TYPE TEST REPORT

Test object:	Aluminium Conductor Steel Rainforced (ACSR Cardinal)
Designation:	ACSR Cardinal
Manufacturer:	EMTA KABLO SANAYI ve TICARET A.S. Istasyon Mah. Ibisaga Cad. No: 4 Tuzla Istanbul TÜRKIYE
Tested for:	EMTA KABLO SANAYI ve TICARET A.S.
Date of tests:	18th March 2021 – 19th March 2021
Project ID:	NAL-10/2021
Order/Contract:	PO: KYS-FRM95 Rev.00, 08.02.2021
Test specification:	EN 50182:2001 Conductors for overhead lines round wire concentric lay stranded conductors
Tests performed:	- Stringing test - Welding of aluminium wires test
Test results:	**The test object fulfilled the relevant requirements of the standard.**

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

This document 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 document comprises 11 pages in total (10 numbered pages,1 page of conductor datasheet).

Budapest,
22nd March 2021

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NAH-1-1251/2019
TESTING LABORATORY

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

1 STL Type Test Certificates of ... Performance

VEIKI-VNL as a STL Member organization with its own testing laboratories (Member Laboratories) is entitled to issue *STL Type Test Certificate of...Performance* if the product to be tested is inside the STL scope, all STL rules are fulfilled and the proven tests fully comply with the applicable IEC Standard and the corresponding STL Guide.

About STL

*The **Short-Circuit Testing Liaison (STL)** provides a forum for voluntary international collaboration between testing organisations. The basic aim is the harmonised application of IEC and Regional/National Standards for type testing of electrical high-voltage power equipment, and unified evaluation then presentation (reporting) of the test results.*

Certificates

STL as a collaboration does not itself issue Certificates. Each STL Member issuing a STL Type Test Certificate is responsible for the validity and contents of that Certificate. A STL Type Test Certificate is issued by STL Members based on tests performed by a STL Member Laboratory within their accredited scope to ISO/IEC 17025.
A detailed description of Certificate documents is available at www.stl-liaison.org.

STL Guides

All STL Members pledge that, when testing for certification to a Standard in respect of which an STL Guide has been issued, they will test only in accordance with the agreed interpretation of the Standard as given in the STL Guide. In addition, the STL Members have agreed to present STL Type Test Certificates in the form given in the STL General Guide. For further information contact us or visit the STL website at www.stl-liaison.org.

2 Type Test Report / Certificate

Type Test 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 standard. This report/certificate can be issued if the test object is completely prepared for testing, test circumstances and results fully comply with one or more (type) tests or test series defined by the applicable standard and all drawings serving the identification of the sample was submitted prior testing and approved by the laboratory. In case of special request Type Test Certificate can be issued which is equal in status, meaning and content requirement of the Type Test Report.

3 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.

4 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.

5 Test Report

Test report is issued in all cases not listed above, e.g.:

- Test(s) were carried out according to instructions of the Client or Technical Specification.
- The test sample, test circumstances, required test parameters and evaluation method of the results do not or partially comply with the prescriptions of the standard.
- The submitted technical documents and drawings are not suitable for the clear identification of the tested object.
- Tests and test series were carried out according to the standard, but the test object failed.

⚠ *Important notice*

Reports and Certificates are issued usually in minimum two original copies. These sealed and bound copies are the original reports. Electronic reports in pdf format may be available and shall be considered as 'for information only'. In case of doubt with respect to the authenticity of the electronic version, please ask for the original sealed and bound version or send the entire electronic report to us for checking its authenticity. Please send this request to our e-mail address: VEIKI-info@dekra.com

Ratings/characteristics assigned by the manufacturer:

Test object:	Aluminium Conductor Steel Rainforced	
Designation:	ACSR CARDINAL	
Manufacturer:	EMTA KABLO SANAYI ve TICARET A.S.	
Structure:		
Core:	1 × Ø 3.38 mm	Steel wire
Layer 1:	6 × Ø 3.38 mm	Steel wire
Layer 2:	12 × Ø 3.38 mm	Aluminium wire
Layer 3:	18 × Ø 3.38 mm	Aluminium wire
Layer 4	24 × Ø 3.38 mm	Aluminium wire
Cross sectional area:	547.3 mm^2	
Nominal diameter:	30.42 mm	
Rated Tensile Strength (RTS):	149.7 kN	
Modulus of elasticity	61.6 GPa	
Nominal conductor mass without grease:	1834 kg/km	
DC resistance at 20 °C:	0.0596 Ω/km	

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

EN 50182:2001	Conductors for overhead lines - Round wire concentric lay stranded conductors

Requirements of manufacturer or purchaser:

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List of manufacturer's drawings for identification of the test object:
Conductor Data Sheet and test specification ACSR CARDINAL (1 page)

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	Stringing test	EN 50182: 2001 Clause 6.4.9, Annex E
2	Welding of aluminium wires	EN 50182: 2001 Clause 6.5.3

DESCRIPTION OF THE TEST

1. Stringing test

1.1. Test method and parameters

Stringing test was carried out according to EN 50182:2001 Clause 6.4.9 and Annex E as shown in Figure 1. The drum was installed on a drum holder which was regulated by an automatic controlled tensioner. The drum was placed 15 m apart from the tensioner. The drum number and the details of the drum is shown on Photo 1. The force of the pulling was measured with a load cell placed at the grip. The pilot cable and the tested conductor was connected together with a swivel. The tension was maintained at 29.94 kN (20% RTS). The test arrangement is shown in Figure 1 and Photos 3-6.

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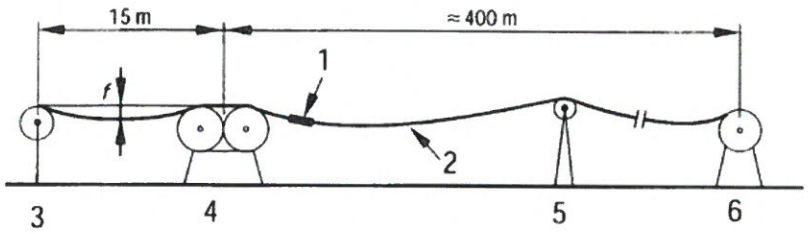

1 Woven grip
2 Pilot cable
3 Drum holder
4 Tensioner
5 Block
6 Pulling winch

Figure 1
Stringing test arrangement

1.2. Test results

During and after the test, deformation or looseness on the outer layer did not occurred on the conductor; therefore the conductor met the requirement of the standard for stringing test.
Surface condition of the conductor and position of the individual wires in the outer layer after the test are shown in Photo 7.

2.Welding of aluminium wires

2.1. Test method and parameters

The manufacturer shall demonstrate to the purchaser that the method used for jointing aluminium wires meets the strength requirements of the relevant standard. The straightened wire shall be installed in a suitable tensile testing machine. The load shall be applied gradually with a rate of separation of the jaws not less than 25 mm/min and not greater than 100 mm/min. The rate of separation of the jaws was 60 mm/min during the test.

The type of the joints were cold presser welded joints.

2.2. Test results

Table 1: Breaking strength values of the welded aluminium wires

Wire	Diameter [mm]	Cross. A [mm^2]	Tensile force [kN]	Tensile stress [N/mm^2]
Welded wire 1	3.398	9.063	1.4872	164.1
Welded wire 2	3.396	9.052	1.4955	165.2
Welded wire 3	3.399	9.069	1.4803	163.2
Welded wire 4	3.401	9.079	1.5436	170.0
Welded wire 5	3.408	9.116	1.5142	166.1
Welded wire 6	3.400	9.076	1.5588	171.8
Welded wire 7	3.407	9.112	1.5709	172.4
Welded wire 8	3.406	9.104	1.5248	167.5
Welded wire 9	3.400	9.072	1.5298	168.6
Welded wire 10	3.394	9.041	1.5478	171.2

The measured tensile stress values are greater than the specified value of 130 N/mm^2 therefore the welded aluminium wires met the requirements of the standard.

