



Test report

InnoBYG small scale demonstration tests - Part 2

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Enclosures: 31

Test date: 2014-03-18
Date: 2014-07-09

1 NAME OF SPONSOR



2 DATE OF TEST

2014-03-18

3 PURPOSE OF TEST

Two small scale tests based on test standard EN 14135 were performed, each with four different test samples, 8 samples in total.

The tests were performed as part of the sub-project "Fire and building materials" in relation to the Danish innovation cluster InnoBYG. The purposes were to

- investigate the difference between different types of covering systems and the general behaviour of cellulose based insulation behind a covering system
- show the general principles of the covering test and the evaluation of the test criteria *and*
- inspire manufacturers and consultants in their innovation process.

4 TEST SPECIMENS

The test specimens were eight different types of coverings, four of these mounted on a substrate of 95 mm thick loose fill paper insulation, and four of these mounted on 95 mm loose fill wood fibre insulation. The insulation was enclosed in a timber frame with a backing board of 9 mm chipboard.

The loose fill paper insulation was applied by blowing with a machine after assembling of the rest of the test specimen.

The loose fill wood insulation was applied by hand before mounting of the chipboard on the non-exposed side.

The exposed area was 500 x 500 mm for all test specimens.

5 DRAWINGS AND DESCRIPTION OF THE TEST SPECIMENS

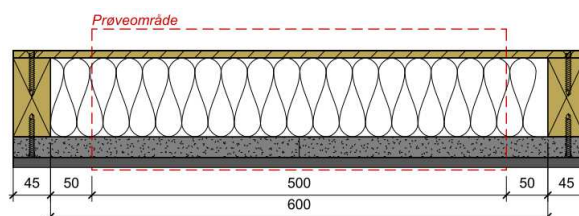
The details of the construction and the measures for the test specimens are described in the enclosed documentation:

Type:	Enclosure:	Description:
Drawing	A1.3	Test specimens A1, A2, A3 and A4
Drawing	A1.4	Test specimens B1, B2, B3 and B4

The test specimens were made by DBI in cooperation with suppliers of the insulation and plaster system suppliers. The test specimens consisted of the components described in the following.

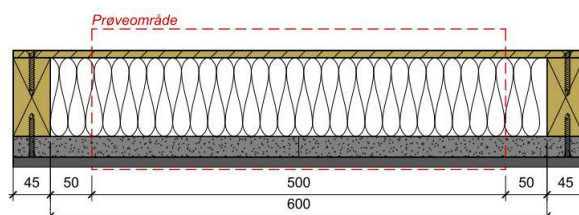
Test specimen A1

External measures:	690 x 690 mm
Covering:	25 mm cement-bonded wood wool boards with a butt joint along the middle of the specimen. 12-15 mm plaster system, consisting of a mineral based plaster base, reinforcement mesh and a plaster finish.
Fixation:	Screws into the timber frame (outside exposed area)
Substrate:	95 mm loose fill paper insulation
Backing board:	9 mm chipboard



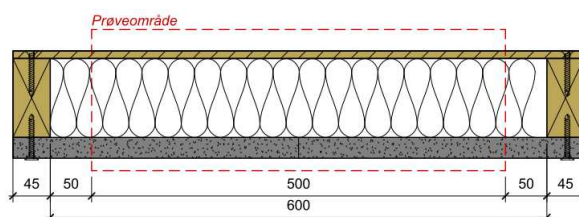
Test specimen A2

External measures:	690 x 690 mm
Covering:	25 mm cement-bonded wood wool boards with a butt joint along the middle of the specimen. 12-15 mm plaster system, consisting of a mineral based plaster base, reinforcement mesh and a plaster finish.
Fixation:	Screws into the timber frame (outside exposed area)
Substrate:	By mistake, no insulation was applied in this specimen.
Backing board:	9 mm chipboard



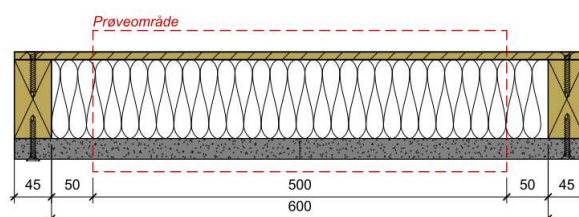
Test specimen A3

External measures:	690 x 690 mm
Covering:	25 mm cement-bonded wood wool boards with a butt joint along the middle of the specimen
Fixation:	Screws into the timber frame (outside exposed area)
Substrate:	95 mm loose fill paper insulation
Backing board:	9 mm chipboard



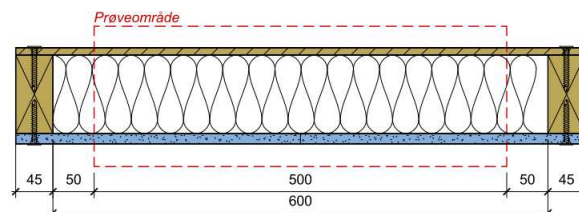
Test specimen A4

External measures:	690 x 690 mm
Covering:	25 mm cement-bonded wood wool boards with a butt joint along the middle of the specimen
Fixation:	Screws into the timber frame (outside exposed area)
Substrate:	95 mm loose fill wood fibre insulation
Backing board:	9 mm chipboard



Test specimen B1

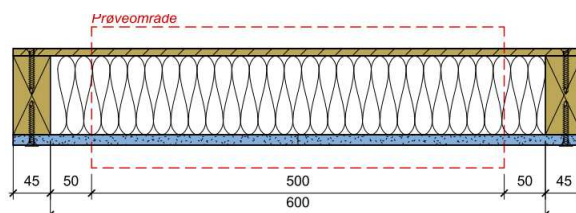
External measures:	690 x 690 mm
Covering:	12,5 mm gypsum plasterboard type A according to EN 520 with a butt joint along the middle of the test specimen
Fixation:	Screws into the timber frame (outside exposed area).
Substrate:	95 mm loose fill paper insulation
Backing board:	9 mm chipboard



Test specimen B2

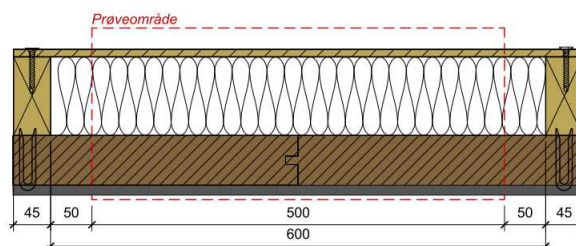
External measures:	690 x 690 mm
Covering:	12,5 mm gypsum plasterboard type A according to EN 520 with a butt joint along the middle of the test specimen

Fixation: Screws into the timber frame (outside exposed area).
 Substrate: 95 mm loose fill wood fibre insulation
 Backing board: 9 mm chipboard



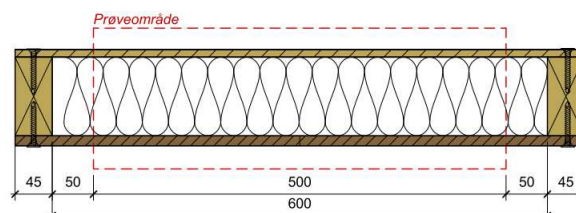
Test specimen B3

External measures: 690 x 690 mm
 Covering: 40 mm rigid wood fibre board (185 kg/m³) with a tongue and groove joint along the middle of the test specimen.
 Fixation: Clamps into the timber frame (outside exposed area).
 Substrate: 95 mm loose fill wood fibre insulation
 Backing board: 9 mm chipboard



Test specimen B4

External measures: 690 x 690 mm
 Covering: 12 mm water proof plywood boards with a butt joint along the middle of the test specimen
 Fixation: Screws into the timber frame (outside exposed area).
 Substrate: 95 mm loose fill paper insulation
 Backing board: 9 mm chipboard



6 TEST CONDITIONS

Conditioning

The test specimens were made by DBI during the middle of February 2014 and were stored under laboratory conditions until the tests.

Mounting

The test specimens were placed on top of a horizontal concrete frame with four openings of 500 x 500 mm.

The area between the test specimens as well as the outer perimeter on the unexposed side was insulated with stone wool insulation in order to prevent any influence between each test specimen.

Fire test

Two fire tests were performed, each with four test specimens. The concrete frame with four test specimens was placed horizontally on the DBI small scale furnace.

Each fire test lasted 10 minutes.

The first fire test was performed at approx. 10 AM and the second fire test was performed at 13 PM. The furnace was ventilated between the two tests.

In order to prevent preheating of the test specimens for the second fire test, the test specimens were not placed on the test frame until just before the start of the second fire test.

DBI enclosure 15.0 shows the position of the thermocouples for measuring the temperature rise on surface of the substrates behind the coverings.

7 TEST RESULTS

The enclosed graphs and tables describe:

Enclosures 1.0 and 1.1 Temperatures on test specimen A1.

Enclosures 2.0 and 2.1 Temperatures on test specimen A2.

Enclosures 3.0 and 3.1 Temperatures on test specimen A3.

Enclosures 4.0 and 4.1 Temperatures on test specimen A4.

Enclosures 5.0 and 5.1 Temperatures on test specimen B1.

Enclosures 6.0 and 6.1 Temperatures on test specimen B2.

Enclosures 7.0 and 7.1 Temperatures on test specimen B3.

Enclosures 8.0 and 8.1 Temperatures on test specimen B4.

Enclosures 9.0 and 9.1 Test 1: Actual minimum-, average- and maximum furnace temperature in relation to the standard temperature.

Enclosures 10.0 and 10.1 Test 1: Ambient temperature in the laboratory during the test.



Enclosures 11.0 and 11.1 Test 1: Furnace pressure measured 100 mm below the test frame.

Enclosures 12.0 and 12.1 Test 2: Actual minimum-, average- and maximum furnace temperature in relation to the standard temperature.

Enclosures 13.0 and 13.1 Test 2: Ambient temperature in the laboratory during the test.

Enclosures 14.0 and 14.1 Test 2: Furnace pressure measured 100 mm below the test frame.

Observations during the tests

During the test the test specimens were constantly observed, and the relevant observations are stated in the following:

Test 1:

Time minutes	Test specimen	Observations
0		Test start
1	all	Weak smoke development in general from the edges of each test specimen
5-6	A3 and A4	Increased smoke development
7	A3 and A4	Smoke has decreased again
9	A3 and A4	Increased smoke development, particularly from A4
10		Test stopped

Test 2:

Time minutes	Test specimen	Observations
0		Test start
5	all	No significant changes of test specimens on unexposed side
9	all	No significant changes of test specimens on unexposed side
10		Test stopped

Photographs

General photographs from both tests are shown on the enclosed photo sheets.

Observations after the tests

Each test specimen was examined after the test and relevant observations and photos are stated in the following:

Test specimen	Observation
A1	Small bits of the surface of the plaster had peeled off at the exposed surface, but the reinforcement net was still intact and kept the plaster together.

The insulation had a light discolouration along the joint line, but was otherwise unaffected.



A2	Small bits of the surface of the plaster had peeled off at the exposed surface, but the reinforcement net was still intact and kept the plaster together.
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This test specimen was by mistake not filled with insulation.

The back side of the cement-bonded wood wool boards had weak discolouration, but was otherwise unaffected.



A3	The cement-bonded wood wool boards were charred on the exposed side and the joint had opened slightly. A through going crack in the board had evolved along the edge of the exposed area.
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The insulation was charred in the area beneath the crack in the board. The insulation had only a light discolouration beneath the joint line.



A4 The cement-bonded wood wool boards were charred on the exposed side and the joint had opened slightly. Through going cracks in the board had evolved along the edges of the exposed area, indicating some stress in the material.

The insulation was charred in the area beneath the cracks in the board. The insulation had only a light discolouration beneath the joint line.



B1 The paper lining of the gypsum plasterboard was charred and had peeled off, but the boards were still in place without cracks. The joint had increased very slightly.

There was no charring or discolouration of the insulation that seemed completely unaffected.



