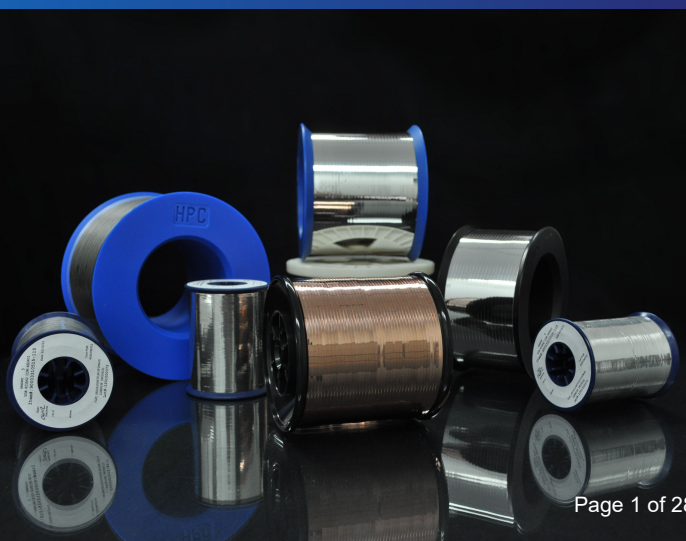
HIGH PERFORMANCE CONDUCTORS LLC

Product Catalog

HPC Sales

1570 Campton Road
Inman, SC 29349
United States
1-864-472-9022



www.internationalwiregroup.com

Catalog Index

HIGH PERFORMANCE CONDUCTORS LLC

About Us

HIGH PERFORMANCE CONDUCTORS LLC

A World Leader in High Performance Conductors

With corporate headquarters in Inman, South Carolina, High Performance Conductors is the world's leading fabricator of specialty high-performance conductors for the aerospace, medical, automotive, computer, telecommunications, mass transportation, geophysical, and electronics markets. For more than 100 years, we have led the way in developing new conductor products and processes to meet our customers' ever-evolving needs.

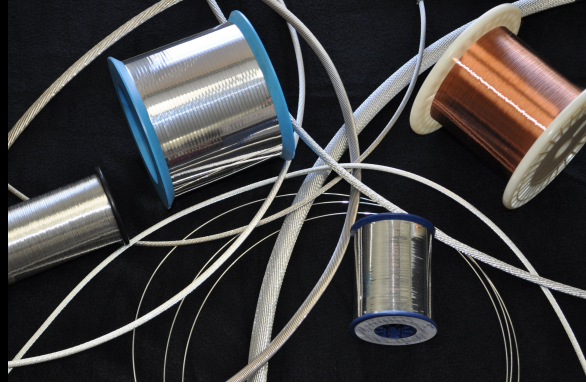
Dedicated to Quality and Service

We are totally committed to service and quality through product innovation with advanced manufacturing, research and development, and engineering support. Our facility in Inman, South Carolina, is the world's largest facility for producing specialty conductors, including a full line of silver-plated and nickel-plated copper and copper alloy conductors. Flat wire, composite products, and high-tensile-strength alloy conductors are also manufactured at Inman. One year's copper wire production there would result in a single wire long enough to circle the globe 21,548 times.

A Global Presence

IWG High Performance Conductors maintains both a national and international presence as a leader in the industry with sales offices located in Inman, South Carolina, and Puurs, Belgium. You will find our products and applications not only throughout North America, but also in markets around the world, including Asia, Europe, Central America, and South America.

Our Capabilities



HIGH PERFORMANCE CONDUCTORS LLC

Our Inman campus, situated on 78 acres is home to our manufacturing facilities for specialty High-Performance Conductors.

The 315,000 ft² facility is ISO 9001-2015 and AS 9100-Rev. D certified and utilizes lean techniques including cellular manufacturing, kanban, 5S, and single-piece flow.

Equipment:
Rod Breakdown Machines
Silver, Nickel & Tin Electroplaters
Heavy and Intermediate Bunchers & Stranders
Planetary Cablers
Multiple Winders, Respoolers, Rolling Mills, Annealing Ovens, and Testing Equipment

Production / Process Information:
Silver, Nickel, and Tin Plated ETP and Oxygen Free Copper
Silver and Nickel Plated Copper Alloys such as CDA 162
Proprietary Alloy Systems such as Tensile-Flex® (135), HPC-80EF, HPC-35EF and CS-95®
Precision-Tolerance Flat Conductors plated with Silver, Nickel, or Tin
Constructions include single end, 7/19/37 strand, smooth bunch, bobbin, and ropes.

