ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ
ТзОВ ВКФ «ЛІЗО»

TESTING LABORATORY
of the LLC PCF "LIZO"

Атестат акредитації
№ 2Н1383
Дійсний до
16 червня 2021 року

79035, Україна, м. Львів
вул. М.Пимоненко, 3
тел.:(032) 294-82-87,
e-mail: lablizo@ukr.net

Accreditation certificate
№ 2Н1383
Expiry date:
16 June, 2021

79035, Ukraine, Lviv
st. Pymonenko, 3
Tel. :(032) 294-82-87,
e-mail: lablizo@ukr.net

2Н1383
ДСТУ ISO/IEC 17025

Digitally signed by Bolgarin Mihail
Date: 2022.04.05 17:04:52 EEST
Reason: MoldSign Signature
Location: Moldova

Approved by
The head of the
testing laboratory of "LIZO Ltd."
D. R. Dovgun
«28» 09 2020

TYPE TESTING REPORT № 40/20

Of the insulation piercing connectors PC 120-16 testing

Requirements: EN 50483:2009, the manufacturer's specifications.

The test methods: EN 50483:2009.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***Insulation piercing connectors PC 120-16 passed the tests by the parameters which were tested, satisfy the manufacturer's declared characteristics and requirements of EN 50483:2009.*** *(the testing results are given at the additional testing reports №№ 40/20-1 … 40/20-12, which is the integral part of this testing report)*

Lviv - 2020

List and numbers of the testing reports where the testing results are given

Test	Testing report
1. Visual examination test and dimensional and material verification test (EN 50483-1:2009 Annex A, Table A.1 and clause 6)	40/20-1
2. Test for permanent marking (EN 50483-1:2009 clause 9.2)	40/20-2
3. Dielectrical voltage test in water (EN 50483-4:2009 clause 8.1.3.1)	40/20-3
4. Corrosion aging tests (EN 50483 - 4:2009 clause 8.1.5.1, 8.1.5.1.3.2 method 1, EN 50483-6:2009 clauses 8.4.1 and clause 8.4.2 method 1	40/20-4
5. Climatic aging test (EN 50483 - 4:2009 clause 8.1.5.2, 8.1.5.2.3.2 method 2, EN 50483-6:2009 clause 8.5.2)	40/20-5
6. Test for mechanical damage of the main conductor (EN 50483-4:2009 clause 8.1.2.1)	40/20-6
7. Branch cable pull-out test (EN 50483-4:2009 clause 8.1.2.2)	40/20-7
8. Connector bolt tightening test (EN 50483-4:2009 clause 8.1.2.3)	40/20-8
9. Shear head function test (EN 50483-4:2009 clause 8.1.2.4)	40/20-9
10. Low temperature impact test (EN 50483-4:2009 clause 8.1.2.5)	40/20-10
11. Low temperature assembly test (EN 50483-4:2009 clause 8.1.4)	40/20-11
12. Electrical ageing test (EN 50483-4:2009 clause 8.1.6, EN 50483-5:2009)	40/20-12

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IPC CHARACTERISTICS

Name: Insulation piercing connector.
Model and type: PC 120-16.
Purpose: Purposed for aluminum and copper conductors.

Technical characteristics

Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.
Weight:	(65 ± 1) g.
Overall dimension (L / W / H):	(31 ± 1) mm / (36 ± 2) mm / (57 ± 2) mm.

Engineering data

Body:	Polyamide resistant to UV, wet and temperature difference.
Contact plate:	Tinned copper.
Sealants:	Polymer resistant to UV, wet and temperature difference.
Bolt, washers:	Galvanized steel.
Shear head:	Zinc alloy.

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ O. O. Nepyivoda

Engineer: _____ D. S. Denys

Engineer: _____ A. S. Shevtsiv

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вул. М.Пимоненко, 3
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st. Pymonenko, 3
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Approved by
The Head of the
testing laboratory of "LIZO Ltd."

D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-1

Visual examination test, dimensional and material verification test of insulation piercing connectors PC 120-16

Requirements: EN 50483-1:2009 Annex A, Table A.1 and clause 6.

The test methods: EN 50483:2009.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***Insulation piercing connector PC 120-16 satisfy the manufacturer's declared characteristics and requirements of EN 50483-1:2009 Annex A, Table A.1 and clause 6.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	1.
Identification numbers of the samples:	№13.
The testing dates:	17.07.2020.
The environmental conditions:	
temperature:	22,8 °C;
air pressure:	96,6 kPa;
humidity:	70 %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

2. Testing procedure:

Verification is performed visually, by the method of measuring and material's determining.

3. Requirements:

IPCs shall be made of the materials, declared by the manufacturer, and to correspond with the dimensions from the drawings. Marking shall be marked in accordance with EN 50483-1:2009 clause 6.

4. Testing results:

During the visual inspection it was found that the samples were executed correctly, the surfaces of the products were smooth, without sharp edges.

Results of examinations of sizes, materials and information for marking are given in Table 1 – Table 3.

Table 1 – The materials, used in production of IPC PC 120-16

№	Component	Material	Correspondence with requirements
1	Body	Polyamide resistant to UV	Satisfy
2	Contact plates	Aluminum alloy	Satisfy
3	Sealants	Polymer resistant to UV	Satisfy
4	Bolt	Galvanized steel	Satisfy
5	Washers	Galvanized steel	Satisfy
6	Shear head	Zinc alloy	Satisfy

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Table 2 – Dimensions of the IPC PC 120-16

№	Dimension	Declared, mm	In fact, mm	Correspondence with requirements
1	Length	(31 ± 1)	31,0	Satisfy
2	Width	(36 ± 2)	36,2	Satisfy
3	Height	(57 ± 2)	56,8	Satisfy

Table 3 – Visual examination of the IPC PC 120-16

№	Controlled marking items	Factual marking	Correspondence with requirements
1	Manufacturer's trade mark or logo	FEMAN	Satisfy
2	Product code or reference	PC 120-16	Satisfy
3	Traceability code / batch number	05/20	Satisfy
4	The minimum and maximum conductor cross sections for which the unit is suitable Main conductor, mm^2: Branch conductor, mm^2:	 6 – 120 1,5 – 16	Satisfy
5	Tightening torque or die reference, if applicable	-	-
6	Recycling code, if any	-	-

There are no defects found during the visual examination of IPC PC 120-16. Submitted testing sample was not used earlier and wasn't processed additionally before the testing. The connector corresponds with the dimensions from the drawings and is made from the materials declared by the manufacturer. The information about manufacturer, product type and reference, usage parameters are clear indicated at sample (Fig.1).

5. Conclusion:

Insulation piercing connectors PC 120-16 satisfy the manufacturer's declared characteristics and requirements of EN 50483-1:2009 Table A.1 and clause 6.

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6. Pictures:

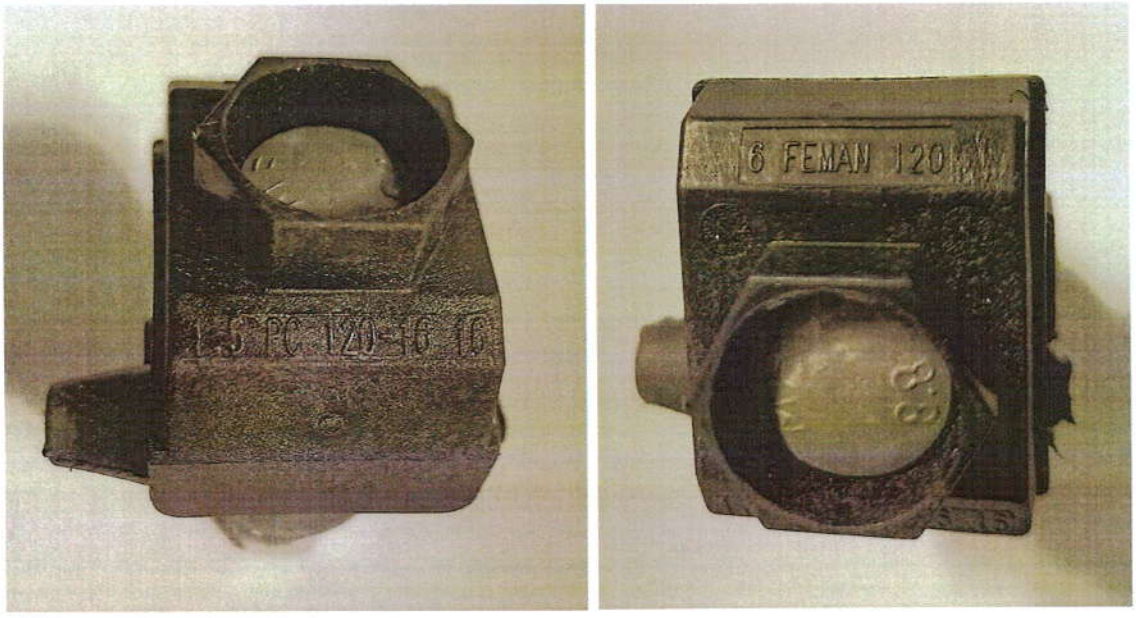

Fig.1 – Clamp's marking

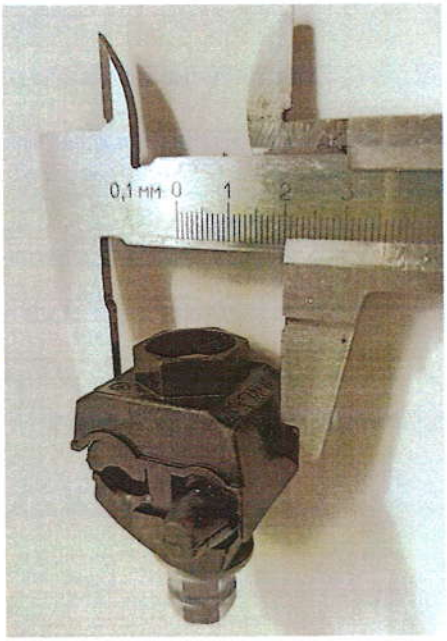

Fig.2 – IPC during the dimension's measurement

7. Test equipment:

№	Type	Model	Latest calibration
1	Slide gauge	ШЦ-1 №0701295	05.04.2020

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ A. S. Shevtsiv

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e-mail: lablizo@ukr.net

Approved by
The head of the
testing laboratory of "LIZO Ltd."
_____ D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-2

Test for permanent marking of insulation piercing connectors PC 120-16

Requirements: EN 50483-1:2009 clause 9.2.4.

The test methods: EN 50483-1:2009 clause 9.2.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***The insulation piercing connectors PC 120-16 passed the test for marking resistance, satisfy manufacturer's declared characteristics and requirements of EN 50483-1:2009 clause 9.2.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	2.
Identification numbers of the samples:	№13, №14.
The testing dates:	03.08.2020.
The environmental conditions:	
temperature:	23,0 °C;
air pressure:	98,2 kPa;
humidity:	71 %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

2. Testing procedure:

The tests were performed in accordance with EN 50483-1:2009 clause 9.2.

The tests were performed at two samples of the IPC. The marking of the connector was rubbed by hand for 15 s with a piece of cloth soaked by water and another 15 s with a piece of cloth soaked by petroleum spirit.

3. Requirements:

The marking shall remain clear and allow the IPC to be easily identified.

4. Testing results:

Since the marking of the IPC is embossed, cast by casting, stability tests have not been carried out. The IPC marking is clear and allows easy identification the IPC (Fig.1).

5. Conclusion:

Marking of the insulation piercing connectors PC 120-16 is clear, allow the IPC to be easily identified, and satisfy requirements of EN 50483-1:2009 clause 9.2.