B2 The paper lining of the gypsum plasterboard was charred and had peeled off, but

the boards were still in place without cracks. The joint had increased very slightly. There was no charring and only very light discolouration of the insulation.



B3 The plaster was intact directly after test. A crack evolved during the cooling of the test specimen, and the plaster layer fell apart during the evaluation process.

The wood fibre board was charred and a smouldering combustion of the board was taking place also after the test.

The insulation behind the wood fibre board was unaffected.



B4 The plywood was charred on exposed side and the boards were a bit deformed. The joint had opened slightly.

The insulation was discoloured and small bits of the insulation had attached itself to the backside of the plywood boards.



8 REMARK

The tests described in this test report were small scale demonstration tests made for a general informative purpose. The test results are not meant to be used for classification or approval by authorities.

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.

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/

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M.Sc. (Eng.)

Enclosures: 31
DBI drawings: 3
DBI graphs and tables: 28



Photo No. 1 Test specimens no A1, A2, A3 and A4 from exposed side before test



Photo No. 2 Test specimens no A1, A2, A3 and A4 from unexposed side before test



Photo No. 3 Test specimens no A1, A2, A3 and A4 after 6 minutes of testing



Photo No. 4 Test specimens no A1, A2, A3 and A4 after 9 minutes of testing



Photo No. 5 Test specimens no A1, A2, A3 and A4 from exposed side after the test



Photo No. 6 Test specimens no B1, B2, B3 and B4 from unexposed side before test



Photo No. 7 Test specimens no B1, B2, B3 and B4 after 5 minutes of testing

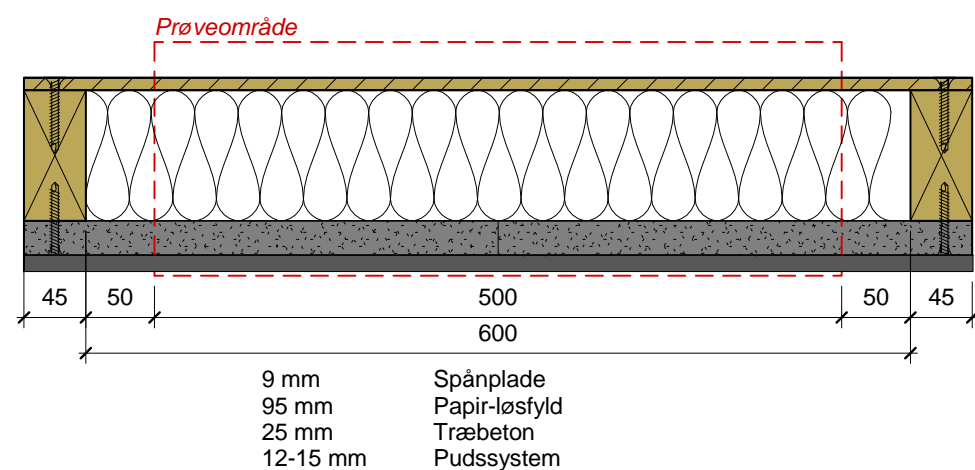


Photo No. 8 Test specimens no B1, B2, B3 and B4 after 9 minutes of testing

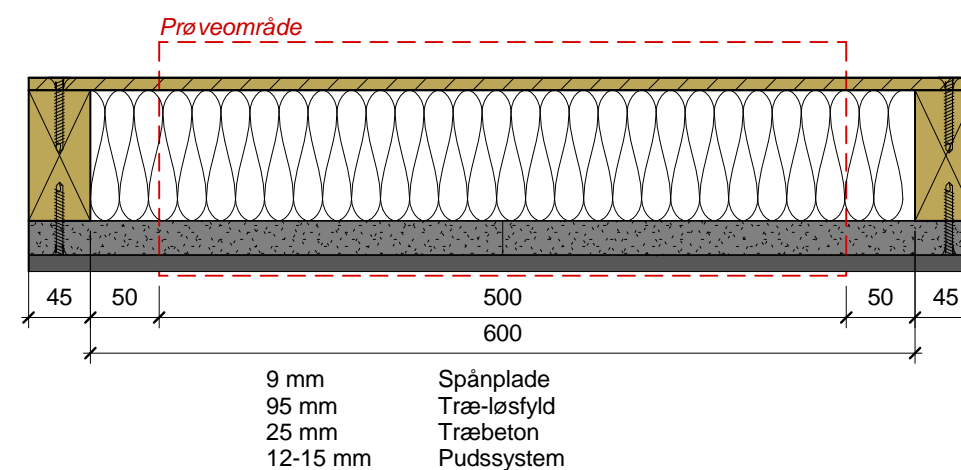


Photo No. 9 Test specimens no B1, B2, B3 and B4 from exposed side after test

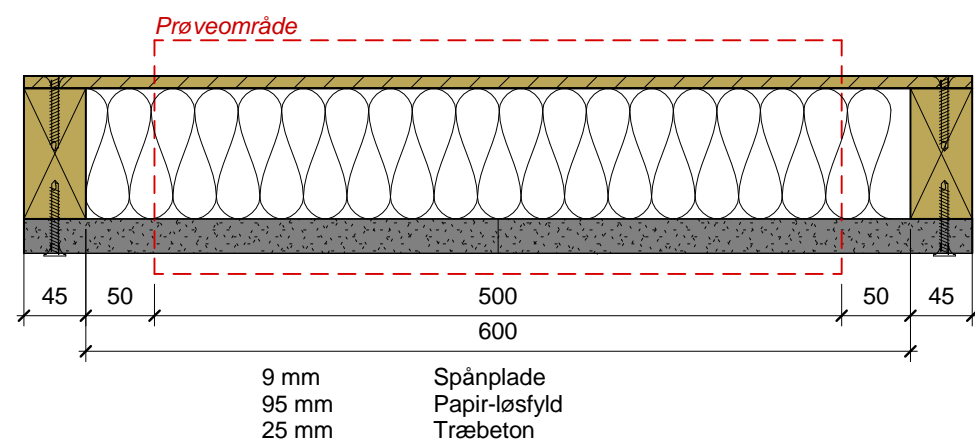
A.1: Løsfyldt papir, Træbetonplade inkl. samling, Pudssystem



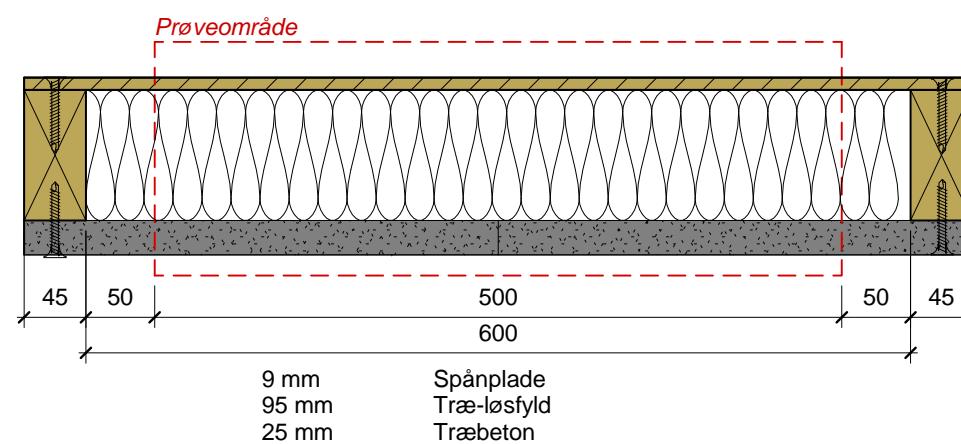
A.2: Løsfyldt træ, Træbetonplade inkl. samling, Pudssystem



A.3: Løsfyldt papir, Træbetonplade inkl. samling



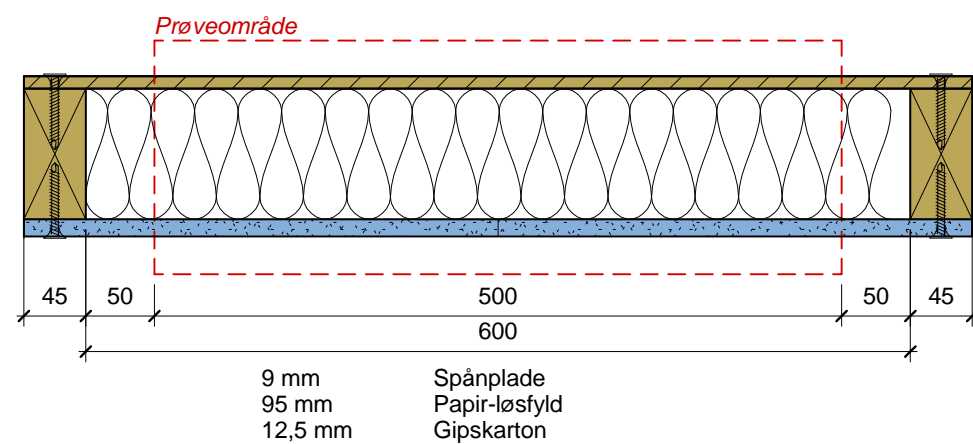
A.4: Løsfyldt træ, Træbetonplade inkl. samling



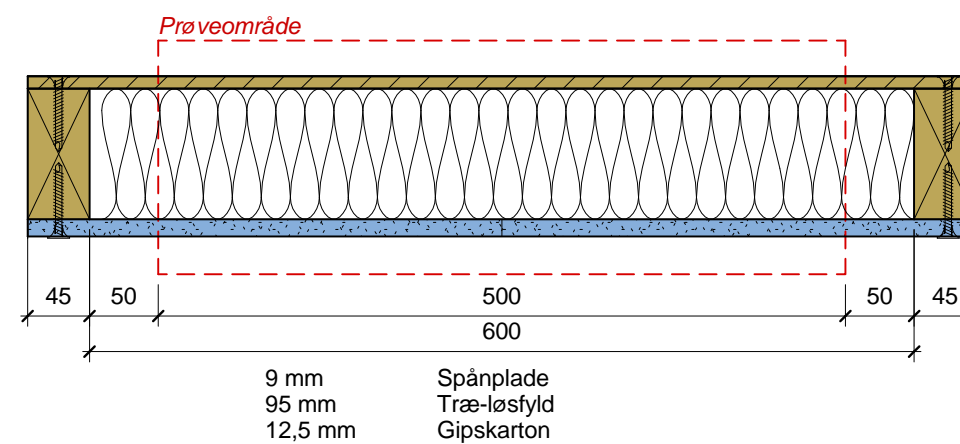
Bygherre: InnoBYG
 Sag: Brandtekniske eksperimenter
 Emne: InnoBYG brandprøvninger del 2, A
 Int.: SLA | Kontr.: CheckerDato: 02/07/14

Sags nr.:
 Tegn. nr.:
A1.3
 Rev. dato:
 Mål: 1 : 5

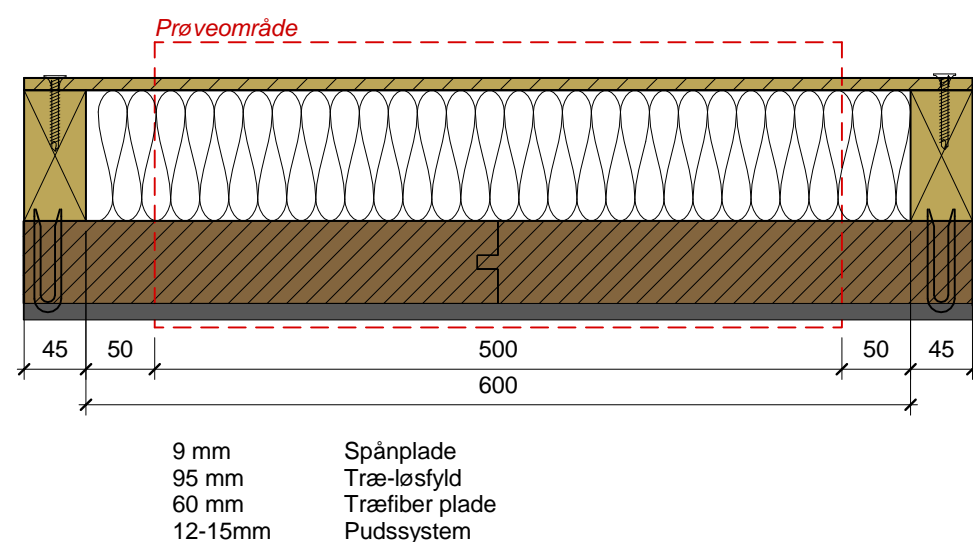
B.1: Løsfyldt papir, Gipskarton inkl. samling



