

LLC "BUILDING LABORATORY"
Testing laboratory for building materials, products and constructions

Accreditation certificate No. 2H366 issued by the National Accreditation Agency of Ukraine
dated September 03, 2018, according to DSTU/ISO/IEC 17025:2006

Approved
Director of testing laboratory
LLC "Building Laboratory"
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"04" __07__2019

PROTOCOL №228
of testing for resistance to climatic influences of facade systems on a flexible basis

TESTING REASON: Application by LLC "IN-DEMAND" №36/1 of 25.02.2019

SAMPLES CHARACTERISTICS: For testing purposes, the client has provided the production sample, that according to the application is identified as experimental sample of a construction with thermal insulation of the constructional class A (with implementation of styrofoam slabs) faced by modular facade system on flexible basis. Sample size: (1000x1000)mm, width - 220mm, amount of samples - 1 item, registration №25.02/12. Assembly system components:

- adhesive mixture for gluing styrofoam slabs in thermal insulation systems;
- thermal insulation - styrofoam slabs "ПСБ-C 25", width - 200mm;
- facade systems on a flexible basis: flexible clinker "IN-CLINKER", flexible brick "IN-BRICK", flexible ceramics "IN-KERAM", producer - LLC "IN-DEMAND".

TESTING PURPOSE: Determining the resistance of facade systems on flexible basis to climatic influences according to p.3.3.3 (table 2, row 8) of TC U 23.9-418829990-001 :2018 (testing in consistence of the constructions of facade systems thermal insulation according to DSTU B B.2.6-36:2008).

SAMPLES SELECTION: Samples selection has been done by Client.

EXECUTANT: LLC "Building laboratory"
legal entity location: 54020, Mykolaiv, Chyhyryna st. 22/14
LLC location: 54029, Mykolaiv, Roboch st. 2"

CLIENT-PRODUCER: LLC "IN-DEMAND",
37710, Ukraine, Poltava reg., Orzhitsky dist., Lazirky, Tsentralna st. 2B/2

Date of samples supplied to the laboratory: 22.02.2019
Date of performing the testing: 25.02-22.05.2019

1. Regulatory references

- DSTU-N B B.1.2-1:2009

System of providing the accuracy of geometrical parameters in building.

Execution of measurements, estimation and control of accuracy of geometrical parameters.
Adjustment.

- DSTU B B.2.6-34:2008

Constructions of houses and buildings. Constructions of external walls with facade thermal insulation.

General technical conditions.

- DSTU B B.2.6-36:2008

Constructions of houses and buildings. Constructions of external walls with facade thermal insulation and plaster facing.

General technical conditions.

- DSTU B B.2.6-101:2010

Constructions of houses and buildings. Method of determining the resistance to heat transfer of enclosing structures.

- TC U 23.9-418829990-001 :2018

Facade system on a flexible basis. Technical conditions.

2. Measurement technical instruments, testing equipment, expendable materials.

Table 1 - List of measurement technical instruments

Name	Type, brand	Characteristics	Scale value/deviation (class)	Calibration date
1	2	3	4	5
Metallic ruler	"ЛМ"	(0÷500)mm	1mm $\Delta=\pm 0,15\text{mm}$	12.04.2018
Caliper	"ШЦ1- I - 150-0,01"	(0÷150)mm	0,01mm $\Delta=\pm 0,03\text{mm}$	12.04.2018
Metallic tape line	"P10Y3Д"	(0÷1000)mm	1mm $\Delta=\pm 0,5\text{mm}$	12.04.2018
Measurement complex	"Ресурс-96"	of the heat flux: (10÷200)W/m ² ; of temperatures: (-40÷50)°C	0,01 W/m ² , $\Delta=\pm 5\%$ 0,01°C, $\Delta=\pm 1^\circ\text{C}$	15.11.2018
Air parameters meter	Ea2	(0÷50)°C 20÷99)% (637÷787)mmHg	0,1°C 1% 1mHg	28.09.2018

Table 2 - List of testing equipment

Name	Type, brand	Characteristics	Calibration date
1	2	3	5
Climatic chamber	-	temperature of cold section: -22°C, $\Delta=\pm 1^\circ\text{C}$ temperature of heat section: 20°C, $\Delta=\pm 1^\circ\text{C}$	30.03.2018

3. Conditions for testing performance:

- temperature, °C: 20-22;
- atmospheric pressure, mmHg: 750-761
- humidity, %: 51-62"

4. Testing results:

Testing method - DSTU B "B.2.6-36:2008" (appendix E), DSTU B B.2.6-101:2010

Visual examination of the samples before testing - defects and mechanical damages of protective and facing layer are absent, color and texture are reported in initial condition.

4.1 Testing conditions in climatic chamber

4.1.1. Conditions for testing the experimental sample in a climatic chamber while determining thermal resistance are presented in table 3.