6. Pictures:

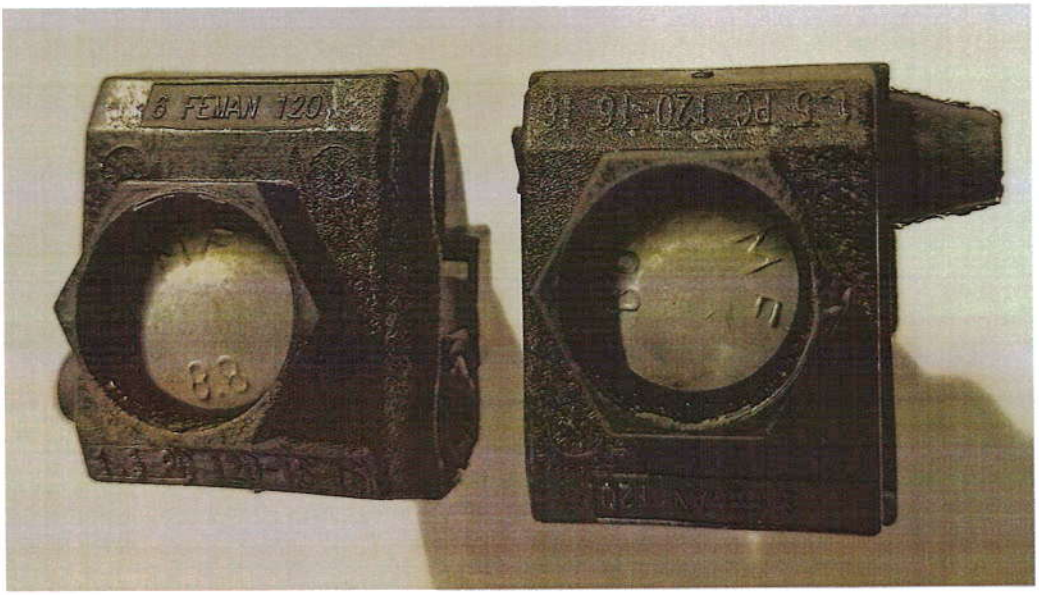

Fig.1 – The IPC after testing

The tests were performed by:

deputy head of the testing laboratory: _____ S. S. Lakhovskyi

engineer: _____ A. S. Shevtsiv

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testing laboratory of "LIZO Ltd."

_____ D. R. Dovgun
«_28_» _____09_____ 2020

TESTING REPORT № 40/20-3

Dielectrical voltage test in water of the insulation piercing connectors PC 120-16

Requirements: EN 50483-4:2009 clause 8.1.3.1.4.
The test methods: EN 50483-4:2009 clause 8.1.3.1.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***The insulation piercing connectors PC 120-16 passed the dielectrical voltage test in water with high voltage 4 kV and satisfy the manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.3.1.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	4.
Identification numbers of the samples:	№15, №16, №17, №18.
The testing dates:	04.08.2020.
The environmental conditions:	
temperature:	22,8 °C;
air pressure:	97,2 kPa;
humidity:	70 %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120	ПВ-1 6
Conductor cross-section:	120 mm^2	6 mm^2
Conductor diameter:	12,5 mm	2,75 mm
Number of strands:	19	1
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,7 mm	1,0 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

The branch conductors:

Type:	ПВ-3 1,5
Conductor cross-section:	1,5 mm^2
Conductor diameter:	1,4 mm
Number of strands:	31
Shape:	Round
Conductor material:	Copper
Insulation thickness:	0,7 mm
Insulation material:	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine
Standard:	IEC 60227-1:2007

2. Testing procedure:

The tests were performed in accordance with EN 50483-4:2009 clause 8.1.3.1.

Two samples of IPC are tested in each of the following conductors' cross-sections combinations of main and branch conductors: max – min and min – min.

IPC is installed at the core in accordance with manufacturer's installation instruction. The bolt is tightened to the minimum torque 7,5 Nm indicated by the manufacturer. Any changes in orientation of the core are absent in zone 10 cm from the IPC.

The connectors assembled at the cores (assemblies) are put into the tank with water into the deep (30 – 40) cm from the connector to water surface.

After IPCs stay in tank under water during 30 min the testing voltage 4 kV is applied between the main core conductor and the metallic electrode, immersed into the water, during 60 s. The voltage is applied with the speed approximately 1 kV/s in accordance with EN 50483-1:2009 clause 9.1.7.

3. Requirements:

No flashovers or breakdowns of the core or IPCs should occur after testing by high voltage 4 kV during 60 s. The maximum leakage current should not exceed (10 ± 0,5) mA in accordance with EN 50483-1: 2009 clause 9.1.5.

4. Testing results:

Table 1 – Testing results

№	Identification number of IPC	Conductors: main - branch (mm^2 - mm^2)	The tightening torque of the bolt, Nm	Leakage current at voltage 4 kV, mA	Flashovers, breakdowns
1	15	min – min 6 – 1,5	7,5	2,0	Absent
	16			2,0	Absent
2	17	max – min 120 – 1,5		1,0	Absent
	18			1,0	Absent

5. Conclusion:

The insulation piercing connectors PC 120-16 have passed the dielectrical voltage test in water at high voltage 4 kV and satisfy the manufacturer declared characteristics and requirements of EN 50483-4:2009 clause 8.1.3.1.

6. Pictures:

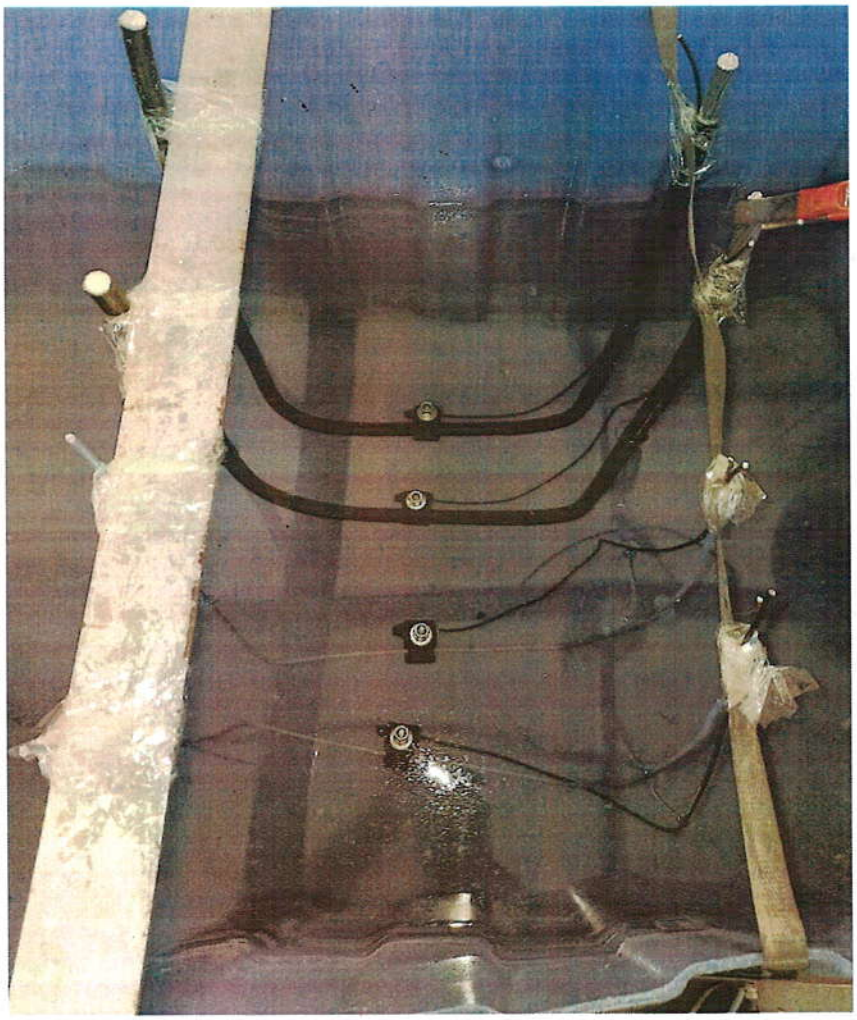

Fig.1 – IPC during the testing

7. Test equipment:

№	Type	Model	Latest calibration date
1	Ruler 1m	VaGo-Tools №003	05.04.2020
2	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
3	High voltage set	ЛІЗО №001	Don't need calibration
4	Voltmeter	E365-1 №913751	08.04.2020
5	Milliamperemeter	E377 №777768	08.04.2020
6	Stopwatch	СОС пр-2б-2-010 №2284	24.04.2020

The tests were performed by:

deputy head of the testing laboratory: _____ S. S. Lakhovskyi

engineer: _____ O. O. Nepyivoda

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testing laboratory of "LIZO Ltd."

D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-4

Corrosion aging tests of insulation piercing connectors PC 120-16

Requirements: EN 50483-4:2009 clause 8.1.5.1.4.

The test methods: EN 50483-4:2009 clause 8.1.5.1, 8.1.5.1.3.2 method 1, EN 50483-6:2009 clause 8.4.1 and clause 8.4.2 method 1.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O** **Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O** **Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***The insulation piercing connectors PC 120-16 have passed the corrosion aging tests and satisfy the manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.5.1,*** **8.1.5.1.3.2** ***method 1.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	2.
Identification numbers of the samples:	№19, №20.
The testing dates:	16.07.2020 - 10.09.2020.
The environmental conditions:	
temperature:	(16 – 24) °C;
air pressure:	(96 – 101) kPa;
humidity:	(45 – 75) %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	ПВ-1 6
Conductor cross-section:	6 mm^2
Conductor diameter:	2,75 mm
Number of strands:	1
Shape:	Round
Conductor material:	Copper
Insulation thickness:	1,0 mm
Insulation material:	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine
Standard:	IEC 60227-1:2007

The branch conductors:

Type:	ПВ-3 1,5
Conductor cross-section:	1,5 mm^2
Conductor diameter:	1,4 mm
Number of strands:	31
Shape:	Round
Conductor material:	Copper
Insulation thickness:	0,7 mm
Insulation material:	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine
Standard:	IEC 60227-1:2007

2. Testing procedure:

The tests are performed in accordance with EN 50483-4:2009 clause 8.1.5.1, 8.1.5.1.3.2 method 1.

Two samples of IPCs are tested in each of the following conductors' cross-sections combinations of main and branch conductors: min – min.

The IPC is placed at the middle of the main core of length (0,5 – 1,5) m. The bolt of the IPC is tightened with minimum torque 7,5 Nm specified by the manufacturer.

The tests are performed in 4 cycles of 14 days. The 14-day cycle consists of 7 days of continuously stay at salt fog chamber and of 7 days of continuously stay at chamber with higher temperature and humidity atmosphere saturated by sulphur dioxide (SO_2) (Fig.1 – Fig.2) in accordance with EN 50483-6:2009 clause 8.4.1 and clause 8.4.2.

2.1. Climatic aging test in the salt fog chamber

The testing equipment and the testing procedure are corresponded with the requirements of EN 60068-2-11:1999.

Dispersion of the salt fog are controlled during the tests by two prefabricated manifolds with area 80 cm^2 of each. The fog gathered in each manifold with speed (1 – 2) ml/hour with average time of dispersion not less than 16 hours.

The brine, which is used for testing, has weight-part concentration (5 ± 2) %. The pH of the brine is within the normal range of 6,5 to 7,2.

Compressed air without impurities of dust and oils with maintaining pressure (120 ± 50) kPa is used to generate the fog. The air is warmed and moistened before feeding to the pulverizer by passing through the heated to 40 ^0C water.

The temperature in the testing chamber is maintained (35 ± 2) ^0C.

2.2. Climatic aging test in chamber with higher temperature and humidity atmosphere saturated by sulfur dioxide (SO^2)

The testing equipment and the testing procedure satisfy requirements of EN ISO 3231. (2 ± 0,2) litres of distilled water are filled into the chamber before each cycle.

Sulphur dioxide in chamber with concentration 0,0667 % is made with the help of the reaction of sodium pyrosulfate ($Na_2S_2O_5$) and sulfamic acid (HSO_3NH_2).

The temperature in the chamber is maintained (40 ± 3) ^0C during 8 hours. Then chamber is opened and temperature is falling to the environmental temperature during 16 hours.

3. Requirements:

At visual control, there shall be no significant traces of rust (over 10 % of the open surface of metal parts of the samples).

The sample's identification marking shall be legible when examined with normal or corrected vision without magnification.

No deterioration of the main parts of the connectors shall occur which would impair their normal function.

It shall be able to remove IPCs with a torque below or equal to the manufacturer's specified maximum torque 10,5 Nm.

4. Testing results:

The rust traces not exceed 10 % of the open surface of metal parts of the samples.

The samples' identification marking were legible when examined with normal or corrected vision without magnification.

There are no deteriorations of the main parts of the IPCs, which would impair their normal function.

The IPCs removal were realized with torque less than maximum manufacturer's specified torque 10,5 Nm.

Table 1 – Testing results when removing the IPCs after corrosion tests

№	Identification number of IPC	Conductors: main – branch (mm^2 / mm^2)	Torque of disassembling when removing the IPCs, Nm	Testing result
1	19	min – min	7,24	Satisfy
	20	6 – 1,5	8,36	Satisfy

5. Conclusion:

Insulation piercing connectors PC 120-16 after stay in the salt fog chamber and in the chamber with higher temperature and humidity atmosphere saturated by sulphur dioxide passed the corrosion aging tests and satisfy manufacturer's declared characteristics and EN 50483-4:2009 clause 8.1.5.1, 8.1.5.1.3.2 method 1.

