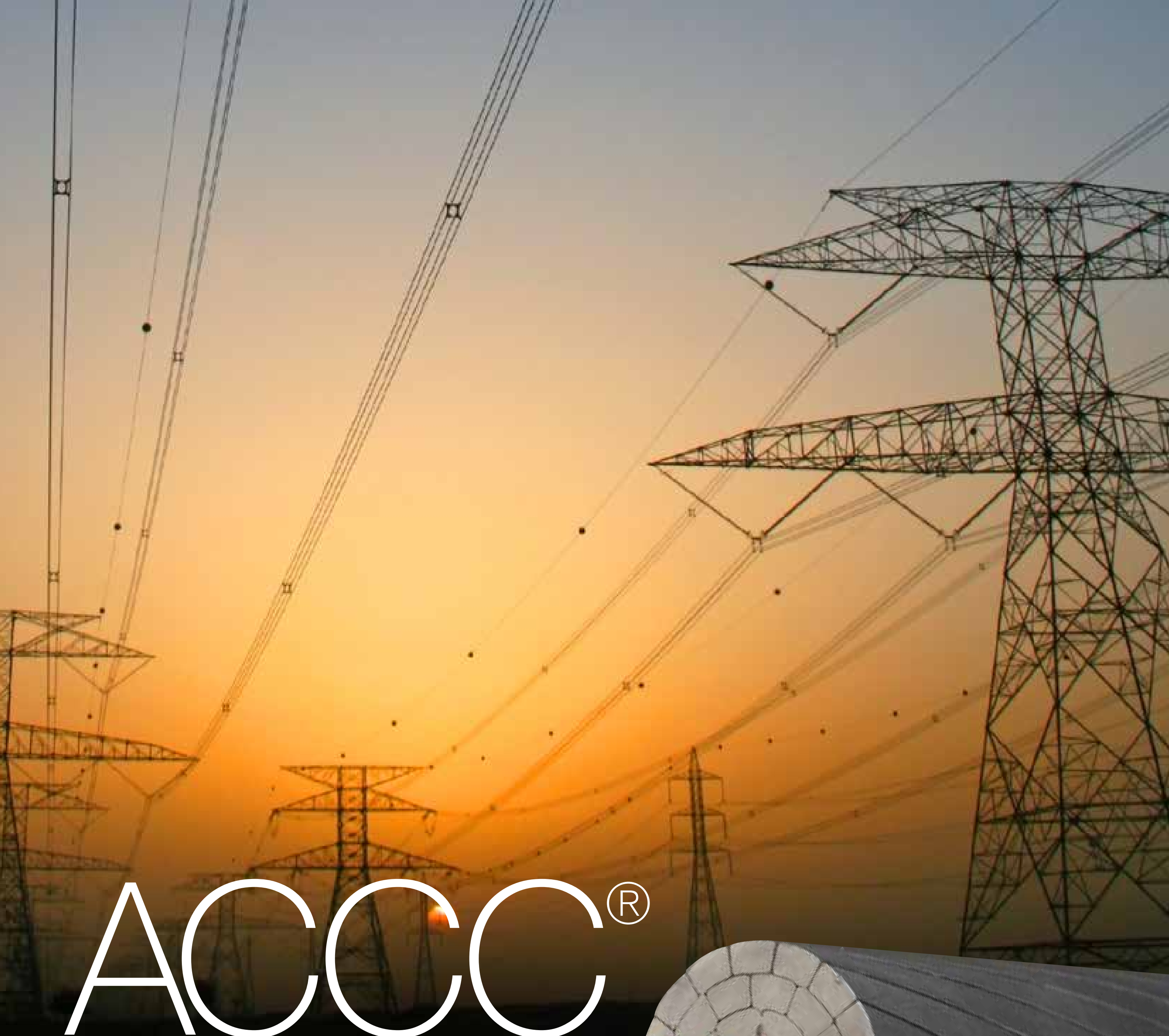

ACCC®

Aluminum Conductor Composite Core

Bringing the future to you

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ACCC®

Aluminum Conductor Composite Core

ACCC® conductor (Aluminum Conductor Composite Core) is a high capacity, low sag conductor which consists of a carbon fiber composite core encased in a protective fiberglass sheath that is helically wrapped with conductive aluminum strands. ACCC® conductors combine efficiency and increased current carrying capacity to deliver more power with less losses based on equal conductor size and weight. It was developed and patented by CTC Cable Corporation, now CTC Global. ACCC® is a registered trademark of CTC Global.

