TYPE TEST REPORT

Test object:	ACSS/MA5 350/45 mm^2 conductor	
Designation:	ACSS overhead conductor	
Manufacturer:	**Egytech Cables - Elsewedy** 10th of Ramdan City Indistrial Zone A3 Cairo **EGYPT**	
Tested for:	**Egytech Cables - Elsewedy**	
Date of tests:	31st July 2019 – 01st August 2019	
Project ID:	NAL-24/2019	
Order/Contract:	P.O No 1 / 2019	
Test specifications:	**EN 50182:2001**	**Conductors for overhead lines - Round wire concentric lay stranded conductors**
	EN 50189:2000	**Conductors for overhead lines - Zinc coated steel wires**
	EN 50326:2003	**Conductors for overhead lines - Characteristic of greases**
	EN 50540:2010	**Conductors for overhead lines – Aluminium Conductors Steel Supported (ACSS)**
	EN 60889:1997	**Hard-drawn aluminium wire for overhead line conductors**
	IEC 61232:1993	**Aluminium-clad steel wires for electrical purposes**

Tests performed: The test object, constructed in accordance with the description, drawings and photographs incorporated in this report has been subjected to the following tests:

- Verification of construction
- DC resistance measurement
- Tests on annealed aluminium wires
- Tests on aluminium-mischmetal alloy-coated steel wires
- Tensile break test
- Drop point test (grease)

Test results: **The test object fulfilled the requirements of the standard.**

This Type 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 27 sheets in total (17 numbered pages, 8 pages of data sheet and 2 pages of test report).

Budapest, 24th November, 2019	Zoltán Takács responsible for the test	Norbert Menyhért supervised by	Balázs Varga head of laboratory

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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:	ACSS/MA5 350/45 mm^2 conductor	
Designation:	ACSS overhead conductor	
Manufacturer:	Elsewedy Cables - Egypt	
Structure:		
Core:	1 × Ø 2.87 mm	Aluminium-mischmetal alloy-coated steel wire
Layer 1:	6 × Ø 2.87 mm	Aluminium-mischmetal alloy-coated steel wires
Layer 2:	9 × Ø 4.31 mm	Annealed aluminium wires
Layer 3:	15 × Ø 4.31 mm	Annealed aluminium wires
Cross-sectional area:		
Aluminium-mischmetal alloy-coated steel wires:	45.3 mm^2	
Annealed aluminium wires:	350.2 mm^2	
Complete conductor:	395.5 mm^2	
Overall diameter:	25.85 mm	
Rated Tensile Strength (RTS):	106.2 kN	
Nominal conductor mass:	1334 kg/km	
Maximum DC resistance at 20°C	0.08 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
EN 50189:2000	Conductors for overhead lines – Zinc coated steel wires
EN 50326:2003	Conductors for overhead lines - Characteristic of greases
EN 50540:2010	Conductors for overhead lines – Aluminium Conductors Steel Supported (ACSS)
EN 60889:1997	Hard-drawn aluminium wire for overhead line conductors
IEC 61232:1993	Aluminium-clad steel wires for electrical purposes

Requirements of manufacturer or purchaser:

TTP specification: Unique No: CR-3571-17 Rev:03

ASTM B856, Standard Specification for Concentric-Lay-Stranded Aluminum Conductors, Coated Steel Supported (ACSS)
ASTM B609, Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes
ASTM B958, Standard Specification for Extra-High-Strength and Ultra-High-Strength Class A, Zinc–5% Aluminum-Mischmetal Alloy-Coated Steel Core Wire for Use in Overhead Electrical Conductors

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

Conductor data sheet ACSS/MA5 350/45 mm^2

Technical data of METALUBE OCG^{TM}6000

Present at the test in charge of manufacturer or purchaser:

Eng. Mona Aly Haggag	Egyptian Electricity Transmission Company (EECT)
Eng. Peter Karmy Botros	Egyptian Electricity Transmission Company (EECT)
Eng. Sameh Abdelrahman	Egytech Cables-Elsewedy
Eng. Mahmoud Ibrahim	Egytech Cables-Elsewedy

TESTS PERFORMED ON THE OVERHEAD LINE CONDUCTOR

No.	Description	Relevant clauses of the standard
1	Verification of construction	EN 50540 Clauses 6.4.1, 6.4.2, 6.4.4 - 6.4.7
2	Tests on-annealed aluminium wires	EN 50540 Clause 5.1.2 EN 60889 Clauses 6.5.1, 10.1, 11
3	Tests on Al-mischmetal alloy-coated steel wires	IEC 61232 Clauses 4.2, 4.4, 6.3.1 - 6.3.6 EN 50189 Clause 11.7
4	Tensile break test	EN 50182 Clause 6.4.8, Annex C
5	DC resistance measurement	EN 50540 Clause 6.4.8
6	Drop point test	EN 50326

DESCRIPTION OF THE TESTS

1. Verification of Construction

1.1. Test method and parameters

The following tests and measurements were performed according to the main parameters specified in the data sheet of the conductor. The tested conductor is shown on Photo 1.

- *Surface condition of conductor:* The conductor sample was checked visually. No crack, breakage, discoloration shall be observed on the surface and on individual wires in the outer layer. It shall free from all visible imperfections.
- *Conductor diameter:* A 6 m long sample was cut from the complete conductor and straightened to a frame with a force to keep it straight. The diameter of the complete conductor sample was measured by a digital calliper in two different direction of the same point. The average of the measured values was the measured diameter of the conductor.
- *Lay ratio and lay direction:* A 6 m long sample was cut from the complete conductor and straightened to a frame with a force to keep it straight. The direction was checked on the outer layer as right-handed or left-handed and recorded. The diameter was checked on the outer layer and the length of the lay is measured. The rate between the lay length and the diameter determine the lay ratio. The procedure was repeated in all layers after removing each layer until reach the core.
- *Number and types of wires:* During the determination of the lay ratio, the number and type of wires were checked in each layer. By this way, the construction of the conductor can be approved.
- *Aluminium area of cross-section:* The cross-sectional area of the aluminium layers was determined from the measured diameter values of the annealed aluminium wire samples (Photo 1).
- *Mass per unit length:* Mass per unit length of the conductor was measured on a sample cut out from the whole conductor. The length was 1m and adjusted to the upper limit of the high precision digital scale. The exact length of the sample was measured and recorded. The mass per unit length was calculated from the measured value, corrected by the ratio between 1000 mm and the measured length.

