OVERHEAD CONDUCTOR

Avatok®

ALUMINUM ALLOY WITH COMPOSITE CORE

This catalog presents the main technical and electrical characteristics of overhead compact conductor from T-shaped aluminum wires with a composite carbon-containing core.

The core is a carbon fiber composite material (carbon fiber). The top coils are trapezoidal wires of annealed aluminum. Able to withstand very high temperatures.

It can be implemented in several versions: with a working temperature on the core surface of 120 ° C, 180 ° C, for some cases - up to 190 ° C.

Composite core has a lower coefficient of linear elongation, and therefore it is less susceptible to thermal expansion than a wire with a steel core. (The coefficient of specific thermal expansion of the composite core is 10 times lower than that of steel.) By replacing a wire with a steel core with a wire with composite materials, you can increase the throughput of the lines. Overhead composite core conductor combines the technology of using high-temperature aluminum with an increased cross-sectional area of the metal.

Composite core:

- increases the strength of the wire, because lighter and stronger than steel;
- reduces sagging wires, incl. when heated;
- increases the conductivity of the wire, because allows you to use 28% more aluminum than in ACSR overhead conductor with equal cross-section value.

T-shaped wires:

- increase the cross section value of the aluminum conductor and the effective ("working") section, which, in turn, increases the conductivity of the wire.

Benefits if using the conductor for power lines building or modernization:

- reduction in the cost of the overhead line reconstruction project while maintaining on the used pilons by reducing stress;
- reducing the cost of the project on new overhead lines by reducing the number of pilons (with an increase in the distance between the pilons) or by using pilons of a lower height for a regalement size;
- savings at ice melting stations equipment - ice and a snow drops times 2.4 faster than round wire conductor, due the smooth surface of the wire and high temperature of conductor;
- the ability to select two options for core operating temperatures.

Benefits in usage.

A) Statistics (the journal "Innovation Science" No. 6/2016) informs us that 35% of failures in the electrical equipment of power lines are due to the influence of ice formations. Of these, 52% are conductors and ropes. According to the IREQ Institute for Electrical Engineering Research in Quebec, Canada, smooth-surface conductor de-icing in 1.7 hours, while round wires conductor deiced in 4 hours. Accordingly, the time of a possible downtime of the line, as well as damage from lack of energy supply due to

conductor breakage, is reduced by 40%. In addition, the number of visits of repair crews to eliminate the accident is reduced - decreases operating costs**;**

B) In one of the reports of the 44th session of CIGRE, published in the journal Energy of the Unified Network No. 5 of 2013, we can find out the diagram shows that due of decreasing in the cost of construction costs, a proportional increase in operating costs is expected; the comparison was given in the subject of using wires with a smooth surface.

МАТЕРИАЛЫ СИГРЭ
ВЫСОКОВОЛЬТНЫЕ ЛИНИИ
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Рис. 1

- increased conductivity of the material allows to reduce line losses and associated air emissions by 20-30%, which makes it possible to increase the transmitted power with lower costs for energy production and less environmental impact;

- overhead conductor with use a composite core, which provides higher wire strength compared to other wires and smaller sag arrows, which allows to increase the line span lengths;

- compact structure, smooth surface of the wire and the elasticity of the core can reduce the load on the supports during icing and wind loads compared with steel-aluminum wires;

- resistance to environmental influences - no corrosion or electrolysis between aluminum wires and the core.

The economic effect of increasing the transmission capacity of overhead lines due to the transfer of additional electricity compared to standard solutions is achieved by the following advantages of the wire:

• reduction of electric and heat losses;

• due to the minimum sag, the alienation of the land is minimized, which avoids deforestation when passing overhead lines in resort or protected areas;

• improving the reliability of overhead lines, reducing the cost of technical service of the line and increasing its life;

• increasing the stability of the power system through the use of high-temperature mode in case of failure of parallel overhead lines.

Overhead aluminum composite core conductor intended for use in the air of types I and II provided that the content of sulfur dioxide in the atmosphere is not more than 150 mg / m³ • day (1.5 mg / m³) on ground of all macroclimatic regions in accordance with GOST 15150 --45ºC version, except for TB and TS.

Annealed aluminum wires comply with IEC 60121 (1960). The conductor, as a completed design, manufactured in accordance of IEC 62219 (2002).