- Greater Strength & Reduced Sag
- Increased Spans on Fewer / Shorter Structures
- Twice the Capacity of AAC, ACSR and Others
- Reduced Line Losses by 25% to 40%
- Lower Overall Lifecycle Costs
- Outstanding Product Warranty

Installed by more than 100 utilities globally; over 25,000km installed at nearly 300 project sites.
A proven and appropriate technology for the modern grid

Greater Strength, Lighter Weight, Reduced Sag
The Hybrid Carbon Composite Core is 40% stronger and 70% lighter than a steel core conductor, thus, greatly improves sag performance and improves the overall reliability of the grid.

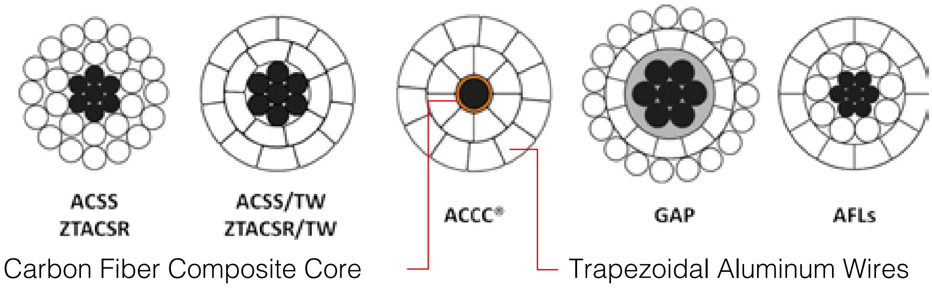
Longer Spans with Less Structures
The greater strength, improved dimensional stability, and an effective self-damping and superior fatigue resistance capabilities allow for increased spans between fewer or shorter structures. By reducing the number or height of required structures, a serious reduction is created in the overall project cost and construction time while minimizing environmental impact.

Ampacity
ACCC® carries twice the current of a conventional conductor making it ideally suited for increasing the capacity of existing transmission and distributions lines without the need to reinforce or replace existing structures, while the light Carbon Composite Core allows the use of 28% more aluminum without a weight penalty using compact trapezoidal strands.

Reduction in Line Losses
Under equal load conditions, the ACCC® reduces line losses by 25 – 40% when compared to that of conductors with same diameter and weight.

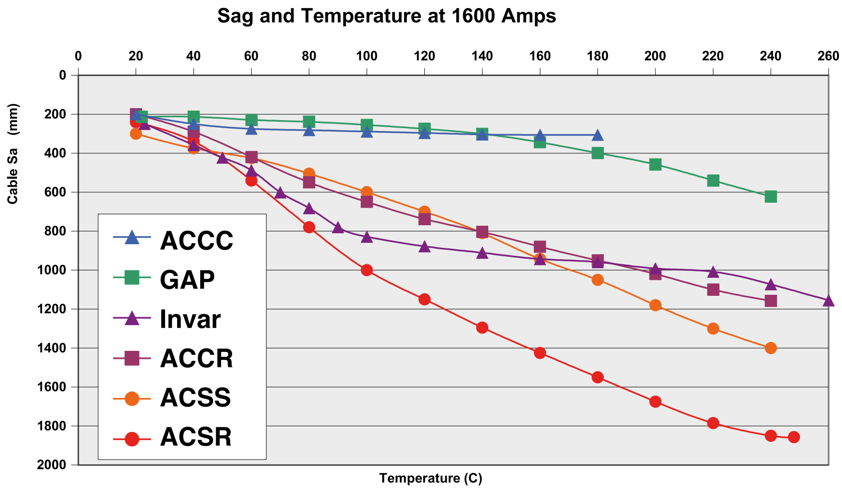
ACCC® Aluminum Conductor Composite Core

The aerospace grade carbon fiber composite core surrounded by glass fibers, encapsulated in specially modified high temperature resistant polymeric resin offers greater strength and line loss reductions.