1.2. Test results

Specified and measured values are listed in Table 1.

Table 1: Conductor parameters

Parameter	Specified values	Measured values
Surface condition	The surface of the conductor shall be free from all visible imperfections.	Complies
Type / Designation of wires	Aluminium-mischmetal alloy-coated steel wires for the core; annealed aluminium wires	Complies
Number and diameter of Aluminium-mischmetal alloy-coated steel wires	(1+6) x 2.87 mm ± 0.051 mm (2.819 – 2.921 mm)	(1+6) x 2.876 – 2.898 mm
Number and diameter of annealed aluminium wires Layer 1	9 x 4.31 mm ±1% (4.267 – 4.353 mm)	9 x 4.303 – 4.339 mm
Number and diameter of annealed aluminium wires Layer 2	15 x 4.31 mm ±1% (4.267 – 4.353 mm)	15 x 4.313 – 4.337 mm
Overall diameter	25.85 mm ± 1% (25.59 – 26.11 mm)	25.73 mm
Cross-sectional area of annealed aluminium layers	350.2 mm^2 ± 2% (343.2 – 357.2 mm^2)	352.5 mm^2
Lay direction		
Steel layer (6)	Right (Z)	Right (Z)
AL layer (8)	Left (S)	Left (S)
AL layer (12)	Right (Z)	Right (Z)
Lay ratio		
Steel layer (6)	16-26	21.3
AL layer (9)	10-16	13.6
AL layer (15)	10-14	10.6
Rated tensile strength (RTS)	106.2 kN	108.3 kN
Mass of conductor (without grease)	1325 kg/km ± 2% (1298.5 – 1351.5 kg/km)	1328.5 kg/km
Mass of conductor (with grease)	1334 kg/km ± 2% (1307.3 – 1360.7 kg/km)	1341.5 kg/km
Maximum DC resistance at 20 °C	0.0800 Ω/km	0.0777 Ω/km

The measured values are in correspondence with the manufacturer's specification given in the data sheet of the conductor.

2. Tests of annealed aluminium wires

2.1 Test method and parameters

The following tests were performed annealed aluminium wire samples after stranding:

- *Appearance, surface finishing and diameter of wires:* The wires were checked visually. The wires shall be smooth and free from imperfections. Each individual wire was measured at three points, where two measurements were taken perpendicularly to each other.
- *Tensile stress:* The sample wire was held in a tensile testing machine and the force was increased until the break of wire occurred (Photo 2). The force was recorded with the data logger of the tensile testing machine. The tensile stress was calculated from the measured breaking load and diameter.
- *Elongation at break:* The elongation was determined by measurement of distance between the markings on samples with broken ends. The markings were originally 250 mm apart.
- *Resistivity measurement:* The resistance of a one-meter long sample wire was measured at room temperature and the value was calculated to 20 °C. The resistivity was calculated from resistance at 20 °C and the cross-sectional area (Photo 3).

2.2 Test results

The results of the measurements are listed in Tables 2-4.

Table 2-a: Appearance, surface condition and diameter of annealed aluminium wires after stranding

Layer / Wire	Appearance and surface condition of wire (Smooth and shall be free from imperfections)	Diameter 4.31 mm ± 1% (4.267 – 4.353 mm)	Cross-section [mm²]
Outer 1	Complies	4.334	14.749
Outer 2	Complies	4.313	14.611
Outer 3	Complies	4.330	14.723
Outer 4	Complies	4.316	14.628
Outer 5	Complies	4.326	14.699
Outer 6	Complies	4.330	14.726
Outer 7	Complies	4.337	14.775
Outer 8	Complies	4.327	14.707
Outer 9	Complies	4.333	14.747
Outer 10	Complies	4.330	14.726
Outer 11	Complies	4.321	14.661
Outer 12	Complies	4.314	14.614
Outer 13	Complies	4.332	14.737
Outer 14	Complies	4.324	14.683
Outer 15	Complies	4.319	14.651

Table 2-b: Appearance, surface condition and diameter of annealed aluminium wires after stranding

Layer / Wire	Appearance and surface condition of wire (Smooth and shall be free from imperfections)	Diameter 4.31 mm ± 1% (4.267 – 4.353 mm)	Cross-section [mm²]
Inner 1	Complies	4.329	14.716
Inner 2	Complies	4.330	14.726
Inner 3	Complies	4.323	14.677
Inner 4	Complies	4.320	14.660
Inner 5	Complies	4.331	14.729
Inner 6	Complies	4.303	14.545
Inner 7	Complies	4.313	14.610
Inner 8	Complies	4.314	14.613
Inner 9	Complies	4.339	14.787
Total cross-sectional area of annealed aluminium layers:			**352.5**

The surfaces of the wires were smooth, free from imperfections and the diameters of the wires were within tolerance. Therefore, the annealed aluminium wires met the requirements of the relevant standard.

Table 3: Tensile stress test results of annealed aluminium wires after stranding

Wire	Cross-section [mm²]	Tensile force [N]	Tensile stress [N/mm²]	Elongation at break	
				[mm]	[%]
Outer 1	14.716	966.1	65.6	84.0	33.6
Outer 2	14.726	977.0	66.3	75.0	30.0
Outer 3	14.677	959.6	65.4	79.0	31.6
Inner 1	14.749	981.5	66.5	87.0	34.8
Inner 2	14.611	988.3	67.6	70.0	28.0
Inner 3	14.723	981.3	66.7	72.0	28.8
Min.			**65.4**		**28.0**

The minimum tensile stress was within the specified tolerance range (60-95 N/mm$^{2)}$. The minimum elongation reached the specified 20%. Therefore, the annealed aluminium wires met the requirements of the relevant standard.