HIGH PERFORMANCE CONDUCTORS LLC

High Performance Conductors – Copper Alloy Comparison

IWG High Performance Conductors' has several copper-alloy options that have decades of service in a variety of industries such as aerospace, geophysical, and medical applications. The table and charts below provide a comparative overview of material properties.

COPPER-ALLOY COMPARISON

Copper-Alloy[1]	Tensile Rating (KSI)			Min Elong	Max Resistivity		Min Conductivity		Thermal
	Soft		Hard	(%)	(Ω-cmil/ft)		(%IACS)		Conductivity
BASE METAL	Min	Typical[2]	Min	Soft[3]	Soft	Hard	Soft	Hard	(BTU-ft/(h-ft2-F)
ETP/OF Copper	-	35	60	-	10.37	10.69	100	97	226
Tensile-Flex (135)	60	73	100	6	11.52	12.20	90	85	200
HPC-35EF	60	66	100	6	11.52	12.20	90	85	200
C162 Cad Copper	55	63	100	6	12.20	12.96	85	80	208
HPC-80EF	55	59	100	6	12.20	12.96	85	80	191
CS-95	95	103	130	6	16.46	25.93	63	40	139

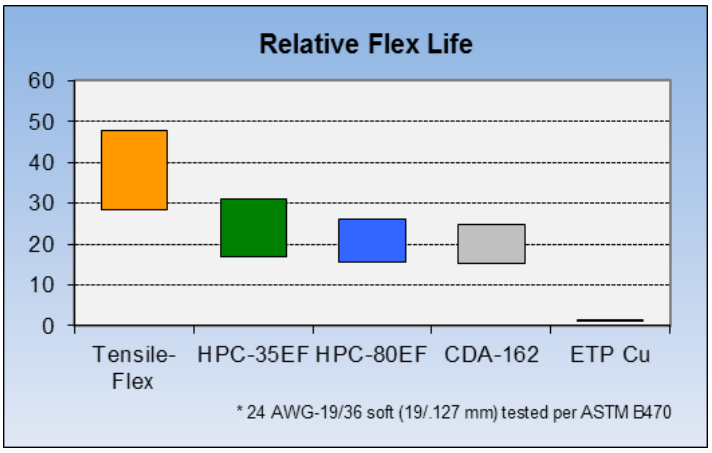
COPPER-ALLOY COMPARISON - METRIC

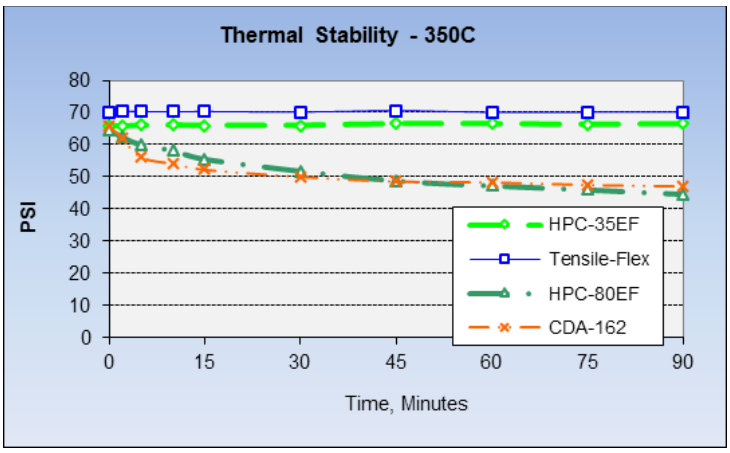
Copper-Alloy[1]	Tensile Rating (MPa)			Min Elong	Max Resistivity		Min Conductivity		Thermal
	Soft		Hard	(%)	(μΩ-cm)		(%IACS)		Conductivity
BASE METAL	Min	Typical[2]	Min	Soft[3]	Soft	Hard	Soft	Hard	(watt/meter-K)
ETP/OF Copper	-	241	414	-	1.72	1.78	100	97	391
Tensile-Flex (135)	414	503	690	6	1.92	2.03	90	85	346
HPC-35EF	414	455	690	6	1.92	2.03	90	85	346
C162 Cad Copper	379	434	690	6	2.03	2.15	85	80	360
HPC-80EF	379	407	690	6	2.03	2.15	85	80	330
CS-95	655	710	897	6	2.74	4.31	63	40	240

1- ETP/OF, HPC-35EF, HPC-80EF, and CS-95 will meet RoHS compliance requirements.

2- Typical tensile ratings based on 24 AWG – 19/36 (19/.127 mm).

3- Typical elongation ratings for ETP/OF will be dependant on the size and relevant ASTM requirement.