ACCC® technology is based on replacing the heavy steel core of traditional electrical transmission conductors with a high strength, light weight carbon fiber composite core and is applicable for all voltages

The lower Coefficient of Thermal Expansion creates less sag at high temperatures and is resists degradation from vibration, corrosion, ultraviolet radiation, corona, chemical and thermal oxidation, but most importantly cyclic load fatigue.



Economics of Efficiency

Investments in the ACCC® conductor will significantly reduce line losses and provide a higher Internal Rate of Return (IRR).

	Peak Amps	Temperature at Peak Amps (ºC)	Load Factor	MVA	Annual Line Losses (MWh)	Line Loss Reduction	Value of Reduction (at $50/MWh)	Value of Reduction per Lineal Conductor (meter)
ACSR	1,000	91	53%	398	75,980	----	----	----
ACCC®	1,000	77	53%	398	55,630	20,350	$1,017,500	$3.39
ACSS	1,600	194	53%	637	251,998	----	----	----
ACCC®	1,600	156	53%	637	179,022	72,976	$3,648,800	$12.16

Key Assumptions:

- *Drake equivalent conductors*
- *100km AC three phase line*
- *230kV line*
- *Ambient temp. 25˚C, wind speed 0.49m/s*

Benefits from Reductions in Line Loss:

- *Savings as high as ~$US3.6mn per year from losses*
- *Savings of $US3.39 per meter from losses when compared to ACSR*
- *Savings of $US12.16 per meter from losses when compared to ACSS*
- *Overall reduction in CO_2 emmissions*

