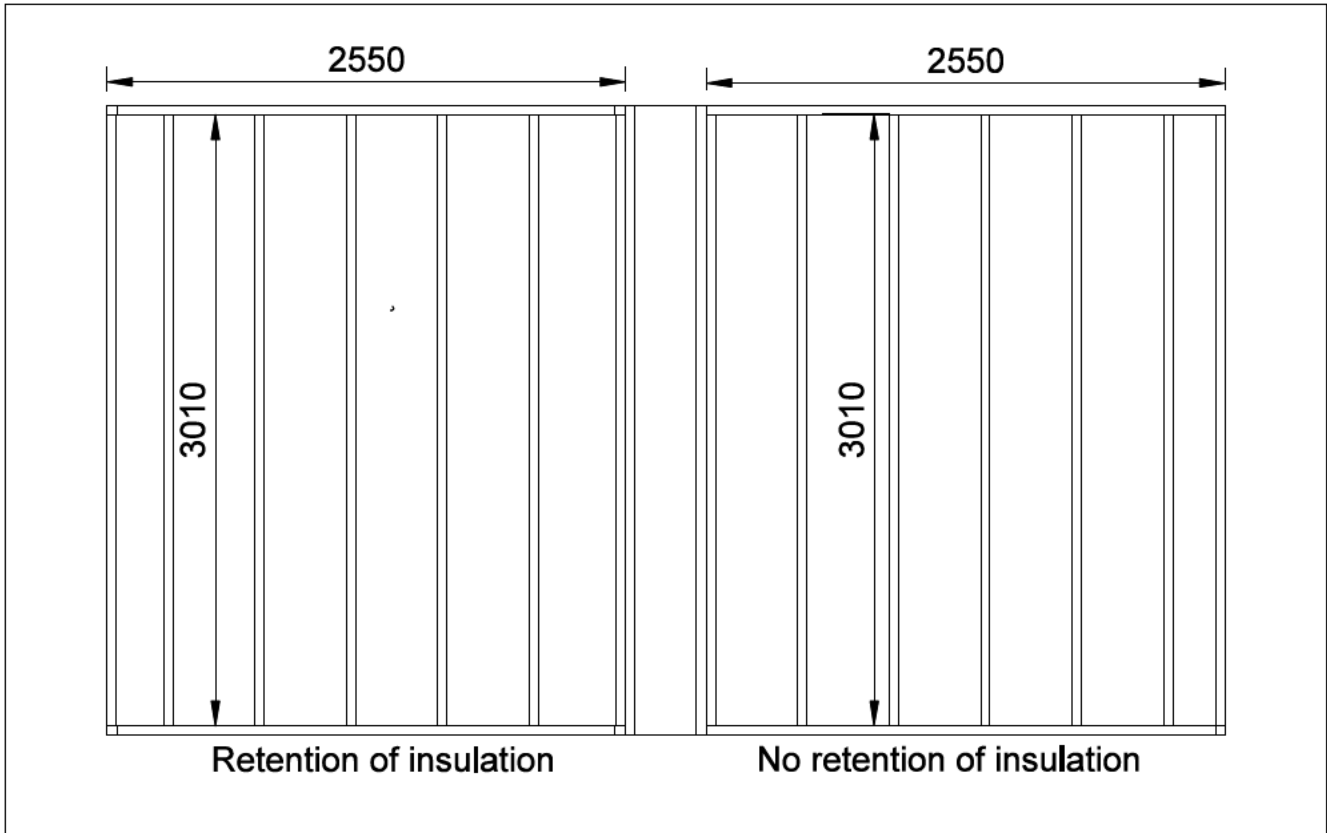
Exposed side



All measurements are in mm



Unexposed side



The 3 fields closest to the fixed edge are with batt insulation. The 3 fields closest to the free edge is with loose fill insulation.