HIGH PERFORMANCE CONDUCTORS LLC

ETP (C110) and OF (C102) Copper – High Performance Copper

ETP Copper is the most widely used copper grade with universal use in electronic applications. ETP copper is rated at 100% minimum conductivity making it the primary choice for applications requiring lower resistance. OF copper offers a higher purity and will be used in applications where resistance to hydrogen embrittlement is a consideration.

IWG High Performance Conductors plated ETP and OF conductors have decades of reliable service in a variety of industries such as:

- High performance electronics
- Medical equipment applications
- High Performance Military and Commercial Aerospace applications
- RoHS Compliant

MATERIAL PROPERTIES		
Composition	ETP: 99.90 Purity, inc. silver (Refer to ASTM B49)	
	OF: 99.95% Purity, inc. silver (Refer to ASTM B49)	
Unified Number	ETP: C11000, OF: C10200	
Density	0.323 lbs/in^3 @68F (8.941 gm/cm^3 @20C)	
Thermal Conductivity	226 BTU-ft/(h-ft^2-F) [(391 watt/meter-K)]	
PHYSICAL PROPERTIES		
	Soft Temper (nom)	*Hard Temper (min)*
Tensile	35,000 PSI (241 MPa)	60,000 PSI (414 MPa)
ELECTRICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Resistivity, max	10.37 cmil-Ω/ft (1.72 mΩ-cm)	10.69 cmil-Ω/ft (1.78 μΩ-cm)
Conductivity	100 % IACS	97% IACS
AVAILABILITY		
Coatings [1]	Silver - ASTM B298, Nickel - ASTM B355, Tin - ASTM B33	
Constructions [2, 3, 4]	Solid: 11 - 54 AWG	
	Stranded: 10 - 42 AWG (7, 19, 37 Unilay and Conc.)	
	Rope Stranded: 4/0 - 8 AWG	
	Flat: 17 - 38 (Equivalent round AWG size)	

1 – Strand sizes less than 44 AWG will not meet 40 micro-inches per ASTM B298

2 – Some sizes do not apply to nickel and tin plated ETP/OF

3 - 37 strand options are unidirectional concentric (UDC), 2-pass conc.(2PC), or 3-pass conc.(3PC)

4 – Alternative constructions available for quote upon request

Revision 10/2014

IWG High Performance Conductors LLC
1570 Campton Road Inman, SC 29349 Phone (864)472-9022 Fax (864)472-3381

HIGH PERFORMANCE CONDUCTORS LLC

Tin Coated Copper (ETP) – Standard Specifications

19-Wire: Tin-Coated Copper Specifications - Lightweight Conductors

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	(Ω/KM)
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
16	19/29	UNI	0.0520	0.0530	1.32	1.35	6.93	7.01	10.3	10.4	4.77	15.7
18	19/30	UNI	0.0460	0.0467	1.17	1.19	5.43	5.54	8.08	8.24	6.15	20.2
20	19/32	UNI	0.0370	0.0378	0.940	0.960	3.46	3.57	5.15	5.31	9.63	31.6
22	19/34	UNI	0.0290	0.0296	0.737	0.752	2.14	2.20	3.18	3.27	15.8	51.8
24	19/36	UNI	0.0230	0.0236	0.584	0.599	1.33	1.39	1.98	2.07	25.7	84.3
26	19/38	UNI	0.0180	0.0188	0.457	0.478	0.844	0.894	1.26	1.33	40.9	134

Rope Stranded: Tin-Coated Copper Specifications - Lightweight Conductors

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	Ω/KM
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
4/0	37x 57/30	CONC	0.565	0.585	14.4	14.9	620	652	923	970	0.056	0.184
3/0	37x 45/30	CONC	0.516	0.531	13.1	13.5	490	518	729	771	0.071	0.233
2/0	19x 70/30	CONC	0.450	0.464	11.4	11.8	389	413	579	615	0.091	0.299
1/0	19x 55/30	CONC	0.405	0.418	10.3	10.6	310	328	461	488	0.116	0.381
1	19x 43/30	CONC	0.360	0.369	9.14	9.37	234	256	348	381	0.146	0.479
2	19x 35/30	CONC	0.320	0.331	8.13	8.41	197	209	293	311	0.183	0.600
4	19x 7/25	UNI	0.250	0.256	6.35	6.50	123	128	183	190	0.280	0.919
6	19x 7/27	UNI	0.198	0.203	5.03	5.16	77.4	81.0	115	121	0.433	1.42
8	19x 7/29	UNI	0.158	0.162	4.01	4.11	49.0	52.0	72.9	77.4	0.701	2.30

Revision: 06/2015

IWG High Performance Conductors LLC
1570 Campton Road Inman, SC 29349 Phone (864)472-9022 Fax (864)472-3381

HIGH PERFORMANCE CONDUCTORS LLC

Tensile-Flex High Performance Copper Alloy

IWG High Performance Conductors' Tensile-Flex copper base alloy has been recognized for more than 30 years as the premium high performance conductor alloy. Its tremendous success in the aerospace, geophysical, medical and other high performance applications is due to its unique combination of high tensile strength, excellent flex life and high conductivity.

