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.

A wire with a 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.

- 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 / m^3 • day (1.5 mg / m^3) 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).

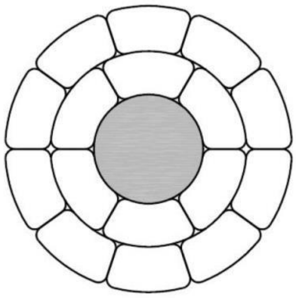

Рис.1: transverse view of overhead conductor with composite core

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	3,57	5,08	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 20°C, Ohm/m
	core	total		Al	total	total	Al	core	
ACCC 150/28	5.97	15.60	6 + 9(15)	150.0	178.0	466	411,42	54,58	0,1864
ACCC 185/28	5.97	17.10	6 + 9 (15)	185.0	213.0	563	508,42	54,58	0,1518
ACCC 218/28	5.97	18.29	6+10 (16)	218.3	246.3	654	599,42	54,58	0,1279
ACCC 240/28	5.97	19.00	6+10 (16)	240.0	268.0	700	645,42	54,58	0,1165
ACCC 245/47	7.75	19,53	8+12 (20)	239,8	286,9	743	651,02	91,98	0,1169
ACCC 310/40	7.11	21.78	6+10 (16)	309.5	349.5	927	849,58	77,42	0,0902
ACCC 350/40	7.11	23.00	6+10 (16)	350.0	390.0	1018	940,58	77,42	0,0798
ACCC 360/47	7.75	23.55	7+11 (18)	361.2	408.2	1083	971,02	91,98	0,0773
ACCC 380/47	7.75	24.40	7+11 (18)	380.0	427.0	1133	1041,02	91,98	0,0736
ACCC 540/47	7.75	28.20	8+12+16 (36)	540.0	587.0	1570	1478,02	91,98	0,0518
ACCC 413/52	8.13	25.14	7+12 (19)	413.4	465.4	1236	1134,78	101,22	0,0676
ACCC 455/52	8.13	26.00	7+12 (19)	455.0	507.0	1352	1250,78	101,22	0,0614
ACCC 480/52	8.13	26.40	9+13 (22)	481.0	533.0	1421	1319,78	101,22	0,0582
ACCC 530/60	8.76	27.70	8+12+16 (36)	530.0	590.2	1568	1450,48	117,52	0,0527
ACCC 620/60	8.76	30.41	8+12+16 (36)	619.0	679.3	1824	1706,48	117,52	0,0453
ACCC 800/60	8.76	34.17	9+13+17 (39)	796.4	856.7	2310	2192,48	117,52	0,0351
ACCC 517/71	9.50	28.14	9+13 (22)	516.7	587.5	1556	1417,78	138,22	0,0541
ACCC 600/71	9.50	30.20	8+12+16 (36)	600.0	670.9	1791	1652,78	138,22	0,0466
ACCC 1000/75	9.78	38.20	8+12+16+20 (56)	995.9	1071.0	2911	2764,52	146,48	0,0283
ACCC 1135/80	10.03	40.69	8+12+16+20 (56)	1135.8	1214.8	3308	3153,93	154,07	0,0248

Model of AVATOK®	breaking tensile of wire , kN	breaking tensile of composite core , kN	Bendin radius for installation purposes	Time of breaking tensile	Gdop. , kg_F / mm^2		Linear extension coefficient	
					Average exploitation mode	overloaded	Below temperature inflection point	Above temperature inflection point
ACCC 150/28	67.4	60,4	780	38,64	11,59	17,39	12.5	1.6
ACCC 185/28	68.5	60,4	855	32,82	9,84	14,77	12.5	1.6
ACCC 218/28	72.7	60,4	914,5	30,12	9,04	13,55	12.9	1.6
ACCC 240/28	74.8	60,4	950	28,48	8,54	12,82	12.9	1.6
ACCC 245/47	115,2	101,8	976,5	40,96	12,29	18,43	17,5	1.6
ACCC 310/40	103.0	85,8	1087,5	30,07	9,02	13,53	13.0	1.6
ACCC 350/40	106.1	85,8	1150	27,76	8,33	12,49	13.0	1.6
ACCC 360/47	122.0	101,8	1177,5	30,50	9,15	13,72	12.8	1.6
ACCC 380/47	124.2	101,8	1220	29,68	8,90	13,36	12.8	1.6
ACCC 540/47	134.1	101,8	1410	23,31	6,99	10,49	13.0	1.6
ACCC 413/52	135.0	112,1	1257	29,60	8,88	13,32	13.0	1.6
ACCC 455/52	138.4	112,1	1300	27,85	8,36	12,53	13.0	1.6
ACCC 480/52	140.0	112,1	1320	26,80	8,04	12,06	13.0	1.6
ACCC 530/60	162.2	130,1	1385	28,04	8,41	12,62	13.0	1.6
ACCC 620/60	165.0	130,1	1520,5	24,79	7,44	11,15	14.0	1.6
ACCC 800/60	183.0	130,1	1708,5	21,80	6,54	9,81	14.0	1.6
ACCC 517/71	182.0	153,8	1407	31,61	9,48	14,22	12.5	1.6
ACCC 600/71	187.0	153,8	1510	28,44	8,53	12,80	13.0	1.6
ACCC 1000/75	228.0	162,1	1910	21,72	6,52	9,78	14.0	1.6
ACCC 1135/80	244.0	172,7	2034,5	20,50	6,15	9,22	14.0	1.6