Table 4: Resistivity of annealed aluminium wires after stranding

Wire	Cross-section [mm²]	T [°C]	R [mΩ/m]	R_{20} [mΩ/m]	Resistivity [nΩ×m]
Outer 1	14.716	27.2	1.89947	1.84591	27.226
Outer 2	14.726	27.3	1.91361	1.85892	27.161
Outer 3	14.677	27.3	1.89194	1.83787	27.059
Inner 1	14.749	26.9	1.91292	1.86117	27.389
Inner 2	14.611	27.3	1.90517	1.85072	27.255
Inner 3	14.723	27.4	1.89314	1.83832	26.980
Max.					**27.389**

The resistivity of the annealed aluminium wires was lower than the specified 27.899 nΩ×m. Therefore, the annealed aluminium wires met the requirements of the relevant standard.

3. Tests on Aluminium-mischmetal alloy-coated steel wires

3.1. Test method and parameters

The tests were carried out on aluminium-mischmetal alloy-coated steel wires before stranding:

- *Appearance, surface finishing and diameter of wires:* The wires were checked visually. The wires shall be smooth and free from imperfection. The diameters of wires were measured at three points, where two measurements were taken perpendicularly to each other. The wire diameters were determined by the average of the measurements.
- *Tensile stress:* The wire was held in a tensile testing machine and the force was increased until the break of wire occurred. The force was recorded with the data logger of the tensile testing machine. The tensile stress was calculated from the measured breaking load and diameter.
- *Elongation at break:* The elongation was determined by measurement of distance between the markings on samples with broken ends. The markings were originally 250 mm apart.
- *Stress at 1% extension:* The steel wire was held in a tensile testing machine. An initial load equivalent to the initial stress of 162 N/mm2 was applied on test sample. An extensometer with a gauge length of 250 mm was applied on the test sample and the initial settings were made. The load was increased until the extensometer indicated an extension of 1% of the original gauge length. The values were recorded and the stress at 1% extension was calculated (Photo 4).
- *Wrapping test:* The steel wires were wrapped around a mandrel with a diameter equal to the wire diameter, eight times with a speed lower than 15 rev/min.
- *Adhesion of zinc coating:* The steel wires were wrapped in a close helix of 8 turns around a cylindrical mandrel with a diameter of four times of the wire diameter. The zinc coating shall remain firmly adhered to the steel and shall not crack or flake.
- *Mass of coating:* For the test a hydrochloric acid was used as a stripping solution with antimony chloride as an added inhibitor. The mass of the tested samples was measured before and after the stripping with an analytical scale. The difference between the two measurements gives the mass value of coating.
- *Resistivity measurement:* The resistance of a one-meter long sample was measured at room temperature and the value was calculated to 20 °C. The resistivity was calculated from resistance at 20 °C and the cross-sectional area.

3.2. Test results

The results of the measurements are listed in Tables 5-9.

Table 5: Appearance, surface condition, diameter and mass of coating of aluminium-mischmetal alloy-coated steel wires before stranding

Wire	Appearance, surface condition (shall be smooth and free from imperfections)	Diameter [mm] 2.87 mm ± 0.051 mm (2.819 – 2.921 mm)	Cross-section [mm²]	Mass of coating [g/m²]
Steel 1	Complies	2.876	6.498	297
Steel 2	Complies	2.896	6.586	292
Steel 3	Complies	2.898	6.594	297
Steel 4	Complies	2.887	6.545	307
Steel 5	Complies	2.884	6.533	306
Steel 6	Complies	2.877	6.502	295
Core wire	Complies	2.879	6.511	296

The surfaces of the wires were smooth, free from imperfections and the diameters of the wires were within tolerance. The mass of coating was higher than the specified 244g/m². Therefore, the aluminium-mischmetal alloy-coated steel wires met the requirements of the relevant specification.

Table 6: Tensile stress test results of aluminium-mischmetal alloy-coated steel wires before stranding

Wire	Cross-section [mm²]	Tensile force [N]	Tensile stress [N/mm²]	Elongation at break	
				[mm]	[%]
Steel 1	6.498	12901.3	1985.5	15.0	6.0
Core wire	6.511	12904.6	1981.8	15.0	6.0
Min.			**1981.8**		**6.0**

The minimum tensile stress was higher than the specified 1900 N/mm². The minimum elongation reached the specified 3.5%. Therefore, the aluminium-mischmetal alloy-coated steel wires met the requirements of the relevant specification.

Table 7: Test results of stress at 1% elongation of aluminium-mischmetal alloy-coated steel wires before stranding

Wire	Diameter [mm]	Cross-section [mm²]	Force at 1% elongation [N]	Stress at 1% elongation [N/mm²]
Core wire	2.879	6.511	10813.0	1660.6

The measured stress at 1% elongation was higher than the specified 1550 N/mm². Therefore, the aluminium-mischmetal alloy-coated steel wire met the requirements of the relevant specification.

Table 8: Resistivity of aluminium-mischmetal alloy-coated steel wires before stranding

Wire	Cross-section [mm²]	T [°C]	R [mΩ/m]	R_{20} [mΩ/m]	Resistivity [nΩ×m]
Steel 1	6.498	28.6	28.4522	27.59777	179.320
Core wire	6.511	28.6	28.4829	27.62755	179.888
Max.					**179.888**

The resistivity of aluminium-mischmetal alloy-coated steel wires was lower than the specified 191.57 nΩ×m. Therefore, the aluminium-mischmetal alloy-coated steel wires met the requirements of the relevant specification.

Table 9: Test results of adhesion of zinc coating, wrapping tests of aluminium-mischmetal alloy-coated steel wires before stranding

Wire	Adhesion of zinc coating (8 turns/4xD)	Wrapping test (8 turns/1xD)
Steel 1	Complies	Complies
Core wire	Complies	Complies

The zinc coating remained firmly adhered to the steel and there was no crack or flake on the surface of the tested wires. No wire broke during the wrapping test. Therefore, the aluminium-mischmetal alloy-coated steel wires met the requirements of the relevant specification.