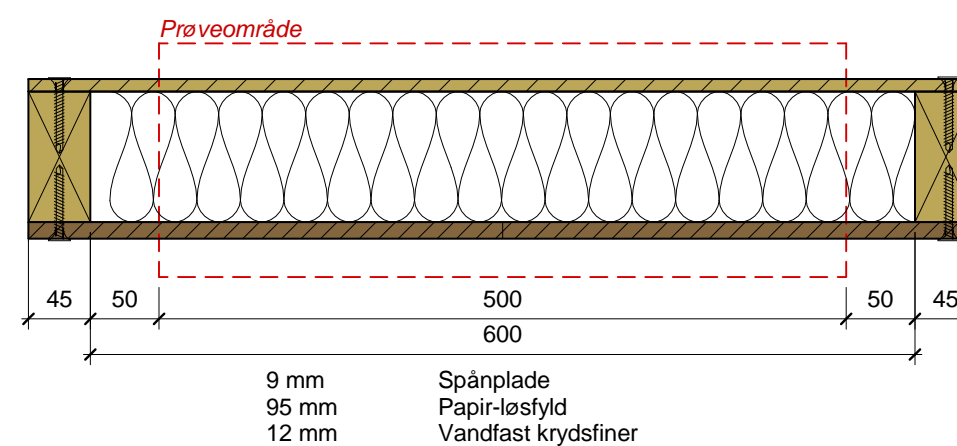
B.2: Løsfyldt træ, Gipskarton inkl. samling



B.3: Løsfyldt træ, Puds bærelære inkl. samling, pudssystem



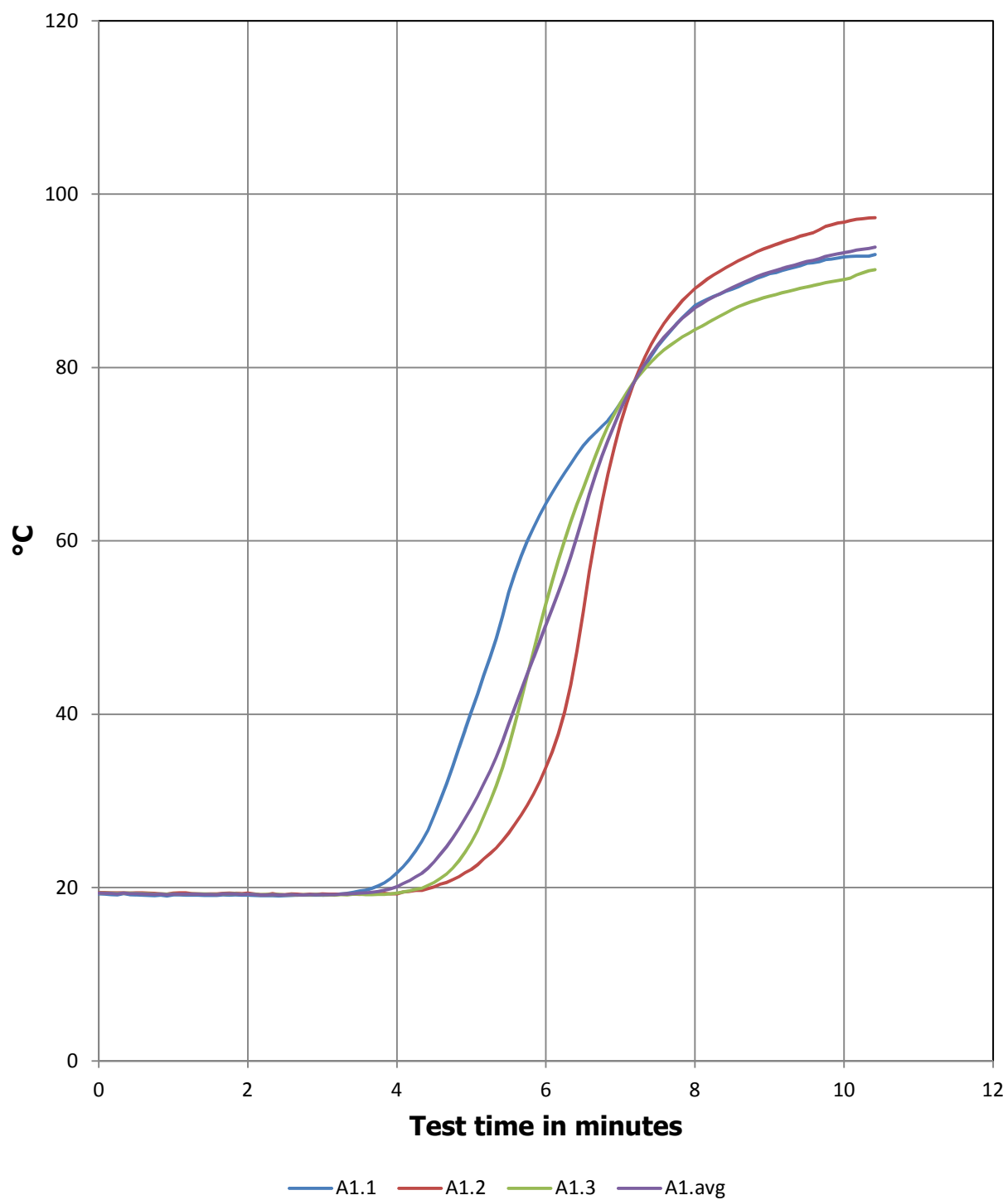
B.4: Løsfyldt papir, Vandfast krydsfiner inkl. samling



Bygherre: InnoBYG
Sag: Brandtekniske eksperimenter
Emne: InnoBYG brandprøvninger del 2, B
Int.: SLA | Kontr.: CheckerDato: 02/07/14

Sags nr.:
Tegn. nr.:
A1.4
Rev. dato:
Mål: 1 : 5

Temperatures on test specimen A1

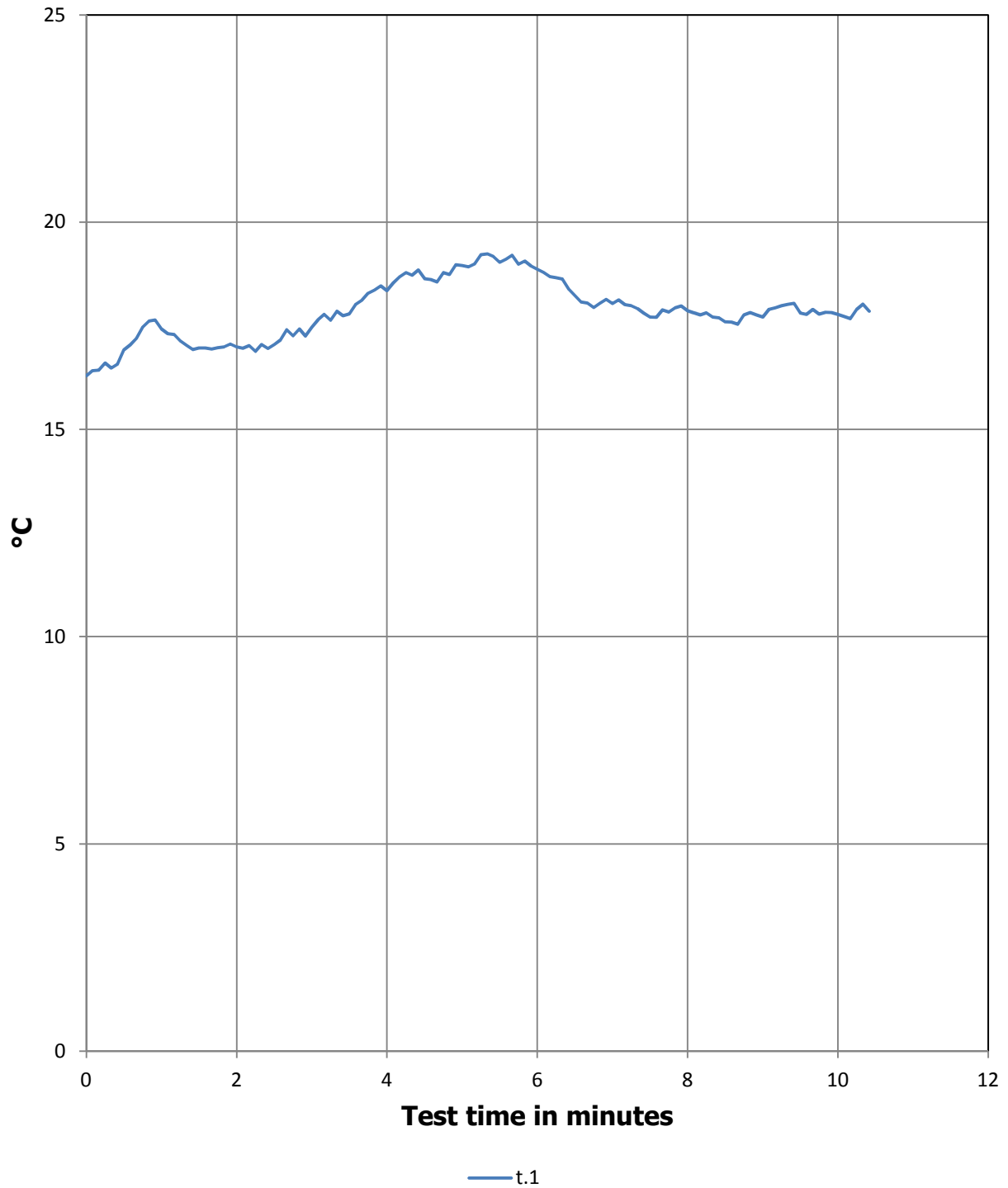




Temperatures on test specimen A1

Min. / °C	A1.1	A1.2	A1.3	A1.Avg
0.0	19.3	19.4	19.4	19.4
0.5	19.1	19.4	19.3	19.3
1.0	19.1	19.4	19.3	19.3
1.5	19.1	19.3	19.2	19.2
2.0	19.1	19.4	19.2	19.2
2.5	19.1	19.2	19.2	19.1
3.0	19.1	19.3	19.2	19.2
3.5	19.6	19.2	19.2	19.4
4.0	21.7	19.3	19.4	20.1
4.5	28.3	20.1	20.6	23.0
5.0	40.3	22.1	25.2	29.2
5.5	54.0	26.3	36.2	38.9
6.0	64.3	33.8	52.7	50.3
6.5	70.9	51.8	66.0	62.9
7.0	75.9	73.5	75.9	75.1
7.5	82.4	84.0	81.4	82.6
8.0	87.1	89.1	84.4	86.9
8.5	89.1	91.9	86.7	89.2
9.0	90.8	93.9	88.2	91.0
9.5	92.0	95.4	89.3	92.2
10.0	92.7	96.8	90.2	93.2

Ambient temperature (test 1)

