

TEST REPORT

Test object: ACSR conductor

Designation: CANNA ACSR 93.3mm² Aerial Earth Wire

Manufacturer: **Borsan Kablo Elk. Ayd. San. Ve Tic. A.S.**
Perpa Ticaret Merkezi A Blok Kat 11
No:1337-47 Sisli/Istanbul

Tested for: Borsan Kablo Elk. Ayd. San. Ve Tic. A.S.

Date of tests: 14th December 2015 – 25th January 2016

Project ID: NAL-25/2015

Order/Contract: NAL-25/2015, 27.11.2015

Test specification: **EN 50182:2001** **Clause 6.4.8 and Annex C**
EN 50189:2000 **Clause 11.4 and 11.5.1**
TS: C610-ATC-R6-RSP-CRG03-50025 **Clause 5.2.6 and 5.3.6 and 5.3.11**

Tests performed: The test object, constructed in accordance with the description, drawings and photographs incorporated in this report has been subjected the following tests:
Tests on the whole conductor:
- Traction test and compliance with accessories
- Verification of the breaking load of the conductor
Test on individual wires:
- Tensile strength test
- Elongation test

Test results: **On the basis of the test results, the conductor type CANNA ACSR 93.3mm² Aerial Earth Wire fulfilled the relevant requirements of the EN 50182:2001 and EN 50189:2000 standards and the Technical Specification: C610-ATC-R6-RSP-CRG03-50025.**

This Test Report has been issued by VEIKI-VNL Electric Large Laboratories Ltd. Testing Laboratory in accordance with above mentioned specification.

The Report applies only to the test object. The responsibility for conformity of any product having the same designations with that tested rests with the Manufacturer.

This Report comprises 13 sheets in total (11 numbered pages and 2 pages of data sheets).

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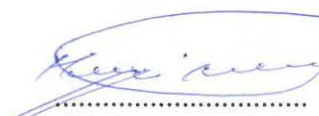
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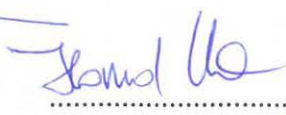
VEIKI-VNL Electric Large Laboratories Ltd. Testing Laboratory is accredited by NAT (Hungarian Accreditation Board) under registration number NAT-1-1251/2015.



Budapest,
02nd February, 2016


Gergely Gál
responsible for the test


Norbert Menyhért
supervised by


Dr. László Varga
managing director

TEST CERTIFICATES OR REPORTS ISSUED BY VEIKI-VNL ELECTRIC LARGE LABORATORIES LTD. TESTING LABORATORY

Type Test Certificate of Complete Type Test

This certificate provides the verification of all the rated characteristics of the equipment as assigned by the manufacturer, by means of the performance of all type tests specified by the standards.

Type Test Certificate of Dielectric Performance

This certificate provides the verification of all dielectric ratings, by means of the performance of the appropriate type tests specified by the standards.

Type Test Certificate of Temperature-Rise Performance

This certificate provides the verification of temperature-rise limits together with measurement of the main circuit resistance, by means of the performance of the appropriate type tests specified by the standards.

Type Test Certificate of Short-Circuit / Making and Breaking Performance

This certificate provides the verification of rated characteristics with respect short-circuit and/or making and breaking performance, by means of the performance of the appropriate type tests specified by the standards.

Type Test Certificate of Switching Performance

This certificate provides the verification of the switching ratings (e.g. capacitive current), by means of the performance of the appropriate type tests specified by the standards.

Prototype Test Report

Prototype tests are required to verify the suitability of the materials and method of manufacture for composite insulators defined by relevant ANSI standards.

Design Test Report

According to IEC standard: The design tests are intended to verify the suitability of the design, materials and method of manufacture (technology) of composite insulators.

According to ANSI standard: The design tests are intended to verify the insulators electrical and mechanical characteristics that depend on its size and shape.

Type Test Report

This report provides the verification of the rated characteristics of the equipment as assigned by the manufacturer, by means of the performance of the appropriate type tests specified by the standards, for type tests not indicated above.