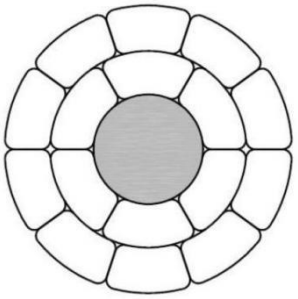

Рис.1: transverse view of overhead conductor with composite core.

type	Nominal conductivity, % IACS	Wire diameter, mm		Temporary breaking resistance N/mm², not less	Unit electrical resistance, nOhm-m, Not over
		From (incl)	to		
1350 O	63	5.97	10.03	58,6	27,35

Coefficient temperature:

- 0,00403 – + 20°C;
- 0,00314 - + 90°C;
- 0,002248 - + 180°C.

Twisted coefficient – 1,02.

Environmental installation temperature: от - 45° C + 45°C.

Environmental usage temperature: от - 60° C + 45°C.

Warranty exploitation time: not less 24 months from loading beginning.

Useful exploitation of conductor: over 50 years.

Main conductor parameters

Model of AVATOK®	Diameter, mm		Consist of wires	Cross section mm²		Weight, kg/km			Resistance with 20ºC, Ohm/m
	Core	Total		Al	Total	Total	Al	Core	
CFCC 150/28	5.97	15.52	6 + 9(15)	150.0	178.0	469.54	413.56	55.98	0.1861
CFCC 185/28	5.97	17.00	6 + 9 (15)	185.0	213.0	566.04	510.06	55.98	0.1509
CFCC 218/28	5.97	18.29	6+10 (16)	218.3	246.3	657.85	601.87	55.98	0.1279
CFCC 240/28	5.97	19.08	6+10 (16)	240.0	268.0	717.67	661.69	55.98	0.1163
CFCC 245/47	7.75	19.71	8+12 (20)	239,8	287.0	755.49	661.14	94.35	0.1164
CFCC 310/40	7.11	21.78	6+10 (16)	309.5	349.2	932.72	853.31	79.41	0.0902
CFCC 350/40	7.11	23.02	6+10 (16)	350.0	389.7	1044.38	964.97	79.41	0.0798
CFCC 360/47	7.75	23.55	7+11 (18)	361.2	408.4	1090.20	995.85	94.35	0.0773
CFCC 380/47	7.75	24.09	7+11 (18)	380.0	427.2	1142.03	1047.68	94.35	0.0735
CFCC 540/47	7.75	28.27	8+12+16 (36)	540.0	587.2	1583.16	1488.81	94.35	0.0520
CFCC 413/52	8.13	25.14	7+12 (19)	413.4	465.3	1243.59	1139.77	103.82	0.0675
CFCC 455/52	8.13	26.25	7+12 (19)	455.0	506.9	1358.28	1254.46	103.82	0.0614
CFCC 480/52	8.13	26.92	9+13 (22)	481.0	532.9	1429.97	1326.15	103.82	0.0580
CFCC 530/60	8.76	28.33	8+12+16 (36)	530.0	590.3	1581.78	1461.24	120.54	0.0529
CFCC 620/60	8.76	30.40	8+12+16 (36)	619.0	679.3	1827.16	1706.62	120.54	0.0453
CFCC 800/60	8.76	34.16	9+13+17 (39)	796.4	856.7	2316.26	2195.72	120.54	0.0352
CFCC 517/71	9.50	28.24	9+13 (22)	516.7	587.6	1566.33	1424.57	141.76	0.0540
CFCC 600/71	9.50	30.19	8+12+16 (36)	600.0	670.9	1796.00	1654.24	141.76	0.0468
CFCC 1000/75	9.78	38.20	8+12+16+20 (56)	995.9	1071.0	2896.00	2745.76	150.24	0.0283
CFCC 1135/80	10.03	40.69	8+12+16+20 (56)	1135.8	1214.8	3289.49	3131.47	158.02	0.0248

