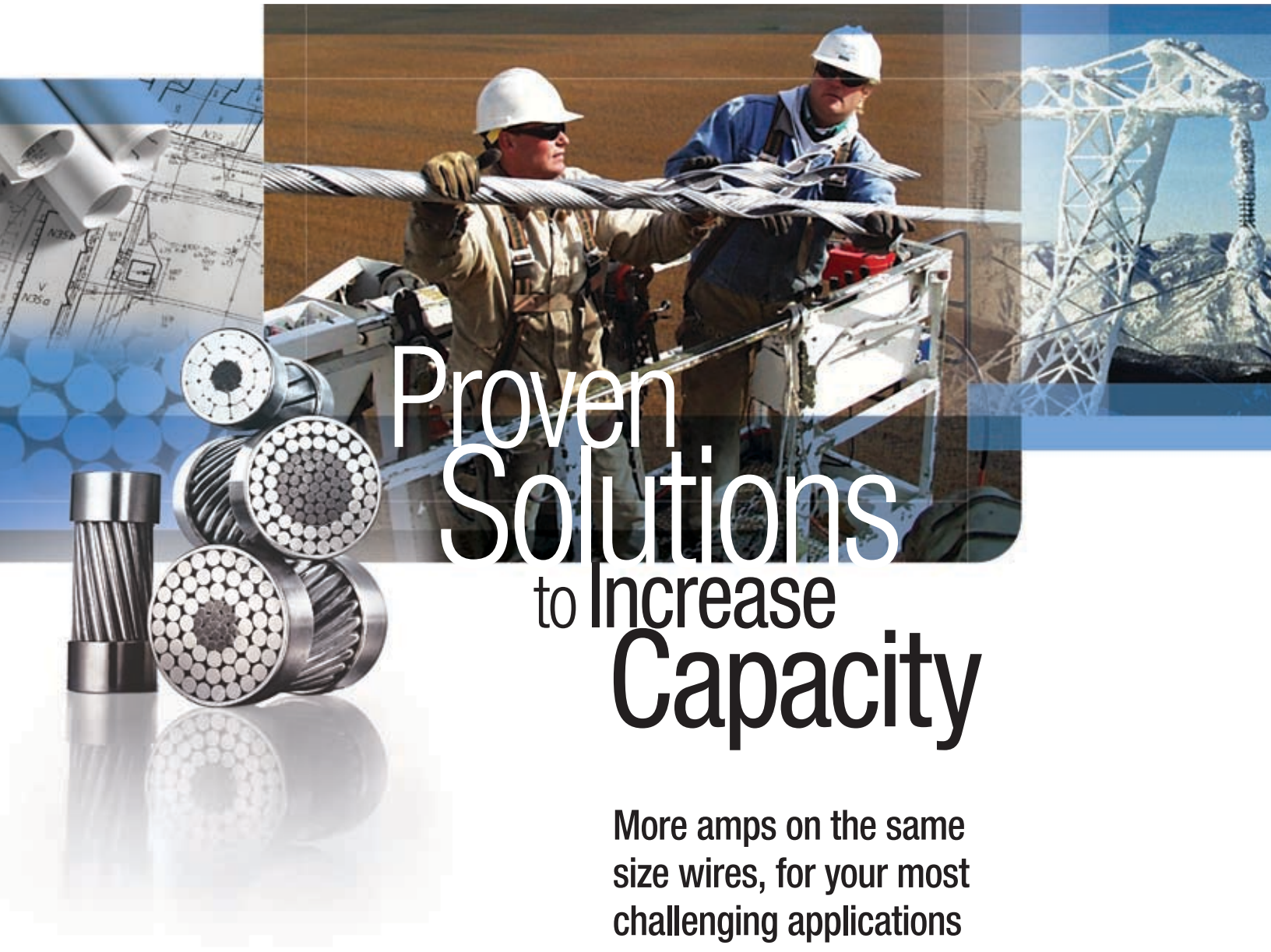
3M™ Aluminum Conductor Composite Reinforced (ACCR)
Technical Summary



Proven Solutions to Increase Capacity

More amps on the same size wires, for your most challenging applications

3M

The strong, lightweight, high capacity conductor

3M™ Aluminum Conductor Composite Reinforced (ACCR) is an all-aluminum-based conductor designed to improve transmission capacity, even in challenging situations and environments.

The tremendous advantages of 3M ACCR are due to innovations in the materials used. Compared to conventional steel core conductors, the 3M ACCR core has:

- Equivalent strength and durability,
- Less weight,
- Better corrosion resistance,
- Equivalent modulus,
- Higher electrical conductivity, and
- Lower thermal expansion.