ACCC® Conductor Sizes – ASTM

ACCC®	Conductor		Diameter		Core Diameter		Weight		Core Related Strength		Cond. Rated Strength		DC @ 20°C	AC @ 25°C	AC @ 75°C	DC @ 180°C	#AC Ampacity	
ASTM Size	(kcmil)	(mm2)	(in)	(mm)	(in)	(mm)	(lb/kft)	(kg/km)	(lb/kft)	(kN)	(lb/kft)	(kN)	(ohm/ mile)	(ohm/ mile)	(ohm/ mile)	(ohm/ mile)	180°C	200°C
Pasadena	305	154.4	0.616	15.65	0.235	5.97	321	478	13,600	60.4	15,500	68.9	0.2885	0.2944	0.3535	0.4749	814	856
Ostrich (Oceanside)	383	194.2	0.680	17.27	0.235	5.97	396	589	13,600	60.4	16,000	71.2	0.2319	0.2374	0.2841	0.3818	938	987
Linnet (La Jolla)	430	218.1	0.720	18.29	0.235	5.97	440	655	13,600	60.4	16,300	72.5	0.2055	0.2103	0.2517	0.3383	1,014	1,067
Oriole (Oxnard)	439	222.3	0.741	18.82	0.280	7.11	463	689	19,300	85.7	22,100	98,3	0.2019	0.2065	0.2471	0.3324	1,033	1,087
Waco	454	230.1	0.770	19.56	0.305	7.75	485	721	22,900	101.7	25,800	114.8	0.1951	0.1996	0.2395	0.3212	1,060	1,115
Laredo	530	268.4	0.807	20.50	0.280	7.11	548	816	19,300	85.7	22,700	101.0	0.1671	0.1712	0.2053	0.2751	1,162	1,223
Irving	609	308.8	0.882	22.40	0.345	8.76	649	965	29,300	130.2	33,200	147.7	0.1454	0.1491	0.1788	0.2394	1,279	1,347
Hawk (Hermosa)	611	309.7	0.858	21.79	0.280	7.11	625	930	19,300	85.7	23,200	103.2	0.1448	0.1485	0.1760	0.2384	1,288	1,358
Dove (Dohney)	714	361.5	0.927	23.55	0.305	7.75	728	1083	22,900	101.7	27,500	122.3	0.1240	0.1274	0.1524	0.2042	1,410	1,485
Grosbeak (Goleta)	821	416.2	0.990	25.15	0.320	8.13	837	1245	25,200	112.0	30,400	135.2	0.1081	0.1114	0.1334	0.1780	1,537	1,620
Lubbock	904	458.0	1.040	26.42	0.345	8.76	924	1376	29,300	130.2	35,100	156.1	0.0979	0.1011	0.1210	0.1612	1,640	1,728
Galveston	1011	512.4	1.090	27.69	0.345	8.76	1025	1526	29,300	130.2	35,700	158.8	0.0875	0.0907	0.1084	0.1440	1,759	1,855
Drake (Del Mar)	1026	519.7	1.108	28.14	0.375	9.53	1052	1565	34,600	153.8	41,200	183.3	0.0863	0.0892	0.1065	0.1421	1,785	1,883
Curlew (Crescent)	1033	523.4	1.140	28.96	0.415	10.54	1082	1610	42,300	188.3	49,000	218.0	0.0862	0.0898	0.1069	0.1419	1,801	1,901
Plano	1059	536.8	1.127	28.63	0.345	8.76	1073	1597	29,300	130.2	36,000	160.1	0.0840	0.0876	0.1045	0.1383	1,813	1,913
Corpus Christi	1103	558.9	1.146	29.11	0.345	8.76	1113	1657	29,300	130.2	36,300	161.5	0.0806	0.0843	0.1005	0.1328	1,859	1,962
Arlington	1151	583.2	1.177	29.90	0.375	9.53	1173	1745	34,600	153.8	41,900	186.4	0.0773	0.0809	0.0964	0.1273	1,915	2,021
Cardinal (Carlsbad)	1222	619.1	1.198	30.43	0.345	8.76	1225	1823	29,300	130.2	37,100	165.0	0.0728	0.0762	0.0906	0.1199	1,990	2,101
Fort Worth	1300	658.9	1.240	31.50	0.375	9.53	1312	1952	34,600	153.8	42,900	190.8	0.0684	0.0721	0.0858	0.1126	2,067	2,182
El Paso	1350	684.0	1.252	31.80	0.345	8.76	1345	2002	29,300	130.2	37,900	168.6	0.0659	0.0698	0.0829	0.1085	2,111	2,229
ULS El Paso	1350	684.0	1.252	31.80	0.345	8.76	1345	2002	34,900	155.1	43,500	193.5	0.0659	0.0698	0.0829	0.1085	2,111	2,229
Beaumont	1429	723.9	1.294	32,87	0.375	9.53	1436	2136	34,600	153.8	43,700	194.4	0.0623	0.0661	0.0785	0.1025	2,193	2,317
San Antonio	1475	747.3	1.315	33.40	0.385	9.78	1486	2212	36,400	162.1	45,900	204.2	0.0603	0.0623	0.0738	0.0993	2,278	2,407
Bittern (Balboa)	1582	801.4	1.345	34.16	0.345	8.76	1566	2331	29,300	130.2	39,400	175.3	0.0566	0.0603	0.0714	0.0932	2,332	2,465
ULS Bittern (Balboa)	1582	801.4	1.345	34.16	0.345	8.76	1566	2331	34,900	155.1	45,000	200.2	0.0566	0.0603	0.0714	0.0932	2,332	2,465
Dallas	1795	909.5	1.452	36.88	0.385	9.78	1795	2671	36,400	162.1	47,900	213.1	0.0497	0.0546	0.0640	0.0818	2,540	2,688
ULS Dallas	1795	909.5	1.452	36.88	0.385	9.78	1795	2671	43,500	193.5	55,000	244.7	0.0497	0.0546	0.0640	0.0818	2,540	2,688
Houston	1927	976.6	1.506	38.25	0.415	10.54	1934	2878	42,300	188.3	54,700	243.3	0.0459	0.0510	0.0596	0.0756	2,674	2,832
Lapwing (Laguna)	1949	987.5	1.504	38.20	0.385	9.78	1940	2887	36,400	162.1	48,900	217.5	0.0458	0.0507	0.0595	0.0754	2,664	2,820
Falcon (Sanoma)	2045	1036.2	1.545	39.24	0.415	10.54	2045	3044	42,300	188.3	55,400	246.4	0.0436	0.0479	0.0563	0.0718	2,760	2,922
Chukar (Carmel)	2242	1135.8	1.604	40.74	0.395	10.03	2220	3303	38,400	170.6	52,700	234.4	0.0398	0.0445	0.0521	0.0655	2,912	3,084
Chukar II (Capistrano)	2606	1320.3	1.720	43.69	0.395	10.03	2570	3825	38,400	170.6	55,100	245.1	0.0344	0.0410	0.0472	0.0567	3,169	3,364
Bluebird (Big Sur)	2741	1388.7	1.762	44.75	0.415	10.54	2703	4022	42,300	188.3	59,900	266.4	0.0326	0.0387	0.0447	0.0537	3,273	3,473