Model of **AVATOK®**	breaking tensile of wire , kN	breaking tensile of composite core , kN	Bending radius for installation purposes	Linear extension coefficient		Elastic modulus, GPa	
				Below temperature inflection point	Above temperature inflection point	Below temperature inflection point	Above temperature inflection point
CFCC 150/28	67.4	58.8	776.0	1.73E-05	2.00E-06	63.6	110
CFCC 185/28	69.5	58.8	850.0	1.81E-05	2.00E-06	62.2	110
CFCC 218/28	71.4	58.8	914.5	1.87E-05	2.00E-06	61.3	110
CFCC 240/28	72.6	58.8	954.0	1.90E-05	2.00E-06	60.7	110
CFCC 245/47	112.9	99.1	985.5	1.71E-05	2.00E-06	64	110
CFCC 310/40	101.2	83.4	1089.0	1.87E-05	2.00E-06	61.3	110
CFCC 350/40	103.6	83.4	1151.0	1.91E-05	2.00E-06	60.6	110
CFCC 360/47	119.9	99.1	1177.5	1.87E-05	2.00E-06	61.4	110
CFCC 380/47	121.0	99.1	1204.5	1.88E-05	2.00E-06	61.1	110
CFCC 540/47	130.2	99.1	1413.5	1.99E-05	2.00E-06	59.4	110
CFCC 413/52	132.8	109.0	1257.0	1.88E-05	2.00E-06	61.1	110
CFCC 455/52	135.2	109.0	1312.5	1.91E-05	2.00E-06	60.6	110
CFCC 480/52	136.7	109.0	1346.0	1.93E-05	2.00E-06	60.4	110
CFCC 530/60	157.1	126.6	1416.5	1.91E-05	2.00E-06	60.6	110
CFCC 620/60	162.3	126.6	1520.0	1.96E-05	2.00E-06	59.9	110
CFCC 800/60	172.5	126.6	1708.0	2.02E-05	2.00E-06	58.9	110
CFCC 517/71	178.7	148.9	1412.0	1.85E-05	2.00E-06	61.6	110
CFCC 600/71	183.5	148.9	1509.5	1.90E-05	2.00E-06	60.8	110
CFCC 1000/75	215.2	157.8	1910.0	2.02E-05	2.00E-06	58.9	110
CFCC 1135/80	231.3	165.9	2034.5	2.04E-05	2.00E-06	58.6	110

Current, A

	Temperature ºC						
Model of AVATOK®	60°C	80°C	100°C	120°C	140°C	160°C	180°C
CFCC 150/28	335	465	556	628	689	742	790
CFCC 185/28	379	530	635	718	789	850	906
CFCC 218/28	419	587	705	799	878	947	1010
CFCC 240/28	443	623	749	849	933	1007	1075
CFCC 245/47	446	629	757	858	944	1019	1087
CFCC 310/40	518	734	886	1007	1108	1198	1279
CFCC 350/40	557	793	959	1090	1200	1298	1387
CFCC 360/47	569	811	981	1115	1229	1330	1421
CFCC 380/47	586	837	1013	1152	1270	1374	1469
CFCC 540/47	718	1039	1263	1442	1593	1727	1849
CFCC 413/52	616	884	1070	1219	1344	1455	1556
CFCC 455/52	652	938	1138	1296	1431	1549	1658
CFCC 480/52	674	971	1179	1343	1483	1607	1720
CFCC 530/60	713	1031	1253	1430	1580	1713	1834
CFCC 620/60	780	1135	1383	1580	1747	1896	2031
CFCC 800/60	900	1324	1619	1855	2056	2234	2397
CFCC 517/71	705	1020	1240	1415	1563	1694	1814
CFCC 600/71	767	1116	1359	1553	1717	1863	1996
CFCC 1000/75	1019	1515	1861	2137	2373	2583	2776
CFCC 1135/80	1094	1637	2016	2319	2579	2811	3024

Terms of measurement:

1. Wind speed 0,5 m/s;
2. Emitting coefficient – 0,9;
3. Absorption coefficient– 0,9;
4. Solar radiation – 1000 W/ m²;
5. Environmental temperature +30°C

Nominal resistance D.C., (Ω/km)