This permits the use of higher operating temperatures, which in turn leads to higher ampacities. Both the core and the outer aluminum-zirconium strands contribute to the overall conductor strength and conductivity.

Physical Properties	Unit	Linnet 336	Ibis 397	Hawk 477	Dove 557	Grosbeak 636
Designation		ACCR_340-T16	ACCR_405-T16	ACCR_470-T16	ACCR_573-T16	ACCR_637-T16
Stranding		26/7	26/7	26/7	26/7	26/7
Diameter						
Indiv Core Wire	mm	2.3	2.5	2.7	2.9	3.1
Indiv Al Wire	mm	2.9	3.2	3.4	3.8	4.0
Total Core	mm	6.8	7.4	8.0	8.8	9.3
Total Conductor	mm	18.4	20.1	21.6	23.9	25.2
Area						
Aluminum	mm^2	172	205	238	291	323
Total Area	mm^2	200	239	277	338	375
Weight						
Core	kg/m	0.098	0.116	0.134	0.164	0.181
Aluminum	kg/m	0.476	0.568	0.659	0.803	0.892
Total Weight	kg/m	0.573	0.684	0.793	0.967	1.073
Strength	kgf	6,305	7,484	8,709	10,478	11,612
Thermal Elongation						
Core	10^{-6}/°C	6.3	6.3	6.3	6.3	6.3
Aluminum	10^{-6}/°C	23.0	23.0	23.0	23.0	23.0
Complete Cable	10^{-6}/°C	16.7	16.7	16.7	16.7	16.7
Heat Capacity						
Core	W-sec/ft-°C	32	38	44	53	59
Aluminum	W-sec/ft-°C	455	542	629	767	851

Electrical Properties						
Resistance						
DC @ 20°C	ohms/km	0.1596	0.1338	0.1153	0.0945	0.0851
AC @ 25°C	ohms/km	0.1634	0.1369	0.1180	0.0968	0.0872
AC @ 50°C	ohms/km	0.1795	0.1505	0.1297	0.1064	0.0958
AC @ 75°C	ohms/km	0.1957	0.1640	0.1414	0.1159	0.1044
AC @ 100°C	ohms/km	0.2119	0.1776	0.1530	0.1255	0.1131
AC @ 210°C	ohms/km	0.2830	0.2373	0.2045	0.1677	0.1510
AC @ 240°C*	ohms/km	0.3024	0.2535	0.2185	0.1792	0.1614
Geometric Mean Radius	mm	7.4615	8.1498	8.7793	9.6941	10.2145
Reactance (0.315 m spacing, 60hz)						
Inductive Xa	ohms/km	0.2797	0.2731	0.2675	0.2600	0.2560
Capacitive X'a		0.1671	0.1629	0.1594	0.1546	0.1521
Ampacity						
210° C	amps	942	1,058	1,167	1,331	1,426
240° C*	amps	1,010	1,135	1,253	1,430	1,533

To learn more about 3M ACCR, or to download the PLS-CADD™ data files, visit us at www.3M.com/ACCR

* Emergency operating temperature, 1,000 hours cumulative. Ampacity ratings were calculated using IEEE Std. 738-1993, with inputs of 40°C air temperature, 0.6 mps wind, and emissivity and absorptivity of 0.5, at sea level.

Drake 795	Cardinal 954	Curlew 1033	Finch 1113	Pheasant 1272	Martin 1351	Falcon 1590
ACCR_824-T16	ACCR_967-T13	ACCR_1036-T13	ACCR_1117-T13	ACCR_1267-T13	ACCR_1334-T13	ACCR_1594-T13
26/19	54/19	54/19	54/19	54/19	54/19	54/19
2.1	2.0	2.1	2.2	2.3	2.4	2.6
4.5	3.4	3.5	3.7	3.9	4.0	4.4
10.6	10.2	10.6	11.0	11.7	12.0	13.1
28.6	30.6	31.7	32.9	35.0	35.9	39.3
418	490	525	566	642	676	808
484	552	591	638	723	761	910
0.229	0.214	0.229	0.247	0.291	0.306	0.365
1.155	1.362	1.458	1.573	1.781	1.875	2.241
1.384	1.576	1.687	1.820	2.071	2.181	2.606
14,606	15,059	16,148	17,418	19,505	20,548	24,313
6.3	6.3	6.3	6.3	6.3	6.3	6.3
23.0	23.0	23.0	23.0	23.0	23.0	23.0
16.5	17.1	17.1	17.1	17.4	17.4	17.4
75	70	75	81	91	96	114
1,102	1,299	1,391	1,500	1,707	1,797	2,147

