



# Copperclad Steel Wire

Dead Soft Annealed | OnyxCCS® | Jacketed

High Strength | Extra High Strength

Composite Conductors | Guy Wire



## Overview

AFL's Copperclad Steel Wire is the ideal solution for grounding wire for power type applications. Composed of a steel core with copper cladding, the steel wire gives the wire its strength and the thin, consistent layer of copper cladding provides electrical conductivity and resistance to corrosion.

To manufacture Copperclad Steel Wire, carbon steel (low, high strength and extra high strength) is bonded with a uniform layer of oxygen-free copper cladding to achieve 30% and 40% IACS (International Annealed Copper Standard) conductivities. It is then concentrically stranded from one to three layers with left-hand lay in the outer layer (right-hand lay optional) and individual wires of the same size. Available in a single wire and 3, 7 and 19 cable strands.

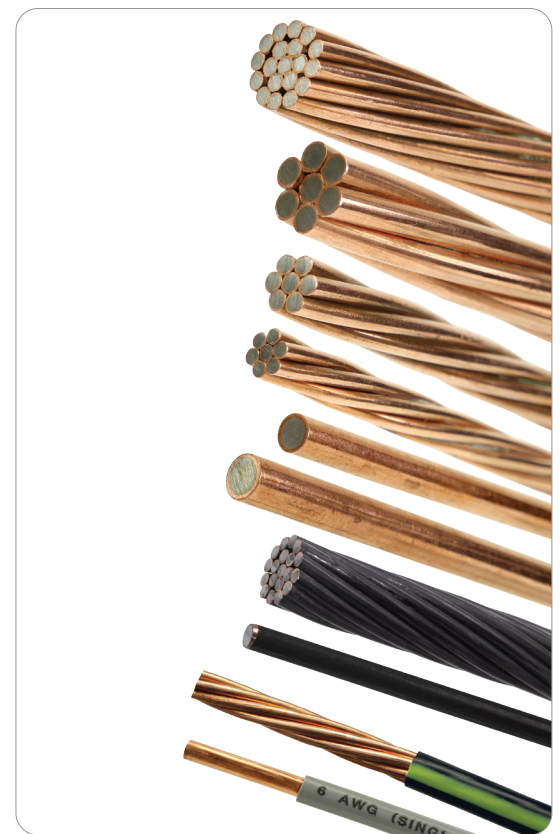
When compared to solid copper, Copperclad Steel Wire has faster impedance to ground for better protection of lines and equipment plus a higher resistance to thermal expansion failures. It also reduces the fatigue damage caused by more than 10 times that of annealed solid copper.

## Features

- Demonstrates the same corrosion-resistant properties as copper while maintaining the high strength of steel
- Stronger than copper and can withstand more mechanical abuse than solid copper wire
- Reduces damage caused during installation or fatigue from vibration or bending
- Low carbon steel core gives the maximum amount of flexibility while maintaining high strength
- Special heat treat process results in a very malleable wire that is easy to handle and install without special tools or equipment
- Copper cladding permanently bonded to the central steel core
- Very little scrap value, discouraging theft and leaving the grounding system intact
- Manufacturing facility certified to ISO 9001:2008

## Applications

- Substation grounding grid and fence ground
- Transmission lines
- Pole ground wire for distribution lines
- Guy Wire
- Messenger Wire



Copperclad Steel Wire (from top) 19-strand, 7-strand large, 7-strand medium, 7-strand small, single-strand small, single-strand large, OnyxCCS® 19- and single-strand, 7-strand black jacket and single-strand jacketed #6 AWG.

## Grounding Applications



AFL's Swage360® Grounding Coupler compressed onto 19-strand Copperclad Steel Wire

Grounding protects the network and eliminates damage from lightning and short-circuit conditions. Annealed or hard drawn Copperclad Steel Wire is an ideal grounding conductor for primary surge arresters as it allows a continuous length of conductor to be installed from the arrester to the buried grounding electrode. The steel core of the Copperclad ground wire can withstand more mechanical abuse and is less susceptible to vibration-induced fatigue than solid copper or aluminum wire.

Depending on the grounding requirement, AFL offers a Copperclad Steel Wire in the conductor size, strength and conductivity designed for the application. Standard connectors used for copper wire can be used on all Copperclad products including exothermic connections.