Tensile-Flex was originally developed for applications requiring high tensile strength and resistance to annealing at elevated temperatures. Tensile-Flex maintains its tensile strength at temperatures exceeding 700°F. The high strength, conductivity, and thermal stability of Tensile-Flex exceeds the properties of comparable copper alloys, enabling it to easily meet requirements of industry specifications SAE AS22759, MIL-W-29606, NEMA WC67, and ASTM B624.

MATERIAL PROPERTIES		
Composition	99% Cu; Balance Cr, Cd	
Unified Number	C18135	
Density	0.323 lbs/in^3 @68F (8.941 gm/cm^3 @20C)	
Thermal Conductivity	200 BTU-ft/(h-ft^2-F) [(346 watt/meter-K)]	
PHYSICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Elongation, min	6%	1%
Tensile, min	60,000 PSI (414 MPa)	100,000 PSI (690 MPa)
ELECTRICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Resistivity, max	11.52 cmil-Ω/ft (1.92 mΩ-cm)	12.20 cmil-Ω/ft (2.03 μΩ-cm)
Conductivity	90 % IACS	85% IACS
Temp. Coeff. of Resist.	0.00342 / °C	0.00342 / °C
AVAILABILITY		
Coatings [1]	Silver - Per ASTM B298, Nickel - per ASTM B355	
Constructions [2, 3, 4]	Solid: 24 - 52 AWG	
	Stranded: 16 - 42 AWG (7 Wire, 19 Wire Unilay and Conc.)	
	Flat: 30 - 38 (Equivalent round AWG size)	

1 – Strand sizes less than 44 AWG will not meet 40 micro-inches per ASTM B298

2 - Solid construction may not meet stated properties.

3 – Some sizes do not apply to nickel plated Tensile-Flex

4 – Alternative constructions available for quote upon request

HIGH PERFORMANCE CONDUCTORS LLC

HPC-35EF - Environmentally Friendly Copper Alloy

IWG High Performance Conductors, in response to global concerns, has taken a leadership role in developing high performance and environmentally friendly alloy systems. These alloys have been specifically designed to be free of heavy metal elements such as cadmium, mercury, and lead.

HPC-35EF was designed for RoHS applications and offers comparable conductivity, tensile strength, and thermal stability to Tensile Flex. Utilizing the same precipitation-hardening strengthening mechanism as Tensile Flex, HPC-35EF meets requirements of industry specifications such as SAE AS22759, MIL-W-29606, NEMA WC67, and ASTM B624.

MATERIAL PROPERTIES		
Composition	99% Cu; Balance Cr, Ag, Si	
Density	0.323 lbs/in^3 @68F (8.941 gm/cm^3 @20C)	
Thermal Conductivity	200 BTU-ft/(h-ft^2-F) [(346 watt/meter-K)]	
PHYSICAL PROPERTIES		
	Soft Temper	***Hard Temper***
Elongation, min	6%	1%
Tensile, min	60,000 PSI (414 MPa)	100,000 PSI (690 MPa)
ELECTRICAL PROPERTIES		
	Soft Temper	***Hard Temper***
Resistivity, max	11.52 cmil-Ω/ft (1.92 mΩ-cm)	12.20 cmil-Ω/ft (2.03 μΩ-cm)
Conductivity	90 % IACS	85% IACS
Temp. Coeff. of Resist.	0.00342 / °C	0.00342 / °C
AVAILABILITY		
Coatings [1]	Silver - Per ASTM B298, Nickel - per ASTM B355	
Constructions [2, 3, 4]	Solid: 24 - 52 AWG	
	Stranded: 16 - 42 AWG (7 Wire, 19 Wire Unilay and Conc.)	
	Flat: 30 - 38 (Equivalent round AWG size)	

1 – Strand sizes less than 44 AWG will not meet 40 micro-inches per ASTM B298

2 - Solid construction may not meet stated properties.