Development Test Report

This report is issued when the test is intended only to provide the Client with information about the performance of the equipment. The tests are performed in accordance with relevant standards, but are not intended to verify compliance of the equipment.

Control Test Report

This report is issued for tests performed on equipment in service, or removed from service. Tests are performed, and compliance is evaluated in accordance with relevant standards.

Test Report

Test report is issued in all cases not listed above.

Ratings/characteristics assigned by the manufacturer:

Test object: ACSR conductor
Designation: CANNA ACSR 93.3mm² Aerial Earth Wire
Manufacturer: Borsan Kablo Elk. Ayd. San. Ve Tic. A.S.

Structure:

Steel Core: (1+6) × Ø2.50 mm ST1A steel
AL Layer: 12 × Ø2.50 mm AL1 aluminium

Total cross-sectional area:

Conductor: 93.3 mm²
Steel Core: 34.4 mm²
AL Layer: 58.9 mm²

Nominal overall diameter: Ø12.5 mm
Rated Tensile Strength (RTS): 48.53 kN
Resistance at 20 °C: 0.490 Ω/km
Nominal mass of the conductor: 431 kg/km (without grease)

The tests were carried out in accordance with the following standards:

EN 50182:2001 Conductors for overhead lines -Round wire concentric lay stranded conductors
EN 50189:2000 Conductor for overhead lines Zinc coated steel wires
C610-ATC-R6-RSP- CRG03-50025 Technical Specification for Aerial Earth Wire

Requirements of manufacturer or purchaser:

Technical Specification for Aerial Earth Wire ACSR 93.3mm²
CRL Document Number: C610-ATC-R6-RSP-CRG03-50025

List of manufacturer's drawings for identification of the test object:

Data sheet of conductor
Data sheet of anchoring clamp

Present at the test in charge of manufacturer or purchaser:-

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TESTS PERFORMED ON THE TEST OBJECT

No.	Description	Relevant clauses of the standard
1	Traction test and compliance with accessories	EN 50182:2001 Clause 6.4.8 and Annex C Technical Specification Clause 5.3.11
2	Verification of the breaking load of the conductor	EN 50182:2001 Clause 6.4.8 and Annex C Technical Specification Clause 5.2.6
3	Tensile strength test of individual steel wires Elongation test of individual steel wires	EN 50189:2000 Clause 11.4 Technical Specification Clause 5.3.6 EN 50189:2000 Clause 11.5.1 Technical Specification Clause 5.3.6

DESCRIPTION OF THE TESTS

1. Traction test and compliance with accessories

1.1. Test method and parameters

The traction test and compliance with accessories was carried out on the conductor according to Clause 6.4.8 and Annex C of EN 50182 standard and Clause 5.3.11 of the Technical Specification. The test was carried out on new conductor sample using an appropriate tensile testing machine. The test arrangement is shown on Photo 2. The conductor sample was prepared with anchoring clamps provided by the Client (See: Photo 3). The total length of the conductor between the clamps was 10.87 m. During the test the tensile force was increased gradually until it reached the breaking load. The breaking load shall reach 43.79 kN according to the technical specification and 46.10 kN (95% of conductor RTS) according to the relevant standard as a requirement of the Client.

1.2. Test Results

The tensile specimen broke at the load of 59.27 kN. This value is higher than the specified 43.79 kN, which is the acceptance criterion of the relevant technical specification and also higher than the specified 46.10 kN (95% of conductor RTS), which is the acceptance criterion of the relevant standard. Based on the test results; the conductor type CANNA ACSR 93.3mm² Aerial Earth Wire fulfilled the requirements of traction test.

The obtained Force-Elongation curve is shown in Figure 1. The conductor ends after breaking test are shown on Photos 4-5.