4. Tensile break test

4.1. Test method and parameters

The verification of tensile break test was carried out on overhead line conductor type ACSS 350/45 mm^2 in accordance with standard EN 50182. The tensile break test was performed on one conductor specimen.

4.2. Test results

The test results were the following:

- Sample 1: the tensile specimen broke at the load of 108.3 kN.

The test arrangement of the tensile break test is shown on Photo 5.

The tensile load was higher than 100.9 kN (95 % of the 106.2 kN RTS), which is the acceptance criterion of the standard. Based on the test results; the overhead line conductor type ACSS 350/45 mm^2 fulfilled the requirements of tensile break test.

The obtained force-elongation curve is shown in Diagram 1. The fractured wires are shown on Photo 6.

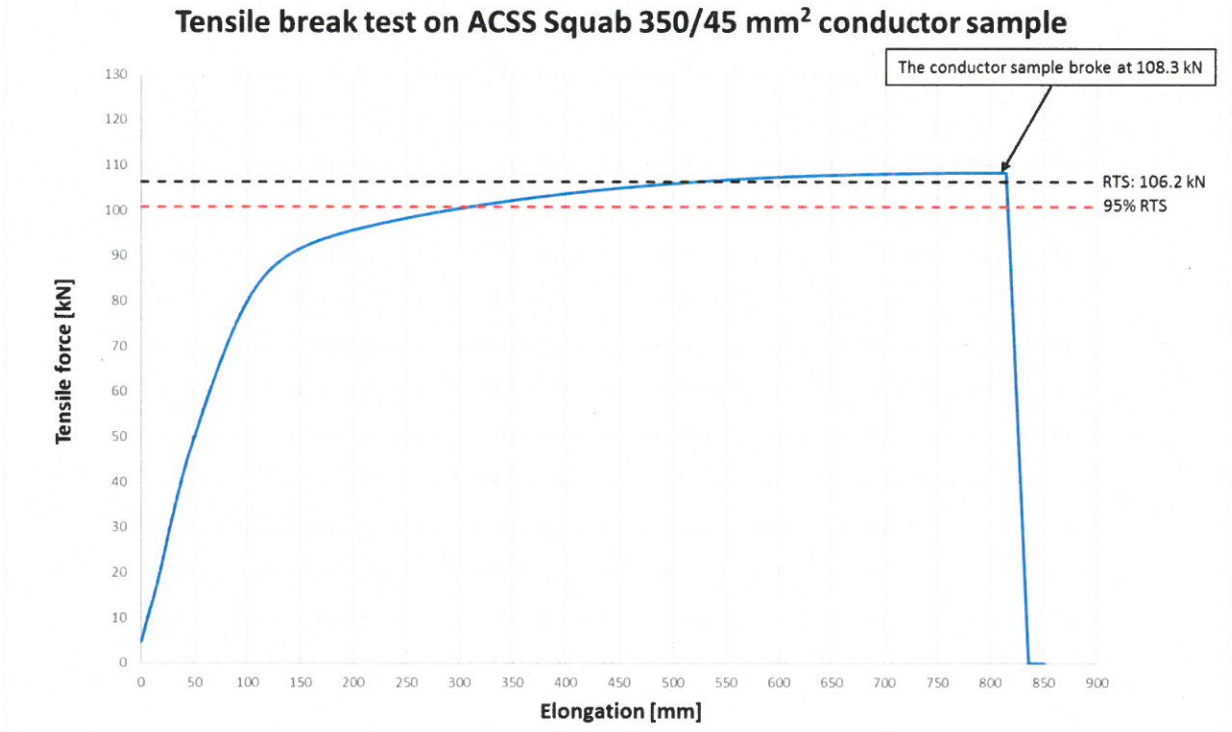

Diagram 1
Force-elongation curve of the tensile break test

5. DC resistance measurement

5.1. Test method and parameters

The DC resistance measurement was carried out on overhead line conductor type ACSS 350/45 mm^2 according to the test procedure agreed with Client.

The conductor was placed in a 6 m long test span. The conductor was fixed by electrically and thermally isolated fittings. The average conductor temperature was measured by three thermocouples installed on the outer layer of the conductor. All resistance measurements were made by using 4-wire digital micro-ohm meter with an internal 200 A DC current supply. The voltage drop was measured in a 3m long conductor section. The test arrangement is shown in Figure 1

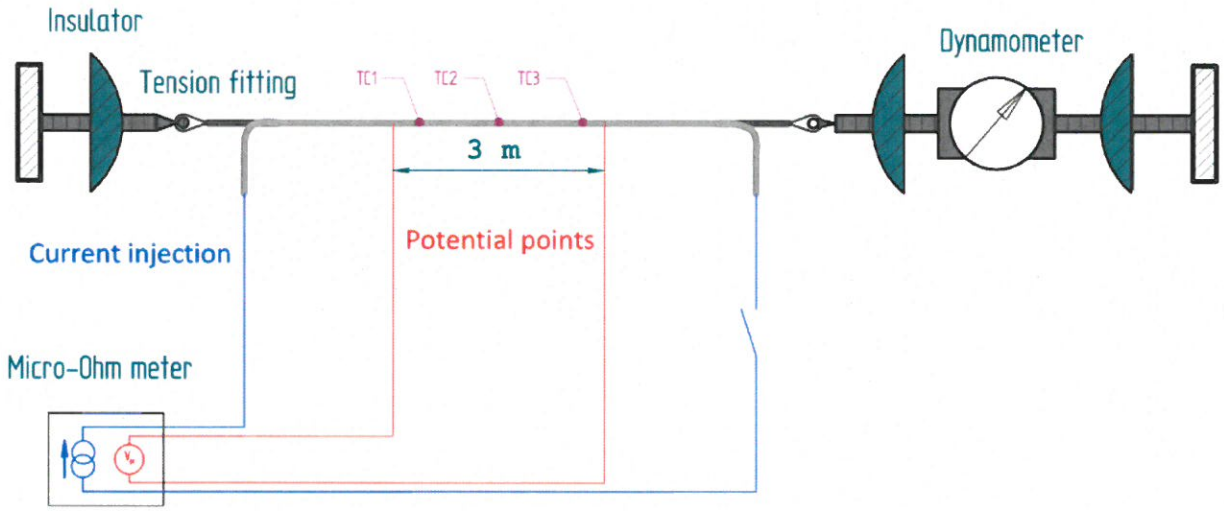

Figure 1
Test circuit diagram for DC resistance measurement

The electrical resistance of the test specimen was measured at ambient temperature. The measured resistance values were corrected to 20°C by means of the formula:

$$R_{20} = \frac{R_\theta}{1+\alpha_{20}(\theta-20)}$$

where

R_θ	is the measured resistance
θ	is the temperature in degree Celsius
α_{20}	is the thermal coefficient of resistance ($\alpha_{20} = 4\times10^{-3}$)

5.2. Test results

Table 16 indicates the results of the DC resistance measurement

Table 16: DC resistance of TACSR(SA)/TW Curlew conductor

Measurement	$R_{\theta\ 3m}$ [μΩ]	R_{θ} [μΩ/m]	Θ [°C]	R_{20} [Ω/km]
1	240.878	80.293	28.4	0.07768
2	241.008	80.336	28.5	0.07769
3	241.057	80.352	28.6	0.07768
4	241.089	80.363	28.6	0.07769
5	241.135	80.378	28.6	0.07771
6	241.234	80.411	28.7	0.07771
7	241.281	80.427	28.7	0.07772
8	241.305	80.435	28.8	0.07770
9	241.328	80.443	28.8	0.07771
10	241.354	80.451	28.8	0.07772
				0.07770

The measured resistance of the conductor (0.07770 Ω/km) was lower than the specified maximum 0.0800 Ω/km; therefore, the conductor met the DC resistance requirement of the data sheet.

6. Drop Point measurement

6.1 Test method and parameters

The dropping point test was carried out on 'METALUBE OCG6000' grease according to EN 50326:2003 standard.
A sample of grease contained in a cup suspended in a test tube was heated in an oil bath. The dropping point of the grease was defined as the average of the temperature at which material falls from the hole in the bottom of the cup and the temperature of the oil bath.
The minimum specified value is 300°C according to the specification.

6.2 Test results

The measured dropping point of the grease was above 300°C which was higher than the specified 300°C.
Result of the test complies with the requirements of the relevant standards and is in conformity with the value specified in the data sheet of the conductor.

Uncertainty of measurements

DC Resistance: ±0.5 %
Conductor temperature: ±1 °C
Length (<120 mm): ±0.05 mm
Length (>120 mm): ±1 mm
Diameter: ±0.01 mm
Force measurement: ±1.5%
Mass measurement: ±20 mg
Mass of wires: ±20 mg

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:
Measuring tape	MODECO	-	-
Digital caliper	Mitutoyo	CD-15CPX	12394972
Digital micrometre caliper	Mitutoyo	MDC-25SX	63115246
Data logger	FLUKE	HYDRA 2620A	1254016
Thermocouples	Omega	"T" type, precision grade	---
Digital balance	Mettler Toledo	TLE 3002	B444213997
Tensile test machine (300 kN)	BARABÁS Mérnökiroda	KSZ	001/2011
Tensile test machine (50 kN) Extensometer	Métisz-Q Kft. VEIKI-VNL Ltd.	ZD10-90 LVDT	263/1111/DSZ 2/2014
DC Microohm-meter	VEIKI-VNL	MO-3	MO-3-03/2015