## Selecting the Right Size for the Application

When selecting a conductor for a ground grid, it must meet the maximum fault current for the identified duration and meet a minimum breaking load as required by the substation design (typically 5,000 pounds). The key to properly sizing Copperclad Steel Wire is the actual fault current requirement. Often solid copper is physically oversized to the actual fault requirement to gain the physical strength needed in the application. With Copperclad, the physical strength is inherent to the product so the primary consideration is electrical.

Traditionally, a chart comparing the ampacity ratings of copper and Copperclad Steel Wire allows the user to visually select the Copperclad equivalent. For example:

**Requirements:** The equivalent to 4/0 copper per the chart is 19#9 40%. A typical maximum fault current for a distribution substation is ~18 kA at 30 cycles. Most engineers upsize to 4/0 copper in order to meet the mechanical strength requirement.

**AFL solution:** A 2/0 copper or 7#6 Copperclad Steel Wire conductor will meet this requirement instead of the larger size 4/0 copper commonly used for ground grids. The conductor safety margin for 7#6 Copperclad Steel Wire is 30% and meets the fault current and mechanical strength requirements.

### 40% Copperclad Steel

CONDUCTOR SIZE (AWG)	NO. OF WIRES	SINGLE WIRE DIAMETER		OVERALL DIAMETER		AREA		FAULT CURRENT AT 0.5 SEC.	WEIGHT		WIRE RESISTANCE		MIN. BREAK LOAD	
		IN.	MM	IN.	MM	CMIL	MM <sup>2</sup>		LBS/KFT	KG/KM	Ω/KFT	Ω/KM	LBF	KGF
19 No. 4	19	0.2043	5.19	1.02	25.95	793031	401.83	107.27	2254.69	3355.44	0.0338	0.1110	21755	9868
19 No. 5	19	0.1819	4.62	0.91	23.10	628665	318.55	85.03	1787.38	2659.98	0.0427	0.1400	17246	7823
19 No. 6	19	0.1620	4.11	0.81	20.57	498636	252.66	67.45	1417.68	2109.81	0.538	0.1765	13679	6205
19 No. 7	19	0.1443	3.67	0.72	18.33	395627	200.47	53.51	1124.82	1673.96	0.0678	0.2224	10853	4923
19 No. 8	19	0.1285	3.26	0.64	16.32	313733	158.97	42.44	891.98	1327.45	0.0855	0.2805	8606	3904
19 No. 9	19	0.1144	2.91	0.57	14.53	248660	126.00	33.63	706.97	1052.12	0.1079	0.3539	6821	3094
4/0	19	0.1055	2.68	0.53	13.40	211475	107.16	28.60	601.25	894.78	0.1268	0.4161	5801	2631
19 No. 10	19	0.1019	2.59	0.51	12.94	197289	99.97	26.69	560.92	834.76	0.1359	0.4460	5412	2455
19 No. 11	19	0.0907	2.30	0.45	11.52	156303	79.20	21.14	444.39	661.34	0.1716	0.5629	4288	1945
7 No. 4	7	0.2043	5.19	0.61	15.57	292169	148.04	39.52	827.40	1231.34	0.0914	0.3000	8015	3636
7 No. 5	7	0.1819	4.62	0.55	13.86	231613	117.36	31.33	655.91	976.13	0.1153	0.3784	6354	2882
7 No. 6	7	0.1620	4.11	0.49	12.34	183708	93.09	24.85	520.24	774.23	0.1454	0.4771	5040	2286
7 No. 7	7	0.1443	3.67	0.43	11.00	145757	73.86	19.72	412.7719	614.29	0.1833	0.6013	3998	1814
2/0	7	0.1379	3.50	0.41	10.51	133115	67.45	18.01	376.9694	561.01	0.2007	0.6584	3652	1656
7 No. 8	7	0.1285	3.26	0.39	9.79	115586	58.57	15.63	327.3285	487.13	0.2311	0.7583	3171	1438
7 No. 9	7	0.1144	2.91	0.34	8.72	91612	46.42	12.39	259.4356	386.09	0.2916	0.9567	2513	1140
7 No. 10	7	0.1019	2.59	0.31	7.76	72685	36.83	9.83	205.8382	306.33	0.3675	1.2058	1994	904
No. 2	7	0.0860	2.18	0.26	6.55	51772	26.23	7.00	146.6137	218.19	0.5160	1.6929	1420	644
No. 4	7	0.0680	1.73	0.20	5.18	32368	16.40	4.38	91.6633	136.41	0.8253	2.7077	888	403
No. 2	1	0.2576	6.54	0.26	6.54	66368	33.63	8.98	186.0875	276.94	0.3985	1.3075	2023	918
No. 4	1	0.2043	5.19	0.20	5.19	41738	21.15	5.65	117.0294	174.16	0.6337	2.0790	1272	577
No. 6	1	0.1620	4.12	0.16	4.12	26250	13.30	3.55	73.6030	109.54	1.0076	3.3057	800	363