Model of AVATOK®	elastic modulus (E), кН/ мм²		Elementary Extension modulus (F), kgF/ mm²		Final Extension modulus (F), kgF/ mm²	
	Below temperature inflection point	Below temperature inflection point (core)	Above temperature inflection point	Above temperature inflection point (core)	Below temperature inflection point	Below temperature inflection point (core)
ACCC 150/28	68	117	6939	11939	7286	12536
ACCC 185/28	67	117	6837	11939	7179	12536
ACCC 218/28	65	117	6633	11939	6964	12536
ACCC 240/28	64	117	6531	11939	6857	12536
ACCC 245/47	76,4	118,6	7796	12102	8186	12707
ACCC 310/40	65	117	6633	11939	6964	12536
ACCC 350/40	64	117	6531	11939	6857	12536
ACCC 360/47	65	117	6633	11939	6964	12536
ACCC 380/47	65	117	6633	11939	6964	12536
ACCC 540/47	63	117	6429	11939	6750	12536
ACCC 413/52	65	117	6633	11939	6964	12536
ACCC 455/52	65	117	6633	11939	6964	12536
ACCC 480/52	65	117	6633	11939	6964	12536
ACCC 530/60	65	117	6633	11939	6964	12536
ACCC 620/60	64	117	6531	11939	6857	12536
ACCC 800/60	63	117	6429	11939	6750	12536
ACCC 517/71	66	117	6735	11939	7071	12536
ACCC 600/71	65	117	6633	11939	6964	12536
ACCC 1000/75	63	117	6429	11939	6750	12536
ACCC 1135/80	62	117	6327	11939	6643	12536

Current, A

	Temperature °C						
Model of AVATOK®	**60°C**	**80°C**	**100°C**	**120°C**	**140°C**	**160°C**	**180°C**
ACCC 150/28	332	467	565	644	711	772	827
ACCC 185/28	375	531	644	735	813	883	946
ACCC 218/28	412	587	713	815	902	980	1051
ACCC 240/28	435	622	756	864	957	1040	1116
ACCC 245/47	534	682	795	886	964	1040	1080
ACCC 310/40	507	731	892	1022	1134	1235	1326
ACCC 350/40	544	789	964	1105	1227	1336	1436
ACCC 360/47	555	806	986	1131	1256	1368	1471
ACCC 380/47	573	834	1021	1172	1303	1419	1526
ACCC 540/47	697	1030	1266	1458	1623	1771	1908
ACCC 413/52	600	877	1074	1234	1372	1495	1608
ACCC 455/52	632	927	1137	1307	1453	1584	1705
ACCC 480/52	652	957	1174	1351	1502	1638	1763
ACCC 530/60	688	1014	1246	1435	1597	1742	1876
ACCC 620/60	753	1121	1382	1594	1776	1940	2091
ACCC 800/60	866	1305	1616	1869	2087	2283	2464
ACCC 517/71	683	1009	1240	1427	1589	1734	1867
ACCC 600/71	734	1084	1333	1535	1709	1865	2008
ACCC 1000/75	974	1487	1850	2145	2400	2630	2843
ACCC 1135/80	1043	1605	2002	2326	2606	2859	3093

Terms of measurement:

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

Nominal resistance D.C., (Ω/km)