Ampacity values based on 60 Hz, zero evelation, 90° sun altitude, 25°C ambient temperature, 0.5 Solar Absorbtivity, 0.5 Emissivity, 2 ft/sec (0.61 m/sec) wind and 96 Watt/ft2 (1033 W/m3), at corresponding surface temperatures. Coefficient of thermal resistance is 0.00404 for ASTM sizes.

ACCC® Conductor Sizes – International

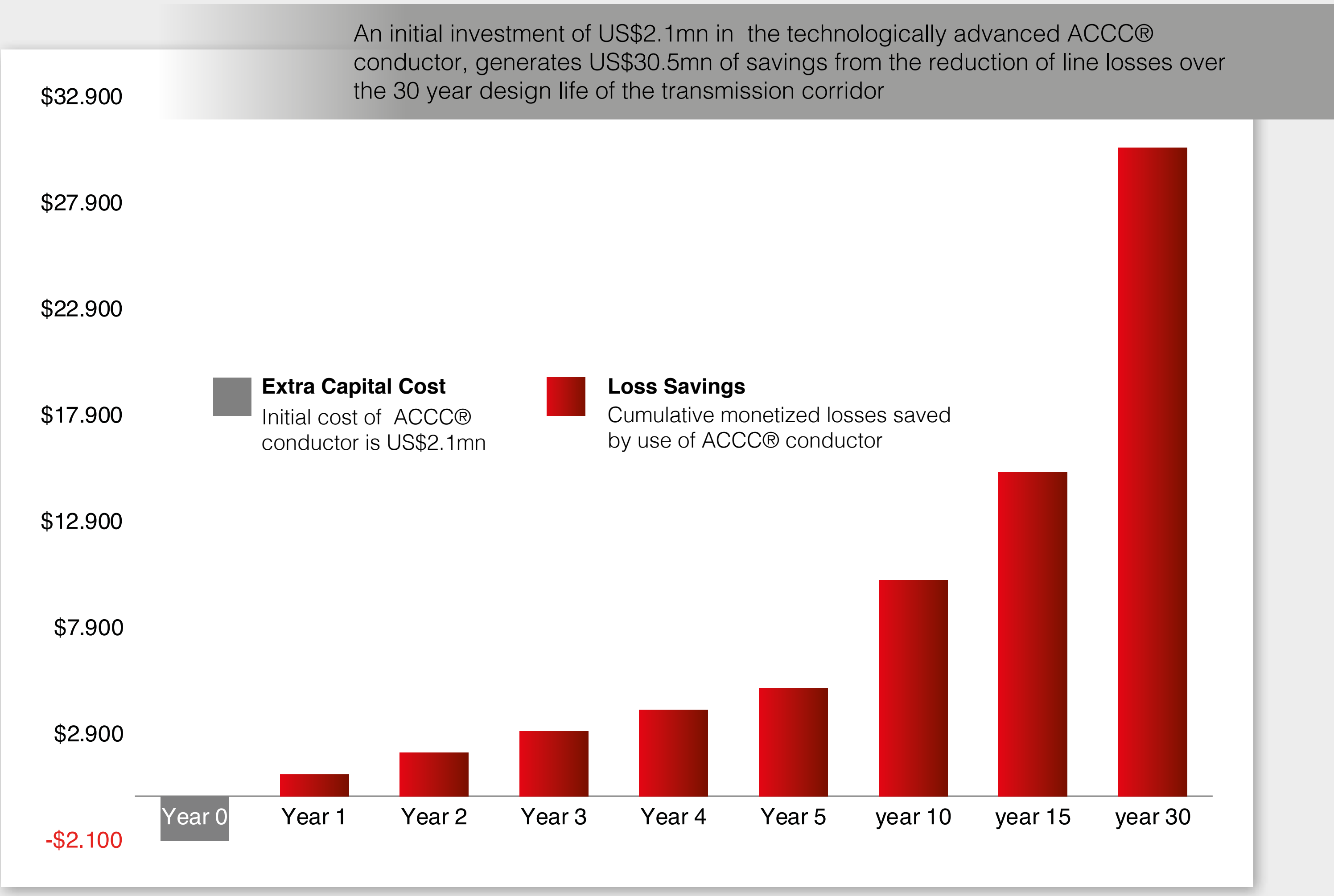
ACCC®	Conductor		Diameter		Core Diameter		Weight		Core Related Strength		Cond. Rated Strength		DC @ 20°C	AC @ 25°C	AC @ 75°C	DC @ 180°C	#AC Ampacity	
International Sizes	(kcmil)	(mm2)	(in)	(mm)	(in)	(mm)	(lb/kft)	(kg/km)	(lb/kft)	(kN)	(lb/kft)	(kN)	(ohm/km)	(ohm/km)	(ohm/km)	(ohm/km)	180°C	200°C
Helsinki	297	150.6	0.616	15.65	0.235	5.97	317	471	13,600	60.4	15,500	68.9	0.1862	0.1902	0.2277	0.3066	802	843
Jaipur	309	156.7	0.650	16.50	0.305	7.75	349	519	22,900	101.7	24,900	110.8	0.1786	0.1824	0.2183	0.2940	832	875
Zadar	356	180.3	0.673	17.09	0.280	7.11	386	574	19,300	85.7	21,600	96.1	0.1552	0.1569	0.1715	0.2555	1,014	1,076
Rovinj	378	191.6	0.673	17.10	0.235	5.97	392	583	13,600	60.4	16,000	71.2	0.1461	0.1477	0.1615	0.2405	1,045	1,110
Copenhagen	434	219.9	0.720	18.29	0.235	5.97	444	661	13,600	60.4	16,400	72.8	0.1272	0.1301	0.1557	0.2094	1,017	1,070
Reykjavik	440	223.1	0.741	18.82	0.280	7.11	466	694	19,300	85.7	22,100	98.3	0.1256	0.1285	0.1537	0.2068	1,032	1,086
Gdansk	491	248.7	0.756	19.20	0.235	5.97	499	743	13,600	60.4	16,700	74.3	0.1127	0.1154	0.1380	0.1855	1,096	1,154
Monte Carlo	451	228.5	0.818	20.78	0.415	10.54	537	799	42,300	188.3	45,200	201.2	0.1230	0.1257	0.1504	0.2025	1,075	1,132
ULS Monte Carlo	451	228.5	0.819	20.79	0.415	10.54	537	799	50,700	225.6	53,600	238.6	0.1230	0.1257	0.1504	0.2025	1,076	1,132
Glasgow	467	236.7	0.769	19.53	0.305	7.75	492	732	22,900	101.7	25,900	115.0	0.1192	0.1219	0.1459	0.1963	1,072	1,128
