

3M™ ACCR



More Amps

More Confidence



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Senior Applications Engineer

What is 3M™ ACCR?



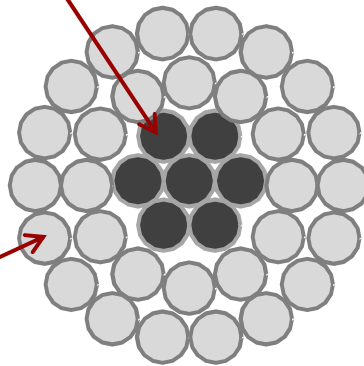
- A high voltage, overhead transmission conductor...
- ...designed as a drop-in replacement for ACSR and other conventional conductors on existing, thermally limited lines
- ...allowing utilities to use existing structures...
- ...capable of carrying 2 or more times the current...
- ...reliably for decades.

Improving Performance of a Proven Conductor Design

ACSR

Coated Steel Core Wires:

- Strength: 1275 MPa
- Density: 7.8 g/cm³
- Coefficient of Thermal Expansion: $12.0 \times 10^{-6}/^{\circ}\text{C}$



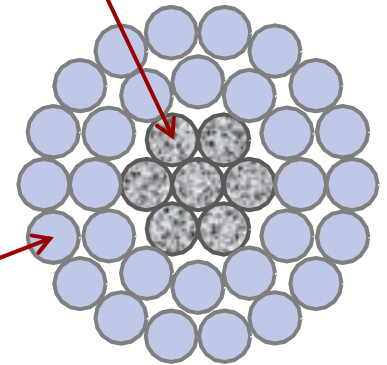
Hardened 1350 H19 Aluminum Conductor Wires

- Rated to 93 °C

ACCR

Aluminum Composite Core Wires:

- Strength: 1380 MPa
- Density: 3.3 g/cm³
- Coefficient of Thermal Expansion: $6.3 \times 10^{-6}/^{\circ}\text{C}$



Hardened Aluminum Zirconium Conductor Wires

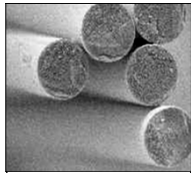
- Rated to 210 °C continuous, 240 °C for 1,000 hours

- A Century of Proven Reliability
- Ampacity limited by sag & conductor temperature

- Same reliable design as ACSR
- Reduced sag & higher temperature rating → ~2 times higher ampacity
- All Aluminum core improves corrosion resistance and conductivity

ACCR Composite Core Wire

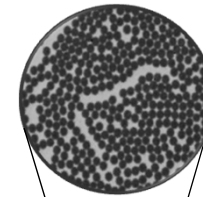
~ 20,000 Continuous
Aluminum Oxide Fibers