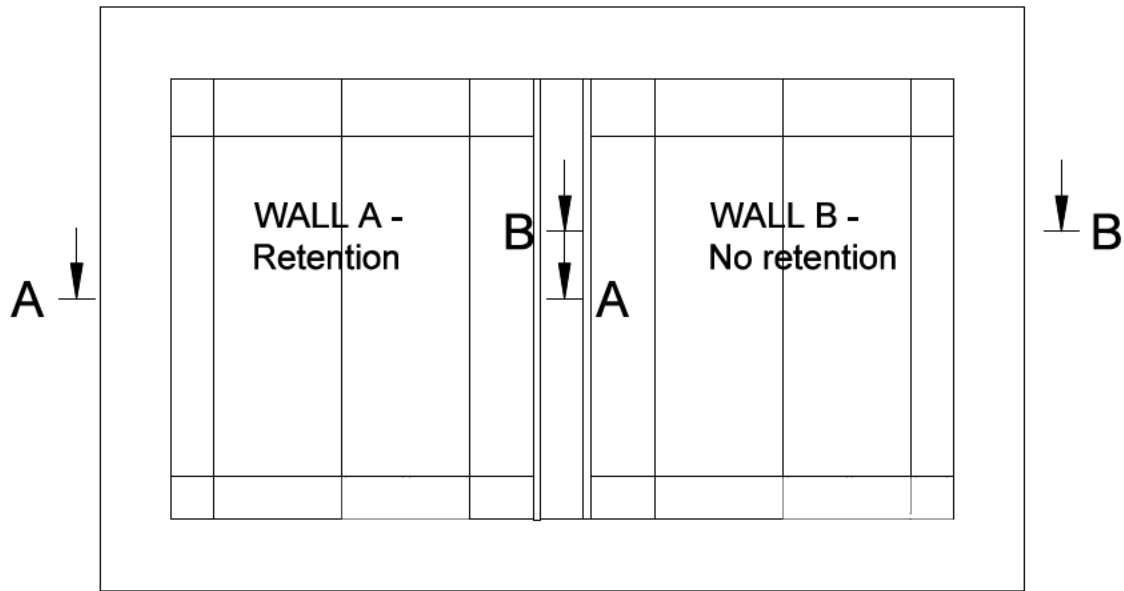
Retention of insulation happens with a 2 mm thick steel wire per 200 mm both on the exposed and unexposed side. The steel wire is stapled to the wood studs.

The 3 fields closest to the fixed edge are with batt insulation. The 3 fields closest to the free edge is with loose fill insulation.

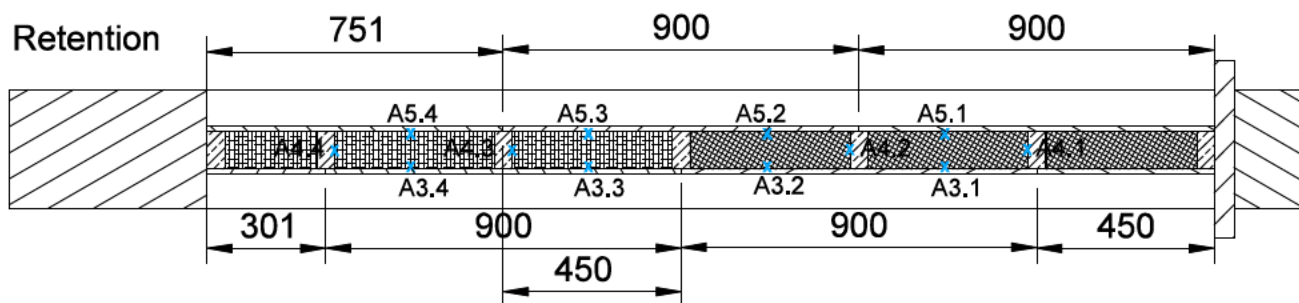
No retention of insulation.

All measurements are in mm



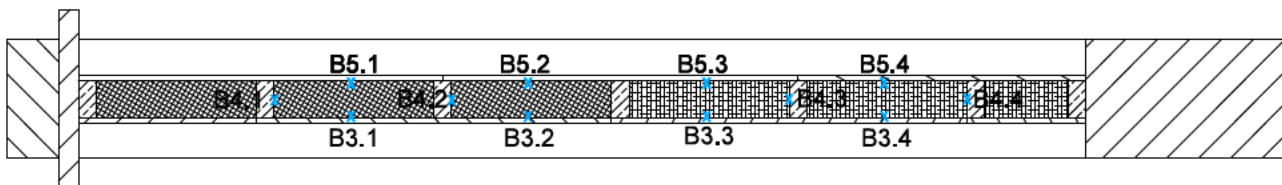


A-A (1:18)



B-B (1:18)

Thermocouples shall be placed at mid height of the construction



No retention

All measurements are in mm