Casablanca	540	273.6	0.807	20.50	0.280	7.11	561	834	19,300	85.7	22,700	101.1	0.1024	0.1049	0.1255	0.1686	1,173	1,235
Oslo	619	313.8	0.882	22.40	0.345	8.76	659	981	29,300	103.2	33,200	147.8	0.0893	0.0911	0.1091	0.1470	1,292	1,361
Lisbon	623	315.5	0.858	21.79	0.280	7.11	637	948	19,300	85.7	23,300	103.5	0.0887	0.0910	0.1088	0.1460	1,284	1,353
Amsterdam	725	367.4	0.927	23.55	0.305	7.75	740	1101	22,900	101.7	27,500	122.4	0.0762	0.0784	0.0936	0.1255	1,419	1,495
ULS 25mm	753	381.8	0.984	25.00	0.415	10.54	817	1216	50,700	225.6	55,600	247.2	0.0730	0.0752	0.0898	0.1202	1,476	1,556
Brussels	832	421.4	0.990	25.15	0.320	8.13	850	1265	25,200	112.0	30,500	135.7	0.0666	0.0687	0.0820	0.1097	1,549	1,632
ULS Leipzig	802	406.4	0.990	25.15	0.375	9.53	842	1253	41,300	183.5	46,600	207.3	0.0690	0.0713	0.0851	0.1136	1,520	1,602
Stockholm 2L	914	463.3	1.039	26.39	0.345	8.76	937	1395	29,300	130.2	35,100	156.2	0.0605	0.0625	0.0746	0.0996	1,649	1,739
Stockholm 3L	895	453.7	1.039	26.39	0.345	8.76	919	1368	29,300	130.2	35,000	155.7	0.0617	0.0637	0.0760	0.1016	1,633	1,722
Warsaw	1002	507.5	1.091	27.71	0.345	8.76	1021	1520	29,300	130.2	35,700	158.7	0.0553	0.0573	0.0683	0.0910	1,751	1,847
Dublin	1035	524.5	1.108	28.14	0.375	9.53	1064	1583	34,600	153.8	41,200	183.3	0.0534	0.0553	0.0660	0.0879	1,790	1,889
Hamburg	1078	546.4	1.127	28.63	0.345	8.76	1093	1627	29,300	130.2	36,200	160.9	0.0514	0.0534	0.0636	0.0846	1,834	1,935
Kolkata	1073	543.5	1.127	28.63	0.375	9.53	1104	1643	34,600	153.8	41,400	184.0	0.0517	0.0536	0.0639	0.0851	1,829	1,930
ULS Mahakam	1075	544.9	1.142	29.01	0.415	10.54	1127	1677	50,700	225.6	57,600	256.3	0.0516	0.0535	0.0638	0.0850	1,839	1,940
Milan	1120	567.7	1.146	29.11	0.345	8.76	1133	1686	29,300	130.2	36,400	162.1	0.0494	0.0514	0.0612	0.0813	1,880	1,984
