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Test report: H5-70008

LQF-708-02
Review No:06

EPIL TEST REPORT

Project No. : H5-70008
Equipment under Test : IPC for low voltage ABC with shear head
Model : IPC1010
Main cross-section : Bare conductor 70 mm² (ACSR-MINK)
Branch cross-section : ABC 16-95 mm²
Nominal torque : 19±2 N.m
Trade Mark



Manufacturer: Electro Niroo Taban Control Engineering Company (NETCO)

Address: Shahma Blvd, Kamal Shahr, End of Robat Mashin Street, Shahid Kamalzadeh St, Plaque 8

Applicant: Electro Niroo Taban Control Engineering Company (NETCO)

Address: Shahma Blvd, Kamal Shahr, End of Robat Mashin Street, Shahid Kamalzadeh St, Plaque 8

Tested According to: EN 50483-4

Date of Sample Reception: 18-May-2021

Date of Tests: 17-Jan-2021

Date of Issue: 06-Jul-2021

Total Number of Pages: 24

Tested by: Technical Expert
M. Ghanbariha

Verified by: Technical Manager
S. Jamshidi

Approved by:

Deputy of Test and Inspection
Prof. B. Vahidi / Prof. S. H. Fathi

Chief Executive Officer
S. M. Mirsadri

on behalf

The statement of conformity decision on the measured values is made based on guard band $w=U, r=1$ rule (ISO/IEC Guide 98-4). The specific false accept/reject risk is up to 2.5%.

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1. GENERAL INFORMATION

1.1. Product Information

Equipment under Test	: IPC for low voltage ABC with shear head
Manufacturer	: Electro Niroo Taban Control Engineering Company (NETCO)
Model	: IPC1010
Main cross-section	: Bare conductor 70 mm ² (ACSR-MINK)
Branch cross-section	: ABC 16-95 mm ²
Nominal torque	: 19±2 N.m
Normative Document	: EN 50483-4

1.2. Tests Results

1	Visual examination	Passed
2	Dimensional and material verification	Performed
3	Test for permanent marking	Passed
4	Test for mechanical damage to conductors	Passed
5	Branch cable pull-out test	Passed
6	Connector bolt tightening test	Passed
7	Shear head function test	Passed
8	Low temperature impact test	Passed
9	Water tightness test	Passed
10	Low temperature assembly test	Passed
11	Electrical ageing test	Passed
12	Corrosion ageing test	Passed
13	Climatic ageing test	Passed

❖ To review the test details, see pages 4 and 23.

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2. PERFORMANCE and RESULTS of TESTS

2.1. Visual examination

2.1.1. Test data

Location : EPIL (Accessory Lab.)
Date : 17-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-1

2.1.2. Ambient conditions

Ambient Temperature : 25 °C

2.1.3. Procedure of test

The test was performed according to EN 50483-1:2009.

2.1.4. Result of test

✓ Passed

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2.2. Dimensional and material verification

2.2.1. Test data

Location : EPIL (Accessory Lab.)
Date : 17-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483

2.2.2. Ambient conditions

Ambient Temperature : 25 °C

2.2.3. Procedure of test

The test was performed according to EN 50483:2009.

2.2.4. Result of test

✓ Performed

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2.3. Test for permanent marking

2.3.1. Test data

Location : EPIL (Accessory Lab.)
Date : 17-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-1 9.2

2.3.2. Ambient conditions

Ambient Temperature : 25 °C

2.3.3. Procedure of test

The marking shall be rubbed by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

2.3.4. Acceptance conditions of test

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

2.3.5. Result of test

✓ **Passed**



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2.4. Test for mechanical damage to the main conductor

2.4.1. Test data

Location : EPIL (Accessory Lab.)
Date : 17-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-4 8.1.2.1

2.4.2. Ambient conditions

Ambient Temperature : 25 °C

2.4.3. Procedure of test

Two samples shall be tested in each of the conductor combinations specified in Table 1. The core shall be mounted in a tensile test machine in a suitable manner. The core length shall be between 0.5 m and 1.5 m. Connectors shall be installed in accordance with the manufacturer's instructions and it shall be tightened to the manufacturer's specified maximum torque. The connectors shall not be removed from the core before the mechanical tensile test. Main conductor shall be tensioned to between 10 % and 15 % of its RTS. The load shall be maintained for 60 s.