	Temperature ºC						
Model of AVATOK®	60°C	80°C	100°C	120°C	140°C	160°C	180°C
CFCC 150/28	0.2161	0.2311	0.2461	0.2611	0.2761	0.2911	0.3061
CFCC 185/28	0.1752	0.1874	0.1996	0.2117	0.2239	0.236	0.2482
CFCC 218/28	0.1485	0.1588	0.1691	0.1794	0.1897	0.2	0.2103
CFCC 240/28	0.1351	0.1444	0.1538	0.1632	0.1726	0.182	0.1913
CFCC 245/47	0.1352	0.1446	0.154	0.1633	0.1727	0.1821	0.1915
CFCC 310/40	0.1047	0.112	0.1193	0.1266	0.1338	0.1411	0.1484
CFCC 350/40	0.0926	0.0991	0.1055	0.1119	0.1183	0.1248	0.1312
CFCC 360/47	0.0897	0.096	0.1022	0.1084	0.1147	0.1209	0.1271
CFCC 380/47	0.0853	0.0912	0.0972	0.1031	0.109	0.1149	0.1208
CFCC 540/47	0.0603	0.0645	0.0687	0.0729	0.0771	0.0813	0.0855
CFCC 413/52	0.0784	0.0839	0.0893	0.0947	0.1002	0.1056	0.1111
CFCC 455/52	0.0712	0.0762	0.0811	0.0861	0.091	0.096	0.1009
CFCC 480/52	0.0674	0.0721	0.0768	0.0814	0.0861	0.0908	0.0955
CFCC 530/60	0.0615	0.0657	0.07	0.0743	0.0785	0.0828	0.0871
CFCC 620/60	0.0526	0.0563	0.0599	0.0636	0.0672	0.0709	0.0745
CFCC 800/60	0.0409	0.0437	0.0466	0.0494	0.0523	0.0551	0.0579
CFCC 517/71	0.0627	0.0671	0.0714	0.0758	0.0802	0.0845	0.0889
CFCC 600/71	0.0543	0.0581	0.0618	0.0656	0.0694	0.0731	0.0769
CFCC 1000/75	0.0329	0.0352	0.0374	0.0397	0.042	0.0443	0.0466
CFCC 1135/80	0.0288	0.0308	0.0328	0.0348	0.0368	0.0388	0.0408

Nominal resistance A.C., (Ω/km)

	Temperature ºC						
Model of AVATOK®	60℃	80℃	100℃	120℃	140℃	160℃	180℃
CFCC 150/28	0.2163	0.2313	0.2463	0.2613	0.2763	0.2913	0.3063
CFCC 185/28	0.1755	0.1876	0.1998	0.2119	0.2241	0.2362	0.2484
CFCC 218/28	0.1488	0.1591	0.1694	0.1797	0.1900	0.2003	0.2106
CFCC 240/28	0.1355	0.1448	0.1542	0.1635	0.1729	0.1822	0.1916
CFCC 245/47	0.1355	0.1448	0.1542	0.1636	0.1730	0.1823	0.1917
CFCC 310/40	0.1052	0.1125	0.1197	0.1269	0.1342	0.1414	0.1487
CFCC 350/40	0.0932	0.0996	0.1060	0.1124	0.1188	0.1252	0.1316
CFCC 360/47	0.0903	0.0965	0.1027	0.1089	0.1151	0.1213	0.1275
CFCC 380/47	0.0859	0.0918	0.0977	0.1036	0.1095	0.1154	0.1213
CFCC 540/47	0.0613	0.0654	0.0695	0.0737	0.0778	0.0820	0.0861
CFCC 413/52	0.0791	0.0845	0.0899	0.0953	0.1007	0.1061	0.1115
CFCC 455/52	0.0720	0.0769	0.0818	0.0867	0.0916	0.0965	0.1014
CFCC 480/52	0.0682	0.0728	0.0774	0.0821	0.0867	0.0914	0.0960
CFCC 530/60	0.0623	0.0665	0.0707	0.0750	0.0792	0.0834	0.0877
CFCC 620/60	0.0537	0.0573	0.0609	0.0645	0.0681	0.0717	0.0753
CFCC 800/60	0.0423	0.0451	0.0479	0.0506	0.0534	0.0562	0.0590
CFCC 517/71	0.0635	0.0678	0.0721	0.0764	0.0808	0.0851	0.0894
CFCC 600/71	0.0552	0.0590	0.0627	0.0664	0.0701	0.0738	0.0776
CFCC 1000/75	0.0346	0.0368	0.0390	0.0412	0.0434	0.0456	0.0478
CFCC 1135/80	0.0309	0.0328	0.0346	0.0366	0.0385	0.0404	0.0423