Uncertainty of measurements

Tensile force measurement: ± 1 %

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:
Load cell	A.S.T. GmbH	AGK-1031/2018	1605453
Instrument	A.S.T. GmbH	AE 703	2016502840
Digital micrometer	Mitutoyo	MDC-25SX	63115246
Tensile test machine (50 kN) Extensometer	Métisz-Q Kft. VEIKI-VNL Ltd.	ZD10-90 LVDT	263/1111/DSZ 2/2014

PHOTOS

Photo 1
Drum placed into the drum holder

Photo 2
Label and markings on the surface of the Drum

Photo 3
Stringing test arrangement

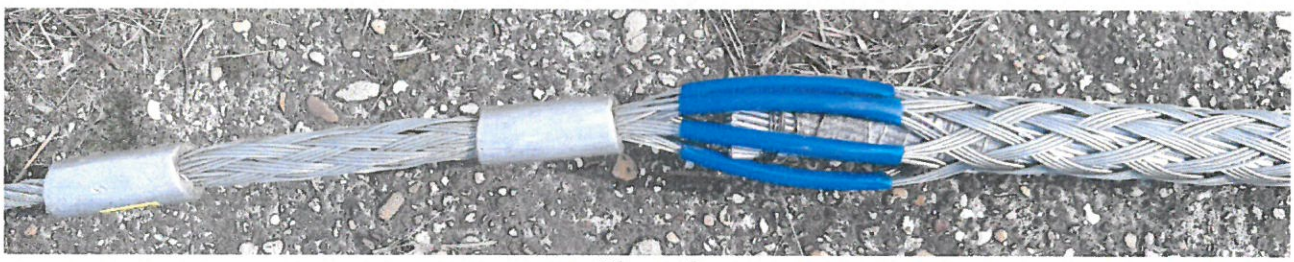

Photo 4
Pulling swivel, "Socks" and "Bug" used for stringing test

Photo 5
Load cell placed into the test circuit and the measured load during the test