Infiltrated with
pure, ductile
aluminum



Aluminum Matrix
Composite Wire



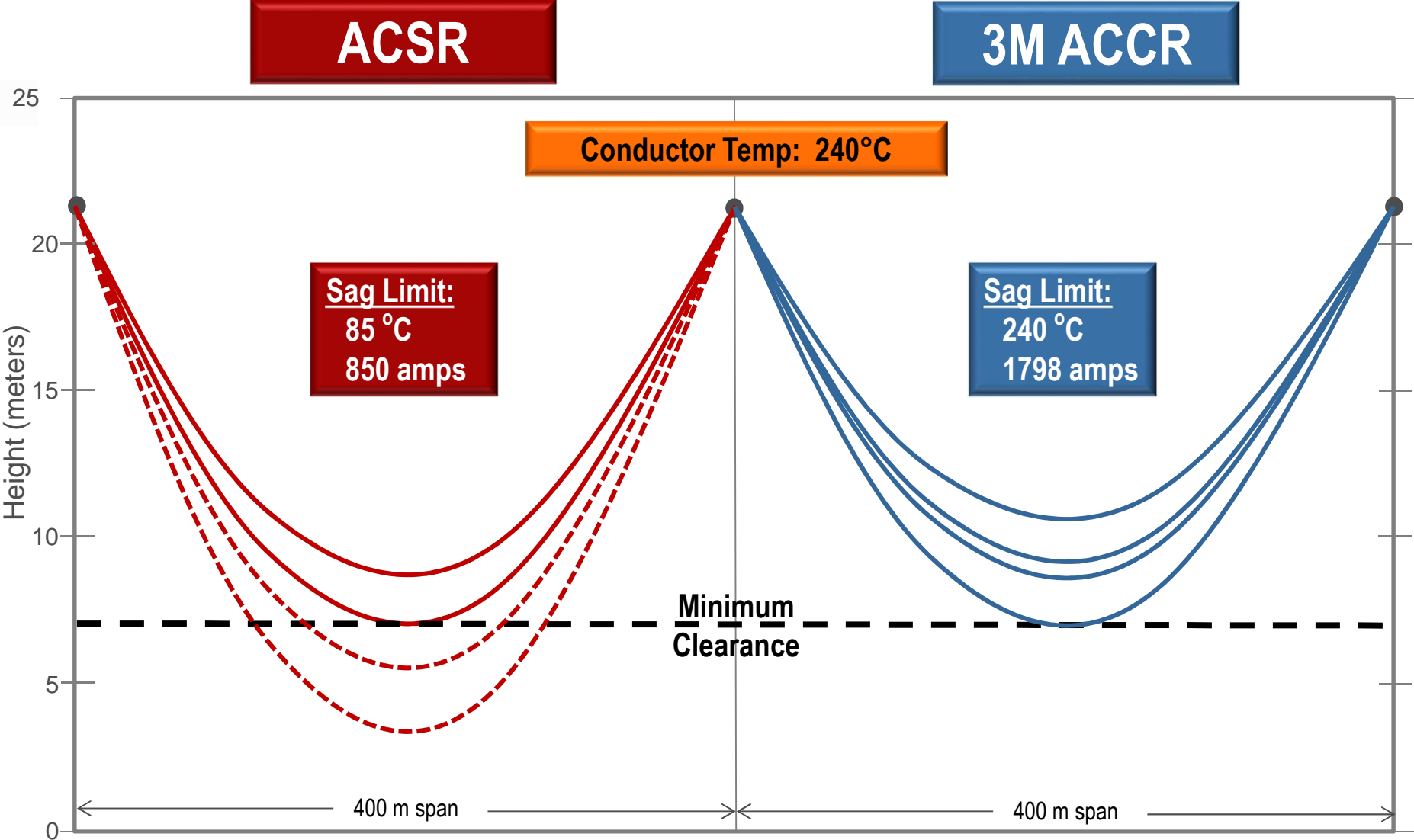
Fiber Properties:

Lightweight and Strong
Low thermal expansion
Extremely stable and heat resistant

Composite Wire Properties:

Strength of steel with half the weight
Coefficient of Thermal Expansion half of steel
Superior stability & corrosion resistance

3M ACCR Maximizes Ampacity of Thermally Constrained Lines



Assumes ACSR and 3M ACCR at 396 m ruling span, initial tension 2,948 kg @ 15° C, max. loading @ -1° C, no ice, 0.5 kg/m² wind; ambient conditions: 0.6m/s wind, 35° C, perpendicular wind direction, 0.5 emissivity and solar absorption.

Property Comparison: 3M ACCR vs. ACSR

Metric Units		Diameter	Weight	Strength	Strength / Weight	Resistance		Ampacity
						DC @ 20°C	AC @ 75°C	
		mm	N/m	N	%	Ohms /km	Ohms /km	amps
Ostrich 300	ACSR	17.3	6.0	56,500		0.1859	0.2272	492
	ACCR	17.2	4.9	53,800		0.1826	0.2240	953
	ACCR vs ACSR	-0.4%	-18.2%	-4.7%	+16 %	-1.8%	-1.4%	+94 %
Hawk 477	ACSR	21.8	9.6	86,700		0.1167	0.1430	659
	ACCR	21.6	7.8	85,400		0.1153	0.1414	1,292
	ACCR vs ACSR	-0.7%	-18.8%	-1.5%	+21 %	-1.3%	-1.2%	+96 %
Drake 795	ACSR	28.1	15.9	140,100		0.0702	0.0862	907
	ACCR	28.6	13.6	143,200		0.0658	0.0808	1,874
	ACCR vs ACSR	+1.9%	-14.9%	2.2%	+20 %	-6.2%	-6.4%	+107 %
Curlew 1033	ACSR	31.6	19.4	162,800		0.0541	0.0692	1,047
	ACCR	31.7	16.6	158,400		0.0534	0.0655	2,154
	ACCR vs ACSR	+0.1%	-14.7%	-2.7%	+14 %	-1.4%	-5.4%	+106 %
Bittern 1272	ACSR	34.2	20.9	151,684		0.0445	0.0563	1,184
	ACCR	34.3	19.3	171,256		0.0450	0.0552	2,465
	ACCR vs ACSR	+0.3%	-7.5%	12.9%	+122%	+1.7%	-1.6%	+108%

Ampacity at 25°C, 2.0 ft/s (0.6 m/s) wind, 0.5 emissivity and absorptivity at sea level., using IEEE Std. 738-1993.