3 – Some sizes do not apply to nickel plated HPC-35EF

4 – Alternative constructions available for quote upon request

HIGH PERFORMANCE CONDUCTORS LLC

Cadmium Copper (C162) - High Performance Copper Alloy

IWG High Performance Conductors' Cadmium Copper Alloy (C162) system has provided decades of reliability in a wide variety of applications for the wire and cable industry. C162 performance characteristics such tensile strength, flex life, thermal stability, and high electrical conductivity make it an excellent choice for a variety of applications such as aerospace, geophysical exploration, and medical equipment applications.

MATERIAL PROPERTIES		
Composition	99% Cu; Balance Cd	
Unified Number	C16200	
Density	0.321 lbs/in^3 @68F (8.885 gm/cm^3 @20C)	
Thermal Conductivity	208 BTU-ft/(h-ft^2-F) [(360 watt/meter-K)]	
PHYSICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Elongation, min	8%	1%
Tensile, min	55,000 PSI (379 MPa)	100,000 PSI (690 MPa)
ELECTRICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Resistivity, max	12.20 cmil-Ω/ft (2.03 mΩ-cm)	12.96 cmil-Ω/ft (2.15 μΩ-cm)
Conductivity	85 % IACS	80 % IACS
Temp. Coeff. of Resist.	0.00319 / °C	0.00319/ °C
AVAILABILITY		
Coatings [1, 2]	Silver - ASTM B298, Nickel - ASTM B355, Tin - ASTM B33	
Constructions [3, 4. 5]	Solid: 24 - 44 AWG	
	Stranded: 16 - 36 AWG (7 Wire, 19 Wire Unilay and Conc.)	
	Flat: 30 - 38 (Equivalent round AWG size)	

1 – Strand sizes less than 44 AWG will not meet 40 micro-inches per ASTM B298

2 - Tin plating availability for hard temper only.

3 - Solid construction may not meet stated properties.

4 – Some sizes do not apply to nickel and tin plated C162

5 – Alternative constructions available for quote upon request

Revision: 10/2014

IWG High Performance Conductors LLC
1570 Campton Road Inman, SC 29349 Phone (864)472-9022 Fax (864)472-3381

HIGH PERFORMANCE CONDUCTORS LLC

HPC-80EF - Environmentally Friendly Copper Alloy

IWG High Performance Conductors, in response to global concerns, has taken a leadership role in developing high performance and environmentally friendly alloy systems. These alloys have been specifically designed to be free of heavy metal elements such as cadmium, mercury, and lead.

HPC-80EF was designed for RoHS applications and offers comparable conductivity, tensile strength, flex life, and thermal stability to C162 Cadmium Copper. Utilizing the same solution strengthening as C162, HPC-80EF was designed to be the RoHS compliant counterpart to C162 in a variety of industries such as commercial aerospace, geophysical exploration, and medical equipment applications.

MATERIAL PROPERTIES		
Composition	99% Cu; Balance Mg	
Density	0.323 lbs/in^3 @68F (8.941 gm/cm^3 @20C)	
Thermal Conductivity	191 BTU-ft/(h-ft^2-F) [(330 watt/meter-K)]	
PHYSICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Elongation, min	8%	1%
Tensile, min	55,000 PSI (379 MPa)	100,000 PSI (690 MPa)
ELECTRICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Resistivity, max	12.20 cmil-Ω/ft (2.03 mΩ-cm)	12.96 cmil-Ω/ft (2.15 μΩ-cm)
Conductivity	85 % IACS	80 % IACS
Temp. Coeff. of Resist.	0.00319 / °C	0.00319/ °C
AVAILABILITY		
Coatings [1, 2]	Silver - ASTM B298, Nickel - ASTM B355, Tin - ASTM B33	
Constructions [3, 4. 5]	Solid: 24 - 52 AWG	
	Stranded: 14 - 42 AWG (7 Wire, 19 Wire Unilay and Conc.)	
	Flat: 30 - 38 (Equivalent round AWG size)	

1 – Strand sizes less than 44 AWG will not meet 40 micro-inches per ASTM B298

2 - Tin plating availability for hard temper only.

3 - Solid construction may not meet stated properties.

4 – Some sizes do not apply to nickel and tin plated HPC-80EF

5 – Alternative constructions available for quote upon request

HIGH PERFORMANCE CONDUCTORS LLC

CS-95 - Ultra-High Strength Copper Alloy

IWG High Performance Conductors' CS-95 copper base alloy system was initially introduced to the wire and cable industry to lead the reduction of size and weight while simultaneously increasing the reliability of cabling systems in aerospace. CS-95 has the outstanding properties of:

- Superior Tensile Strength
- Superior Flex Life
- Unsurpassed Strength and Conductivity to Weight Ratio
- Medium Electrical Conductivity
- RoHS Compliant

CS-95 has a history of reliable service in a wide variety of applications such as:

- High Performance Military and Commercial Aerospace
- Medical Diagnostic Equipment
- Miniature Invasive Medical Sensors and Probes
- Miniature Electronics

MATERIAL PROPERTIES		
Composition	98% Cu; Balance Ni, Be	
Unified Number	C17510	
Density	0.319 lbs/in^3 @68F (8.830 gm/cm^3 @20C)	
Thermal Conductivity	139 BTU-ft/(h-ft^2-F) [(240 watt/meter-K)]	
PHYSICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Elongation, min	6%	1%
Tensile, min	95,000 PSI (655 MPa)	130,000 PSI (897 MPa)
ELECTRICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Resistivity, max	16.46 cmil-Ω/ft (2.74 mΩ-cm)	25.93 cmil-Ω/ft (4.31 μΩ-cm)
Conductivity	63 % IACS	40% IACS
Temp. Coeff. of Resist.	0.00198 / °C	0.00198 / °C
AVAILABILITY		
Coatings [1]	Silver - Per ASTM B298, Nickel - per ASTM B355	
Constructions [2, 3, 4]	Solid: 26 - 56 AWG	
	Stranded: 22 - 46 AWG (7 Wire, 19 Wire Unilay and Conc.)	

1 – Strand sizes less than 44 AWG will not meet 40 micro-inches per ASTM B298

2 - Solid construction may not meet stated properties.

3 – Some sizes do not apply to nickel plated CS-95

4 – Alternative constructions available for quote upon request

HIGH PERFORMANCE CONDUCTORS LLC

Nickel Coated Copper (ETP) – Standard Specifications

7-Wire: Nickel-Coated Copper Specifications

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	(Ω/KM)
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
18	7/26	CONC	0.0474	0.0483	1.20	1.23	5.41	5.65	8.05	8.41	6.20	20.3
20	7/28	CONC	0.0375	0.0390	0.953	0.991	3.37	3.60	5.01	5.36	10.0	32.8
22	7/30	CONC	0.0297	0.0309	0.754	0.785	2.11	2.32	3.14	3.45	16.0	52.5
24	7/32	CONC	0.0235	0.0246	0.597	0.625	1.33	1.47	1.98	2.19	25.4	83.3
26	7/34	CONC	0.0184	0.0195	0.467	0.495	0.843	0.920	1.25	1.37	41.6	136
28	7/36	CONC	0.0148	0.0159	0.376	0.404	0.494	0.611	0.735	0.909	65.9	216
30	7/38	CONC	0.0117	0.0129	0.297	0.328	0.312	0.401	0.464	0.597	106	348

19-Wire: Nickel-Coated Copper Specifications - Lightweight Conductors

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	(Ω/KM)
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
16	19/29	UNI	0.0520	0.0530	1.32	1.35	6.93	7.20	10.3	10.7	4.76	15.6
18	19/30	UNI	0.0460	0.0470	1.17	1.19	5.47	5.65	8.14	8.41	6.10	20.0
20	19/32	UNI	0.0370	0.0378	0.940	0.960	3.46	3.60	5.15	5.36	9.73	31.9
22	19/34	UNI	0.0290	0.0296	0.737	0.752	2.14	2.25	3.18	3.35	15.6	51.2
24	19/36	UNI	0.0230	0.0236	0.584	0.599	1.33	1.39	1.98	2.07	25.6	84.0
26	19/38	UNI	0.0180	0.0188	0.457	0.478	0.844	0.930	1.26	1.38	42.2	138

Rope Stranded: Nickel-Coated Copper Specifications - Lightweight Conductors

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	Ω/KM
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
4/0	37x 57/30	CONC	0.565	0.585	14.4	14.9	620	652	923	970	0.056	0.184
3/0	37x 45/30	CONC	0.516	0.528	13.1	13.4	490	518	729	771	0.071	0.233
2/0	19x 70/30	CONC	0.450	0.464	11.4	11.8	389	413	579	615	0.089	0.292
1/0	19x 55/30	CONC	0.405	0.418	10.3	10.6	310	328	461	488	0.113	0.371
1	19x 43/30	CONC	0.360	0.369	9.14	9.37	244	254	363	378	0.144	0.472
2	19x 35/30	CONC	0.320	0.331	8.13	8.41	197	209	293	311	0.175	0.574
4	19x 7/25	UNI	0.250	0.256	6.35	6.50	123	128	183	190	0.275	0.902
6	19x 7/27	UNI	0.198	0.203	5.03	5.16	78.6	82.0	117	122	0.436	1.43
8	19x 7/29	UNI	0.158	0.162	4.01	4.11	49.0	52.0	72.9	77.4	0.694	2.28