2.4.4. Acceptance conditions of test

The conductor shall maintain the test load for 60 s without breaking or any damage that would prevent the correct function of the cable.



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2.4.5. Result of test

The results are shown in Table 1.

Table 1: Result of mechanical damage to the main conductor test

Sample	Branch cross-section (mm ²)	Main cross-section (mm ²)	Main conductor RTS (kN)	Pre-load (kN)	Load in 60s (0.6 RTS)	Result
1	Max	Max	21.67	0.20 RTS	13.00 kN	Passed
2	95	70 (ACSR-MINK)		4.33 kN		Passed
3	Min	Max	21.67	0.20 RTS	13.00 kN	Passed
4	16	70 (ACSR-MINK)		4.33 kN		Passed

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2.5. Branch cable pull-out test

2.5.1. Test data

Location : EPIL (Accessory Lab.)
Date : 17-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-4 8.1.2.2

2.5.2. Ambient conditions

Ambient Temperature : 25 °C

2.5.3. Procedure of test

Two samples shall be tested in each of the conductor combinations specified in Table 2. The branch connector shall be positioned and then installed in accordance with the manufacturer's instructions and it shall be tightened to the manufacturer's specified maximum torque. The core lengths shall be between 0.2 m and 0.5 m. The core, or in the case of a bare conductor, the conductor, shall be marked at the IPC so that any slippage during the test can be measured. According Figure1, a tensile load (F) shall be applied approximately axially, between the branch conductor and the opposing main conductor which shall be secured in a mechanical device, at a rate between 100 N/min and 500 N/min. This load shall be 1 kN or 10 % of the MBL of the branch conductor whichever is less. The load shall be maintained for 60 s.

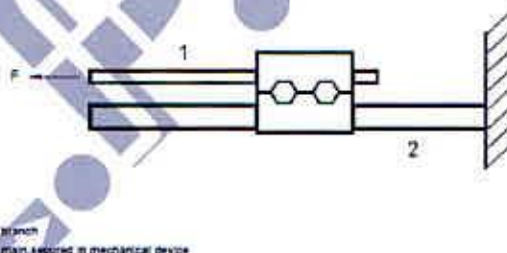


Figure 1: Test arrangement for branch cable pull-out test

2.5.4. Acceptance conditions of test

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

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2.5.5. Result of test

The results are shown in Table 2.

Table 2: Result of branch cable pull-out test

Sample	Branch cross-section (mm ²)	Main cross-section (mm ²)	Branch conductor MBL (kN)	Load in 60s	slippage	Branch cable damage	Result
1	Min	Max & Min	1.92	0.1 MBL	0	No damage	Passed
2	16	70 (ACSR-MINK)		0.192 kN	0	No damage	Passed

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2.6. Connector bolt tightening test

2.6.1. Test data

Location	: EPIL (Accessory Lab.)
Date	: 17-Jan-2021
Engineer of EPIL	: Mr. Ghanbariha
Normative document	: EN 50483-4 8.1.2.3

2.6.2. Ambient conditions

Ambient Temperature : 25 °C

2.6.3. Procedure of test

Two samples shall be tested in each of the conductor combinations specified in Table 3. The core on to which the IPC is to be installed shall be tensioned to 20 % of its MBL. The IPCs shall be installed on to cores for which it is designed. The connectors shall be tightened, in accordance with EN 50483-1, 9.1.10, to the maximum torque specified by the manufacturer, plus 20 %.

2.6.4. Acceptance conditions of test

The connector shall be undamaged.

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2.6.5. Result of test

The results are shown in Table 3.

Table 3: Result of connector bolt tightening test

Sample	Branch cross-section (mm ²)	Main cross-section (mm ²)	Main conductor RTS (kN)	20% of Main conductor RTS (kN)	Result
1	Max	Max	21.67	4.33 kN	Passed
2	95	70 (ACSR-MINK)			Passed
3	Min	Max	21.67	4.33 kN	Passed
4	16	70 (ACSR-MINK)			Passed

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2.7. Shear head function test

2.7.1. Test data

Location : EPIL (Accessory Lab.)
Date : 18-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-4 8.1.2.4

2.7.2. Ambient conditions

Ambient Temperature : 25 °C

2.7.3. Procedure of test

Six samples shall be tested in each of the conductor combinations specified in Table 4 and at each of the following temperatures:

- the minimum temperature shall be $(-10 \pm 3) ^\circ\text{C}$;
- the maximum temperature shall be $(50 \pm 3) ^\circ\text{C}$.