## OnyxCCS<sup>®</sup> Copperclad Steel Wire

OnyxCCS offers the same benefits as standard Copperclad Steel (CCS) while offering enhanced protection against copper theft. In addition to the inherent strength of a CCS product, OnyxCCS has a chemically-etched surface treatment which permanently darkens the standard CCS. This process discourages theft of a utility's copper infrastructure and does not compromise mechanical nor electrical properties.

OnyxCCS is offered in all sizes of the AFL Copperclad product line. To order OnyxCCS, the part number pre-fix "CCX" replaces "CCS". EX: **CCX07074DR1000F**



OnyxCCS<sup>®</sup> Copperclad Steel Wire

# Copperclad Part Number Nomenclature

## Ordering Information

**Step 1:** Determine Catalog Number.

**Step 2:** Determine Package Code.

**Step 3:** Assemble complete part number—Catalog Number + Package Code

- Example: For a 2,000 ft. reel of 40% and 7#8 DSA, the complete part number is CCS07084DR2000F.

### Step 1—Catalog Number

CATALOG NUMBER (NOT ALL SIZES LISTED)		
CONDUCTOR CONFIGURATION	30% CONDUCTIVITY	40% CONDUCTIVITY
#6 Jacketed		CCS01064D-JV*
#4 Jacketed		CCS01044D-JV*
#2 Jacketed		CCS01024D-JV*
#4 Stranded Jacketed		CCS4STR4D-JV*
#2 Stranded Jacketed		CCS2STR4D-JV*
#2 Stranded		CCS2STR4D
#4 Stranded		CCS4STR4D
#2	CCS01023D	CCS01024D
#4	CCS01043D	CCS01044D
#6	CCS01063D	CCS01064D
3#5	CCS03053D	CCS03054D
3#6	CCS03063D	CCS03064D
3#7	CCS03073D	CCS03074D
3#8	CCS03083D	CCS03084D
3#9	CCS03093D	CCS03094D
3#10	CCS03103D	CCS03104D
7#5	CCS07053D	CCS07054D
7#6	CCS07063D	CCS07064D
7#7	CCS07073D	CCS07074D
7#8	CCS07083D	CCS07084D
7#9	CCS07093D	CCS07094D
7#10	CCS07103D	CCS07104D
19#5	CCS19053D	CCS19054D
19#6	CCS19063D	CCS19064D
19#7	CCS19073D	CCS19074D
19#8	CCS19083D	CCS19084D
19#9	CCS19093D	CCS19094D

\* See Jacket detail sheet for alternate jacketing configurations and part numbers.

### Step 2—Package Code

Select preference of packaging type.

COILS		REELS		SPOOLS	
CODE (LBS)	CODE (FT)	CODE (LBS)	CODE (FT)	CODE (LBS)	CODE (FT)
C50P	C334F	R500P	R500F	S25P	S318F
C100P		R1000P	R1000F		
C200P		R2000P	R2000F		
		R3521P	R3521F		

Not all sizes listed.

### Step 3—Assemble Complete Part Number



## Explanation of Copperclad Part Numbers

CCS	0707	4	D	R	1000	F
Copperclad Steel (CCX = Onyx)	Stranding <b>0707</b> = 7 Strands of #7 <b>0102</b> = Single Strand of #2	Conductivity (IACS Int'l Annealed Copper) <b>3</b> = 30% <b>4</b> = 40 %	Material Type <b>D</b> = DSA (Dead Soft Annealed) <b>H</b> = High Strength <b>E</b> = Extra High Strength	Package Type <b>R</b> = Reel <b>S</b> = Spool <b>C</b> = Coil	Package Quantity	Unit of Measure <b>F</b> = Feet (ft) <b>P</b> = Pounds (lbs)