PHOTOS

Photo 1
Cross-sectional view of the tested conductor

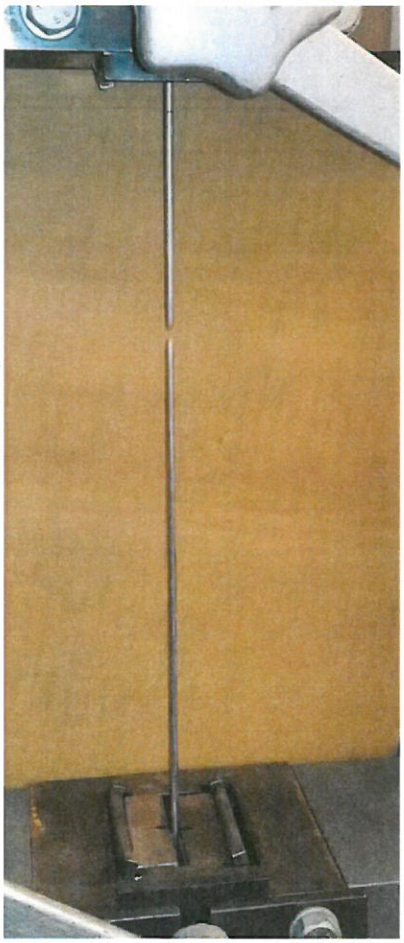

Photo 2
Annealed aluminium wire after the tensile test

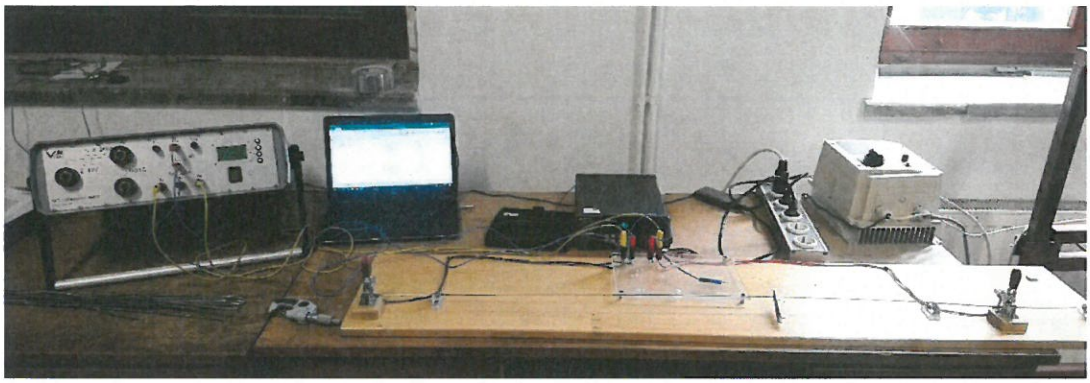

Photo 3
Resistivity measurement of annealed aluminium wires

Photo 4
Stress at 1% extenion on Al-clad steel wire

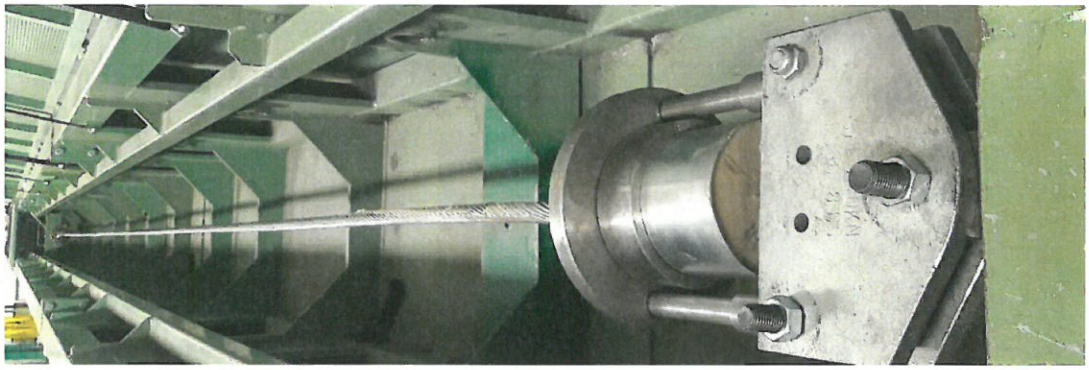

Photo 5
Test arrangement of the tensile break test

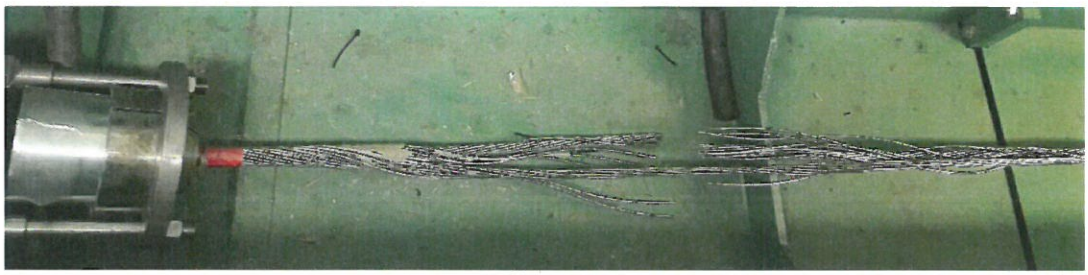

Photo 6
The fractured wires after the tensile break test

El Sewedy Cables
Power Cables Division

ELSEWEDY CABLES

Egytech Cables Company

Quality Control and Improvement Division
Quality planning

Type Test Plan (TTP)

Work order	CR 3571-17
Description	350/ 45 mm2 ACSS/MA5

Date of issue: 31/1/2019

VNL VEIKI a DEKRA company

VNL 1144 /VNL 2019 NOV 24.

(T.T.P.) Type Test Plan.
350/45 mm2 ACSS/MA5
Specification: ATSM B 856 , ASTM B 609, ASTM B 958

ELSEWEDY CABLES

S/N	Test.	Test Type.	Test Equipment	Clause No.	Reference Acceptance Value
1-Tests on Aluminum wires					
1.1	Tensile Strength	Type Test	Tensile M/C	ASTM B609 Clause 7	60 - 95 Mpa
1.2	Resistivity	Type Test	Ohmmeter	ASTM B609 Clause 9	Max 0.027899 Ω·mm2/m
1.3	Wire Diameter	Type Test	Micrometer	ASTM B609 Clause 11	4.31 (+/- 1 %) mm
1.4	Elongation Test for Aluminum wire	Type Test	Tensile M/C	ASTM B609 Clause 14.5	Elongation test after stranding shall not less than 20%
2-Tests on Aluminum Mischmetal Alloy cotaed steel core (before stranding)					
2.1	Tensile Strength	Type Test	Tensile M/C	ASTM B 856 clause 5.2 ASTM B958 Clause 7	Min 1900 Mpa
2.2	Elongation Test	Type Test	Tensile M/C	ASTM B 856 clause 5.2 ASTM B958 Clause 7	Min 3.5%
2.3	Stress at 1% Extension	Type Test	Tensile M/C	ASTM B 856 clause 5.2 ASTM B958 Clause 7	Min 1550 Mpa
2.4	Wrap Test	Type Test	wrapping M/C	ASTM B 856 clause 5.2 ASTM B958 Clause 8	wire Not fracture
2.5	Coating Test	Type Test	Chemical Analysis	ASTM B 856 clause 5.2 ASTM B958 Clause 9	Min 244 g/m2
2.6	Adherence of coating Test	Type Test	cylindrical mandrel	ASTM B958 Clause 10	The Zn–5Al–MM alloy-coated wire shall be capable of being wrapped in a close helix at a rate not exceeding 15 turns/min around a cylindrical without cracking or flaking the coating to such an extent that any Zn–5Al–MM alloy can be removed by rubbing with the bare fingers.
2.7	Resistivity	Type Test	ohmeter	ASTM B958 Clause 12.2	Max 0.19157 Ωmm2/m
2.8	Diameter	Type Test	Micrometer	ASTM B 856 clause 5.2 ASTM B958 Clause 13	2.87 (+/- 0.051) mm

Prepared by:
Eng/Ahmed El Essawy
Eng/ Sherif Mohy

Revised by:
Eng/Sameh Hafez.
2 of 3

Approved by:
Eng/Sherif El-Sherif.