Rome	1169	592.5	1.177	29.90	0.375	9.53	1192	1774	34,600	153.8	42,100	187.1	0.0474	0.0494	0.0588	0.0780	1,935	2,043
Vienna	1242	629.2	1.198	30.43	0.345	8.76	1245	1853	29,300	130.2	37,200	165.5	0.0445	0.0466	0.0554	0.0733	2,007	2,119
Budapest	1319	668.3	1.240	31.50	0.375	9.53	1333	1984	34,600	153.8	43,000	191.4	0.0420	0.0440	0.0523	0.0691	2,088	2,205
Prague	1363	690.7	1.251	31.78	0.345	8.76	1364	2031	29,300	130.2	38,000	169.0	0.0407	0.0428	0.0508	0.0670	2,126	2,245
ULS Prague	1363	690.7	1.251	31.78	0.345	8.76	1364	2031	34,900	155.1	43,800	194.8	0.0407	0.0428	0.0508	0.0670	2,126	2,245
Mumbai	1353	685.4	1.251	31.78	0.375	9.53	1367	2035	34,600	153.8	43,200	192.0	0.0410	0.0431	0.0511	0.0675	2,119	2,238
Munich	1447	733.1	1.293	32.84	0.375	9.53	1458	2170	34,600	153.8	43,800	195.0	0.0384	0.0405	0.0480	0.0632	2,211	2,336
London	1498	759.0	1.315	33.40	0.385	9.78	1511	2248	36,400	162.1	46,000	204.8	0.0370	0.0391	0.0464	0.0609	2,264	2,392
Paris	1606	813.7	1.345	34.16	0.345	8.76	1590	2366	29,300	130.2	39,600	175.9	0.0345	0.0368	0.0435	0.0568	2,358	2,492
Bordeaux	1738	880.8	1.408	35.76	0.415	10.54	1859	2766	42,300	188.3	53,500	237.9	0.0318	0.0340	0.0402	0.0524	2,491	2,633
Antwerp	1865	944.8	1.451	36.86	0.385	9.78	1855	2760	36,400	162.1	48,400	215.2	0.0297	0.0321	0.0378	0.0489	2,598	2,748
ULS Antwerp	1865	944.8	1.451	36.86	0.385	9.78	1855	2760	43,500	193.5	55,600	247.3	0.0297	0.0321	0.0378	0.0489	2,598	2,748
Berlin (Madrid-Ice)	1986	1006.5	1.504	38.20	0.415	10.54	1982	2949	42,300	188.3	55,100	245.0	0.0278	0.0303	0.0356	0.0458	2,713	2,872
Madrid	1999	1013.0	1.504	38.20	0.385	9.78	1981	2948	36,400	162.1	49,200	219.1	0.0276	0.0302	0.0354	0.0454	2,721	2,880
Athens	2782	1409.6	1.762	44.75	0.415	10.54	2732	4066	42,300	188.3	60,200	267.6	0.0199	0.0231	0.0267	0.0328	3,335	3,538