The connector assemblies shall be placed in a temperature controlled environment until they reach the test temperature. The temperature shall be maintained for a minimum of 15 min. The assembly can be removed from the chamber and the torque applied outside. In this case the temperature of the connector shall be monitored and the torque applied within the temperature limits defined above. The shear head shall then be tightened, in accordance with the manufacturer's installation instructions, until the head shears. This torque shall be recorded. The test shall be repeated for the six samples at each of the specified temperatures and cross-section combination.

2.7.4. Acceptance conditions of test

For each of the test temperatures and cross-section combination, the torque at which the shear head shears, shall be within the tolerances of the manufacturer's specified torque range.

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2.7.5. Result of test

The results are shown in Table 4.

Table 4: Result of shear head function test

Sample	Branch cross-section (mm ²)	Main cross-section (mm ²)	Shear head breaking torque (N.m)		Torque tolerance (N.m)	Result
			-10 ± 3 °C	50 ± 3 °C		
1	Min 16	Max 70 (ACSR-MINK)	18	19	19 ± 2	Passed
2			20	19.5		Passed
3			18	19		Passed
4			18.5	19		Passed
5			19	19.5		Passed
6			20	19		Passed
7	Max 95	Max 70 (ACSR-MINK)	18	19		Passed
8			18	19		Passed
9			17.3	19		Passed
10			18.5	19.5		Passed
11			17.2	19.5		Passed
12			18	19		Passed

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2.8. Low temperature impact test

2.8.1. Test data

Location : EPIL (Accessory Lab.)
Date : 18-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-4 8.1.2.5

2.8.2. Ambient conditions

Ambient Temperature : 25 °C

2.8.3. Procedure of test

Two connectors shall be installed in the manner for which they are designed. The samples shall be tested in each of the conductor combinations specified in Table 5. The connectors and the cores shall be placed in a temperature controlled environment at (-10 ± 3) °C until they reach the test temperature. Two impacts shall be made on each sample, one acting from the top and one acting on the side.

2.8.4. Acceptance conditions of test

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

2.8.5. Result of test

The results are shown in Table 5.

Table 5: Result of low temperature impact test

Sample	Branch cross-section (mm ²)	Main cross-section (mm ²)	Result
1	Max	Max	Passed
2	95	70 (ACSR-MINK)	Passed
3	Min	Max	Passed
4	16	70 (ACSR-MINK)	Passed

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2.9. Water tightness test

2.9.1. Test data

Location : EPIL (Accessory Lab.)
Date : 18-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-4 8.1.3.2

2.9.2. Ambient conditions

Ambient Temperature : 25 °C

2.9.3. Procedure of test

Two samples shall be tested in each of the conductor combinations specified in Table 6. Figure 2 shows the test arrangement. The length of main cores shall be approximately 30 cm. The connectors shall be tightened to the minimum torque specified by the manufacturer. The assembly of connector and cores shall be placed at the bottom of a water tank. The depth of water shall be measured above the core. The tap core shall pass out of the tank through an appropriate seal, which shall be designed to prevent any excessive stress on the insulation. The assembly shall be left in the water for 24 h.

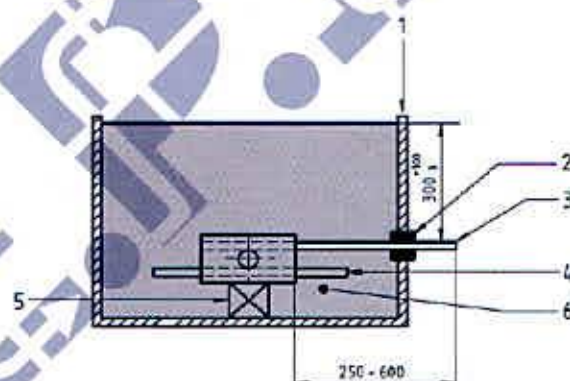


Figure 2: Test arrangement for water tightness test

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2.9.4. Acceptance conditions of test

No trace of water shall be observed at the end of the core.

2.9.5. Result of test

The results are shown in Table 6.