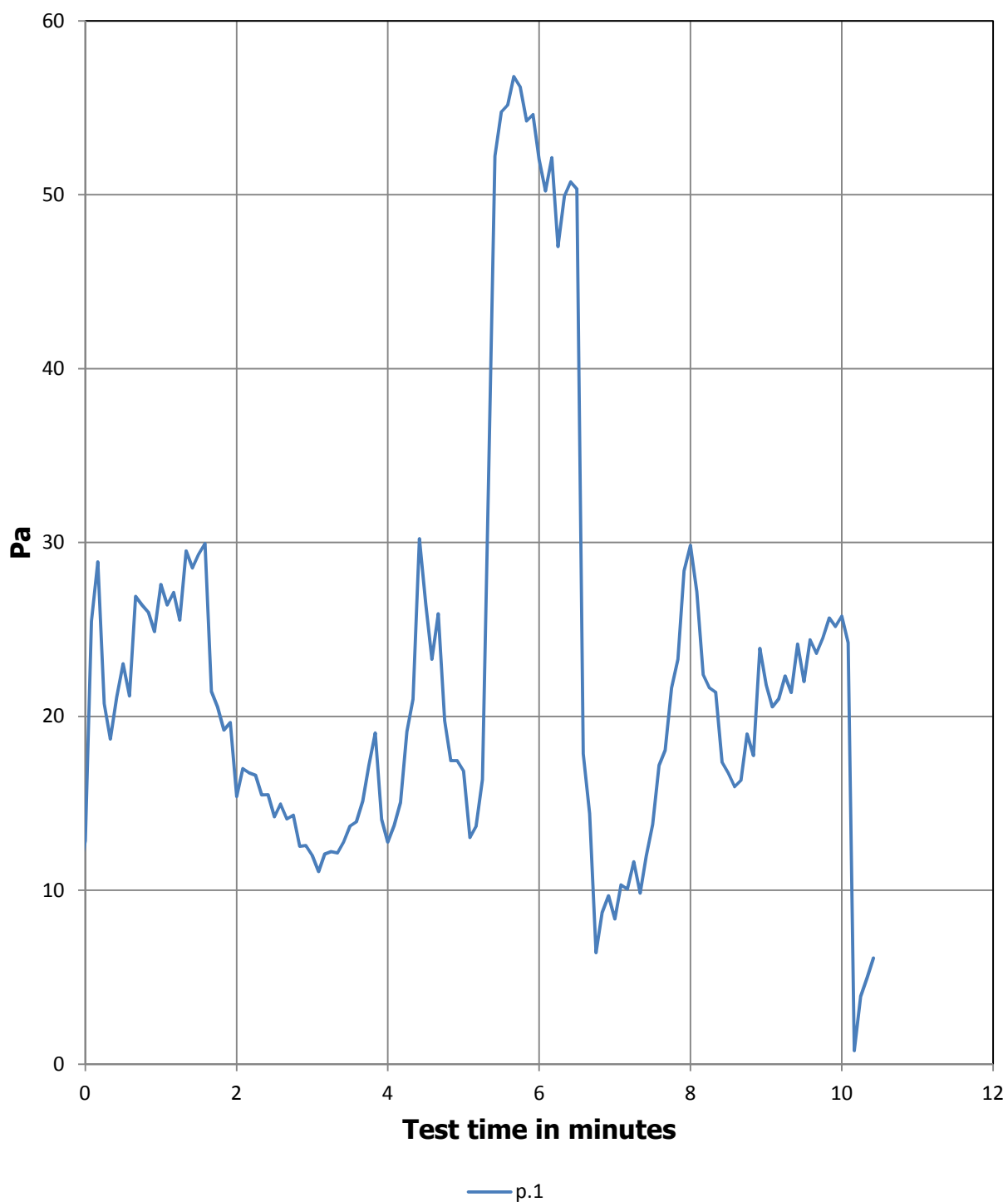




Ambient temperature (test 1)

Min. / °C	t.1
0.0	16.3
0.5	16.9
1.0	17.4
1.5	17.0
2.0	17.0
2.5	17.0
3.0	17.5
3.5	17.8
4.0	18.3
4.5	18.6
5.0	19.0
5.5	19.0
6.0	18.9
6.5	18.2
7.0	18.0
7.5	17.7
8.0	17.9
8.5	17.6
9.0	17.7
9.5	17.8
10.0	17.8

Furnace pressure (test 1)

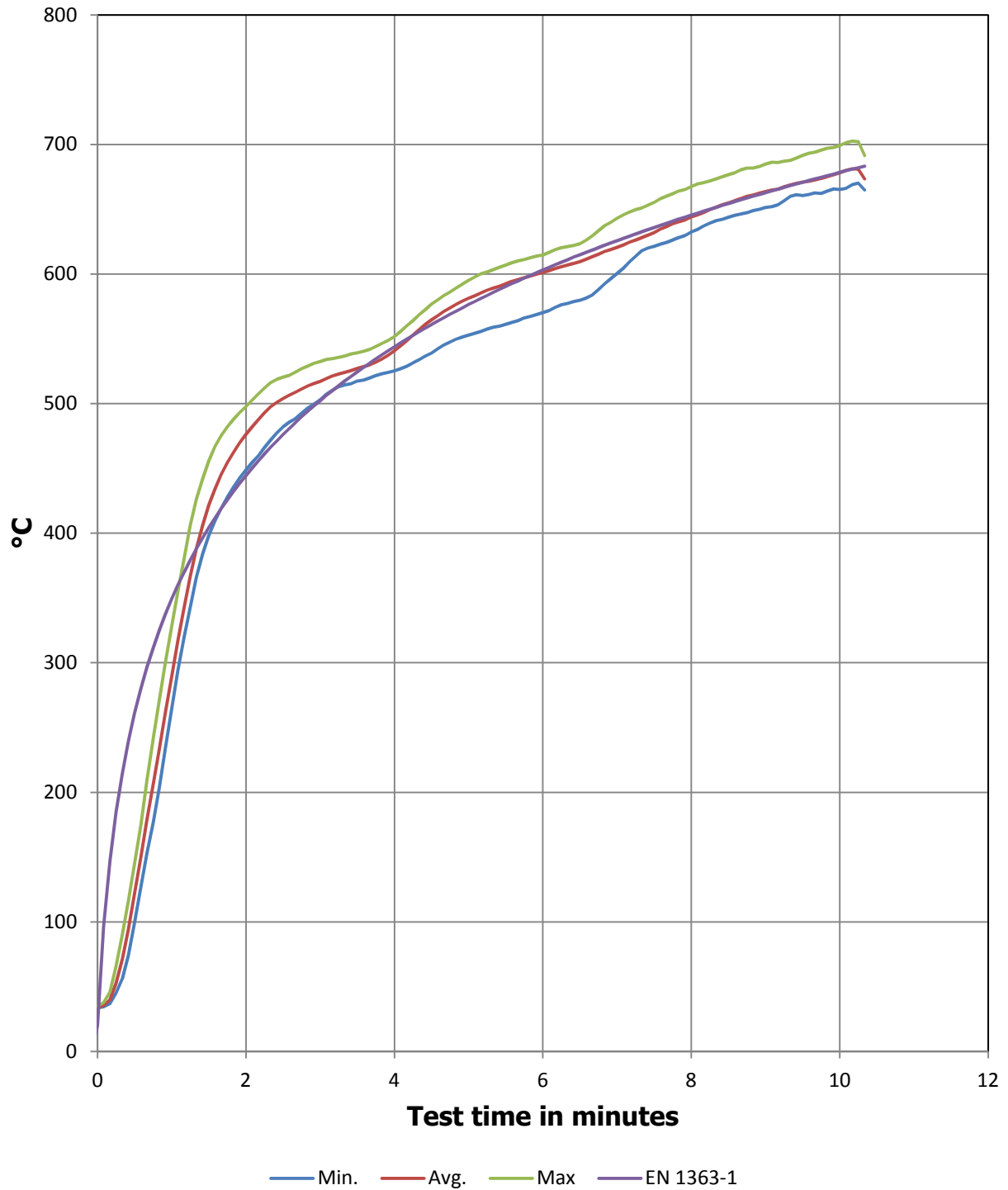




Furnace pressure (test 1)

Min. / Pa	p.1
0.0	12.8
0.5	23.0
1.0	27.6
1.5	29.3
2.0	15.4
2.5	14.2
3.0	12.0
3.5	13.7
4.0	12.8
4.5	26.4
5.0	16.9
5.5	54.8
6.0	52.0
6.5	50.3
7.0	8.4
7.5	13.8
8.0	29.8
8.5	16.7
9.0	21.8
9.5	22.0
10.0	25.8

Furnace temperature (test 2)

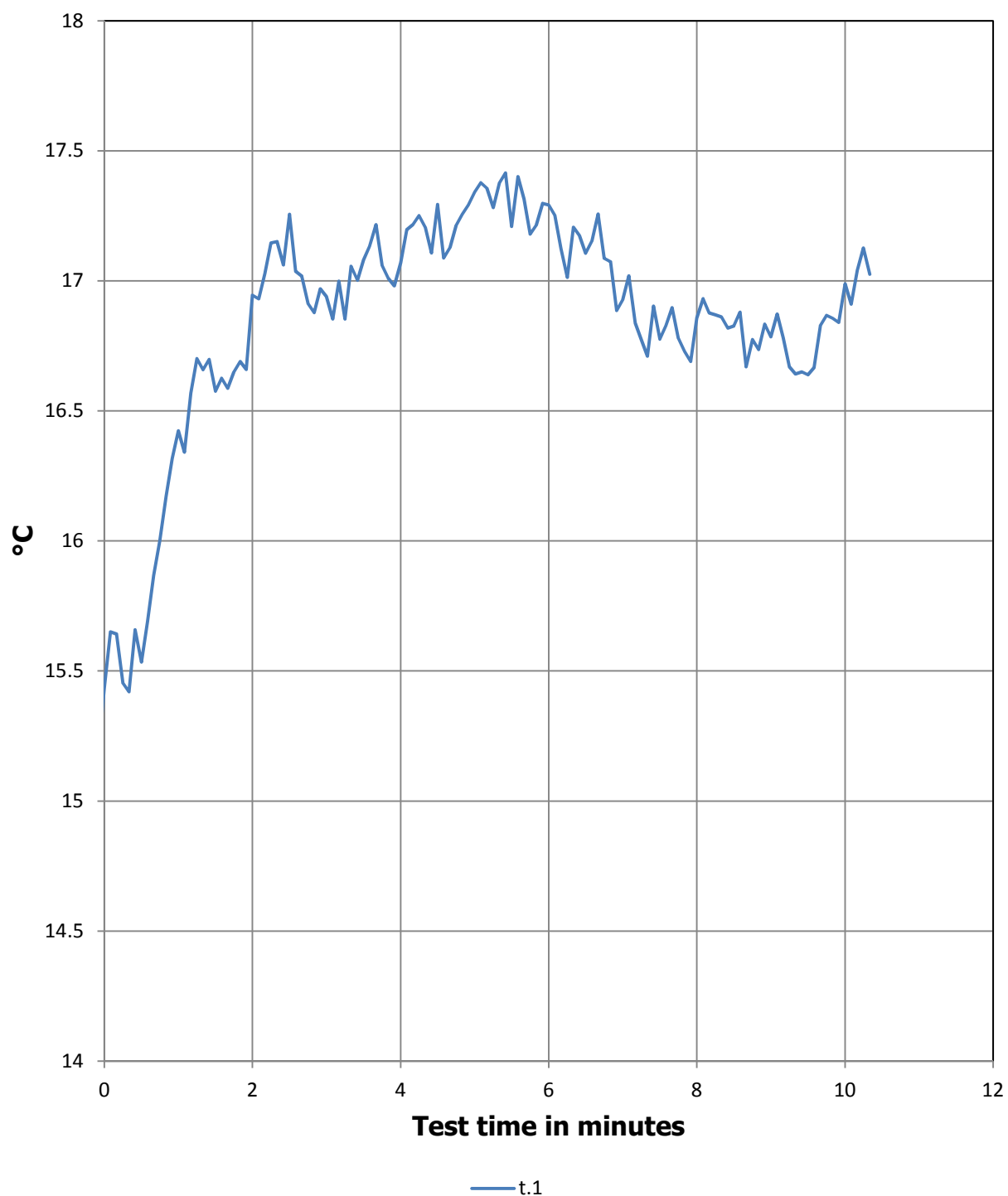




Furnace temperature (test 2)