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M.1 1144 /VNL 2019 NOV 24.

(T.T.P.) Type Test Plan.
350/45 mm2 ACSS/MA5
Specification: ATSM B 856 , ASTM B 609, ASTM B 958

ELSEWEDY CABLES

S/N	Test.	Test Type.	Test Equipment	Clause No.	Reference Acceptance Value
3-Tests on Aluminum Conductor coated steel supported					
3.1	Lay length and direction	Type Test	Ruler	ASTM B856 Clause 7	16-26 (steel) R.H 10-16 (AL inner layer) L.H 10-13 (AL outer layer) R.H
3.2	Construction and diameter	Type Test	Visual Inspection	As per Technical Data Sheet	24 / (4.31 ±1 %) mm (Al) 7 /(2.87 ±0.051) mm (steel)
3.3	Rated Strength of conductor	Type Test	Tensile M/C	ASTM B856 Clause 9	Min 106.2 KN
3.4	Varation of area	Type Test	caliper (calculated method)	ASTM B856 Clause 13	Varation of area shall not less than 98 % of 350.15 mm2 (Al) 45.28 mm2 (steel)
3.5	Electrical resistance for conductor	Type Test	Ohmmeter	ASTM B856 Clause 11	Max 0.08 Ω/km
3.6	Conductor and grease Weight	Type Test	balance	ASTM B856 Clause 11	1325 (+/- 2 %) without grease 1334 (+/- 2 %) with grease
3.7	Grease drop point	Type Test	thermometer bath tube cup test tube	BS EN ISO 2176 cluase 2	Min 300 °C

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ELSEWEDY CABLES

DATA SHEET

A - TECHNICAL PARTICULARS

- Maker's name :	EL SEWEDY CABLES	
- Type	ACSS/MA5	
- Standards applied :	ASTM B 856,958, 609	
- Cross-section of aluminum wire	350.2	mm^2
- Diameter of aluminum wire : [Fully Annealed]	4.31	mm
- Number of aluminum wires :	24	
- Cross-section of steel wire : [MA5]	45.3	mm^2
- Diameter of steel wire :	2.87	mm
- Number of steel wires :	7	
- Overall diameter of conductor :	25.85	mm
- Grease application [Y / N] :	Y[Steel core only greased]	
- outer layer Direction :	R.H	
- Conductor weight (without grease) :	1325 ± 2%	Kg/Km
- Conductor weight (with grease) :	1334 ± 2%	Kg/Km
- Length of conductor on drums	2000 ± 5%	M
- Type of drum	Wooden Fully lagged	

B - PERFORMANCE

-Rated Strength (UTS)	106.2	kN
- Maximum D.C. resistance of conductor at 20° C :	0.08	Ω/Km
- Density of aluminum wire material :	2.703	Kg/dm^3
- Density of steel wire material :	7.78	Kg/dm^3

- **Steel Core** *Ultra-High-Strength Class A Zinc–5% Aluminum-Mischmetal Alloy-Coated Steel (MA5)*

Signature: .....

Date : .....

In case of the customer approved or accept this technical offer, please sign below and add stamp if possible and send it back with your order.

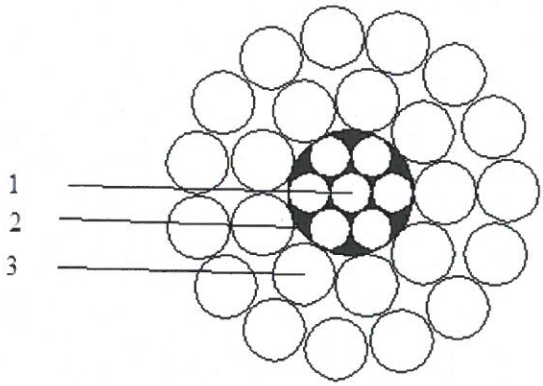
Customer Approval

Name : .....

Signature :

E.1 1144 /VNL 2019 NOV 24.

SHAKER
CONSULTANCY GROUP



Size : **350/45** mm^2		*Type* :	**ACSS/MA5**
		Standard:	**ASTM B 856,958,609**
Code : **AJ0-T001-U-00-00**			***EL-SEWEDY CABLES***
Sr.	Description		
1.	*Ultra-High-Strength Class A Zinc–5% Aluminum-Mischmetal Alloy-Coated Steel Core (MA5) (7wires)*		
2.	***Grease***		
3.	**Annealed Aluminum** *(24 wires)*		
Not to Scale	*Drawn by* *Mr. Nabil Abdallah*		*Approved by* ***Eng.*** *Mohamed Mansour*

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VEIKI VNL VILLAMOS NAGYLABORATÓRIUMOK Kft. * 1147 BUDAPEST, VÁGÓHÍD U. 2-4. * VEIKI VNL ELECTRIC LARGE LABORATORIES

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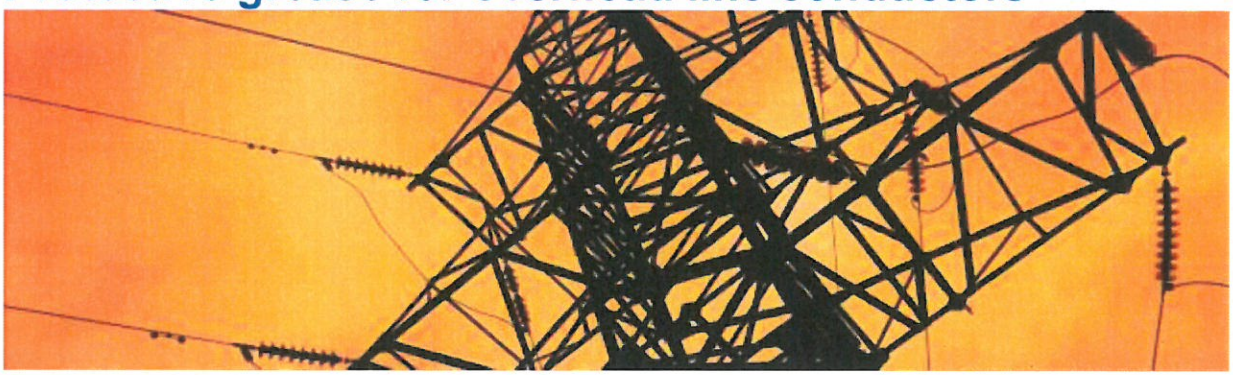
Technical Data

METALUBE®

OCG™6000

Protective grease for overhead line conductors



Description

OCG6000 is an advanced, fully synthetic grease specifically developed for the protection of high temperature, low sag "GAP" (GTACSR and GZTACSR) overhead conductors. The unique combination of additives and base fluids delivers extreme thermal stability and outstanding corrosion protection.