	Temperature °C						
Model of AVATOK®	**60℃**	**80℃**	**100℃**	**120℃**	**140℃**	**160℃**	**180℃**
ACCC 150/28	0.2176	0.2331	0.2486	0.2641	0.2796	0.2951	0.3106
ACCC 185/28	0.1766	0.1891	0.2017	0.2142	0.2268	0.2394	0.2519
ACCC 218/28	0.1496	0.1603	0.1709	0.1815	0.1922	0.2028	0.2134
ACCC 240/28	0.1361	0.1458	0.1554	0.1651	0.1748	0.1844	0.1941
ACCC 245/47	0.1172	0.1385	0.1548	0.1642	0.1736	0.1830	0.1925
ACCC 310/40	0.1058	0.1133	0.1207	0.1282	0.1357	0.1432	0.1507
ACCC 350/40	0.0937	0.1003	0.1069	0.1135	0.1201	0.1267	0.1334
ACCC 360/47	0.0908	0.0972	0.1036	0.1100	0.1164	0.1228	0.1292
ACCC 380/47	0.0864	0.0924	0.0985	0.1046	0.1107	0.1168	0.1229
ACCC 540/47	0.0613	0.0656	0.0698	0.0741	0.0784	0.0826	0.0869
ACCC 413/52	0.0795	0.0851	0.0906	0.0962	0.1018	0.1074	0.1130
ACCC 455/52	0.0724	0.0775	0.0826	0.0877	0.0927	0.0978	0.1029
ACCC 480/52	0.0685	0.0733	0.0780	0.0828	0.0876	0.0924	0.0972
ACCC 530/60	0.0626	0.0669	0.0713	0.0757	0.0800	0.0844	0.0888
ACCC 620/60	0.0539	0.0576	0.0613	0.0650	0.0688	0.0725	0.0762
ACCC 800/60	0.0424	0.0452	0.0481	0.0509	0.0538	0.0567	0.0595
ACCC 517/71	0.0638	0.0683	0.0727	0.0772	0.0817	0.0861	0.0906
ACCC 600/71	0.0553	0.0591	0.0629	0.0668	0.0706	0.0745	0.0783
ACCC 1000/75	0.0347	0.0370	0.0393	0.0415	0.0438	0.0461	0.0484
ACCC 1135/80	0.0309	0.0329	0.0348	0.0368	0.0388	0.0408	0.0428

The calculated data of the active, inductive resistance, capacitive conductivity

Model of AVATOK®	Conductor diameter mm	Nominal active resistance. (r0), Ohm/km t=20℃	110кВ, Dcp=5 m		220кВ, Dcp=8 m		330кВ, Dcp=11 m, m=2		500кВ, Dcp=14 m, m=3	
			X0, Ohm/km	b0, Ohm/km	X0, Ohm/km	b0, Ohm/km	X0, Ohm/km	b0, Ohm/km	X0, Ohm/km	b0, Ohm/km
ACCC 150/28	15,7	0,1864	0,420	2,702	0,449	2,519	0,410	2,713	0,310	3,614
ACCC 185/28	17,1	0,1518	0,414	2,739	0,444	2,551	0,408	2,732	0,307	3,648
ACCC 218/28	18,3	0,1279	0,410	2,769	0,440	2,577	0,405	2,747	0,305	3,673
ACCC 240/28	19,0	0,1165	0,408	2,785	0,437	2,591	0,404	2,755	0,304	3,688
ACCC 245/47	19,5	0,1199	0,406	2,798	0,436	2,602	0,403	2,761	0,303	3,699
ACCC 310/40	21,8	0,0902	0,399	2,847	0,429	2,644	0,400	2,785	0,300	3,742
ACCC 350/40	23,0	0,0798	0,396	2,873	0,425	2,667	0,398	2,797	0,298	3,764
ACCC 360/47	23,6	0,0773	0,394	2,884	0,424	2,676	0,398	2,802	0,297	3,774
ACCC 380/47	24,4	0,0736	0,392	2,901	0,422	2,691	0,396	2,810	0,296	3,788
ACCC 540/47	28,2	0,0518	0,383	2,973	0,413	2,752	0,392	2,843	0,292	3,849
ACCC 413/52	25,1	0,0676	0,390	2,916	0,420	2,704	0,395	2,817	0,295	3,801
ACCC 455/52	26,0	0,0614	0,388	2,932	0,418	2,718	0,394	2,825	0,294	3,815
ACCC 480/52	26,4	0,0582	0,387	2,940	0,417	2,724	0,394	2,828	0,294	3,821
ACCC 530/60	27,7	0,0527	0,384	2,964	0,414	2,745	0,392	2,839	0,292	3,841
ACCC 620/60	30,4	0,0453	0,378	3,012	0,408	2,786	0,390	2,861	0,289	3,881
ACCC 800/60	34,2	0,0351	0,371	3,073	0,401	2,838	0,386	2,889	0,286	3,932
ACCC 517/71	28,1	0,0541	0,383	2,972	0,413	2,752	0,392	2,843	0,292	3,848
ACCC 600/71	30,2	0,0466	0,379	3,008	0,408	2,783	0,390	2,859	0,289	3,878
ACCC 1000/75	38,2	0,0283	0,364	3,135	0,394	2,891	0,382	2,916	0,282	3,982
ACCC 1135/80	40,7	0,0248	0,360	3,171	0,390	2,921	0,380	2,931	0,280	4,011