Time Minutes	Measured			Norm EN 1363-1	Area under curve		Dev. [%]	Limit [%]
	Minimum	Average	Maximum		Measured	EN 1363-1		
0.0	33.7	34.2	35.0	20.0	0	0	#DIV/0!	
0.5	99.2	121.7	144.9	261.1	31	85	-63.7	
1.0	264.8	289.7	328.4	349.2	134	240	-44.1	
1.5	398.2	421.6	455.7	404.3	315	429	-26.5	
2.0	448.8	476.2	497.8	444.5	542	642	-15.6	
2.5	482.0	503.8	520.3	476.2	788	872	-9.7	
3.0	503.1	517.2	532.4	502.3	1043	1117	-6.6	
3.5	517.4	527.1	539.3	524.5	1304	1374	-5.1	
4.0	525.2	540.9	551.9	543.9	1571	1641	-4.3	
4.5	539.1	564.7	576.7	561.0	1847	1917	-3.7	
5.0	552.9	581.3	595.1	576.4	2134	2202	-3.1	
5.5	561.1	592.3	607.0	590.4	2427	2494	-2.7	15.0
6.0	570.1	601.2	614.7	603.1	2726	2792	-2.4	15.0
6.5	579.9	609.6	623.5	614.9	3029	3096	-2.2	15.0
7.0	600.3	620.6	642.9	625.8	3336	3407	-2.1	15.0
7.5	621.4	632.1	655.3	635.9	3649	3722	-2.0	15.0
8.0	632.4	644.0	667.5	645.5	3969	4042	-1.8	15.0
8.5	643.9	654.9	676.8	654.4	4293	4367	-1.7	15.0
9.0	651.3	663.7	684.8	662.8	4623	4697	-1.6	15.0
9.5	660.6	670.9	691.6	670.8	4957	5030	-1.5	15.0
10.0	665.2	678.1	699.1	678.4	5294	5368	-1.4	15.0

Ambient temperature (test 2)

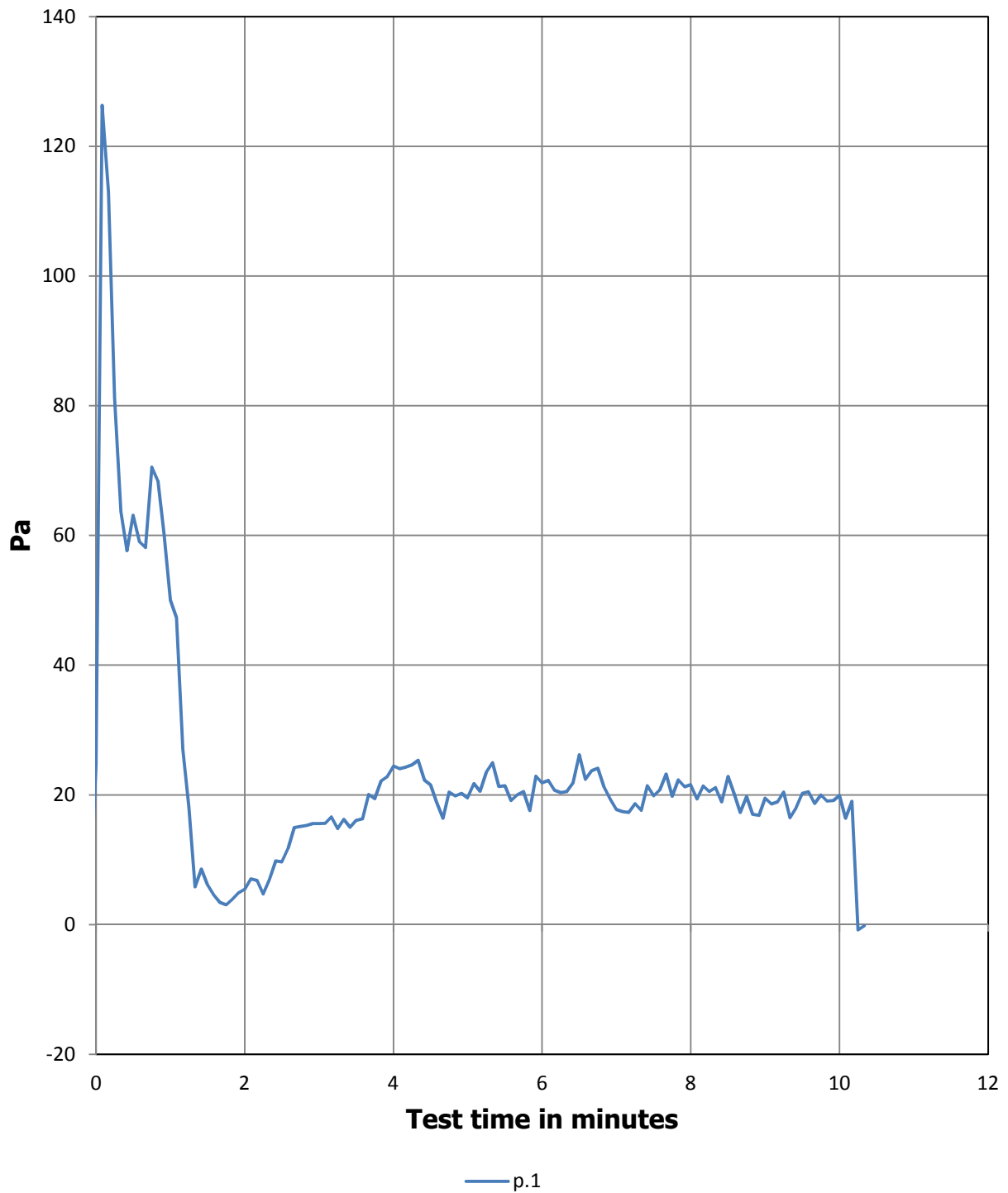




Ambient temperature (test 2)

Min. / °C	t.1
0.0	15.4
0.5	15.5
1.0	16.4
1.5	16.6
2.0	16.9
2.5	17.3
3.0	16.9
3.5	17.1
4.0	17.1
4.5	17.3
5.0	17.3
5.5	17.2
6.0	17.3
6.5	17.1
7.0	16.9
7.5	16.8
8.0	16.9
8.5	16.8
9.0	16.8
9.5	16.6
10.0	17.0

Furnace pressure (test 2)

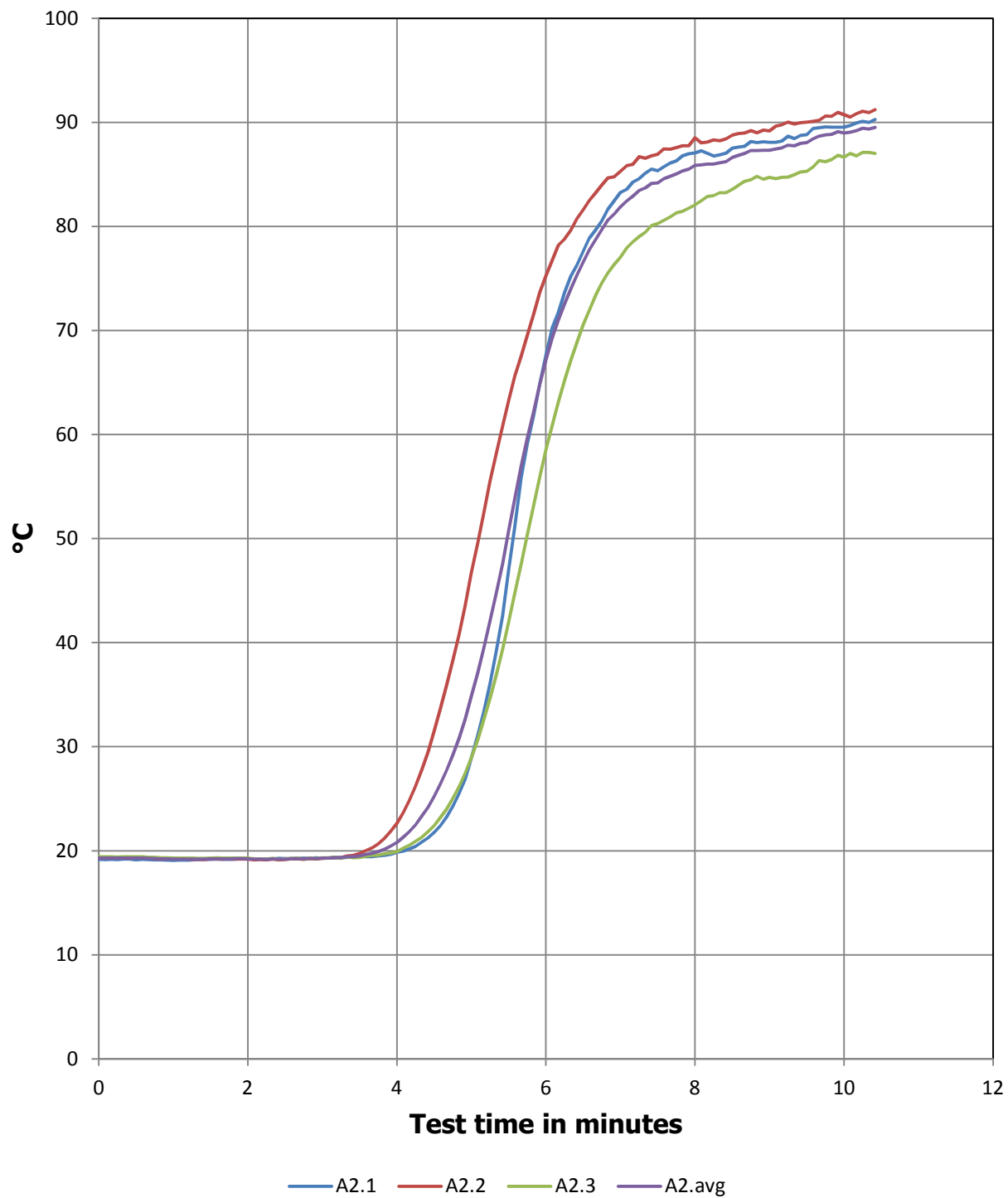




Furnace pressure (test 2)

Min. / Pa	p.1
0.0	24.6
0.5	63.1
1.0	50.0
1.5	6.1
2.0	5.5
2.5	9.7
3.0	15.6
3.5	16.1
4.0	24.4
4.5	21.5
5.0	19.5
5.5	21.4
6.0	21.9
6.5	26.2
7.0	17.7
7.5	19.9
8.0	21.6
8.5	22.8
9.0	19.5
9.5	20.2
10.0	19.9