6. Pictures:

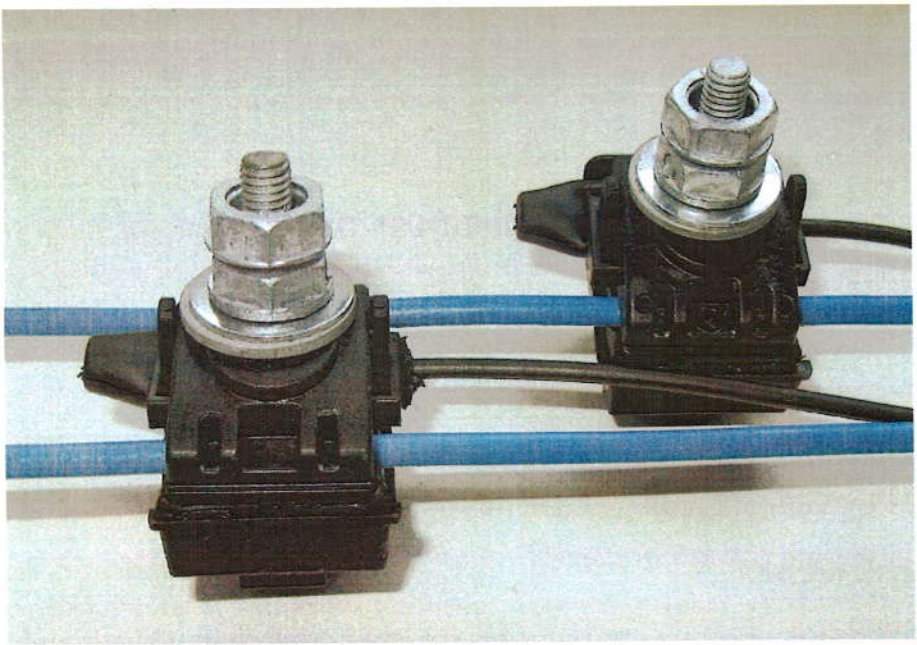

Fig.1 – IPCs after the fourth cycle of testing

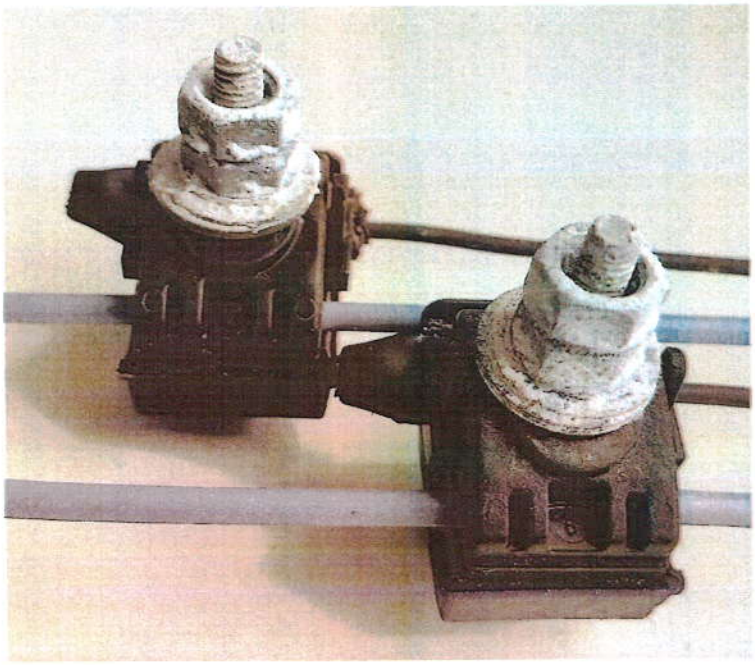

Fig.2 – IPCs after the testing

7. Test equipment:

№	Type	Model	Latest calibration date
1	Ruler 1m	VaGo-Tools №003	05.04.2020
2	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
3	Stopwatch	СОС пр-2б-2-010 №2284	24.04.2020
4	Salt fog chamber	ЛІЗО №001	Don't need calibration
5	Measurement and control device with resistive temperature transducer	РТ 0102 №14-558 ТСП-1388 №15-201	08.04.2020
6	pH-meter	РН-009 інв..№00133	Calibrated before using
7	Working standard pH	PH 4,01±0,01	15.06.2020
8	Working standard pH	PH 7,00±0,01	15.06.2020
9	Chamber with higher temperature and humidity atmosphere saturated by sulfur dioxide	ЛІЗО №001	Don't need calibration
10	Measurement and control device with resistive temperature transducer	РТ 0102 №14-557 ТСП-1388 №15-201	08.04.2020
11	Tensile test machine, factory №001	ЛІЗО №001	Don't need calibration
12	Load cell	FB 50K №0032	06.04.2020

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ O. O. Nepyivoda

Engineer: _____ D. S. Denys

Engineer: _____ A. S. Shevtsiv

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ
ТзОВ ВКФ «ЛІЗО»

TESTING LABORATORY
of the LLC PCF "LIZO"

2H1383
ДСТУ ISO/IEC 17025

Атестат акредитації
№ 2H1383
Дійсний до
16 червня 2021 року

79035, Україна, м. Львів
вул. М.Пимоненко, 3
тел.:(032) 294-82-87,
e-mail: lablizo@ukr.net

Accreditation certificate
№ 2H1383
Expiry date:
16 June, 2021

79035, Ukraine, Lviv
st. Pymonenko, 3
Tel. :(032) 294-82-87,
e-mail: lablizo@ukr.net

Approved by
The head of the
testing laboratory of "LIZO Ltd."

D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-5

Climatic aging test (UV-radiation) of insulation piercing connectors PC 120-16

Requirements: EN 50483-4:2009 clauses 8.1.5.2.4, 8.1.5.2.4.1, 8.1.5.2.4.3.

The test methods: EN 50483-4:2009 clauses 8.1.5.2, 8.1.5.2.3.2 method 2, EN 50483-6:2009 clause 8.5.2.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***The insulation piercing connectors PC 120-16 have passed the climatic aging test (UV-radiation). Connectors satisfy the manufacturer's declared characteristics and requirements of EN 50483-4:2009 clauses 8.1.5.2, 8.1.5.2.3.2 method 2.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	4.
Identification numbers of the samples:	№21, №22, №23, №24.
The testing dates:	16.07.2020 - 10.09.2020.
The environmental conditions:	
temperature:	(16 – 24) °C;
air pressure:	(96 – 101) kPa;
humidity:	(45 – 75) %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120	ПВ-1 6
Conductor cross-section:	120 mm^2	6 mm^2
Conductor diameter:	12,5 mm	2,75 mm
Number of strands:	19	1
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,7 mm	1,0 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

The branch conductors:

Type:	ПВ-3 1,5
Conductor cross-section:	1,5 mm^2
Conductor diameter:	1,4 mm
Number of strands:	31
Shape:	Round
Conductor material:	Copper
Insulation thickness:	0,7 mm
Insulation material:	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine
Standard:	IEC 60227-1:2007

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2. Testing procedure:

2.1. Climatic aging test (UV-radiation)

The tests were performed in accordance with EN 50483-4:2009 clause 8.1.5.2, 8.1.5.2.3.2 method 2.

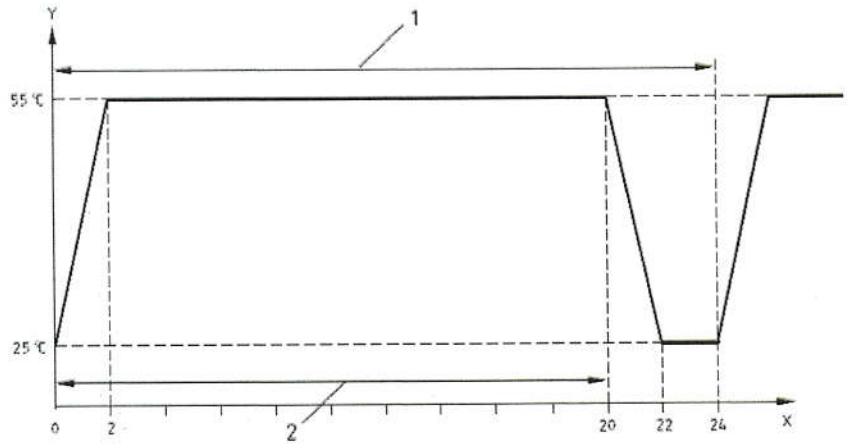
Two samples of IPC are tested in each of the following conductors' cross-sections combinations of main and branch conductors: min – min and max – min. IPC is installed at the core in accordance with manufacturer's installation instruction. The IPC bolt is tightened to the minimum torque - 7,5 Nm indicated by the manufacturer. Any changes in orientation of the core are absent in zone 10 cm from the IPC. Samples were tested for climatic aging in the solar radiation simulation chamber (Fig.2).

Testing chamber ensured radiation 1,120 kW/m^2 ± 10 % in the measuring plane with the spectral distribution according to Table 1. Radiation was irradiated by the cylindrical lamp with xenon arc, with power 1 kW which was situated vertically at the center of the chamber. The IPCs samples were situated at the lamp center plane at the distance from the lamp center, which ensures the indicated power (1,120 kW/m^2 ± 10 %). The radiation was controlled by the radiometer in the range of (300- 400) nm at the beginning of each cycle. Radiated power value was set 4,3 mW/cm^2 by the lamp electrical current change in case of necessity.

56 cycles with 24 hours durability were performed. Each cycle includes 20 hours of radiation and 4 hours with radiation power off with temperature modes in accordance with Fig.1. The temperature was measured by the shielded from the heat source thermometer in the plane which was situated 50 mm lower from the radiation measurement plane, at the middle of the distance from the sample to the chamber wall.

Table 1 – Spectral energy distribution and the tolerance

№	Spectral range	Ultraviolet B	Ultraviolet A	Visible light			Infrared radiation
1	Wavelength	0,28 nm - 0,32 nm	0,32 nm - 0,40 nm	0,40 nm - 0,52 nm	0,52 nm - 0,64 nm	0,64 nm - 0,78 nm	0,78 nm - 3,0 nm
2	Radiation power	5 W/m^2	63 W/m^2	200 W/m^2	186 W/m^2	174 W/m^2	492 W/m^2
3	Tolerance	± 35 %	± 25 %	±10 %	± 10 %	± 10 %	± 10 %



1. 1 cycle;
2. radiation period (20 hours);
3. *Y* = temperature axis;
4. *X* = time axis in hours.

Fig.1 – Temperature – Radiation – Time dependence

2.2. Dielectrical voltage test in air after the climatic aging test (UV-radiation)

The tests were performed in accordance with EN 50483-4:2009 clause 8.1.3.1.3.2.

After the climatic aging test, the connectors, assembled together with core in the assemblies, are put into the tank and covered by (1 – 2) cm of metallic balls with (1,3 – 1,7) mm diameter.

After IPCs stay in tank under balls during 60 s the testing voltage 4 kV is applied between the main core conductor and the metallic balls during 60 s. The voltage is applied with the speed approximately 1 kV/s in accordance with EN 50483-1:2009 clause 9.1.7.

2.3. Dielectrical voltage test in water after the dielectrical voltage test in air

The tests were performed in accordance with EN 50483-4:2009 clause 8.1.3.1.3.1.

After dielectrical voltage test in air, the connectors assembled are put into the tank with water into the deep (30 – 40) cm from the connector to water surface.

After IPCs stay in tank under water during 30 min the testing voltage 1 kV is applied between the main core conductor and the metallic electrode, immersed into the water, during 60 s. The voltage is applied with the speed approximately 1 kV/s in accordance with EN 50483-1:2009 clause 9.1.7.

3. Requirements:

There shall be no degradation of the main parts, which will influence to the samples characteristics.

The sample's identification marking should be legible when examined with normal and corrected vision.

No flashover or breakdown of the core or IPC shall occur after testing by high voltage 4 kV during 60 s in air. The maximum leakage current shall not exceed (10 ± 0,5) mA in accordance with EN 50483-1:2009 clause 9.1.5.

No flashover or breakdown of the core or IPC shall occur after tasting by high voltage 1 kV during 60 s in water. The maximum leakage current shall not exceed (10 ± 0,5) mA in accordance with EN 50483-1:2009 clause 9.1.5.

4. Testing results:

4.1. Testing results of climatic aging test (UV-radiation)

Insulation piercing connectors PC 120-16 have no any damages, which would influenc the samples characteristics after the climatic aging test (UV-radiation).