OCG6000 utilises a non-melting thickener system that results in a grease with a drop point over 300°C and extremely low oil separation at operating temperatures up to 210°C. This minimises oil migration from the core to the outer surface of the conductor helping to reduce corona effects.

OCG6000 meets the performance requirements of several international standards – see below for details.

Features and benefits

- Excellent thermal stability maximises product integrity over the operational life of the conductor
- Extremely low oil separation – even at post fault conductor temperatures of up to 210°C
- Maintains flexibility down to -50°C, prevents cracking and flaking of the grease film at low ambient temperatures
- Provides good corrosion protection to steel, galvanised steel, aluminium and aluminium alloy conductor components
- Reduces abrasive wear and fretting on the conductor that can result due to thermal expansion/contraction and varying weather conditions

Metalube Limited, 4 Huntsman Drive, Northbank Industrial Park, Irlam, Manchester M44 5EG, UK
Tel: +44 (0)161 775 7771 Fax: +44 (0)161 775 7511 post@metalube.co.uk www.metalube.co.uk

Company registration number: 2263118; Company registered in England VAT registration number GB108244927000

Technical Data

METALUBE®

OCG™6000

Approvals and standards

OCG6000 meets the requirements of:

- BS EN 50326:2002 with the designation 20A210
- IEC 61394:2011 with the designation 20A210
- RTE specification NT-ING-CNER-DL-DML-12-00049

OCG6000 is type approved by:

- UK National Grid to NGTS 3.4.2
- UK National Grid to NGTS 3.4.13

Recommended instructions for use

OCG6000 is designed for application at ambient temperatures and does not require heating prior to use.

Note: Greases of different types may not be compatible with OCG6000 - application equipment should be thoroughly cleaned to remove residues of previous lubricants to avoid incompatibility issues.

Pack sizes

OCG6000 is available in 180 kg drums

VEIKI a DEKRA company

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Global specialists in high-performance lubricants

Metalube Limited, 4 Huntsman Drive, Northbank Industrial Park, Irlam, Manchester M44 5EG, UK
Tel: +44 (0)161 775 7771 Fax: +44 (0)161 775 7511 post@metalube.co.uk www.metalube.co.uk

Company registration number: 2263118; Company registered in England VAT registration number GB108244927000

ISOQAR UKAS 0026

Cert No 2367QM8001

Technical Data

METALUBE®

OCG™6000

Technical data (typical values)

Property	Test method	Result
Appearance	MSTM 1	Smooth black tenacious grease
Typical S.G. @ 20°C		0.94
Base oil type	–	Synthetic
Worked penetration	IP50	220 mm/10
Drop point	IP132	>300°C
Oil separation 24 hours at 210°C	IP121 (modified)	0.01%
Oil separation 90 days at 210°C	IP121 (modified)	0.19%

Storage

Store OCG6000 out of direct sunlight and protect from frost. Storage temperature should ideally be controlled to between 5°C and 35°C.

The product information in this publication is based on knowledge and experience at the time of printing. There are many factors outside our control or knowledge which affect the use and performance of our products, for which reason it is given without responsibility.

Issue date 12-14

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Global specialists in high-performance lubricants

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ISOQAR REGISTERED UKAS MANAGEMENT SYSTEMS 0026

Cert No 2367QM8001

MOL LubCheck
PROFESSIONAL OIL ANALYSIS SERVICES

Olajdiagnosztikai jelentés

Jegyzőkönyv szám:	**008971/2019**	**Kapcsolattartó:**	**ALBERT KRISZTIÁN**
Berendezés azonosító:	**KENŐZSÍR ACSS 350/45**	**Partner neve:**	**VEIKI-VNL VILLAMOS NAGYLABORATÓRIUM**
Rendszer:	**Kenőzsír**		
Berendezés gyártó/modell:		**Telephely:**	**VEIKI-VNL VILLAMOS NAGYLABORATÓRIUM KFT.**
Terméknév:	'		
Viszkozitási fokozat:			

SZAKVÉLEMÉNY

Vizsgálati eredmények igény szerint.

Minta adatok	Mintaszám		**648611**			
	Referencia szám					
	Mintavétel dátuma					
	Beérkezés dátuma		**2019.11.18**			
	Berendezés élettartam	üzemóra/km				
	Olaj élettartam	üzemóra/km				
	Olajcsere					
Cseppenéspont		°C	**300 felett**			

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MOL-LUB Kft. LubCheck Laboratóriuma
2931 Almásfüzitő Fő út 21.
Email: lubcheck@mol.hu
Web: mol.hu/kenoanyagok

A jelentés a NAH-1-1808/2017 számon akkreditált Kenőanyag Laboratóriumi Központ vizsgálati eredményei alapján készült.

Szakvéleményt kiállította:
Luptákné Juhász Ilona* (+36-20-455-5754)
2019.11.20

Jelmagyarázat

Súlyos	Figyelmeztető	Normál

LubCheck
PROFESSIONAL OIL ANALYSIS SERVICES

Vizsgálati szabványok

Jegyzőkönyv szám 008971/2019

Vizsgálati módszer	Vizsgálati szabvány
Cseppenéspont	MSZ ISO 2176:1996

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