Revision: 07/2010

IWG High Performance Conductors LLC
1570 Campton Road Inman, SC 29349 Phone (864)472-9022 Fax (864)472-3381

HIGH PERFORMANCE CONDUCTORS LLC

Silver-Coated Copper (ETP) – Standard Specifications

7-Wire: Silver-Coated Copper Specifications

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	(Ω/KM)
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
18	7/26	CONC	0.0475	0.0485	1.21	1.23	5.32	5.60	8.05	8.41	6.20	20.3
20	7/28	CONC	0.0370	0.0384	0.940	0.975	3.31	3.52	5.01	5.36	10.0	32.8
22	7/30	CONC	0.0294	0.0303	0.747	0.770	2.07	2.23	3.14	3.45	16.0	52.5
24	7/32	CONC	0.0237	0.0247	0.602	0.627	1.33	1.43	1.98	2.19	25.4	83.3
26	7/34	CONC	0.0186	0.0195	0.472	0.495	0.824	0.894	1.25	1.37	41.6	136
28	7/36	CONC	0.0146	0.0153	0.371	0.389	0.494	0.568	0.735	0.909	65.9	216
30	7/38	CONC	0.0116	0.0123	0.295	0.312	0.312	0.367	0.464	0.597	106	348

19-Wire: Silver-Coated Copper Specifications - Lightweight Conductors

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	(Ω/KM)
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
16	19/29	UNI	0.0520	0.0530	1.32	1.35	6.93	7.25	10.3	10.8	4.50	14.8
18	19/30	UNI	0.0460	0.0470	1.17	1.19	5.48	5.70	8.15	8.48	5.79	19.0
20	19/32	UNI	0.0370	0.0378	0.940	0.960	3.48	3.65	5.18	5.43	9.19	30.2
22	19/34	UNI	0.0290	0.0296	0.737	0.752	2.14	2.22	3.18	3.30	15.1	49.5
24	19/36	UNI	0.0230	0.0236	0.584	0.599	1.33	1.40	1.98	2.08	24.1	79.1
26	19/38	UNI	0.0180	0.0188	0.457	0.478	0.844	0.894	1.26	1.33	38.4	126

Rope Stranded: Silver-Coated Copper Specifications - Lightweight Conductors

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	Ω/KM
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
4/0	37x 57/30	CONC	0.570	0.585	14.5	14.9	620	657	923	978	0.054	0.177
3/0	37x 45/30	CONC	0.516	0.528	13.1	13.4	490	522	729	777	0.068	0.223
2/0	19x 70/30	CONC	0.450	0.464	11.4	11.8	389	421	579	626	0.085	0.279
1/0	19x 55/30	CONC	0.405	0.418	10.3	10.6	310	329	461	490	0.108	0.354
1	19x 43/30	CONC	0.360	0.369	9.14	9.37	244	256	363	381	0.139	0.456
2	19x 35/30	CONC	0.320	0.331	8.13	8.41	197	211	293	314	0.170	0.558
4	19x 7/25	UNI	0.250	0.256	6.35	6.50	123	131	183	195	0.264	0.866
6	19x 7/27	UNI	0.198	0.203	5.03	5.16	78.6	83.5	117	124	0.418	1.37
8	19x 7/29	UNI	0.158	0.162	4.01	4.11	49.0	52.5	72.9	78.1	0.658	2.16

Revision: 06/2016

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Silver and Nickel Coated HPC-35EF – Standard Specifications

MATERIAL PROPERTIES		
Density	0.323 lbs/in^3 @68F (8.941 gm/cm^3 @20C)	
Thermal Conductivity	200 BTU-ft/(h-ft^2-F) [(346 watt/meter-K)]	
PHYSICAL PROPERTIES		
	Soft Temper	***Hard Temper***
Elongation	6%	1%
Tensile	60,000 PSI (414 MPa)	100,000 PSI (690 MPa)
ELECTRICAL PROPERTIES		
	Soft Temper	***Hard Temper***
Resistivity	11.52 cmil-Ω/ft (1.92 mΩ-cm)	12.20 cmil-Ω/ft (2.03 μΩ-cm)
Conductivity	90 % IACS	85% IACS
Temp. Coeff. of Resist.	0.00342 / °C	0.00342 / °C