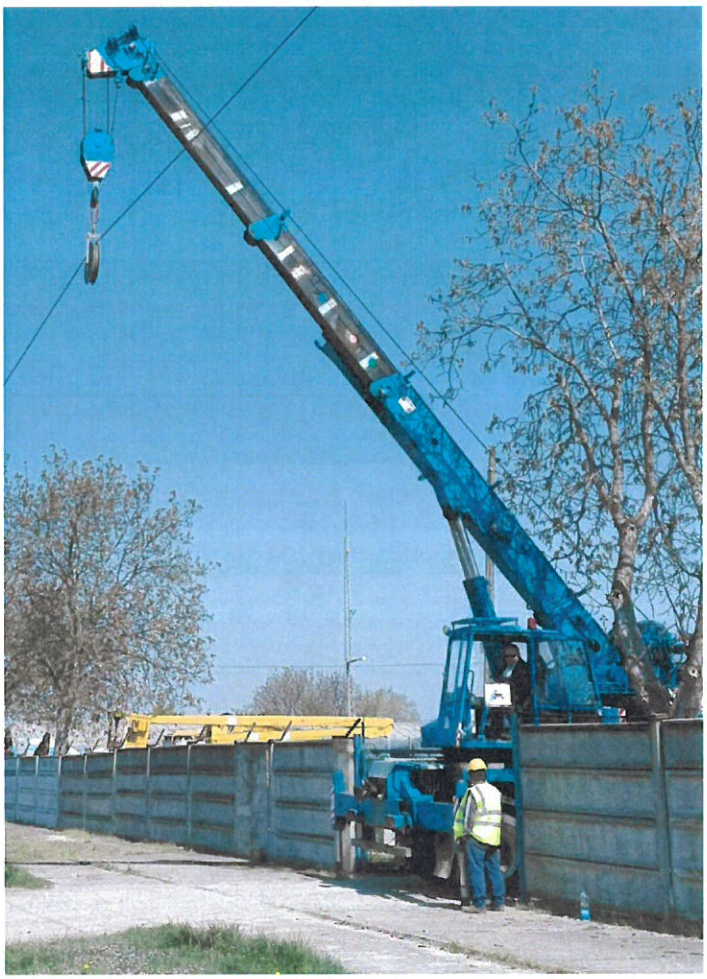

Photo 6
The block device used for the stringing test

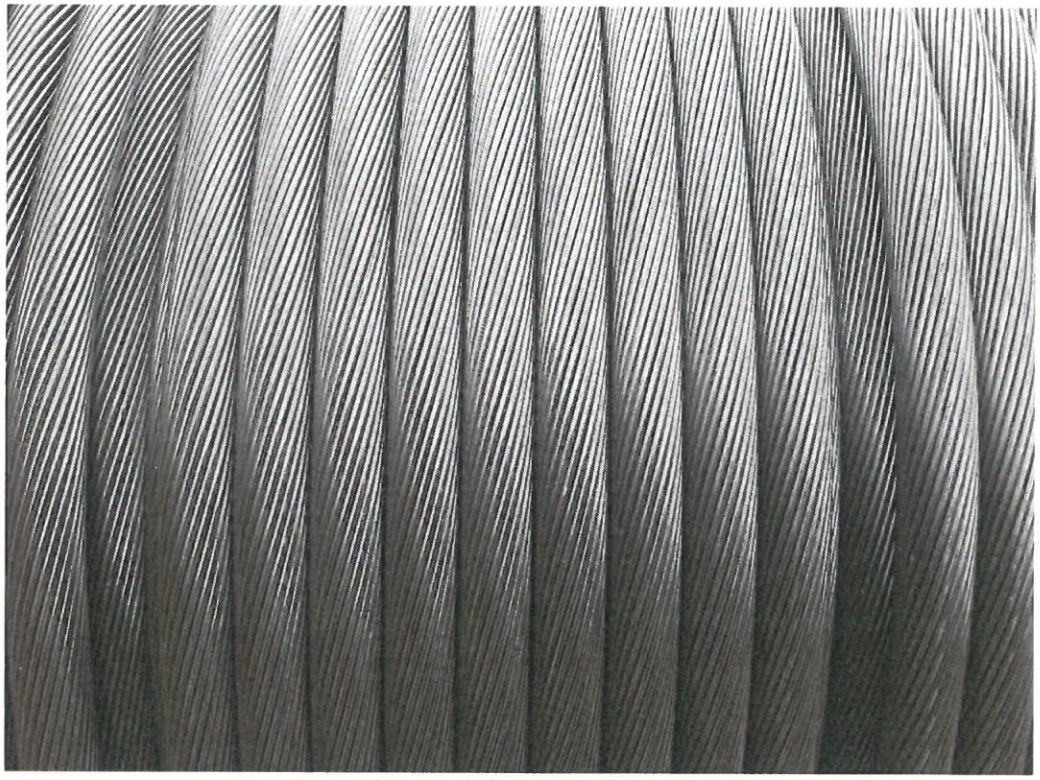

Photo 7
The condition of the conductor surface after the stringing test

Photo 8
Broken welded aluminium wire after the test

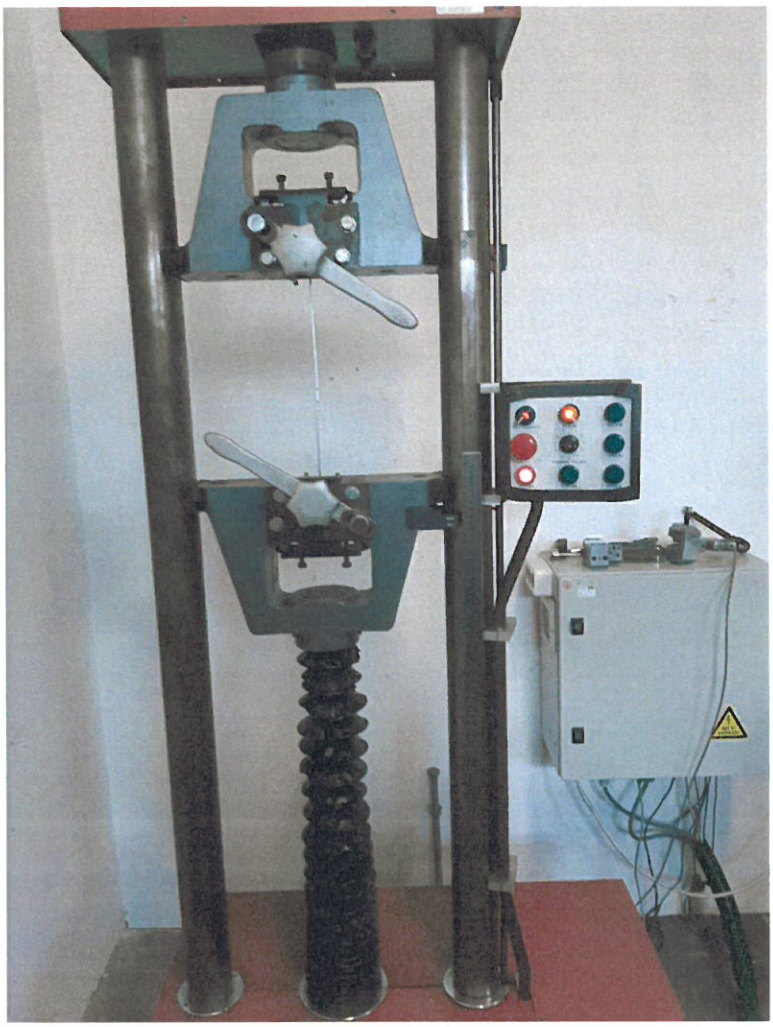

Photo 9
Test arrangement of the tensile test on welded aluminium wires

EMTA
CONDUCTOR & CABLE

CODE NAME			CARDINAL					
STANDARD			ASTM B 232/B 232M – 01					
Aluminium Conductor Steel Reinforced	Size/ Nominal sectional area	AWG / MCM	954					
	Aluminum strand	Number	54		Diameter	3,38	mm	
	Steel strand(for ACSR only)		7			3,38		
	Calculated area	Alum.	484,5	mm²	Total	547,3	mm²	
		Steel	62,8					
	Minumum breaking strength	kN	149,7					
	Outside diameter	mm	30,42					
	Standard weight	Alum.	1.343	kg/km	Total	1.834	kg/km	
		Steel	491	kg/km				
	Calculated resistance 20°C	D.C.	0,0596			Ohm/km		
	Modulus of elasticity	Final	70.000			N/mm²		
	Coefficient of linear expansion	Per °C	19.3 * 10⁻⁶					
	Lay ratio and Direction of lay		Outer		Second		Third	
		Alum.	10 - 13	Right	10 - 16	Left	10 - 17	Right
		Steel	18 - 30	Right				
	Length of each reel	m (+/- %2)	2.000					
	Reel type	mm*mm*mm	1950 * 900 * 950 (1110)					
	Net weight per drum (without grease)	kg	3.668					
	Gross weight per drum	kg	4.118					
	Grease weight Acc. To BS EN 50182_2001*	kg/km (+/-%20)						
	Grease type							
ALUMINUM WIRE	Diameter	mm	3,38					
	Ultimate tensile strength	N/mm²	160					
	Conductivity at 20°C	% IACS	61					
STEEL CORE WIRE	Diameter	mm	3,38					
	Ultimate tensile strength	N/mm²	1.410					
	Stress at 1% extension	N/mm²	1.240					
	Elongation in 250 mm	%	4,0					
	Galvanizing weight of coating	g/m²	260					
	Torsion	turns	14					

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