The samples' identification markings are legible when examined with normal and corrected vision.

4.2. Testing results for the dielectrical voltage test in air after the climatic aging test (UV-radiation)

Table 2 – Testing results for the dielectrical voltage test in air

№	Identification number of IPC	Conductors: main – branch (mm^2 – mm^2)	Leakage current at voltage 4 kV with duration 60 s, mA
1	21	min – min	0,0
	22	6 – 1,5	0,0
2	23	max – min	0,0
	24	120 – 1,5	0,0

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4.3. Testing results for the dielectrical voltage test in water after the dielectrical voltage test in air

Table 3 – Testing results for the dielectrical voltage test in water

№	Identification number of IPC	Conductors: main – branch (mm^2 – mm^2)	Leakage current at voltage 1 kV with duration 60 s, mA
1	21	min – min	3,0
	22	6 – 1,5	3,0
2	23	max – min	1,0
	24	120 – 1,5	2,0

5. Conclusion:

All samples of the insulation piercing connectors PC 120-16 have passed the dielectrical voltage test in air at high voltage 4 kV during 60 s and the dielectrical voltage test in water at high voltage 1 kV during 60 s after the climatic aging test (UV-radiation), satisfy the manufacturer declared characteristics and requirements of EN 50483-4:2009 clauses 8.1.5.2, 8.1.5.2.3.2 method 2.

6. Pictures:

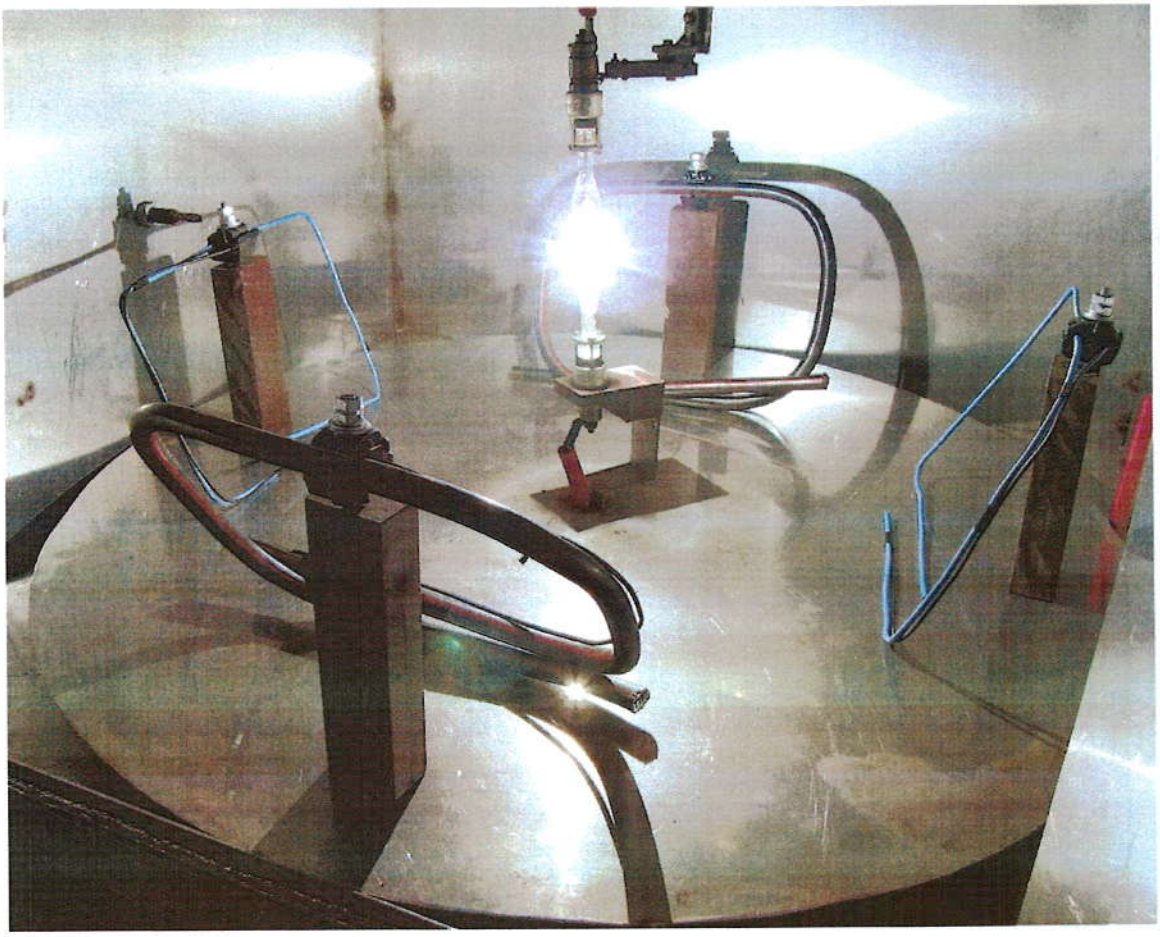

Fig.2 – IPC during the testing in the solar radiation simulation chamber

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7. Test equipment:

№	Type	Model	Latest calibration date
1	Ruler 1m	VaGo-Tools №003	05.04.2020
2	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
3	Stopwatch	СОС пр-2б-2-010 №2284	24.04.2020
4	Solar radiation simulation chamber	ЛІЗО №001	Don't need calibration
5	Measurement and control device with resistive temperature transducer	РТ-0102 №14-513 ТСП-1388 №14-026	08.04.2020
6	UV radiometer	ТЕНЗОР-31 №Р028/2014	31.03.2020
7	High voltage set	ЛІЗО №001	Don't need calibration
8	Voltmeter	Е365-1 №913751	08.04.2020
9	Milliamperemeter	Е377 №777768	08.04.2020

The tests were performed by:

deputy head of the testing laboratory: _____ S. S. Lakhovskyi

engineer: _____ O. O. Nepyivoda

engineer: _____ D. S. Denys

engineer: _____ A. S. Shevtsiv

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ
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2H1383
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79035, Україна, м. Львів
вул. М.Пимоненко, 3
тел.:(032) 294-82-87,
e-mail: lablizo@ukr.net

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79035, Ukraine, Lviv
st. Pymonenko, 3
Tel. :(032) 294-82-87,
e-mail: lablizo@ukr.net

Approved by
The Head of the
testing laboratory of "LIZO Ltd."

D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-6

Test for mechanical damage of the main conductor of insulation piercing connectors PC 120-16

Requirements: EN 50483-4:2009 clause 8.1.2.2.4.

The test methods: EN 50483-4:2009 clause 8.1.2.1.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O** **Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O** **Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***The insulation piercing connectors PC 120-16 passed the test for mechanical damage of the main conductor and satisfies manufacturer's declared characteristics and requirement of EN 50483-4:2009 clause 8.1.2.1.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	6.
Identification numbers of the samples:	№25, №26, №27, №28, №29, №30.
The testing dates:	17.08.2020.
The environmental conditions:	
temperature:	24,6 °C;
air pressure:	96,8 kPa;
humidity:	69 %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120	ПВ-1 6
Conductor cross-section:	120 mm^2	6 mm^2
Conductor diameter:	12,5 mm	2,75 mm
Number of strands:	19	1
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,7 mm	1,0 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

The branch conductors:

Type:	AsXSn 4x16	ПВ-3 1,5
Conductor cross-section:	16 mm^2	1,5 mm^2
Conductor diameter:	4,7 mm	1,4 mm
Number of strands:	7	31
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,2 mm	0,7 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

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2. Testing procedure:

The tests are performed in accordance with EN 50483-4:2009 clause 8.1.2.1.

Two samples of IPCs are tested in each of the following conductors' cross-sections combinations of main and branch conductors: max-max, min – min and min – max.

The main core is inserted to the tensile machine as showed at Fig.1. Tensile load 10 % of MBL of the conductor is applied to it. The length of the main core is between 0,5 m to 1,5 m (EN 50483-4:2009 clause 8.1.2.1.2).

IPCs' samples are installed in accordance with manufacturer's installation instruction. The IPC bolt is tightened to the maximum torque 10,5 Nm indicated by the manufacturer. The tensile test load is applied to the main conductor until it reached values from Table 1 and maintained during 60 s.

Table 1 – Tensile test load applied to the main conductor

№	System type	Conductor	Tensile test load
1	Self supporting	Aluminium (16 mm² to 25 mm²)	1200 N or 40 % MBL of the cable, whichever is the greater
		Aluminium (> 25 mm²)	80 % MBL of the cable

3. Requirements:

Main conductor shall sustain the tensile test load for 60 s without breaking or any damages that would prevent the correct function of the cable.

4. Testing results:

MBL determination of the ПВ-1 6. Three samples of the conductor were broken at tensile machine. Load applied with speed 50 N/s.

Calculated value of MBL of the conductor is 90% of intermediate value of last three breakes.

Table 2 – MBL of the cable ПВ-1 6

№	№ of the conductor sample	Conductor cross-section, mm²	Breaking load of the conductor, kN	Mean value of breaking load of the conductor, kN	Calculated value of MBL of the conductor, kN
1	1	6	1,30	1,31	1,18
2	2		1,32		
3	3		1,30		

Table 3 – Testing results

№	Identification number of IPC	Conductors: main - branch (mm² - mm²)	The tightening torque of the bolt, Nm	MBL of the main conductor, kN	Tensile test load for 60s, kN	Breaking or damages of the conductor
1	25	max – max 120 – 16	10,5	18,43	14,74	Absent
	26					Absent
2	27	min – min 6 – 1,5	10,5	1,18	0,24	Absent
	28					Absent
3	29	min – max 6 – 16	10,5	1,18	0,24	Absent
	30					Absent

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5. Conclusion:

The main conductors at which IPCs PC 120-16 were installed and to which the tensile test load were applied, have passed the test for mechanical damage of the main conductor and satisfies requirement of EN 50483-4:2009 clause 8.1.2.1.

6. Pictures:

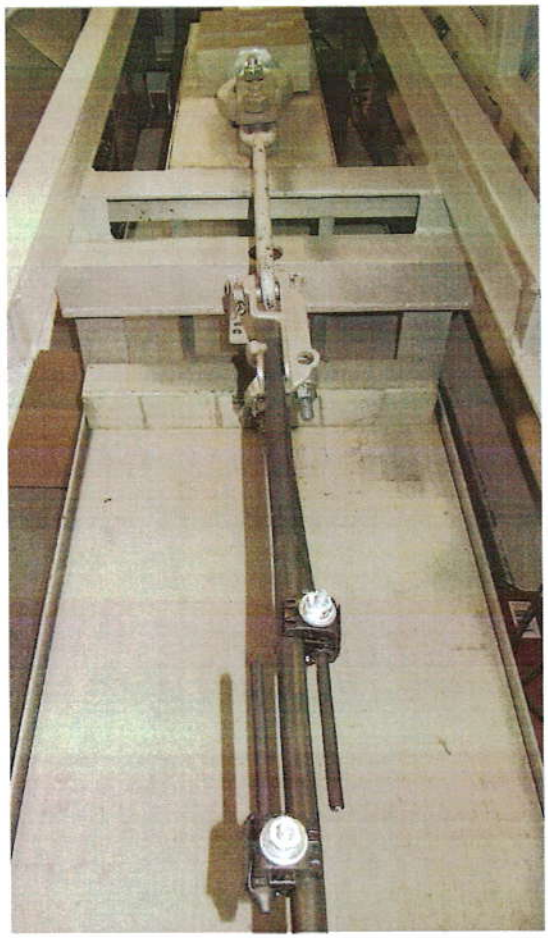

Fig.1 – IPCs in the test

7. Test equipment:

№	Type	Model	Latest calibration date
1	Ruler 1m	VaGo-Tools №003	05.04.2020
2	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
3	Stopwatch	СОС пр-2б-2-010 №2284	24.04.2020
4	Tensile test machine, factory №001	ЛІЗО №001	Don't need calibration
5	Load cell	FB 50K №0032	06.04.2020

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ O. O. Nepyivoda

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ
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79035, Україна, м. Львів
вул. М.Пимоненко, 3
тел.:(032) 294-82-87,
e-mail: lablizo@ukr.net

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79035, Ukraine, Lviv
st. Pymonenko, 3
Tel. :(032) 294-82-87,
e-mail: lablizo@ukr.net

Approved by
The head of the
testing laboratory of "LIZO Ltd."
D. R. Dovgun
« 28 » 09 2020

TESTING REPORT № 40/20-7

Branch cable pull-out test of insulation piercing connectors PC 120-16

Requirements: EN 50483-4:2009 clause 8.1.2.2.4.