0.0658	0.0572	0.0534	0.0495	0.0437	0.0415	0.0347
0.0674	0.0585	0.0546	0.0507	0.0447	0.0425	0.0355
0.0741	0.0643	0.0600	0.0557	0.0491	0.0467	0.0390
0.0808	0.0701	0.0655	0.0607	0.0536	0.0509	0.0426
0.0874	0.0759	0.0709	0.0657	0.0580	0.0551	0.0461
0.1168	0.1014	0.0947	0.0878	0.0775	0.0736	0.0615
0.1248	0.1083	0.1012	0.0938	0.0828	0.0786	0.0658
10.5612	11.3533	11.7491	12.2016	12.9933	13.3327	14.5769
0.2535	0.2481	0.2455	0.2426	0.2379	0.2360	0.2292
0.1460	0.1428	0.1412	0.1394	0.1364	0.1352	0.1309
1,691	1,855	1,941	2,042	2,219	2,298	2,588
1,820	1,997	2,090	2,199	2,392	2,477	2,792

For a complete library of lab and field tests, organized by both conductor size and test subject, visit our website: www.3M.com/ACCR

Conformance to National Standards

All materials shall conform to the applicable American National Standards Institute (ANSI) C119.4; American Society for Testing and Materials (ASTM) Standards B193, B557, B941; or International Annealed Copper Standard (IACS).

Physical Characteristics

Aluminum Strands

The aluminum strands are composed of an aluminum-zirconium alloy and are round in shape, although trapezoidal is also available. The minimum conductivity of any individual aluminum strand is not less than 60 percent of the International Annealed Copper Standard (IACS).

The aluminum-zirconium strands are a hard drawn aluminum with mechanical properties very similar to 1350-H19 aluminum (23-25 ksi, 158-172 MPa) ultimate tensile strength. This is NOT a soft annealed aluminum. The addition of a small amount of zirconium to the aluminum confers the property of heat resistance. That is, the aluminum-zirconium may be heated to high temperatures, without softening (annealing) and losing its strength like 1350-H19 aluminum would. Thus when the aluminum-zirconium cools to ambient temperatures, it retains its strength.

Core Strands

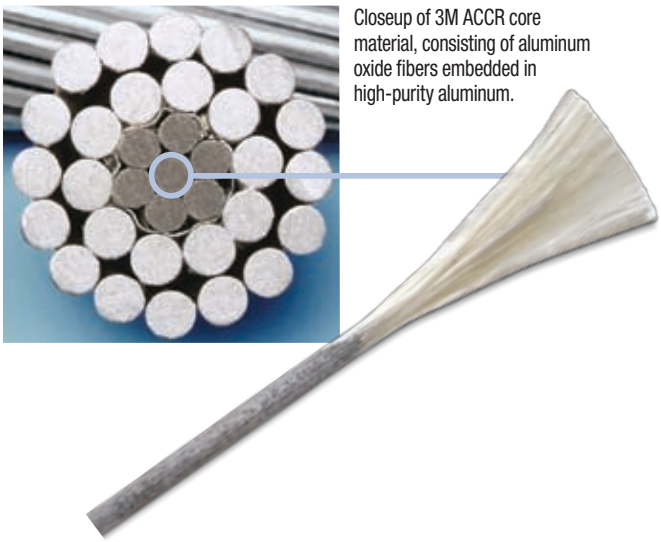
The core strands contain aluminum oxide fibers embedded in high-purity aluminum forming a wire. This type of material is called a fiber reinforced metal matrix. It contains NO polymers or plastic: the base material is metallic aluminum. This material confers the properties that make 3M ACCR conductor lightweight, while performing with high strength and low sag at high temperatures. This is because the fiber reinforced metal matrix composite has strength equivalent to steel, with weight (density) similar to aluminum, but with less thermal expansion than steel and strength retention at high temperatures. Additionally, some of the secondary properties are also favorable. These include low creep, high electrical conductivity (from the aluminum constituent), and corrosion resistance (similar to aluminum).

Conductor Stranding

3M ACCR uses constructions that are very similar to ACSR. It uses most of the same dimensions for wire sizes and conductor sizes. Aluminum-zirconium layers are helically stranded using the same lay lengths and lay directions as ACSR. The core wires are also helically stranded but use longer lay lengths than the steel cores found in ACSR.

3M™ Aluminum Fiber Core

Each strand of 3M ACCR core wire is reinforced with tens of thousands of ultra-high-strength aluminum oxide fibers. The result is a solution specifically designed for high-temperature operation – providing dramatic ampacity gains with significantly less sag than standard options.



Closeup of 3M ACCR core material, consisting of aluminum oxide fibers embedded in high-purity aluminum.

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Please recycle. Printed in USA.
Issued: 11/07
80-6016-0280-0