Table 6: Result of water tightness test

Sample	Branch cross-section (mm ²)	Main cross-section (mm ²)	Result
1	Max	Max	Passed
2	95	70 (ACSR-MINK)	Passed
3	Min	Max	Passed
4	16	70 (ACSR-MINK)	Passed

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2.10. Low temperature assembly test

2.10.1. Test data

Location : EPIL (Accessory Lab.)
Date : 18-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-4 8.1.4

2.10.2. Ambient conditions

Ambient Temperature : 25 °C

2.10.3. Procedure of test

Two samples shall be tested in each of the conductor combinations specified in Table 7. The connectors and core shall be further pre-conditioned until they reach the test temperature of $(-10 \pm 3) ^\circ\text{C}$, then they shall be assembled at this temperature in the cold chamber. Electrical continuity shall be measured between the main and branch cables. The IPC shall be installed in accordance with the manufacturer's instructions using a torque meter. The torque at which continuity is achieved shall be recorded.

2.10.4. Acceptance conditions of test

Electrical continuity shall be achieved at a torque value less than, or equal to, 70 % of the manufacturer's specified minimum installation torque.

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2.10.5. Result of test

The results are shown in Table 7.

Table 7: Result of low temperature assembly test

Sample	Branch cross-section (mm ²)	Main cross-section (mm ²)	Continuity torque (N.m)	Maximum acceptable torque (N.m)	Result
1	Max	Max	9.0	11.9	Passed
2	95	70 (ACSR-MINK)	9.3		Passed
3	Min	Max	6.3		Passed
4	16	70 (ACSR-MINK)	6.0		Passed

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2.11. Electrical ageing test

2.11.1. Test data

Location : EPIL (Accessory Lab.)
Date : 19-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-4 8.1.6

2.11.2. Ambient conditions

Ambient Temperature : 25 °C

2.11.3. Procedure of test

The test was performed according to EN 50483-5:2009.

2.11.4. Acceptance conditions of test

The requirements are shown in Table 8.

Table 8: Requirements of electrical ageing test

Parameter	Maximum Value
Initial scatter α	0.3
Mean scatter β	0.3
Assessment of resistance stability	15%
Resistance factor ratio λ	2.0
Temperature stability $\Delta\theta_i$	$\overline{\Delta\theta_j} - 10 \leq \Delta\theta_i \leq \overline{\Delta\theta_j} + 10$
Maximum temperature θ_{ij} of each connector	θ_R



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2.11.5. Result of test

The results are shown in Table 9.

Table 9: Result of electrical ageing test

Parameter	Maximum value	Connector 1	Connector 2	Connector 3	Connector 4	Connector 5	Connector 6
Initial scatter α	0.3	0.22					
Mean scatter β	0.3	0.22					
Assessment of resistance stability (%)	15%	11.1	10.0	10.5	11.6	10.3	12.2
Resistance factor ratio λ	2.0	1.12	1.11	1.11	1.13	1.11	1.13
Maximum temperature θ_j of each connector (°C)	100	62.9	63.2	63.0	62.5	63.1	65.3

✓ Passed

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2.12. Corrosion ageing test

2.12.1. Test data

Location : EPIL (Accessory Lab.)
Date : 19-Jan-2021
Engineer of EPIL : Mr. Ghanbariha
Normative document : EN 50483-4 8.1.5.1.3.1

2.12.2. Ambient conditions

Ambient Temperature : 25 °C

2.12.3. Procedure of test

Two samples shall be tested in min-min conductor combination. The connector shall be placed in the middle of the main core of length 0.5 m to 1.5 m. It shall be tightened to the minimum torque specified by the manufacturer. The number of cycles shall be 4 (4 weeks) as defined in EN 50483-6, 8.4.1.

2.12.4. Acceptance conditions of test

Visual inspection shall be carried out and there shall be no significant trace of red rust. The sample's identification marking shall be legible when examined with normal or corrected vision, without magnification. No deterioration of the connectors shall occur which would impair their normal function. For a connector designed with a shear-head it shall be able to be removed with a torque below, or equal to, the manufacturer's specified maximum torque.

2.12.5. Result of test

After 1 week of corrosion ageing test and then washing the samples:

- The corrosion level of the whole IPC is less than 10% and the result is confirmed.
- The marking was legible.
- There was no destruction in the sample that could damage its proper functioning.
- The connector removal torque was 15 N.m, which is less than the maximum torque (21 N.m).