The test methods: EN 50483-4:2009 clause 8.1.2.2.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***Insulation piercing connectors PC 120-16 passed the branch cable pull-out test, satisfies manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.2.2.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	4.
Identification numbers of the samples:	№31, №32, №33, №34.
The testing dates:	16.08.2020.
The environmental conditions:	
temperature:	23,6 °C;
air pressure:	96,7 kPa;
humidity:	70 %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120	ПВ-1 6
Conductor cross-section:	120 mm^2	6 mm^2
Conductor diameter:	12,5 mm	2,75 mm
Number of strands:	19	1
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,7 mm	1,0 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

The branch conductors:

Type:	ПВ-3 1,5
Conductor cross-section:	1,5 mm^2
Conductor diameter:	1,4 mm
Number of strands:	31
Shape:	Round
Conductor material:	Copper
Insulation thickness:	0,7 mm
Insulation material:	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine
Standard:	IEC 60227-1:2007

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2. Testing procedure:

The tests are performed in accordance with EN 50483-4:2009 clause 8.1.2.2.

Two samples of IPC are tested in each of the following conductors' cross-sections combinations of main and branch conductors: max – min, min – min.

IPC is inserted into the tensile machine as showed at Fig.1 in accordance with manufacturer's installation instruction. The branch core length is between 0,2 m to 0,5 m (EN 50483-4:2009 clause 8.1.2.2.2).

The IPC bolt is tightened to the maximum torque 10,5 Nm indicated by the manufacturer. The mark is made near the IPC at the branch cable, which will permit to measure its slippage. The tensile load is applied approximately axially between the branch conductor and opposing main conductor with the rate between 100 N/min to 500 N/min. This load is 10 % of the MBL of the branch conductor and is maintained for 60 s.

3. Requirements:

Branch core slippage shall not exceed 3 mm. The cores shall maintain the test load for 60 s without breaking or any damages that would prevent the correct function of the cable.

4. Testing results:

MBL determination of the ПВ-3 1,5. Three samples of the conductor were broken at tensile machine. Load applied with speed 50 N/s.

Calculated value of MBL of the conductor is 90% of intermediate value of last three breakes.

Table 1: MBL of the cable ПВ-3 1,5

№	№ of the conductor sample	Conductor cross-section, mm^2	Breaking load of the conductor, kN	Mean value of breaking load of the conductor, kN	RTS of the conductor, kN
1	1	1,5	0,40	0,41	0,37
2	2		0,42		
3	3		0,40		

Table 2 – Testing results

№	Identification number of IPC	Conductors: main – branch (mm^2 – mm^2)	The testing load: 60 s, 10 % of the MBL, kN	Branch conductor slippage, mm	Breaking or damages of the conductors
1	31	max – min 120 – 1,5	0,04	0	Absent
	32			0	Absent
2	33	min – min 6 – 1,5	0,04	0	Absent
	34			0	Absent

5. Conclusion:

There was no slippage of the branch conductors during the testing of the IPCs PC 120-16. The cores maintained the test load for 60 s without breaking or any damages that would prevent the correct function of the cable.

Insulation piercing connectors PC 120-16 passed the branch cable pull-out test and satisfies requirements of EN 50483-4:2009 clause 8.1.2.2.

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

6. Pictures:

Fig.1 – IPC in the test

7. Test equipment:

№	Type	Model	Latest calibration date
1	Ruler 1m	VaGo-Tools №003	05.04.2020
2	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
3	Stopwatch	СОС пр-2б-2-010 №2284	24.04.2020
4	Tensile test machine, factory №001	ЛІЗО №001	Don't need calibration
5	Load cell	FB 50K №0032	06.04.2020
6	Slide gage	ШЦ-1 №0701295	05.04.2020

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ D. S. Denys

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

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2H1383
ДСТУ ISO/IEC 17025

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79035, Україна, м. Львів
вул. М.Пимоненко, 3
тел.:(032) 294-82-87,
e-mail: lablizo@ukr.net

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79035, Ukraine, Lviv
st. Pymonenko, 3
Tel. :(032) 294-82-87,
e-mail: lablizo@ukr.net

Approved by
The head of the
testing laboratory of "LIZO Ltd."
D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-8

Connector bolt tightening test for insulation piercing connectors PC 120-16

Requirements: EN 50483-4:2009 clause 8.1.2.3.4.

The test methods: EN 50483-4:2009 clause 8.1.2.3.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***Insulation piercing connectors PC 120-16 have passed the connector bolt tightening test, satisfies manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.2.3.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	6.
Identification numbers of the samples:	№35, №36, №37, №38, №39, №40.
The testing dates:	17.08.2020.
The environmental conditions:	
temperature:	24,6 °C;
air pressure:	96,8 kPa;
humidity:	69 %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120	ПВ-1 6
Conductor cross-section:	120 mm^2	6 mm^2
Conductor diameter:	12,5 mm	2,75 mm
Number of strands:	19	1
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,7 mm	1,0 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

The branch conductors:

Type:	AsXSn 4x16	ПВ-3 1,5
Conductor cross-section:	16 mm^2	1,5 mm^2
Conductor diameter:	4,7 mm	1,4 mm
Number of strands:	7	31
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,2 mm	0,7 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

2. Testing procedure:

The tests are performed in accordance with EN 50483-4:2009 clause 8.1.2.3.

Two samples of IPCs are tested in each of the following conductors' cross-sections combinations of main and branch conductors: max – max, min – min and min – max.

The connector is installed at the main core, which is tensioned previously to 20 % of MBL of the core.

The connectors are installed as shown at Fig. 1 and tightened with torque 12,6 Nm which is 20 % greater than maximum torque (10,5 Nm) specified by the manufacturer.

3. Requirements:

The connector shall be undamaged.

4. Testing results:

Table 1 – Testing results

№	Identification number of IPC	Conductors: main – branch (mm^2 – mm^2)	MBL of the main conductor, kN	Tensile load of the main core 20 % of the MBL, kN	The tightening torque of the connector's bolt, Nm	Breaking or damaging of the IPC
1	35	max – max 120 – 16	18,43	3,69	12,6	Absent
	36					Absent
2	37	min – min 6 – 1,5	1,18	0,24	12,6	Absent
	38					Absent
3	39	min – max 6 – 16	1,18	0,24	12,6	Absent
	40					Absent

5. Conclusion:

Insulation piercing connectors PC 120-16 have no any damages after applying of the torque 12,6 Nm to the connectors' bolts. This torque is 20 % greater than maximum torque specified by the manufacturer (10,5 Nm). IPC PC 120-16 satisfy requirements of EN 50483-4:2009 clause 8.1.2.3.

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

6. Pictures:

Fig.1 – IPC in the test

7. Test equipment:

№	Type	Model	Latest calibration date
1	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
2	Tensile test machine, factory №001	ЛІЗО №001	Don't need calibration
3	Load cell	FB 50K №0032	06.04.2020

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ O. O. Nepyivoda

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

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79035, Україна, м. Львів
вул. М.Пимоненко, 3
тел.:(032) 294-82-87,
e-mail: lablizo@ukr.net

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79035, Ukraine, Lviv
st. Pymonenko, 3
Tel. :(032) 294-82-87,
e-mail: lablizo@ukr.net

Approved by
The head of the
testing laboratory of "LIZO Ltd."
D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-9

Shear head function test of insulation piercing connector PC 120-16

Requirements: EN 50483-4:2009 clause 8.1.2.4.4.

The test methods: EN 50483-4:2009 clause 8.1.2.4.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***The insulation piercing connectors PC 120-16 passed the shear head function test, satisfies the manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.2.4.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	24.
Identification numbers of the samples:	№41 … №64.
The testing dates:	21.08.2020.
The environmental conditions:	
temperature:	(23,6 – 24,0) °C;
air pressure:	97,8 kPa;
humidity:	(70 – 71) %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120	ПВ-1 6
Conductor cross-section:	120 mm^2	6 mm^2
Conductor diameter:	12,5 mm	2,75 mm
Number of strands:	19	1
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,7 mm	1,0 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

The branch conductors:

Type:	AsXSn 4x16	ПВ-3 1,5
Conductor cross-section:	16 mm^2	1,5 mm^2
Conductor diameter:	4,7 mm	1,4 mm
Number of strands:	7	31
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,2 mm	0,7 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

2. Testing procedure:

The tests are performed in accordance with EN 50483-4:2009 clause 8.1.2.4.

Six samples of IPC are tested in each of the following conductors' cross-sections combinations of main and branch conductors: min – min, max – max.

The tests are performed for each of the testing temperatures:

- minimum temperature: -10 ^{0}C (± 3 ^{0}C);
- maximum temperature: 50 ^{0}C (± 3 ^{0}C).

Prepared assemblies are placed in the chamber with controlled temperature until they reach the testing temperature. The testing temperature is maintained in the chamber during 15 minutes. The shear head is tightened in accordance with the manufacturer's installation instruction. Value of the tightening torque is registered by the electronic torque wrench (Fig.1, Fig.2).

3. Requirements:

For each of the testing temperatures and cross-section combinations, the torque, at which the shear head is sheared, should be within the tolerances of the manufacturer's specified torque range (9 ± 1,5) Nm.

4. Testing results:

Table 1 – Testing results

№	Identification number of IPC	Conductors: main - branch (mm^2 - mm^2)	Environmental temperature the assembly preliminary equalizing, ^{0}C	IPC shear heads tightening torque value, Nm	Testing results
1	41	min – min 6 – 1,5	-10	7,62	Satisfy
	42			7,51	Satisfy
	43			9,55	Satisfy
	44			9,99	Satisfy
	45			8,16	Satisfy
	46			7,53	Satisfy
2	47		50	7,68	Satisfy
	48			8,62	Satisfy
	49			7,52	Satisfy
	50			7,54	Satisfy
	51			9,48	Satisfy
	52			7,86	Satisfy
3	53	max – max 120 – 16	-10	8,45	Satisfy
	54			8,65	Satisfy
	55			9,43	Satisfy
	56			9,15	Satisfy
	57			8,02	Satisfy
	58			9,19	Satisfy
4	59		50	9,17	Satisfy
	60			8,40	Satisfy
	61			8,12	Satisfy
	62			7,52	Satisfy
	63			7,97	Satisfy
	64			7,59	Satisfy

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

5. Conclusion:

The insulation piercing connectors PC 120-16 passed the shear head function test within the bounds of the manufacturer indicated tightening torque (9 ± 1,5) Nm under low temperature -10 ^{0}C (± 3 ^{0}C) and under high temperature 50 ^{0}C (± 3 ^{0}C). The insulation piercing connectors PC 120-16 satisfy the manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.2.4.

6. Pictures:

Fig.1 – Testing under maximal temperature

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

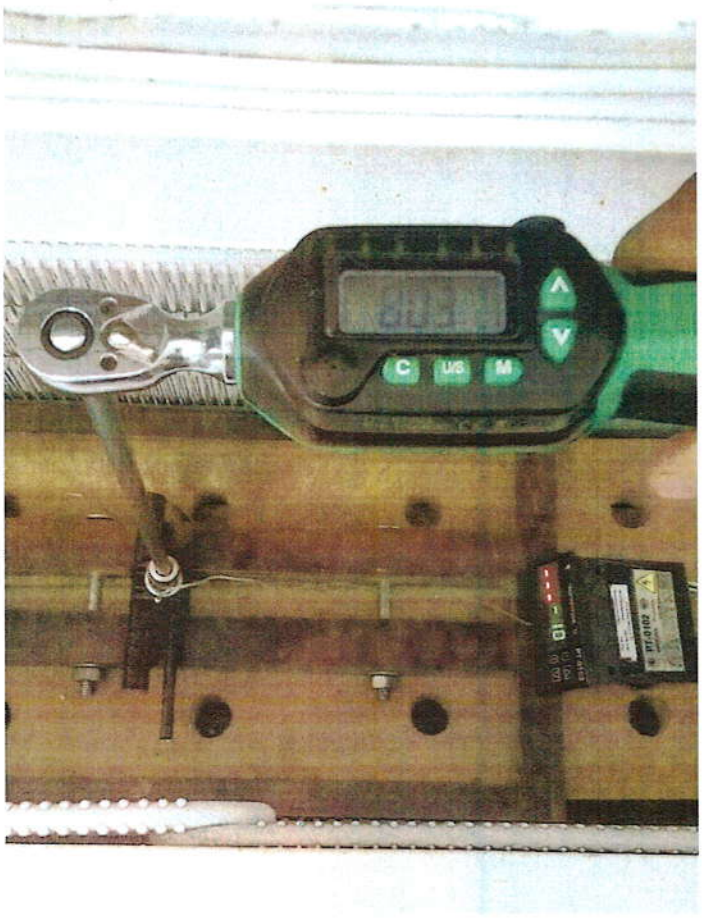

Fig.2 – Testing under minimal temperature

7. Test equipment:

№	Type	Model	Latest calibration date
1	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
2	Cold chamber	ЛІЗО № 001	Don't need calibration
3	Temperature measurement and control device with resistive temperature transducer	РТ-0102 №14-571 ТСП-0287 №14-039	08.04.2020
4	Electrical chamber (heat chamber)	Едельвейс №0298	Don't need calibration
5	Temperature measurement and control device with resistive temperature transducer	РТ-0102 №15-398 ТСП-0287 №15-009	09.04.2020

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ D. S. Denys

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

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79035, Україна, м. Львів
вул. М.Пимоненко, 3
тел.:(032) 294-82-87,
e-mail: lablizo@ukr.net

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79035, Ukraine, Lviv
st. Pymonenko, 3
Tel. :(032) 294-82-87,
e-mail: lablizo@ukr.net

Approved by
The Head of the
testing laboratory of "LIZO Ltd."