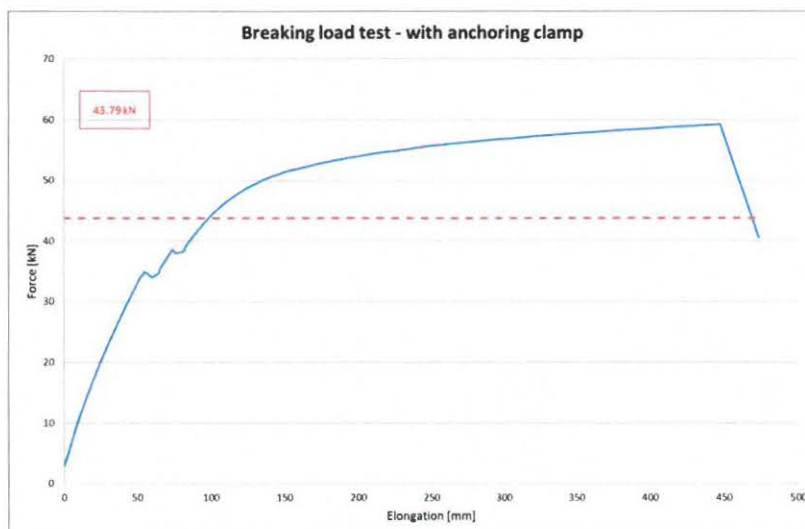


Figure 1
Force-Elongation curve of breaking load test with accessories

2. Verification of the breaking load of the conductor

2.1 Test method and parameters

The verification of the breaking load of the conductor was carried out according to Clause 6.4.8 and Annex C of the standard EN 50182 and Clause 5.2.6 of the Technical Specification. The test of sample was carried out on new conductor sample using an appropriate tensile test machine. The test arrangement is shown on Photo 6. The conductor sample was prepared with cold hardening epoxy resin type conical end fittings (See: Photo 7). The total length of the conductor between the end fittings was 13.36 m. The conductor was stressed for one hour at a load of 30kN (62% of RTS). Then the force was increased progressively until break of the conductor sample. The breaking load shall reach 46.10kN which was 95% of the rated tensile strength according to the specification.

2.2 Test results

The conductor was loaded gradually until reached the specified value of 30 kN which was 62% of the assigned breaking load and kept constant for one hour. Then the force was increased progressively until break of the conductor sample occurred. The tensile specimen broke at the load of 52.79 kN. This value is higher than the specified 46.10 kN, which is the acceptance criterion of the relevant standard. Based on the results; the conductor type CANNA ACSR 93.3mm² Aerial Earth Wire fulfilled the requirements of breaking load test.

The obtained Force-Elongation curve is shown in Figure 2. The conductor ends after breaking test are shown on Photo 8.

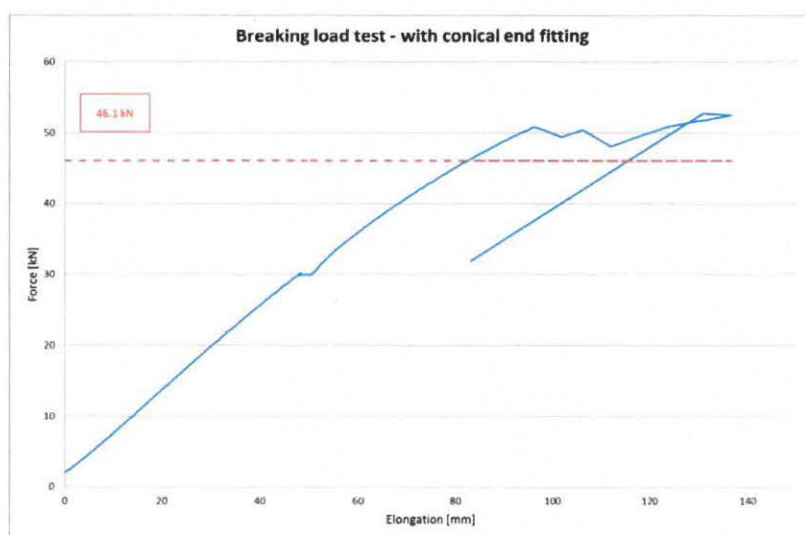


Figure 2

Force-Elongation curve of breaking load test with special conical end fitting

3. Tests on individual wires: Tensile and elongation test for steel wires

3.1 Test method and parameters

The tensile and the elongation tests were carried out on zinc coated steel wires according to Clause 11.4 and 11.5.1 of the standard EN 50189 and Clause 5.3.6 of the Technical Specification. The steel wire samples were taken from strand and straightened for the tests.