Temperatures on test specimen A2

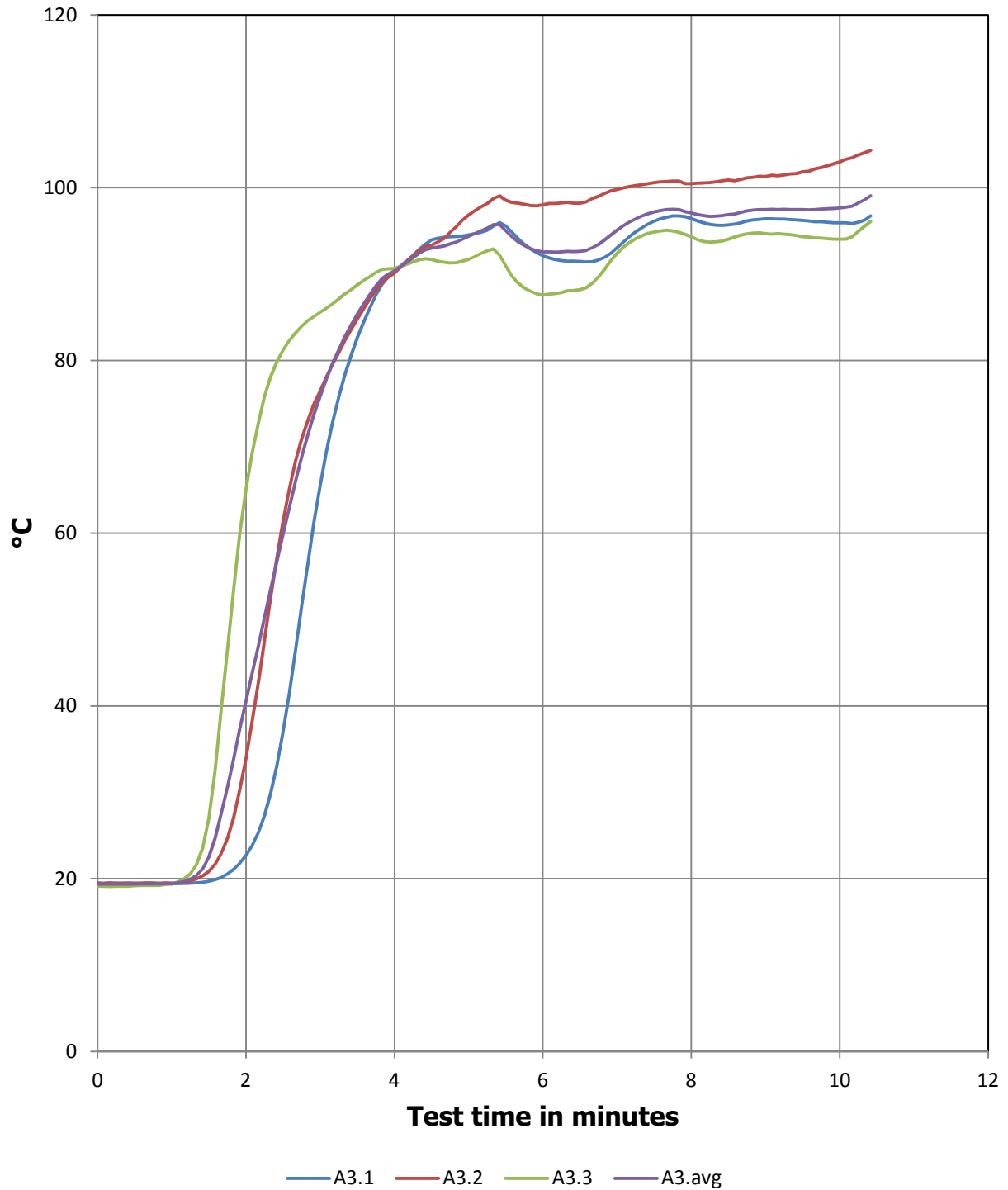




Temperatures on test specimen A2

Min. / °C	A2.1	A2.2	A2.3	A2.Avg
0.0	19.2	19.3	19.4	19.3
0.5	19.1	19.3	19.4	19.3
1.0	19.1	19.2	19.3	19.2
1.5	19.2	19.2	19.3	19.2
2.0	19.2	19.2	19.3	19.2
2.5	19.3	19.1	19.2	19.2
3.0	19.3	19.3	19.3	19.3
3.5	19.5	19.7	19.3	19.5
4.0	19.9	22.7	19.9	20.8
4.5	21.7	31.5	22.4	25.2
5.0	28.9	46.7	28.9	34.8
5.5	47.0	63.3	42.0	50.8
6.0	67.6	75.2	58.5	67.1
6.5	77.6	81.6	70.6	76.6
7.0	83.3	85.3	77.0	81.8
7.5	85.4	86.9	80.3	84.2
8.0	87.1	88.5	82.1	85.9
8.5	87.5	88.8	83.6	86.6
9.0	88.1	89.2	84.7	87.3
9.5	88.8	90.0	85.3	88.1
10.0	89.5	90.7	86.7	89.0

Temperatures on test specimen A3

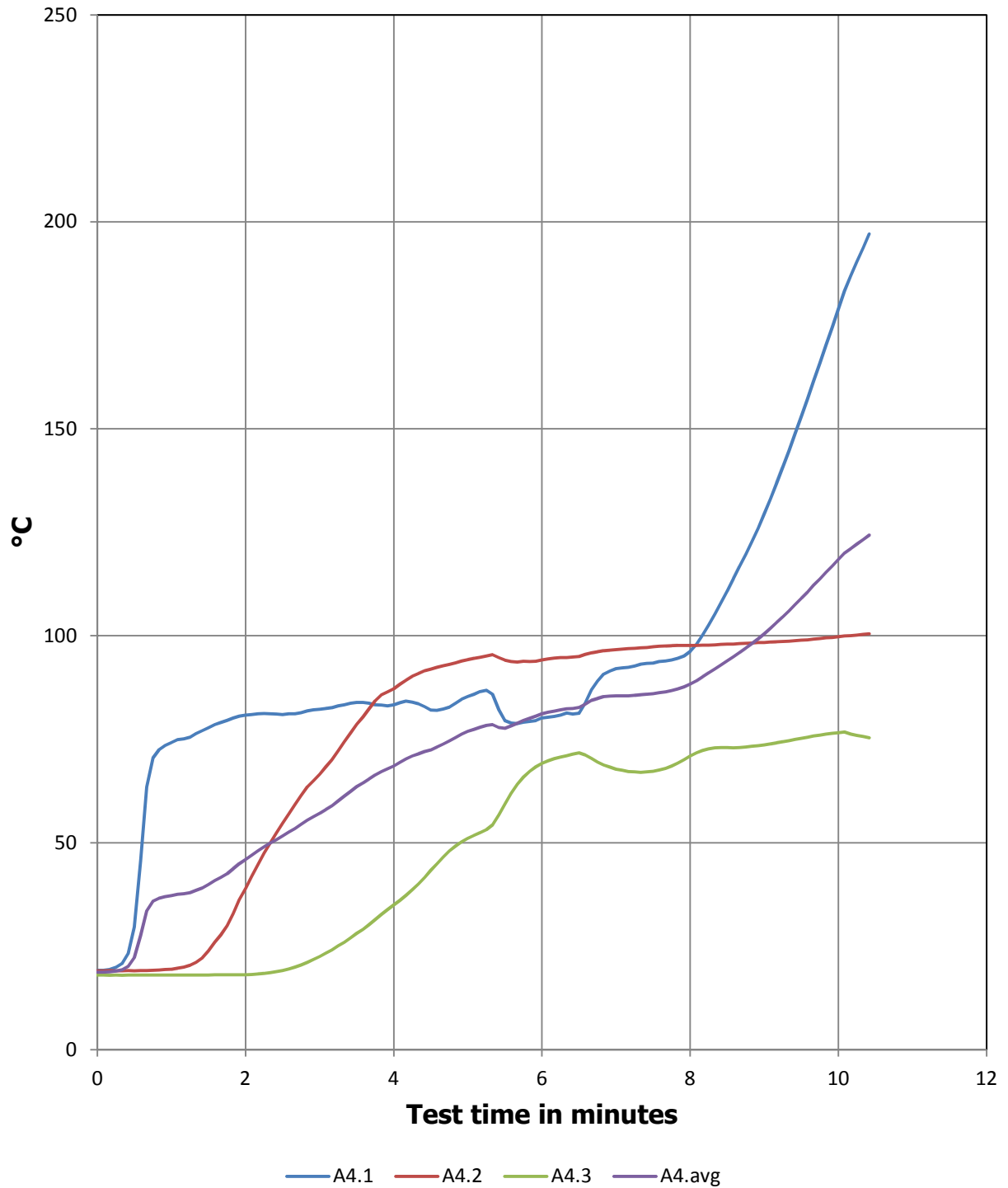




Temperatures on test specimen A3

Min. / °C	A3.1	A3.2	A3.3	A3.Avg
0.0	19.5	19.5	19.1	19.4
0.5	19.4	19.5	19.2	19.4
1.0	19.4	19.5	19.4	19.4
1.5	19.7	20.8	27.0	22.5
2.0	22.7	33.9	65.1	40.6
2.5	37.0	61.4	81.2	59.9
3.0	65.6	76.5	85.6	75.9
3.5	82.6	84.8	88.8	85.4
4.0	90.3	90.1	90.6	90.4
4.5	93.9	93.3	91.7	93.0
5.0	94.5	96.8	91.7	94.3
5.5	95.6	98.5	91.0	95.0
6.0	92.1	98.0	87.6	92.6
6.5	91.5	98.2	88.2	92.6
7.0	93.0	99.8	92.4	95.1
7.5	96.1	100.6	94.9	97.2
8.0	96.4	100.5	94.3	97.1
8.5	95.7	100.9	94.0	96.9
9.0	96.4	101.3	94.7	97.5
9.5	96.2	101.8	94.3	97.5
10.0	95.9	103.0	94.0	97.6

Temperatures on test specimen A4

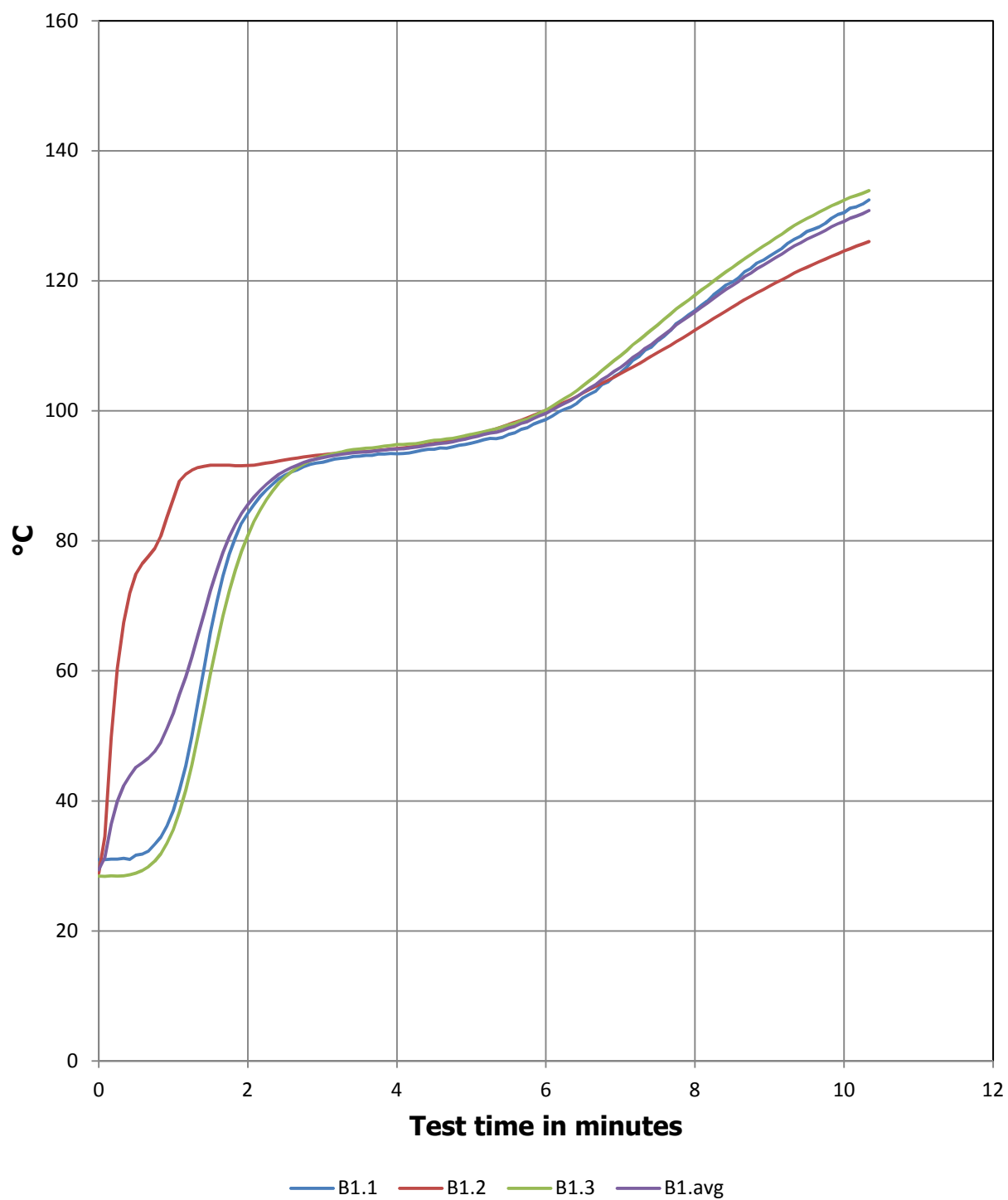




Temperatures on test specimen A4

Min. / °C	A4.1	A4.2	A4.3	A4.Avg
0.0	19.2	19.1	18.0	18.8
0.5	29.7	19.1	18.0	22.3
1.0	74.2	19.5	18.0	37.2
1.5	77.8	23.8	18.1	39.9
2.0	80.8	39.0	18.1	46.0
2.5	81.0	54.7	19.1	51.6
3.0	82.2	66.5	22.5	57.1
3.5	83.9	78.6	28.1	63.5
4.0	83.3	87.2	35.0	68.5
4.5	82.1	91.9	43.3	72.4
5.0	85.3	94.2	51.0	76.8
5.5	79.5	94.1	59.4	77.7
6.0	80.1	94.1	69.2	81.1
6.5	81.3	95.0	71.7	82.7
7.0	92.0	96.7	67.8	85.5
7.5	93.4	97.3	67.3	86.0
8.0	96.2	97.7	70.9	88.3
8.5	110.9	98.0	73.0	93.9
9.0	129.5	98.4	73.7	100.5
9.5	153.1	98.9	75.2	109.1
10.0	178.9	99.8	76.6	118.4