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2.13. Climatic ageing test

2.13.1. Test data

Location	: EPIL (Accessory Lab.)
Date	: 19-Jan-2021
Engineer of EPIL	: Mr. Ghanbariha
Normative document	: EN 50483-4 8.1.5.2

2.13.2. Ambient conditions

Ambient Temperature : 25 °C

2.13.3. Procedure of test

The test was performed according to subclause 8.1.5.2 of EN 50483-4:2009.

2.13.4. Result of test

✓ Passed

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3. FIGURES

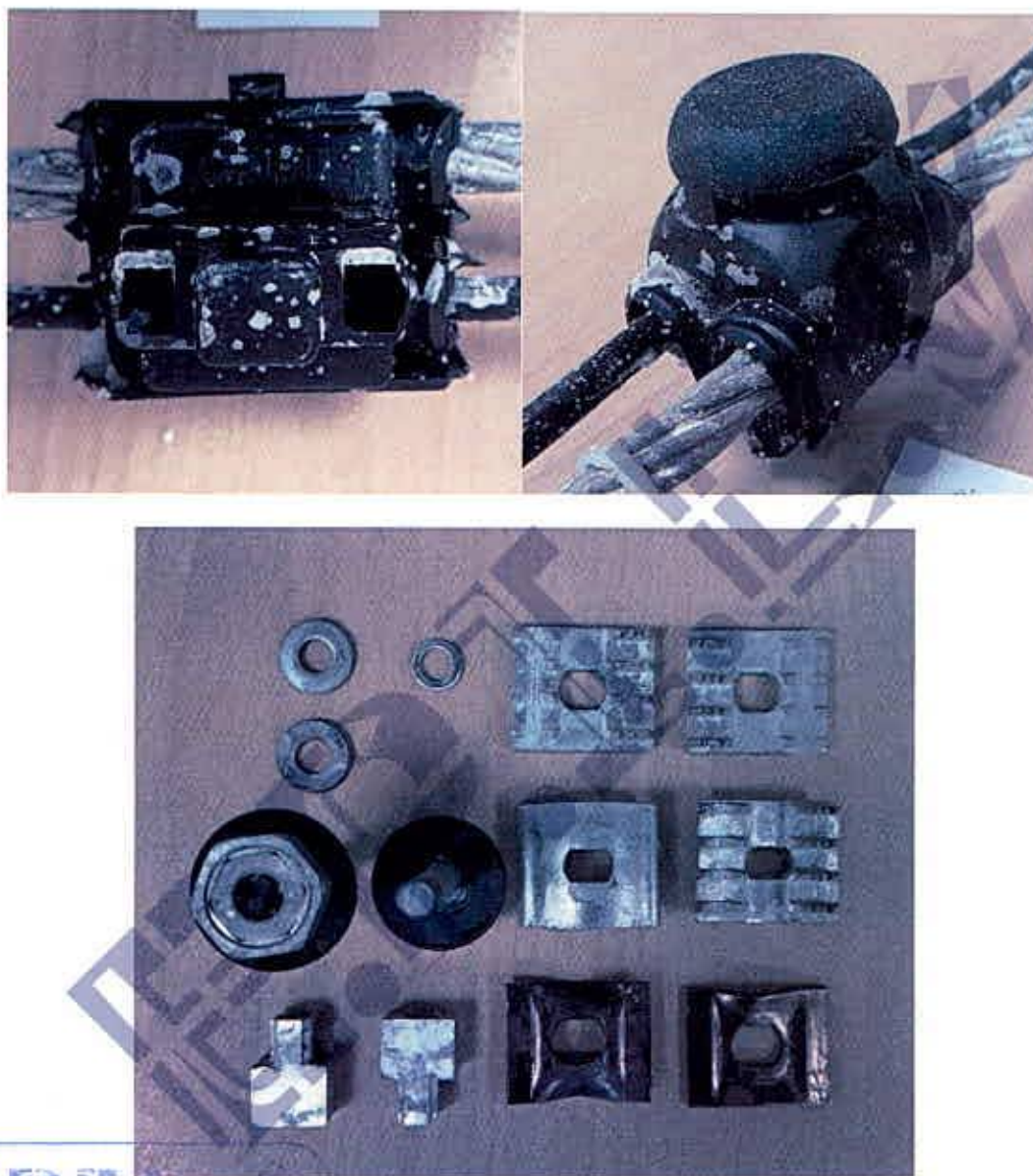


Figure 3: The IPC after corrosion ageing test