D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-10

Low temperature impact test of insulation piercing connectors PC 120-16

Requirements: EN 50483-4:2009 clause 8.1.2.5.4.

The test methods: EN 50483-4:2009 clause 8.1.2.5.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***Insulation piercing connectors PC 120-16 passed low temperature impact test, satisfy the manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.2.5.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	4.
Identification numbers of the samples:	№65, №66, №67, №68.
The testing dates:	21.08.2020.
The environmental conditions:	
temperature:	24,0 °C;
air pressure:	97,2 kPa;
humidity:	70 %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120
Conductor cross-section:	120 mm^2
Conductor diameter:	12,5 mm
Number of strands:	19
Shape:	Round
Conductor material:	Aluminum
Insulation thickness:	1,7 mm
Insulation material:	XLPE
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1

The branch conductors:

Type:	AsXSn 4x16	ПВ-3 1,5
Conductor cross-section:	16 mm^2	1,5 mm^2
Conductor diameter:	4,7 mm	1,4 mm
Number of strands:	7	31
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,2 mm	0,7 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

2. Testing procedure:

The tests are performed in accordance with EN 50483-4:2009 clause 8.1.2.5. Two samples of IPCs are tested in each of the following conductors' cross-sections combinations of main and branch conductors: max – min and max – max.

Assemblies are placed in the cold chamber with controlled temperature until they reached the testing temperature -10 °C (± 3 °C).

The assemblies are removed from the cold chamber by turns and are tested for impact from top and from side with help of the impact test device shown at Fig.1.

The testing samples of the IPCs are placed between the metallic plane and anvil 50 mm in diameter with a spherical contact radius of 300 mm and mass 100 g. The impacts are dashed to anvil with the help of cylindrical weight 900 g falling freely through 200 mm.

3. Requirements:

No damage should occur which would affect the correct function of the connector.

4. Testing results:

Table 1 – Testing results

№	Identification number of IPC	Conductors: main – branch (mm^2 – mm^2)	The samples temperature during the testing, ^0C	Damages
1	65	max – min 120 – 1,5	-10	Absent
	66			Absent
2	67	max – max 120 – 16	-10	Absent
	68			Absent

5. Conclusion:

Insulation piercing connectors PC 120-16 have no any damages which would impede the correct function of the connectors after the low temperature -10 ^0C (± 3 ^0C) impact test. Connectors have passed the tests and satisfy the manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.2.5.

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

6. Pictures:

Fig.1 – IPCs during the testing

7. Test equipment:

№	Type	Model	Latest calibration date
1	Ruler 1m	VaGo-Tools №003	05.04.2020
2	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
3	Cold chamber	ЛІЗО № 001	Don't need calibration
4	Temperature measurement and control device with resistive temperature transducer	РТ-0102 №14-571 ТСП-0287 №14-039	08.04.2020
5	Impact device	ЛІЗО №001	Don't need calibration

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ O. O. Nepyivoda

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вул. М.Пимоненко, 3
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79035, Ukraine, Lviv
st. Pymonenko, 3
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e-mail: lablizo@ukr.net

Approved by
The Head of the
testing laboratory of "LIZO Ltd."

D. R. Dovgun
«28» 09 2020

TESTING REPORT № 40/20-11

Low temperature assembly test of insulation piercing connectors PC 120-16

Requirements: EN 50483-4:2009 clause 8.1.4.4.

The test methods: EN 50483-4:2009 clause 8.1.4.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***The assemblies of the insulation piercing connectors PC 120-16 passed the test for stability of the electrical contact between conductors under low temperature, satisfy manufacturer's declared characteristics and requirements of EN 50483-4:2009 clause 8.1.4.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	6.
Identification numbers of the samples:	№69, №70, №71, №72, №73, №74.
The testing dates:	21.08.2020.
The environmental conditions:	
temperature:	24,0 °C;
air pressure:	97,8 kPa;
humidity:	70 %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120	ПВ-1 6
Conductor cross-section:	120 mm^2	6 mm^2
Conductor diameter:	12,5 mm	2,75 mm
Number of strands:	19	1
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,7 mm	1,0 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

The branch conductors:

Type:	AsXSn 4x16	ПВ-3 1,5
Conductor cross-section:	16 mm^2	1,5 mm^2
Conductor diameter:	4,7 mm	1,4 mm
Number of strands:	7	31
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,2 mm	0,7 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

2. Testing procedure:

The tests are performed in accordance with EN 50483-4:2009 clause 8.1.4.

Two samples of IPCs are tested in each of the following conductors' cross-sections combinations of main and branch conductors: max – max, min – max and max – min.

The conductors and IPCs are cooled to the testing temperature -10 ^{0}C (± 3 ^{0}C) before the tests.

The connector's bolt is tightened with the help of electronic torque wrench before the stable electrical contact occurrence between the conductors, which is fixed with the help of ohmmeter after the assembly of the conductors and connectors achieved the temperature -10 ^{0}C (± 3 ^{0}C). We are fixing the tightening torque of the connector's bolt at which stable electrical contact is obtained (Fig.1).

3. Requirements:

Stable electrical contact should be achieved between the conductors under the low temperature -10 ^{0}C (± 3 ^{0}C) with connector's nut tightening torque less or equal to 70 % of the minimum tightening torque declared by the manufacturer (7,5 Nm), notably 5,25 Nm.

4. Testing results:

Table 1 – Testing results

№	Identification number of IPC	Conductors: main - branch (mm^2 - mm^2)	The sample's temperature during the testing, ^{0}C	The tightening torque of the connector's bolt at which stable electrical contact between conductors was achieved, Nm	Testing result
1	69	max – max 120 – 16	-10	4,36	Satisfy
	70			4,44	Satisfy
2	71	min – max 6 – 16	-10	3,86	Satisfy
	72			4,10	Satisfy
3	73	max – min 120 – 1,5	-10	4,80	Satisfy
	74			5,02	Satisfy

5. Conclusion:

The assemblies of the insulation piercing connectors PC 120-16 passed the test for stability of the electrical contact between conductors under low temperature -10 ^{0}C (± 3 ^{0}C) with connector's bolt tightening torque less or equal to 70 % of the minimum tightening torque declared by the manufacturer (7,5 Nm), satisfies requirements of EN 50483-4:2009 clause 8.1.4.

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6. Pictures:

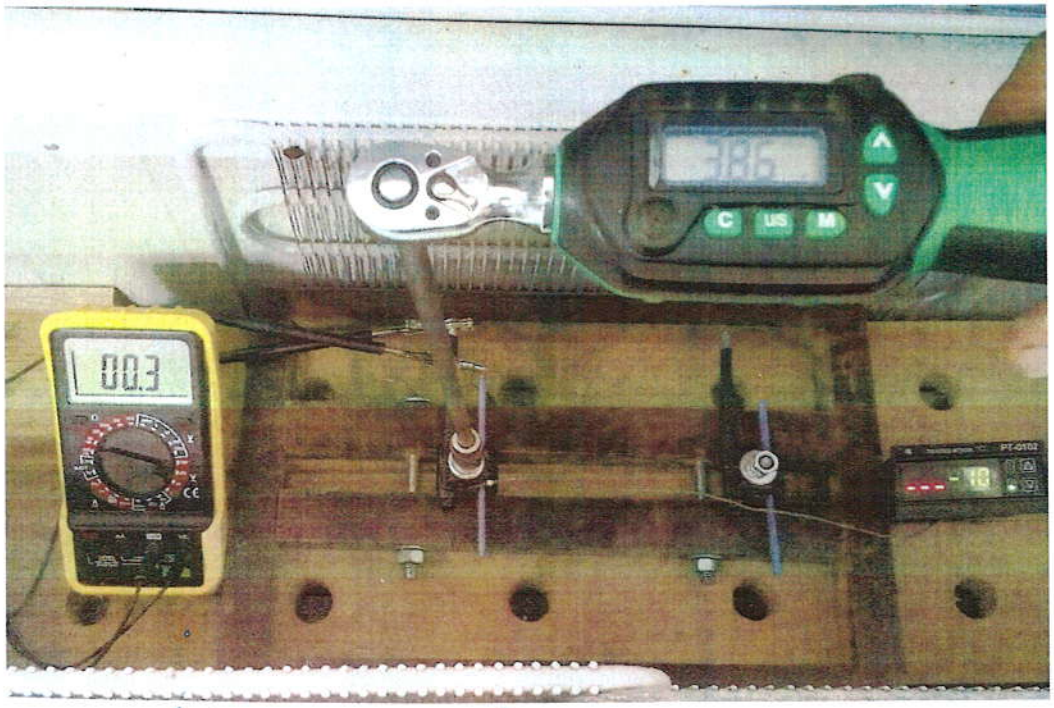

Fig.1 – IPC during the test

7. Test equipment:

№	Type	Model	Latest calibration date
1	Torque wrench	DG2-030 №DG2-030-07000584	05.04.2020
2	Cold chamber	ЛІЗО № 001	Don't need calibration
3	Temperature measurement and control device with resistive temperature transducer	РТ-0102 №14-571 ТСП-0287 №14-039	08.04.2020
4	Multimeter	Topex №11602228	Don't need calibration

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ A. S. Shevtsiv

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ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ
ТзОВ ВКФ «ЛІЗО»

TESTING LABORATORY
of the LLC PCF "LIZO"

2H1383
ДСТУ ISO/IEC 17025

Атестат акредитації
№ 2Н1383
Дійсний до
16 червня 2021 року

79035, Україна, м. Львів
вул. М.Пимоненко, 3
тел.:(032) 294-82-87,
e-mail: lablizo@ukr.net

Accreditation certificate
№ 2Н1383
Expiry date:
16 June, 2021

79035, Ukraine, Lviv
st. Pymonenko, 3
Tel. :(032) 294-82-87,
e-mail: lablizo@ukr.net

Approved by
The head of the
testing laboratory of "LIZO Ltd."

_____ D. R. Dovgun
«_28_» _____09_____ 2020

TESTING REPORT № 40/20-12

Electrical ageing test of insulation piercing connectors PC 120-16

Requirements: EN 50483-5:2009 clause 8.6.

The test methods: EN 50483-4:2009 clause 8.1.6 and EN 50483-5:2009.

Product name:	**Insulation piercing connector (IPC)**
Model and type:	**PC 120-16**
Manufacturer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Customer:	**"FEMAN" D.O.O Vihorska 1, 35000 Jagodina, Serbia**
Reason:	**Contract № 12-06-20 of 25.06.2020**
Testing results:	***Insulation piercing connectors PC 120-16 have passed the electrical ageing test, satisfies manufacturer's declared characteristics and requirements of EN 50483-5:2009.***

Lviv - 2020

Samples' receiving date:	15.07.2020
Quantity of the tested samples:	12.
Identification numbers of the samples:	№1 … №12.
The testing dates:	20.07.2020 - 29.08.2020.
The environmental conditions:	
temperature:	(16 – 24) °C;
air pressure:	(96 – 101) kPa;
humidity:	(45 – 75) %.

1. Tested samples:

Insulation piercing connectors:

Model and type:	PC 120-16.
Class:	A1.
Main conductor cross-sections:	(6 – 120) mm^2.
Branch conductor cross-sections:	(1,5 – 16) mm^2.
The tightening torque of the bolt:	(9 ± 1,5) Nm.
Batch number:	05/20.
Installation temperature:	From -10 °C to +50 °C.