The wires were held in the tensile test machine and the force was increased until break of wires occurred (See: Photo 9). The force was recorded with the data logger of the tensile test machine. Elongation was determined by measurement of distance between markings on samples with broken ends fitted. Markings were originally 250 mm apart.

3.2. Test results

Table 1: Dimensional checking, tensile break test and elongation measurement on wires

Wire	Diameter [mm] ±0.04mm	Cross- section [mm ²]	Tensile Force [N]	Tensile stress [N/mm ²]	Elongation manual [mm]	Elongation manual [%]
Outer 1	2.49	4.869	8436	1732.4	10	4.0
Outer 2	2.48	4.830	8299	1718.1	9.5	3.8
Outer 3	2.48	4.830	8453	1750.0	11	4.4
Outer 4	2.49	4.869	8339	1712.6	12	4.8
Outer 5	2.50	4.909	8289	1688.7	13	5.2
Outer 6	2.49	4.869	8427	1730.7	12	4.8
Core	2.51	4.948	8332	1683.9	11	4.4
Minimum:	-	-	-	1683.9	-	3.8

The tensile stress was higher on all samples than the specified 1350 N/mm². Elongation at break was higher than the specified 3.0%. Based on the test results the zinc coated steel wires of the conductor fulfilled the requirements of the tensile and elongation tests.

Uncertainty of measurements

Force measurement: ±1 %

Length (<120 mm): ±0.02 mm

Length (>120 mm): ±1 mm

Diameter: ±0.01 mm

The uncertainty values given in this report are the standard deviation values multiplied by k=2. Measurement uncertainty was estimated according to the method described in the EA-4/02 document.

Measuring devices used for the tests:

Designation	Manufacturer	Type	S/N:
Tensile test machine (300 kN)	BARABÁS Mérnökiroda Kft.	KSZ	001/2011
Tensile test machine (50 kN)	Métisz-Q Kft.	ZD10-90	263/1111/DSZ
Measuring tape	Modeco	5 m	---
Digital caliper	Mitutoyo	CD-15CPX	12394972
Laser odometer	Bosch	DLE 70	417373104