Temperatures on test specimen B1

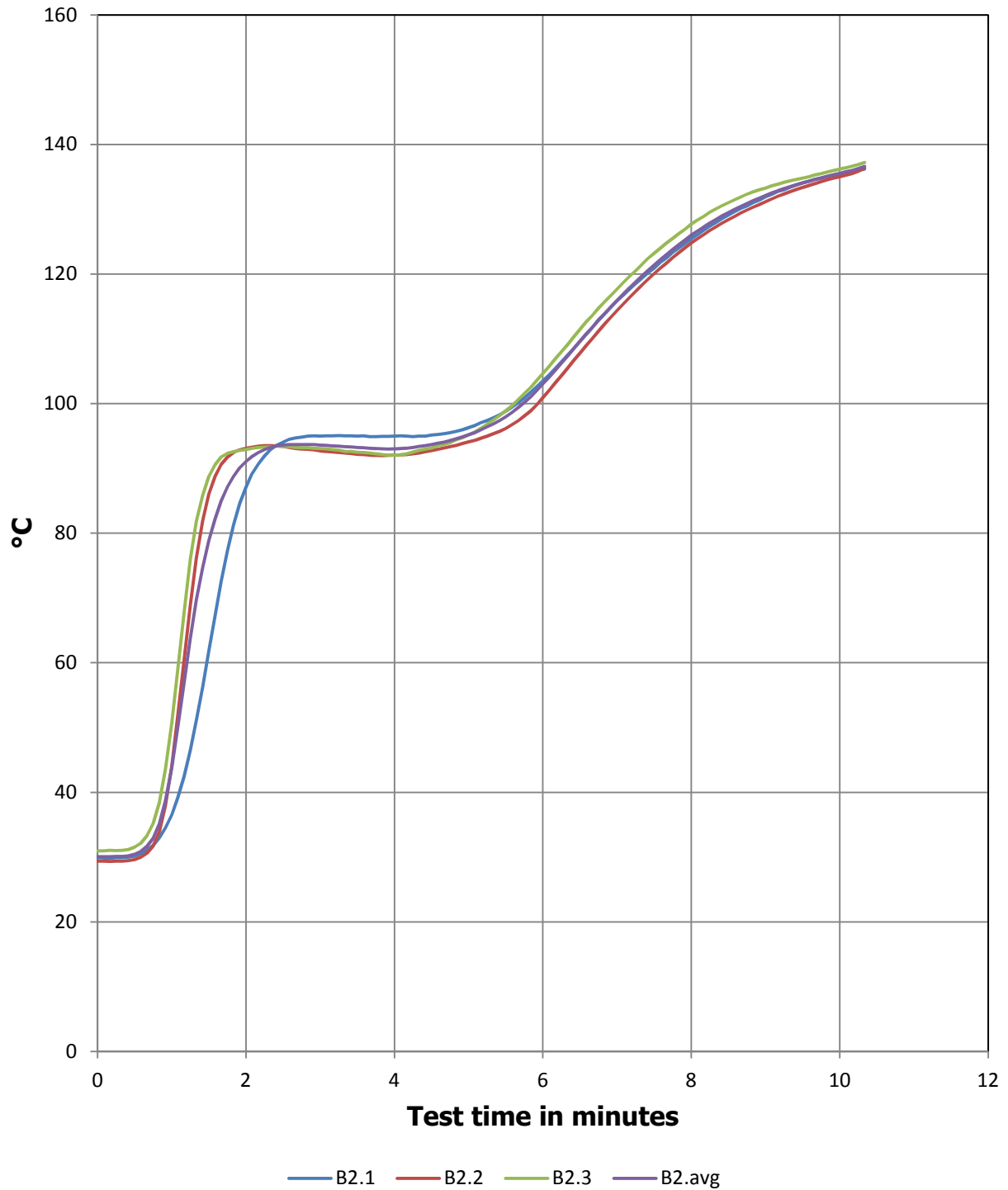




Temperatures on test specimen B1

Min. / °C	B1.1	B1.2	B1.3	B1.Avg
0.0	31.0	28.9	28.4	29.4
0.5	31.7	74.9	28.9	45.1
1.0	38.5	86.5	35.6	53.5
1.5	66.0	91.6	59.6	72.4
2.0	84.3	91.6	80.8	85.6
2.5	90.1	92.5	89.8	90.8
3.0	92.1	93.2	93.0	92.8
3.5	93.0	93.7	94.1	93.6
4.0	93.4	94.2	94.8	94.1
4.5	94.1	95.0	95.5	94.8
5.0	95.0	96.2	96.4	95.9
5.5	96.4	97.9	97.8	97.3
6.0	98.7	100.0	100.1	99.6
6.5	102.0	102.8	103.9	102.9
7.0	105.8	105.7	108.4	106.7
7.5	110.8	109.0	113.2	111.0
8.0	115.4	112.4	117.8	115.2
8.5	119.8	115.9	122.0	119.3
9.0	123.8	119.2	125.9	123.0
9.5	127.6	122.1	129.6	126.4
10.0	130.5	124.6	132.4	129.1

Temperatures on test specimen B2

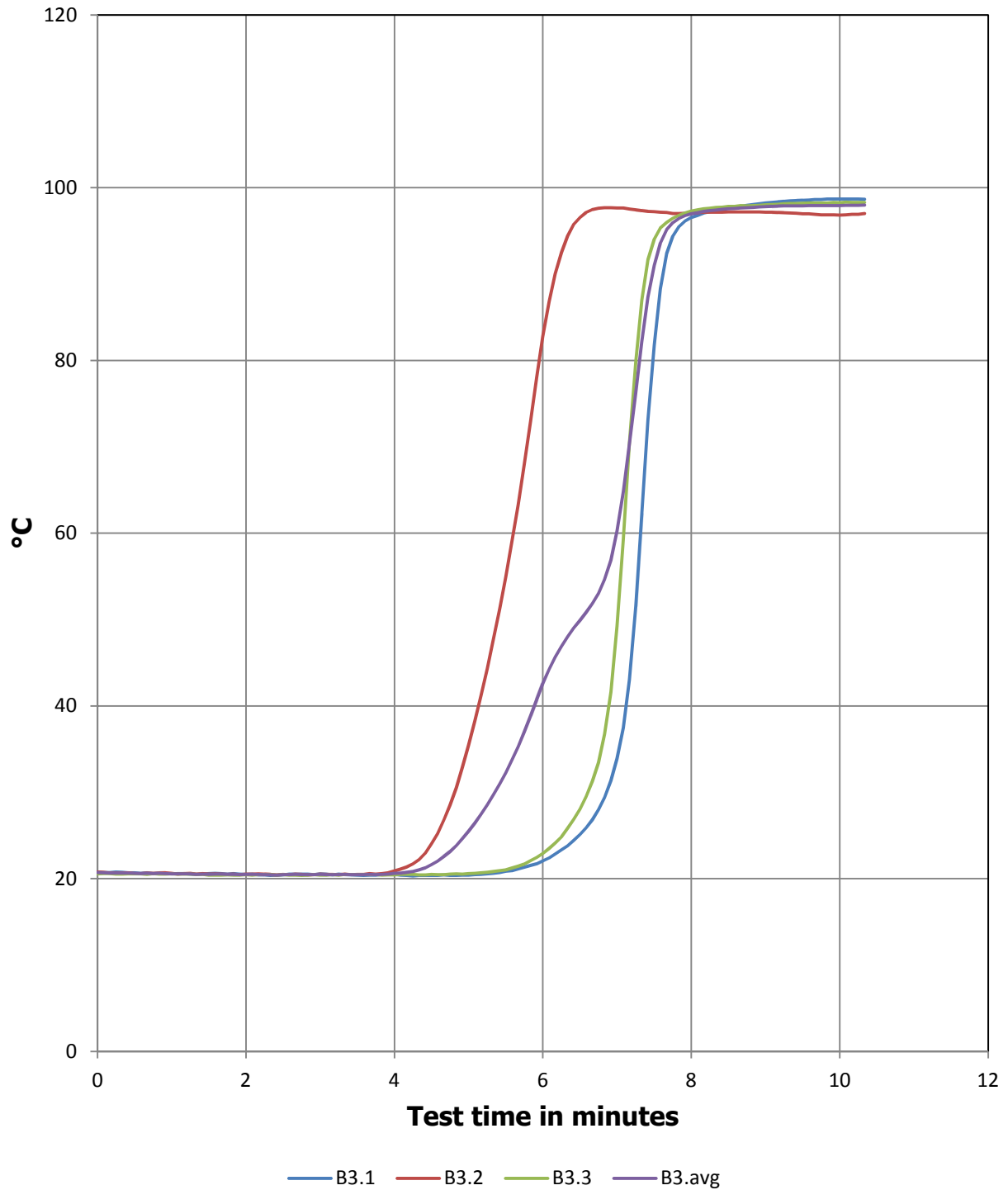




Temperatures on test specimen B2

Min. / °C	B2.1	B2.2	B2.3	B2.Avg
0.0	29.9	29.4	31.0	30.1
0.5	30.2	29.6	31.5	30.4
1.0	36.5	44.1	50.7	43.8
1.5	61.8	86.0	88.7	78.8
2.0	87.1	93.1	92.9	91.1
2.5	94.0	93.4	93.4	93.6
3.0	95.0	92.7	93.1	93.6
3.5	95.0	92.2	92.5	93.2
4.0	95.0	92.0	92.0	93.0
4.5	95.1	92.8	93.1	93.7
5.0	96.3	94.1	95.2	95.2
5.5	98.8	96.2	98.9	98.0
6.0	103.5	100.9	104.6	103.0
6.5	109.6	107.8	111.5	109.6
7.0	115.8	114.4	117.7	115.9
7.5	120.9	120.1	123.2	121.4
8.0	125.4	124.8	127.7	126.0
8.5	129.1	128.4	131.0	129.5
9.0	131.9	131.1	133.3	132.1
9.5	134.1	133.4	134.8	134.1
10.0	135.4	135.0	136.2	135.5