The main conductors:

Type:	AsXSn 4x120	ПВ-1 6
Conductor cross-section:	120 mm^2	6 mm^2
Conductor diameter:	12,5 mm	2,75 mm
Number of strands:	19	1
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,7 mm	1,0 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

The branch conductors:

Type:	AsXSn 4x16	ПВ-3 1,5
Conductor cross-section:	16 mm^2	1,5 mm^2
Conductor diameter:	4,7 mm	1,4 mm
Number of strands:	7	31
Shape:	Round	Round
Conductor material:	Aluminum	Copper
Insulation thickness:	1,2 mm	0,7 mm
Insulation material:	XLPE	PVC
Manufacturer / country:	PJSC «Yuzhcable works» / Ukraine	PJSC «Yuzhcable works» / Ukraine
Standard:	HD626:S1	IEC 60227-1:2007

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2. Testing procedure:

The tests are performed in accordance with EN 50483-5:2009.

Two circuits (Fig.2) are mounted with main and branch conductors for the following conductors' cross-sections combinations: max – max and min – min.

The conducting paths lengths and configuration are chosen in accordance with Fig.1 and Table 1 of EN 50483-5:2009 and specified in Table 1.

Table 1 – The conducting paths lengths

№	The conducting paths lengths, mm				
	l_a	l_b	l_{ra}	l_{rb}	d
1	200	150	350	350	880
2	150	150	300	300	600

The circuit is made by welding of the conductors, which insures uniform distribution of the electrical current in the measurement points.

The dimensional stabilization of the insulating sheath of the conductors is performed in the heat chamber during 1 hour under temperature 30 ^{0}C higher than rated temperature of the conductor, before conductors' welding.

IPCs are installed in accordance with manufacturer's installation instructions with nut tightening torque 7,5 Nm, which is minimal tightening torque specified by the manufacturer. Tightening is provided in accordance with EN 50483-1:2009 clause 9.1.8, speed of tightening complied to EN 50483-1:2009 clause 9.1.10.

The temperature of the reference conductors and the connectors is measured by the resistive temperature transducer in accordance with EN 50483-5:2009 clause 5.4.1.

The electrical resistance of the IPCs and the reference conductors are measured between two adjacent measurement points (points of the potential balancing) under the direct current. Measurements are performed by volt-ammeter method. The resistance is calculated by division of the voltage drop to the direct current value which is not more than 10 % of the heat cycle current value. Direct current and voltage drop measurement is performed with the precision of measurements within the range ± 0,2 %.

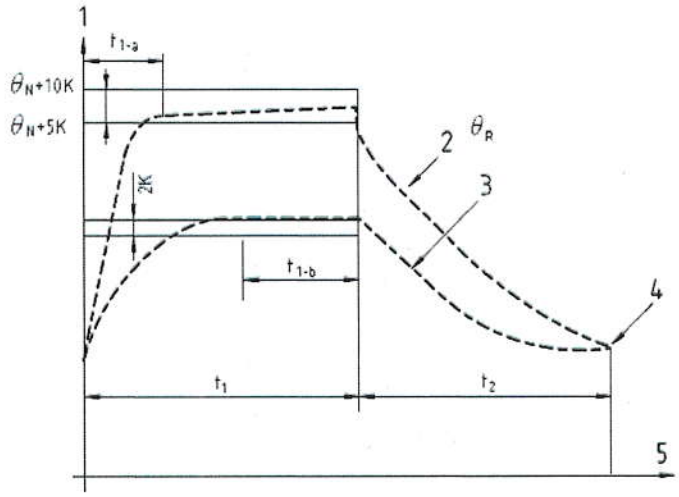
1000 heat cycles are needed.

Measurements of the temperature and resistance valuation are made for the next cycles:

- 0 (before the heat cycle), only valuation of the resistance;
- 200, before short circuit;
- 200, after short circuit;
- 250;
- else after each 75 cycles (14 measurements in sum).

Temperature measurement and resistance valuation are provided for the reference conductors and all IPCs. The results are documented. Maximum temperatures of the reference conductors and of each IPC are fixed immediately before or after the heat cycle.

The resistance of each IPC of the circuit is measured before the first heat cycle. The purpose of the first heat cycle is to determine the reference conductor temperature for its application in subsequent cycles and to identify the median temperature connector. The curve of a heat cycle is shown at Fig.1.



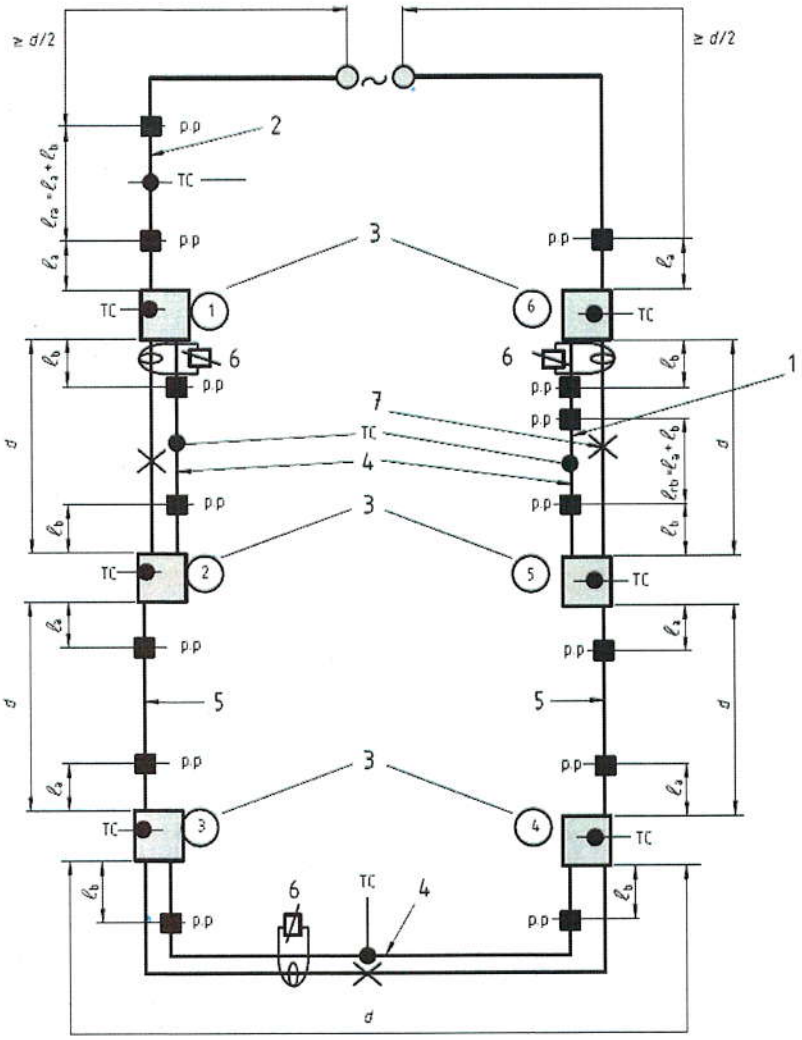
1. temperature axis;
2. temperature of the reference conductor θ_R;
3. median temperature of the connector;
4. temperature ≤ 35 ^{0}C for connectors and reference conductor;
5. time axis.

Fig.1 – First heat cycle

The resistance calculations for the testing loop connectors are performed after 200 cycles of heating and cooling. Then six short-circuits are applied for each connector from the testing loop. The short-circuit test is performed by short impulses. The duration of each impulse is (t_{sc} ± 0,15) s. The testing loop is cooled to the temperature ≤ 35 ^{0}C after each impulse. The short-circuit current I_{sc} depends of the testing loop conductor with smaller cross-section.

The measurements results evaluation and the calculation of the following parameters are performed after 1000 cycles of heating-cooling:

- the initial scatter δ, between six initial values of resistances R_j, calculated before the first heat cycle;
- the mean scatter β, between the six values of resistance R_j, averaged over the last 11 measurement intervals;
- ratio λ of the resistances, calculated for heat cycles to the resistances, calculated for initial cycle;
- the resistance stability, calculated for last 11 measurements;
- the maximum temperature $\theta_{j\,max}$ on each connector;
- the stability of the connector's temperature $\Delta\theta_j$;



A – cross section of the conductor (mm²);
d – length of the conductor between IPC's;
$d \geq 80\sqrt{A}$ or 500 mm minimum;
p.p. – potential point;
TC – thermocouple.

1. Reference conductor A_2R_2 with insulation between equalizers;
2. Reference conductor A_1R_1 with insulation between equalizers;
3. IPCs;
4. Conductor A_2R_2 with insulation between equalizers;
5. Conductor A_1R_1 with insulation between equalizers;
6. Resistance adapter;
7. Switcher.

Fig.2 – Testing loop

3. Requirements:

Table 2 – Test requirements

№	Parameter	Maximum value
1	Initial scatter δ	0,3
2	Mean scatter β	0,3
3	Assessment of resistance stability	15 %
4	Resistance factor ratio λ	2,0
5	Temperature stability $\Delta\theta_j$	$\overline{\Delta\theta_j} - 10 \;\; \Delta\theta_j \; \overline{\Delta\theta_j} + 10$
6	Maximum temperature θ_j of each connector	θ_R

4. Testing results:

4.1. Connectors testing results in circuit with conductors combination (max – max) 120 mm² – 16 mm²

Table 3 – Medium value, stability and ratio of the connectors' resistances *

№	Cycle	IPC №1		IPC №2		IPC №3		IPC №4		IPC №5		IPC №6	
		Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ
1	0	82,1	-	80,3	-	68,5	-	77,1	-	94,1	-	83,3	-
2	200	138,7	1,69	125,0	1,56	109,9	1,61	118,9	1,54	164,0	1,74	131,2	1,57
3	200	128,8	1,57	113,2	1,41	99,2	1,45	119,8	1,55	165,7	1,76	121,3	1,46
4	250	142,1	1,73	122,9	1,53	111,6	1,63	122,9	1,59	166,8	1,77	142,6	1,71
5	325	144,5	1,76	123,9	1,54	117,5	1,72	125,9	1,63	168,5	1,79	146,0	1,75
6	400	150,0	1,83	125,6	1,57	118,0	1,72	130,4	1,69	167,5	1,78	154,4	1,85
7	475	153,6	1,87	128,6	1,60	118,7	1,73	133,1	1,73	169,8	1,80	157,2	1,89
8	550	149,9	1,83	133,9	1,67	116,3	1,70	134,1	1,74	173,4	1,84	158,2	1,90
9	625	152,1	1,85	132,3	1,65	119,6	1,75	136,8	1,78	174,5	1,86	157,2	1,89
10	700	154,6	1,88	138,1	1,72	127,8	1,87	141,5	1,84	178,1	1,89	159,4	1,91
11	775	161,5	1,97	141,6	1,76	124,8	1,82	142,0	1,84	179,4	1,91	161,8	1,94
12	850	158,5	1,93	140,9	1,76	124,8	1,82	142,9	1,85	179,9	1,91	157,6	1,89
13	925	159,0	1,94	141,2	1,76	126,6	1,85	142,3	1,85	182,6	1,94	160,9	1,93
14	1000	159,0	1,94	141,4	1,76	127,8	1,87	142,5	1,85	182,3	1,94	161,5	1,94
15	Mean resistances value	153,2	-	133,7	-	121,2	-	135,9	-	174,8	-	156,1	-
16	Resistance stability	12,7 %		14,0 %		13,4 %		14,7 %		9,0 %		12,3 %	

* Value of the connectors resistance indicated for temperature 20 °C.

Thermal profile: I_N = 450 A, I_B = 130 A, $t_{1\text{-}a}$ = 12 min, $t_{1\text{-}b}$ = 12 min, t_2 = 11 min, I = 15 A.
SC test: I_{sc} = 1918 A, t_{sc} = 1,0 s.