Ampacity values based on 50 Hz, zero evelation, 90° sun altitude, 25°C ambient temperature, 0.5 Solar Absorbtivity, 0.5 Emissivity, 2 ft/sec (0.61 m/sec) wind and 96 Watt/ft2 (1033 W/m3), at corresponding surface temperatures. Coefficient of thermal resistance is 0.00403 for internaional sizes.

ACCC® Aluminum Conductor Composite Core

Unmatched Financial Returns with the ACCC® Conductor

100km Test Line Analysis shows the cumulative value of line loss savings over the project life in the difference of initial capital cost of ACCC® Drake versus ACSR Drake.



EMTA KABLO SANAYİ ve TİCARET A.Ş. / EMTA CONDUCTOR & CABLE INC.

Head Office - Istanbul
Istasyon Mahallesi Ibisaga Cad. No: 4
Tuzla - Istanbul / TURKEY
T: +90 216 446 66 06 (Pbx) **F**: +90 216 446 43 93

Plant - Osmaniye
Kadirli Organize Sanayi Bolgesi 1. Cadde No: 15
Kadirli - Osmaniye / TURKEY
T: +90 328 739 23 05 **F**: +90 328 739 23 08

Ankara Branch Office
Çetin Emeç Bulvarı Ceyhun Atıf Kansu Cad. 1368 Sok.
No: 1/7 Balgat - Ankara / TÜRKİYE
T: +90 312 284 01 93-94 **F**: +90 312 284 01 95

Branch Office - CANADA
HSBC Building No: 1500- 885 West Georgia St.
V6C-3E8 Vancouver B.C. / CANADA
T: + 1 604 601 20 24
www.emtacanada.com

Branch Office - IRAQ
Anykawa-Hadyab No: 240/2/552 Arbil / IRAQ
M: +964 750 461 14 64

sales@emtaconductor.com • support@emtaconductor.com
www.emtaconductor.com