Extensive Product Testing



Conductor Mechanical Design

Conductor strength
Dead-end strength
Joint strength
Stress-Strain behavior
Stiffness
Thermal expansion

Conductor Electrical Design

Conductor resistance

Installation

Sheave Testing
Torsion

High Temperature Performance

Validate sag / tension calculations
Validate stability of conductor and accessories during thermal cycling

Accessory Design

DE Strength
Joint Strength
Current Cycle
Dampers
Repair Sleeve
Galloping
Aeolian Vibration
Corona RIV
Spacer
Repair Splice
Suspension - turn angle
Suspension - unbalanced load
Suspension - ET profile







Long-term Confidence

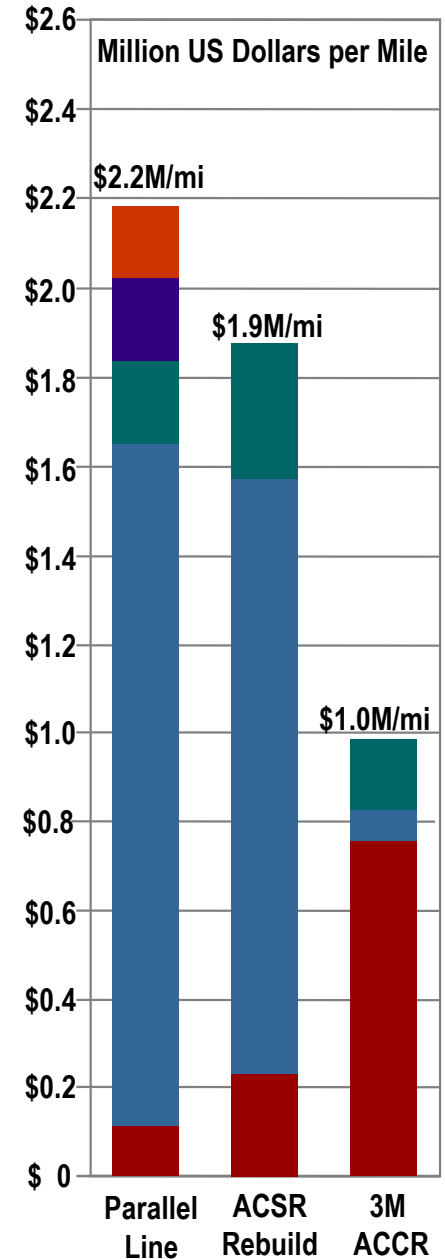
Creep
Aeolian Vibration
Damping
Galloping
Impact
Corrosion Resistance
Lightning Resistance
Fault current
Shotgun
Suspension slip & strength
Hardware Temperature
DE Sustained Load – RT, ET
Thermal/Current Cycling



Transmission Upgrade Cost Comparison

100% ampacity upgrade of 17 mile, double circuit 220 kV line

Conductor (inc. connectors)	Structures	Stringing	Substation	Land & Permitting	Construction Outage
					
Build parallel line with ACSR 1033 kcmil (823mm²) Curlew					
\$119,000	\$1,546,000	\$180,000	\$180,000	\$150,000 (right-of-way unavailable)	No outage but several years to build
Rebuild line with twin bundled ACSR 1033 kcmil (823mm²) Curlew					
\$238,000	\$1,332,000	\$300,000	---	---	24 month outage
Reconductor with 3M ACCR 1622 kcmil (823mm²) Pecos					
\$755,000	\$63,000	\$150,000	---	---	Two 2-month outages

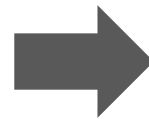


Notes: 1) Total costs reported by utility, some component costs estimated

ACCR Advantage

ACCR Maximizes Ampacity

- Typically doubles ampacity of ACSR lines
- Provides significantly more ampacity than other high capacity conductors for most lines

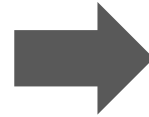


Maximizes Value of Existing Lines

- More Revenue from more power
(200 amp upgrade on 220 kV line can deliver energy worth \$3M/year)
- Flexibility to accommodate changing power flows
- Quick access to renewables
- Increased grid robustness and reliability

ACCR Avoids Tower Rebuilds

- Lower weight and thermal expansion of ACCR reduces sag without increasing loads on towers

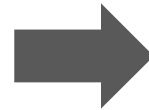


Saves Time and Money --- Easier

- Significantly reduced construction costs
- Much shorter outages
- Less impact on communities & environment
- Reduced or no permitting

ACCR is Extremely Robust

- Resistant to heat, cold, corrosion, NO₂, UV
- Resistant to fatigue and creep
- Modulus matches ACSR (low strain under load)



ACCR Works Everywhere

- Deserts, wetlands, coasts, & mountains
- Congested cities & long water crossings
- Heavy ice and wind loads

ACCR is Reliable

- >100 installations around the world
- > 15 years of very reliable field history



Confidence

- 100% successful installations

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