Table 4 – Maximum temperature and temperature stability of the connectors

№	Cycle	Main conductor	Branch conductor	IPC №1		IPC №2		IPC №3		IPC №4		IPC №5		IPC №6		In circuit
		T (°C)	T (°C)	T (°C)	Δθj	T (°C)	Δθj	T (°C)	Δθj	T (°C)	Δθj	T (°C)	Δθj	T (°C)	Δθj	T (°C)
1	1	98,0	97,0	71,0	-	75,0	-	72,0	-	74,0	-	73,0	-	70,0	-	19,5
2	200	97,0	97,0	75,0	22,0	78,0	19,0	75,0	22,0	80,0	17,0	83,0	14,0	72,0	25,0	23,0
3	200	98,0	97,0	75,0	23,0	79,0	19,0	76,0	22,0	83,0	15,0	85,0	13,0	73,0	25,0	23,2
4	250	98,0	98,0	76,0	22,0	78,0	20,0	77,0	21,0	84,0	14,0	85,0	13,0	74,0	24,0	23,8
5	325	98,0	99,0	77,0	21,0	79,0	19,0	77,0	21,0	85,0	13,0	86,0	12,0	75,0	23,0	23,4
6	400	98,0	98,0	79,0	19,0	79,0	19,0	78,0	20,0	86,0	12,0	85,0	13,0	75,0	23,0	23,6
7	475	98,0	98,0	80,0	18,0	80,0	18,0	79,0	19,0	86,0	12,0	85,0	13,0	75,0	23,0	23,2
8	550	98,0	99,0	80,0	18,0	80,0	18,0	80,0	18,0	88,0	10,0	86,0	12,0	75,0	23,0	26,9
9	625	98,0	99,0	80,0	18,0	82,0	16,0	82,0	16,0	87,0	11,0	85,0	13,0	74,0	24,0	26,0
10	700	98,0	99,0	81,0	17,0	83,0	15,0	84,0	14,0	88,0	10,0	85,0	13,0	74,0	24,0	21,6
11	775	98,0	98,0	81,0	17,0	83,0	15,0	85,0	13,0	88,0	10,0	85,0	13,0	75,0	23,0	23,6
12	850	98,0	98,0	82,0	16,0	83,0	15,0	86,0	12,0	88,0	10,0	85,0	13,0	74,0	24,0	23,8
13	925	98,0	98,0	82,0	16,0	83,0	15,0	86,0	12,0	88,0	10,0	85,0	13,0	74,0	24,0	24,0
14	1000	98,0	98,0	82,0	16,0	84,0	14,0	87,0	11,0	90,0	8,0	86,0	12,0	75,0	23,0	24,3
15	Max. value	98,0	99,0	82,0	-	84,0	-	87,0	-	90,0	-	86,0	-	75,0	-	26,9
16	$\overline{\Delta\theta_j}$	-	-	-	18,0	-	16,7	-	16,1	-	10,9	-	12,7	-	23,5	-

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4.2. Connectors testing results in circuit with conductors combination (min – min) 6 mm² – 1,5 mm²

Table 5 – Medium value, stability and ratio of the connectors' resistances *

№	Cycle	IPC №1		IPC №2		IPC №3		IPC №4		IPC №5		IPC №6	
		Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ	Resistance, мΩ	Resistance ratio, λ
1	0	149,3	-	132,3	-	148,6	-	159,8	-	140,1	-	154,9	-
2	200	181,7	1,22	143,5	1,08	179,0	1,20	189,3	1,18	158,2	1,13	185,3	1,20
3	200	185,8	1,24	141,0	1,07	173,8	1,17	186,6	1,17	159,2	1,14	179,5	1,16
4	250	198,5	1,33	147,1	1,11	182,8	1,23	192,2	1,20	166,8	1,19	185,8	1,20
5	325	201,9	1,35	154,6	1,17	185,0	1,25	195,3	1,22	168,7	1,20	188,5	1,22
6	400	208,9	1,40	158,9	1,20	186,3	1,25	197,5	1,24	172,2	1,23	189,8	1,23
7	475	208,5	1,40	157,3	1,19	191,1	1,29	198,9	1,24	175,7	1,25	196,1	1,27
8	550	208,3	1,40	164,4	1,24	196,9	1,33	207,6	1,30	183,6	1,31	204,0	1,32
9	625	214,6	1,44	163,1	1,23	198,2	1,33	205,3	1,28	183,5	1,31	201,1	1,30
10	700	211,0	1,41	161,9	1,22	194,8	1,31	201,7	1,26	185,7	1,33	206,0	1,33
11	775	214,7	1,44	164,7	1,24	201,1	1,35	205,8	1,29	181,5	1,30	208,8	1,35
12	850	217,3	1,46	170,9	1,29	201,8	1,36	207,9	1,30	188,5	1,35	210,1	1,36
13	925	216,9	1,45	167,8	1,27	202,7	1,36	213,1	1,33	189,4	1,35	211,0	1,36
14	1000	222,9	1,49	170,6	1,29	201,8	1,36	214,8	1,34	189,6	1,35	214,2	1,38
15	Mean resistances value	211,2	-	161,9	-	194,8	-	203,6	-	180,5	-	201,4	-
16	Resistance stability	11,5 %		14,7 %		10,2 %		11,1 %		12,6 %		14,1 %	

* Value of the connectors resistance indicated for temperature 20 °C.

Thermal profile: I_N = 75 A, I_B = 31 A, $t_{1\text{-}a}$ = 10 min, $t_{1\text{-}b}$ = 11 min, t_2 = 10 min, I = 10 A.
SC test: I_{SC} = 218 A, t_{SC} = 1,0 s.

Table 6 – Maximum temperature and temperature stability of the connectors

№	Cycle	Main conductor	Branch conductor	IPC №1		IPC №2		IPC №3		IPC №4		IPC №5		IPC №6		In circuit
		T (°C)	T (°C)	T (°C)	Δθj	T (°C)	Δθj	T (°C)	Δθj	T (°C)	Δθj	T (°C)	Δθj	T (°C)	Δθj	T (°C)
1	1	77,0	75,0	41,0	-	41,7	-	41,4	-	40,0	-	42,8	-	44,6	-	24,2
2	200	78,0	77,0	41,6	36,4	42,5	35,5	41,9	36,1	40,5	37,5	43,1	34,9	45,6	32,4	24,6
3	200	78,0	77,0	42,6	35,4	42,0	36,0	41,9	36,1	40,0	38,0	43,3	34,7	44,8	33,2	24,6
4	250	78,0	76,0	42,0	36,0	42,0	36,0	42,0	36,0	40,0	38,0	43,0	35,0	45,0	33,0	23,9
5	325	78,0	76,0	42,4	35,6	42,0	36,0	43,0	35,0	40,5	37,5	43,4	34,6	45,2	32,8	24,1
6	400	78,0	76,0	42,6	35,4	42,0	36,0	44,0	34,0	41,0	37,0	43,5	34,5	46,0	32,0	24,0
7	475	78,0	76,0	43,0	35,0	42,1	35,9	44,3	33,7	41,2	36,8	44,0	34,0	46,4	31,6	23,0
8	550	78,0	75,0	43,8	34,2	42,1	35,9	44,5	33,5	41,3	36,7	44,0	34,0	46,0	32,0	22,0
9	625	78,0	76,0	44,0	34,0	42,5	35,5	44,6	33,4	41,6	36,4	44,2	33,8	46,5	31,5	23,1
10	700	78,0	77,0	44,0	34,0	43,0	35,0	44,4	33,6	41,5	36,5	44,0	34,0	46,4	31,6	23,0
11	775	78,0	76,0	44,0	34,0	43,0	35,0	44,4	33,6	42,0	36,0	44,5	33,5	46,8	31,2	23,8
12	850	78,0	78,0	44,2	33,8	43,4	34,6	44,6	33,4	42,5	35,5	44,5	33,5	46,6	31,4	22,4
13	925	78,0	76,0	44,4	33,6	43,7	34,3	45,0	33,0	42,9	35,1	44,6	33,4	47,0	31,0	22,3
14	1000	78,0	76,0	45,0	33,0	44,0	34,0	45,0	33,0	43,0	35,0	44,5	33,5	47,2	30,8	22,8
15	Max. value	78,0	78,0	45,0	-	44,0	-	45,0	-	43,0	-	44,6	-	47,2	-	24,6
16	$\overline{\Delta\theta_j}$	-	-	-	34,4	-	35,3	-	33,8	-	36,4	-	34,0	-	31,7	-

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Table 7 – Testing results

№	Parameter	Result		Accepted value
		Circuit 1 (max – max)	Circuit 2 (min – min)	
1	Initial scatter δ	0,170	0,111	≤ 0,3
2	Mean scatter β	0,217	0,155	≤ 0,3
3	Assessment of resistance stability	Table 3	Table 5	≤ 15 %
4	Resistance factor ratio λ	Table 3	Table 5	≤ 2,0
5	Temperature stability $\Delta\theta_j$	Table 4	Table 6	$\overline{\Delta\theta_j} - 10 \;\; \Delta\theta_j \; \overline{\Delta\theta_j} + 10$
6	Maximum temperature θ_j of each connector	Table 4	Table 6	θ_R

5. Conclusion:

At the basis of comparison of the calculated parameters with maximum accessible parameters after 1000 cycles of heating-cooling all tested samples of IPCs PC 120-16 passed the test and satisfies requirements for class A in accordance with EN 50483-5:2009.

6. Pictures:

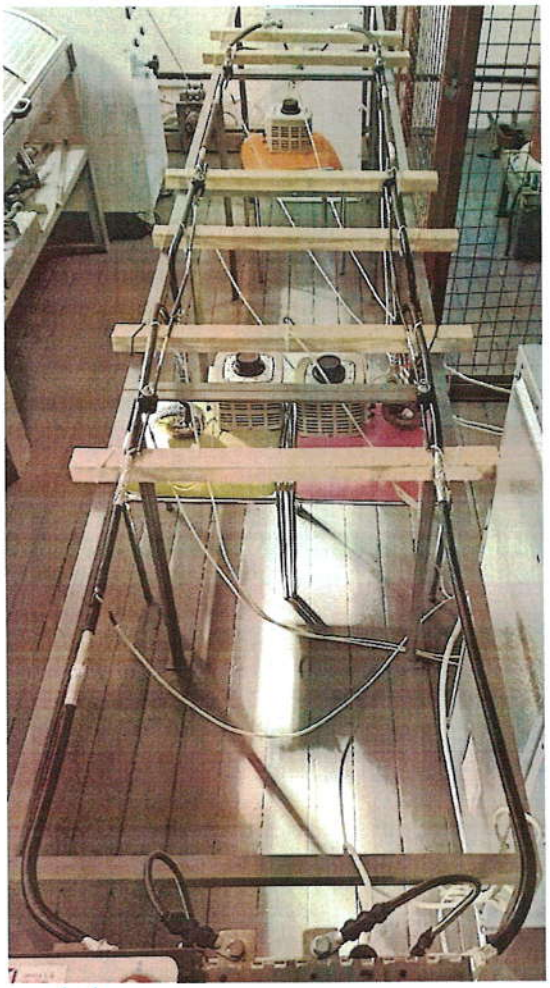

Fig.3 – IPCs in circuit with conductors' combination max – max during the testing

ВИПРОБУВАЛЬНА ЛАБОРАТОРІЯ "ЛІЗО"

7. Test equipment:

№	Type	Model	Latest calibration date
1	Ruler 1m	VaGo-Tools №003	05.04.2020
2	Torque wrench	DT-030S2 №17000067	05.04.2020
3	Stopwatch	СОС пр-2б-2-010 №2284	24.04.2020
4	Millivoltmeter	М2016 №7824	08.04.2020
5	Voltmeter	М2007 №12341	08.04.2020
6	Amperemeter	Э514 №45541	08.04.2020
7	Heat chamber	ILKA №20200113	Don't need calibration
8	Measurement and control device with resistive temperature transducer	РТ-0102 №14-070 ТСП-0287 №14-352, №14-355	08.04.2020
9	Source of current	РГ-53С-М2 №001	Don't need calibration
10	Measurement and control device with resistive temperature transducer	РТ-0102 №16-005 ТСП-0287 №№ 16-001, 16-002, 16-004, 16-005, 16-006, 16-007, 16-008, 16-009	07.04.2020
11	Measurement and control device with resistive temperature transducer	РТ-0102 №16-286 ТСП-0287 №14-027	08.04.2020
12	Shunt	75ШСМОМ3 №375802	27.09.2016
13	Panel for electrical ageing test	ЛІЗО №002	Don't need calibration
14	Source of current	РГ-53С №001	Don't need calibration
15	Measurement and control device with resistive temperature transducer	РТ-0102 №17-004 ТСП-0287 №№ 16-010, 16-011, 16-012, 16-013, 16-014, 16-016, 16-017, 16-018	06.04.2020
16	Measurement and control device with resistive temperature transducer	РТ-0102 №16-287 ТСП-0287 №14-025	08.04.2020р
17	Shunt	75ШСМ №035109	04.01.2017
18	Panel for electrical ageing test	ЛІЗО №001	Don't need calibration
19	Source of current for short-circuit testing	ЛІЗО №001	Don't need calibration

The tests were performed by:

Deputy Head of the testing laboratory: _____ S. S. Lakhovskyi

Engineer: _____ O. O. Nepyivoda

Engineer: _____ D. S. Denys

Engineer: _____ A. S. Shevtsiv

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