PHOTOS



Photo 1
Cross-sectional view of the tested conductor



Photo 2
Test arrangement of the tensile break test with accessories

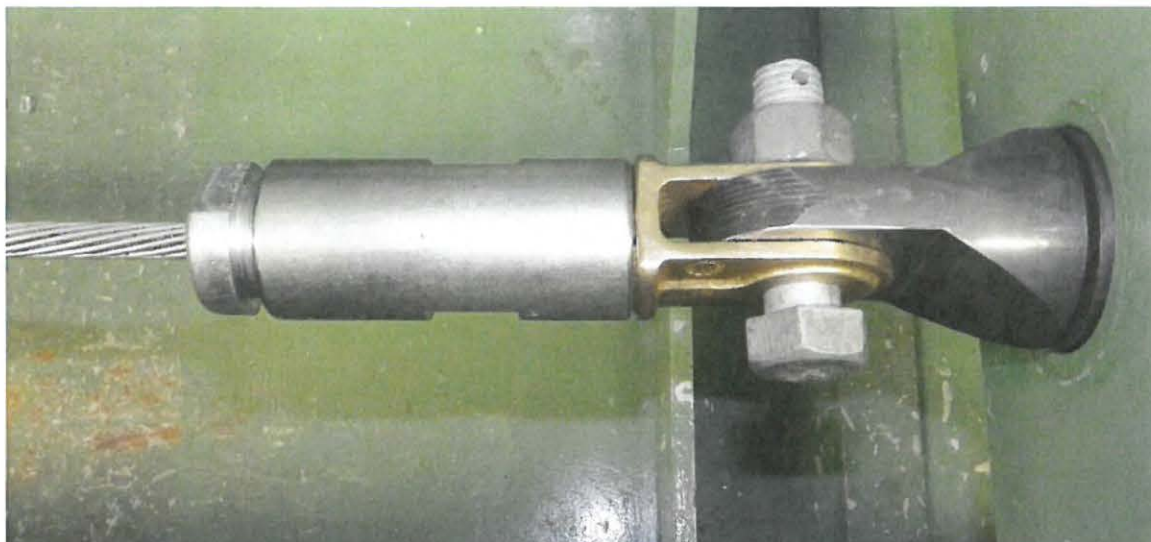


Photo 3
Anchoring clamp used for the tensile break test

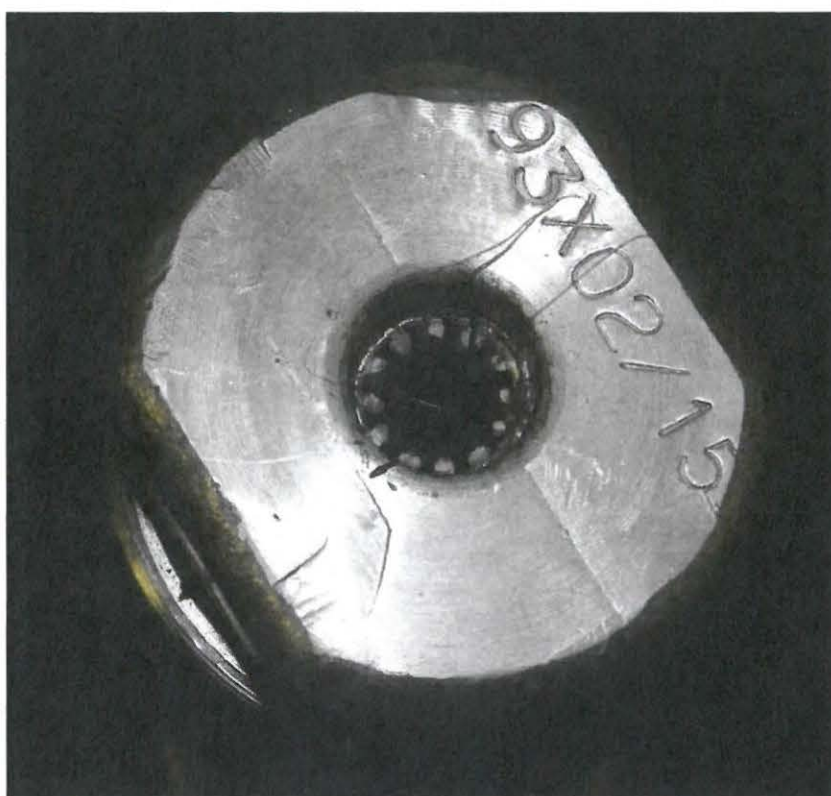


Photo 4
Broken conductor inside the accessory after tensile break test



Photo 5
Broken conductor after tensile break test (anchoring clamps used)