Table 3 - Testing conditions in climatic chamber while determining the thermal resistance

Testing type	Test duration, h	Average temperature in heat section of chamber, °C	Average temperature in cold section of chamber, °C	Average air humidity (in heat section of chamber), %
1	2	3	4	5
Before taking the cyclic climatic influences	72	20,5	-22	55,1
After taking the cyclic climatic influences	72	19,8	-22,5	55,9

4.1.2. Conditions of cyclic climatic testings of the experimental sample inside the climatic chamber section (one-side effect: external CFT side):

- amount of cycles of climatic influences - 75 (requirements of "DSTU B 23.9-418829990-001:2018");
- cycle components: sprinkling - freezing - melting - heating;
- parameters of cyclic testings are presented in table 4.

Table 4 - Parameters of cyclic testings

Indicators of cyclic testings	Stage of cyclic influence			
	sprinkling	freezing	melting	heating
1	2	3	4	5
Time of influence, h	3,0	6,0	4,0	8,0
Parameters of the stages of cyclic influence	Air temperature: from 16°C to 22°C. Water flow is directed from up to down onto the surface of the facing layer in a way so that a continuous water membrane appears all over the outside surface of the sample. Schedule: two cycles of soaking in water, every third cycle - in alkaline solution, every sixth cycle - in acid solution. As an alkaline solution, the 3% water solution of NaHCO₃ is used; as an acid solution the 3% water solution of H₂SO₄ is used.	Air temperature outside: $t_{\text{out}} = -(22 \pm 2)^{\circ}\text{C}$. Speed of samples cooling: 30°C/hour. Outside the sample, the conditions are providing forced convection with heat transfer coefficient $(23 \pm 5) \text{ W}/(\text{m}^2 \cdot \text{K})$. From the inside, the conditions are providing the inside air temperature of $(16 \pm 22)^{\circ}\text{C}$ with the heat transfer coefficient of $(8,7 \pm 1,5) \text{ W}/(\text{m}^2 \cdot \text{K})$.	Sample melting is done on air with temperature from 18°C to 22°C in conditions of natural convection with the heat transfer coefficient $(5 \pm 1,5) \text{ W}/(\text{m}^2 \cdot \text{K})$.	Schedule: odd cycles - heating in climatic chamber in conditions of forced free convection with the air temperature from the outer side $t_{\text{out}} = -(60 \pm 1)^{\circ}\text{C}$ with the heat transfer coefficient $(8 \pm 1,5) \text{ W}/(\text{m}^2 \cdot \text{K})$. - Radiation of the outside surface of the sample is done with the air temperature from 16°C to 22°C. - Intensity level of UF radiation - 80W/m².

4.2. Assessment of resistance to climatic influences.

The assessment of resistance of the construction of facade systems to the climatic influence was made considering the results of comparing the initial value (before cyclic climatic testings) of thermal resistance of the assembly system and the value of thermal resistance of the assembly system after the cyclic climatic influences.

Also in the process of climatic testings (in every 10 cycles) and after the testings, there was the examination of sample surface recording the changes of the facing layer (presence or absence of damages such as cracks, splits, color changes).

The assessment of assembly system sample resistance to climatic influences is presented in table 5.

Table 5 - The assessment of assembly system sample resistance to climatic influences

Registration № of sample	Thermal resistance, $m^2 \cdot K/W$		Thermal resistance change, ΔR , %		Appearance (presence of damages) of protective and facing layer of the system after (or in process of) testing		Testing assessment (fulfilling the requirements of D.1 of DSTU B "B.2.7-36:2008" (according to declarative service life of facade system*))	
	before cyclic climatic testings, R_0	after cyclic climatic testings, R_{75}	by testing results	requirement	by testing results	requirement	by testing results	requirement
1	2	3	4	5	6	7	8	9
№25.02/12	4,256	4,112	3,3	not more that 10	damages and color change on protective and facing layer are absent	damages such as cracks or color changes on protective and facing layer are not allowed	0,1	not more than 0,1
* - declarative service life of construction with facade thermal insulation is 25 years (according to client's application).								

NOTES:

1. Testing protocol refers only to those samples that have been tested.
2. Testing protocol can not be copied, unless completely, without permission of LLC "Building Laboratory".

CONCLUSION: *The results of testing for resistance to climatic influences of an experimental sample of a construction with facade thermal insulation using styrofoam slabs with facing modular facade system on a flexible basis are assessed positively: damages and color change on protective and facing layer are absent, change in thermal resistance does not exceed the normal values.*

According to the testing results, the modular facade system on a flexible basis: flexible clinker "IN-CLINKER", flexible brick "IN-BRICK", flexible ceramics "IN-KERAM" corresponds to the requirements."

Responsible executor
and responsible for protocol conduction

I category engineer

Pichuhin Y.