Temperatures on test specimen B3

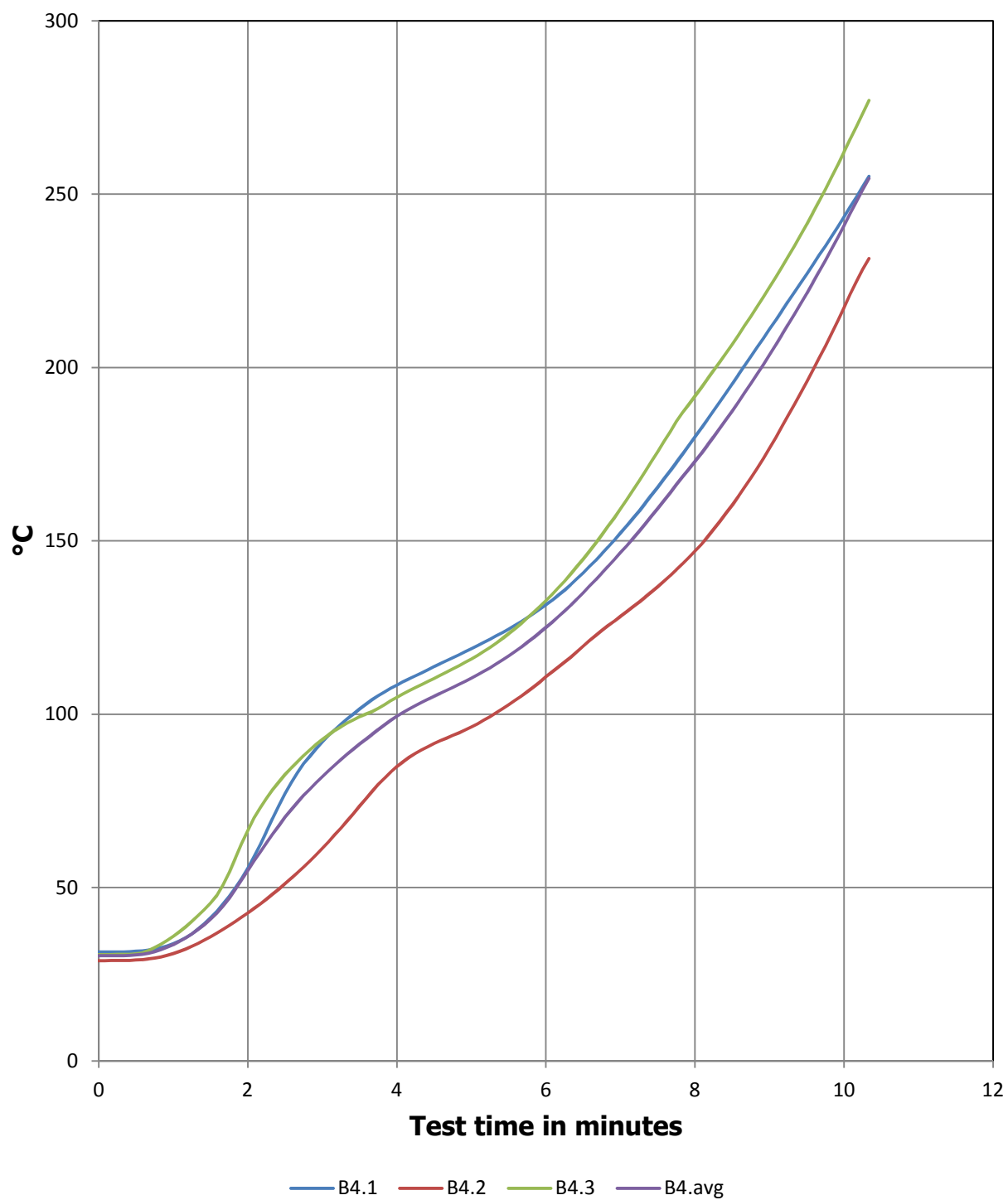




Temperatures on test specimen B3

Min. / °C	B3.1	B3.2	B3.3	B3.Avg
0.0	20.8	20.8	20.6	20.7
0.5	20.7	20.6	20.6	20.6
1.0	20.6	20.6	20.6	20.6
1.5	20.6	20.5	20.4	20.5
2.0	20.5	20.5	20.5	20.5
2.5	20.4	20.5	20.5	20.5
3.0	20.6	20.5	20.4	20.5
3.5	20.4	20.5	20.5	20.5
4.0	20.5	20.9	20.4	20.6
4.5	20.4	24.1	20.5	21.6
5.0	20.4	35.4	20.6	25.5
5.5	20.9	54.9	21.0	32.3
6.0	22.1	82.8	22.9	42.6
6.5	25.1	96.6	28.1	49.9
7.0	33.9	97.6	49.2	60.3
7.5	81.8	97.2	94.0	91.0
8.0	96.5	97.1	97.3	97.0
8.5	97.7	97.2	97.8	97.6
9.0	98.2	97.2	98.0	97.8
9.5	98.5	97.0	98.2	97.9
10.0	98.7	96.8	98.3	97.9

Temperatures on test specimen B4

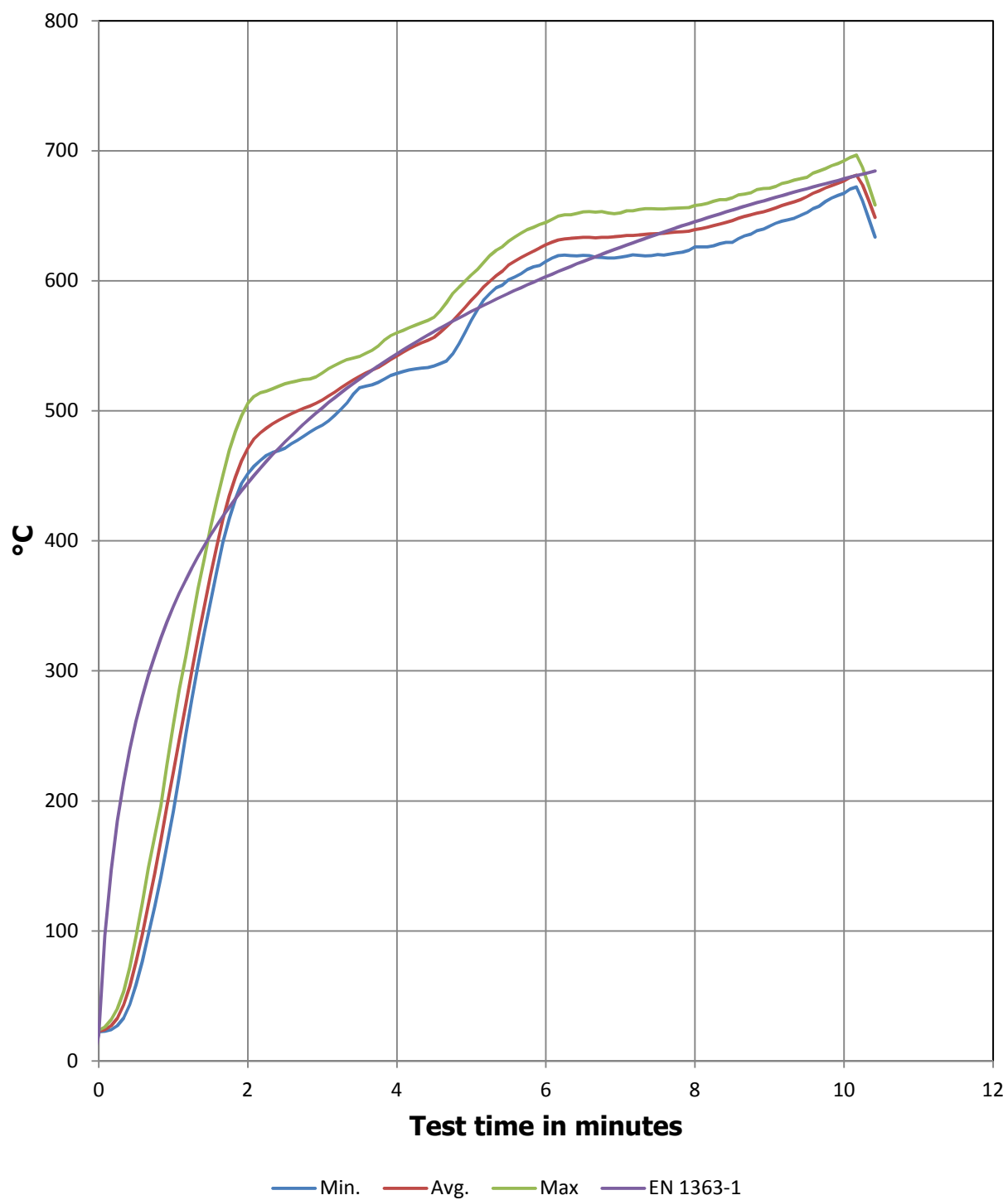




Temperatures on test specimen B4

Min. / °C	B4.1	B4.2	B4.3	B4.Avg
0	31.4	28.9	30.7	30.3
0.5	31.6	29.1	30.9	30.6
1.0	33.8	31.0	35.9	33.5
1.5	41.3	35.8	45.5	40.9
2.0	55.6	42.7	66.5	54.9
2.5	77.1	51.1	82.6	70.3
3.0	92.0	61.3	92.7	82.0
3.5	101.5	73.5	99.3	91.4
4.0	108.4	84.9	104.9	99.4
4.5	113.7	91.5	110.3	105.2
5.0	118.9	96.3	115.9	110.4
5.5	124.5	102.7	123.2	116.8
6.0	131.6	110.7	132.7	125.0
6.5	140.8	119.6	144.7	135.0
7.0	152.2	128.2	159.2	146.6
7.5	165.4	136.8	175.7	159.3
8.0	179.9	147.0	191.7	172.9
8.5	195.3	160.4	206.7	187.5
9.0	211.1	176.7	223.2	203.7
9.5	227.0	195.9	241.4	221.4
10.0	243.4	217.3	262.1	240.9

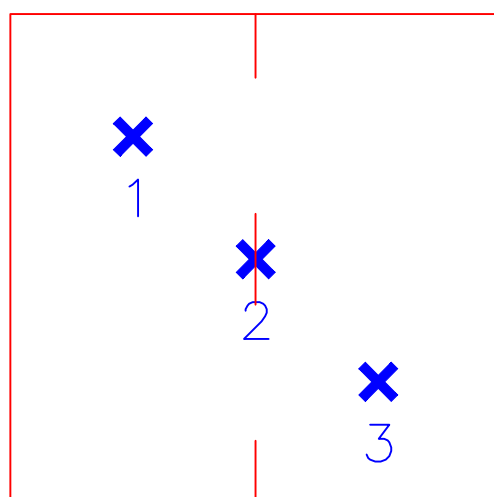
Furnace temperature (test 1)





Furnace temperature (test 1)

Time Minutes	Measured			Norm EN 1363-1	Area under curve		Dev. [%]	Limit [%]
	Minimum	Average	Maximum		Measured	EN 1363-1		
0.0	22.4	22.9	23.6	20.0	0	0	#DIV/0!	
0.5	58.3	75.8	95.2	261.1	19	85	-77.2	
1.0	191.7	221.9	258.5	349.2	92	240	-61.5	
1.5	352.7	373.4	409.9	404.3	242	429	-43.6	
2.0	451.7	471.3	505.8	444.5	457	642	-28.8	
2.5	471.2	495.4	520.8	476.2	700	872	-19.8	
3.0	488.9	508.4	529.1	502.3	951	1117	-14.9	
3.5	517.8	526.6	541.9	524.5	1210	1374	-12.0	
4.0	528.8	542.3	560.1	543.9	1477	1641	-10.0	
4.5	534.6	556.5	572.0	561.0	1751	1917	-8.7	
5.0	569.6	585.0	604.4	576.4	2036	2202	-7.5	
5.5	600.8	612.1	630.4	590.4	2336	2494	-6.3	15.0
6.0	614.9	627.7	644.8	603.1	2646	2792	-5.2	15.0
6.5	619.6	633.5	653.1	614.9	2962	3096	-4.3	15.0
7.0	618.0	634.3	652.3	625.8	3279	3407	-3.8	15.0
7.5	620.2	636.4	655.3	635.9	3596	3722	-3.4	15.0
8.0	626.0	639.3	658.0	645.5	3915	4042	-3.2	15.0
8.5	629.7	646.2	663.9	654.4	4236	4367	-3.0	15.0
9.0	642.0	654.5	671.2	662.8	4562	4697	-2.9	15.0
9.5	652.4	664.6	679.5	670.8	4891	5030	-2.8	15.0
10.0	667.3	676.9	692.2	678.4	5227	5368	-2.6	15.0



- ✘ Thermocouples placed on the back side of the covering

All measurements are in mm

Danish Institute of Fire and security Technology

Sponsor: INNOBYG

Subject: Small scale tests

File No.: FUN0001

Enclosure: 15.0