Photo 6
Test arrangement of the tensile break test with conical end fittings

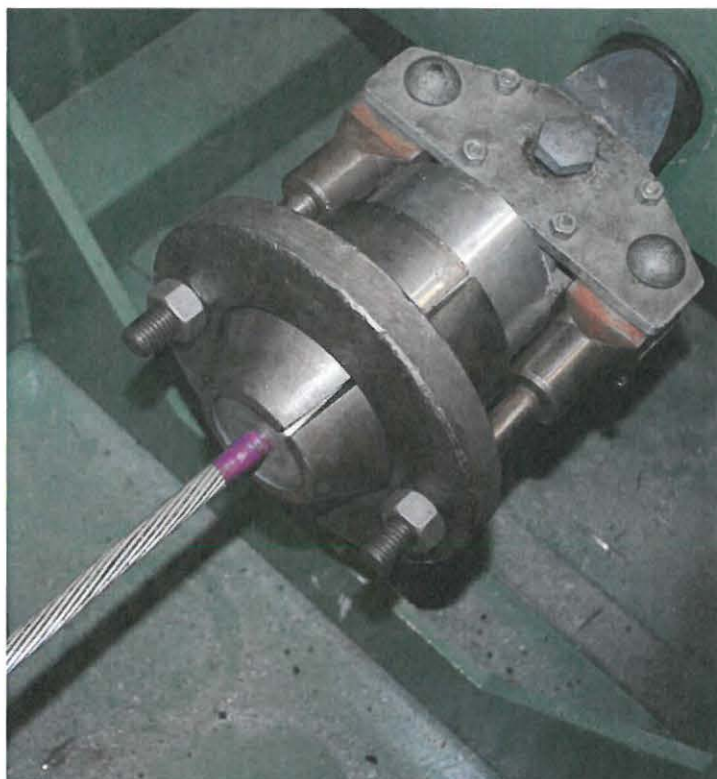


Photo 7
Conical end fitting used for the tensile break test

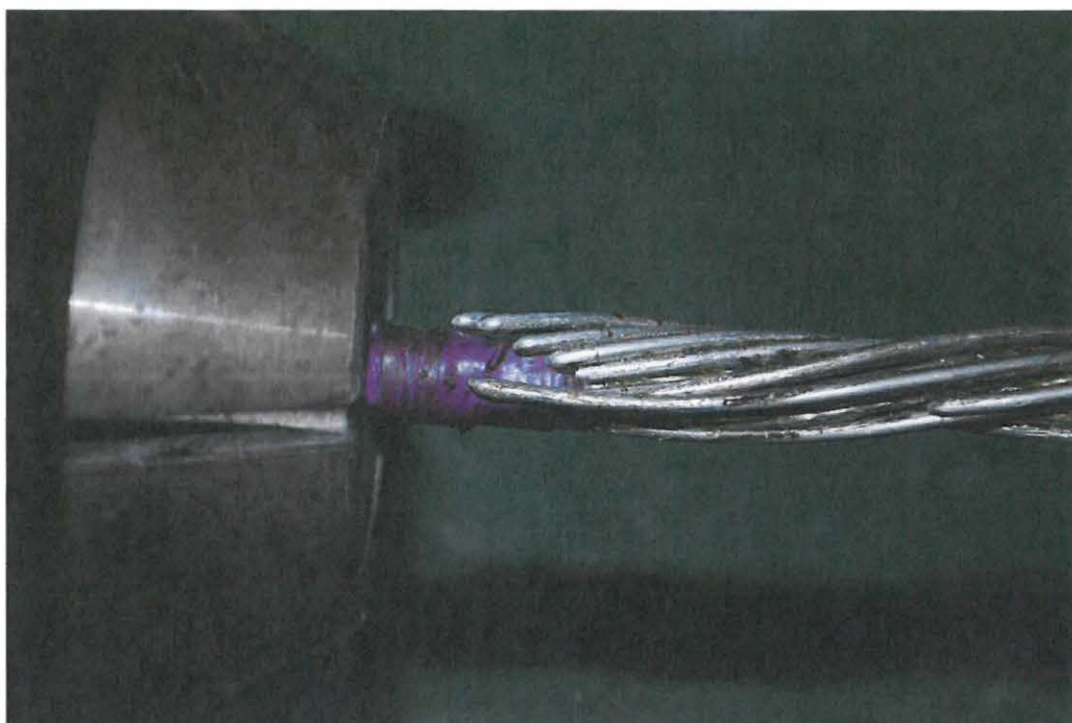


Photo 8
Broken conductor after tensile break test

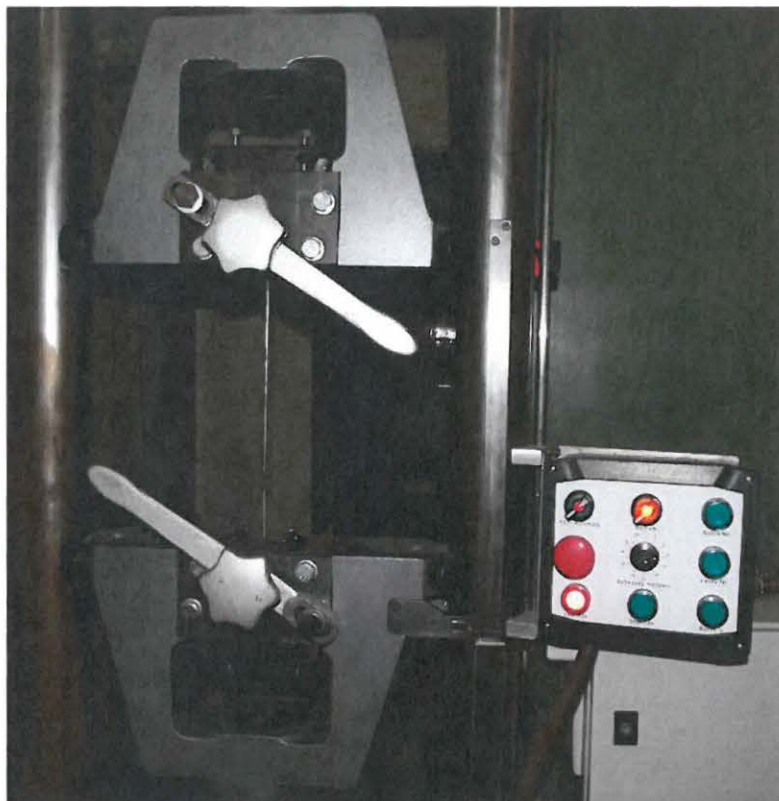


Photo 9
Test arrangement of tensile break test of individual steel wires



KABLO ELEKTRİK AYDINLATMA İNŞAAT SAN. ve TİC. A.Ş.

TYPE CANNA 93.3 mm² ACSR AERIAL EARTH WIRE
MANUFACTURER BORSAN KABLO ELEKTRİK AYDINLATMA İNŞAAT SANAYİ VE TİCARET A.Ş.
ADDRESS ORGANİZE SANAYİ SİTESİ ORGANİZE SANAYİ BULVARI NO:34 TEKKEKÖY / SAMSUN / TURKEY
CONSTRUCTION 7X2.50 STEEL + 12X2.50 AL , GREASED
OUTER DIAMETER 12.50 MM
INDIVIDUAL WIRE TYPES 2,50 MM STEEL WIRE + 2,50 MM AL WIRE

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BORSAN KABLO
ELEKTRİK AYDINLATMA İNŞAAT SAN. ve TİC. A.Ş.
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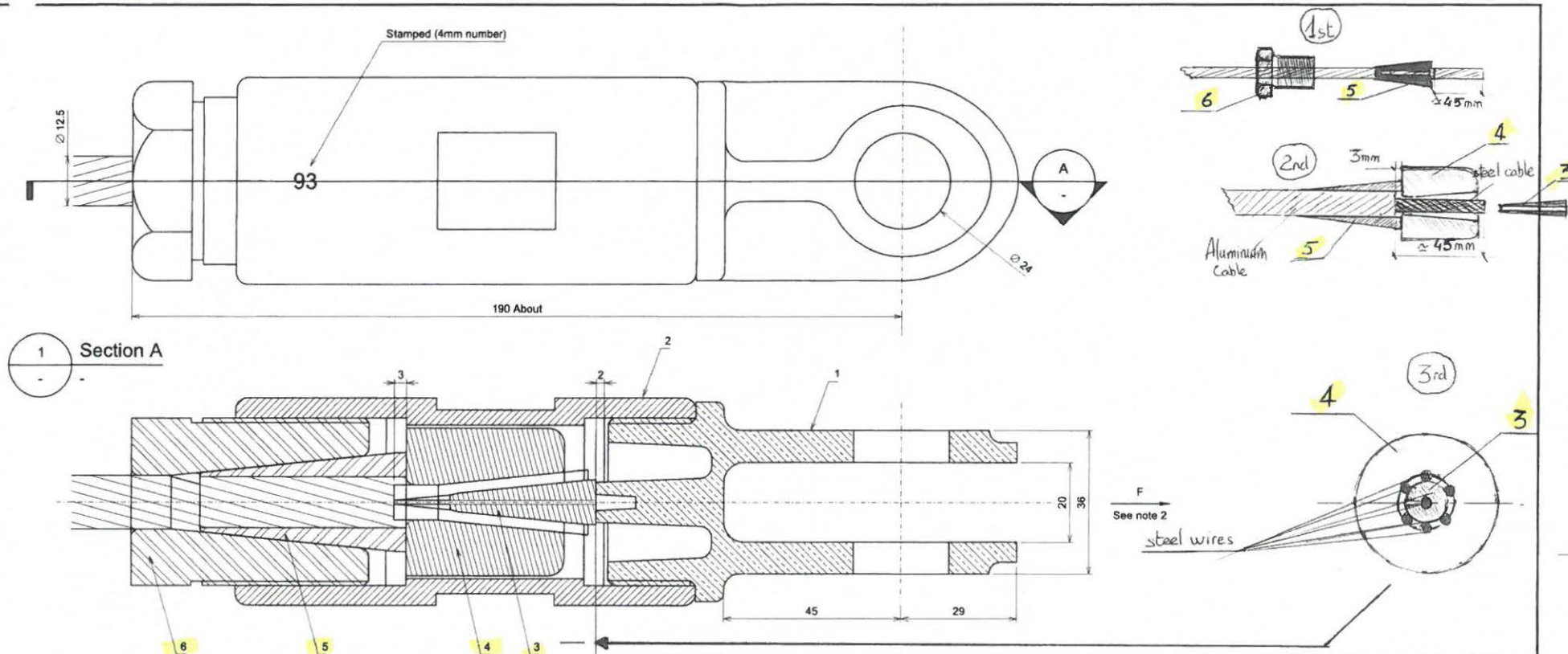


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Notes:

1/ The part of the cable attached to the clamp, as well as all parts of wedges, sockets and sleeve body will be carefully cleaned under grease using a file steel brush.

The parts are then assembled and tightened, after having filled the sleeve body with neutral, non-graphited, grease.

2/ Breaking load: $F \geq 4610 \text{ daN}$

3/ Logo supplier year and month of production (number in relief).

4/ Mass = 1.65 kg

6	Socket right hand threaded in aluminium	Aluminium alloy EN AW Al 99.5	For cast aluminium parts C610-ATC-R6-RSP-CRG03-50016	1
5	Wedge in aluminium for ACSR cable	Aluminium alloy EN AW Al 99.5	For cast aluminium parts C610-ATC-R6-RSP-CRG03-50016	1
4	Cupped element for ACSR cable	galvanized steel S235JR	For hot dip galvanizing C610-ATC-R6-RSP-CRG03-50009	1
3	Wedge in galvanized steel	Galvanized steel S235JR	For hot dip galvanizing C610-ATC-R6-RSP-CRG03-50009	1
2	Termination clamp body	Galvanized steel S235JR	For hot dip galvanizing C610-ATC-R6-RSP-CRG03-50009	1
1	Clevis body	Copper alloy CuAl10Fe2-C-GM	For copper aluminium casting C610-ATC-R6-RSP-CRG03-50007	1
	Assembly including			
Item	Description	Material	Technical specification	Qty

Notes:

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All dimensions in millimetres unless otherwise stated.



Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ
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www.crossrail.co.uk

Contract: Systemwide Main Works

Originator: Alstom TSO Costain Joint Venture

Location: Central Sections General

Title: Anchoring clamp for aerial earth wire
ACSR 93.3mm² - Sub assembly

By: S.MOUSSA

Chk: S.MOUSSA

App: G.DUVAL

Auth: —

Scale: 1:1 @ A3

Org No: C610-ATC-R6-DDD-CRG03-50502

Rev: P01 Sult: S4