7-Wire: Silver-Coated HPC-35EF Standard Product Specifications

AWG	CONST	BRK STRNG		DIAMETER				WEIGHT				RESIST (@20C)	
		LBS	(N)	INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	(Ω/KM)
		MIN	MIN	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
28	7/36	8.20	36.4	0.0146	0.0153	0.371	0.389	0.493	0.568	0.734	0.845	72.2	237
30	7/38	5.20	23.1	0.0116	0.0123	0.295	0.312	0.311	0.367	0.463	0.546	114	374
32	7/40	3.20	14.2	0.0090	0.0096	0.229	0.244	0.195	0.224	0.290	0.333	189	620
34	7/42	1.85	8.22	0.0072	0.0078	0.183	0.198	0.126	0.155	0.188	0.231	280	920
36	7/44	1.19	5.29	0.0057	0.0063	0.145	0.160	0.0787	0.0960	0.117	0.143	446	1,463
38	7/46	0.75	3.33	0.0045	0.0051	0.114	0.130	0.0510	0.0627	0.076	0.093	755	2,477
40	7/48	0.35	1.56	0.0033	0.0039	0.084	0.099	0.0305	0.0365	0.045	0.054	1,250	4,101
42	7/50	0.30	1.33	0.0028	0.0032	0.072	0.082	0.0195	0.0260	0.029	0.039	1,734	5,689

19-Wire Unilay: Silver-Coated HPC-35EF Standard Product Specifications - Lightweight Conductors

AWG	CONST	BRK STRNG		DIAMETER				WEIGHT				RESIST (@20C)	
		LBS	(N)	INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	(Ω/KM)
		MIN	MIN	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
20	19/32	58.1	258	0.0370	0.0376	0.940	0.955	3.46	3.60	5.15	5.36	10.5	34.5
22	19/34	35.8	159	0.0290	0.0296	0.737	0.752	2.14	2.25	3.18	3.35	17.4	57.1
24	19/36	22.4	99.6	0.0230	0.0236	0.584	0.599	1.33	1.44	1.98	2.14	27.4	89.9
26	19/38	14.2	63.1	0.0180	0.0187	0.457	0.475	0.844	0.912	1.26	1.36	43.5	143

19-Wire Unilay: Nickel-Coated HPC-35EF Standard Product Specifications - Lightweight Conductors

AWG	CONST	BRK STRNG		DIAMETER				WEIGHT				RESIST (@20C)	
		LBS	(N)	INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	(Ω/KM)
		MIN	MIN	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
20	19/32	58.1	258	0.0370	0.0376	0.940	0.955	3.46	3.60	5.15	5.36	11.1	36.4
22	19/34	35.8	159	0.0290	0.0296	0.737	0.752	2.14	2.25	3.18	3.35	18.1	59.4
24	19/36	22.4	99.6	0.0230	0.0236	0.584	0.599	1.33	1.45	1.98	2.16	28.9	94.8
26	19/38	14.2	63.1	0.0181	0.0187	0.460	0.475	0.846	0.904	1.26	1.35	47.4	156

HIGH PERFORMANCE CONDUCTORS LLC

High Performance Precision Flat Wire Conductors

IWG High Performance Conductors manufactures precision tolerance flat wire conductors for a variety of applications including commercial & military aerospace, communication, medical, and automotive. Flat conductors are typically processed as braided shield, served shield, and laminated cables.

Material Availability[1]	Equivalent AWG Sizes[2]	Coatings (Temper) Availability Ag-Silver, Ni-Nickel, Sn-Tin
ETP Copper	17-38	Ag (soft, hard), Ni (soft, hard), Sn (hard)
OF Copper	17-38	Ag (soft, hard), Ni (soft, hard), Sn (hard)
Tensile-Flex® (135)	30-38	Ag (soft, hard), Ni (soft, hard)
HPC-35EF®	30-38	Ag (soft, hard), Ni (soft, hard)
C162 Cad Copper	30-38	Ag (soft, hard), Ni (soft, hard), Sn (hard)
HPC-80EF®	30-38	Ag (soft, hard), Ni (soft, hard), Sn (hard)

Dimensional Availability[2]	Min	Max
Width	0.0100 in (0.254 mm)	0.1500 in (3.810 mm)
Thickness	0.0010 in (0.025 mm)	0.0100 in (0.254 mm)
Aspect Ratio (Width / Thickness)	5:1	55:1

Width	Tolerance
0.0100 in to 0.0499 in (0.254 mm to 1.267 mm)	+/- 0.0013 in (0.0330 mm)
0.0500 in to 0.0699 in (1.270 mm to 1.775 mm)	+/- 0.0015 in (0.0381 mm)
0.0700 in to 0.0999 in (1.778 mm to 2.537 mm)	+/- 0.002 in (0.0508 mm)
0.1000 in to 0.1249 in (2.540 mm to 3.172 mm)	+/- 0.003 in (0.0762 mm)
0.1250 in to 0.1500 in (3.175 mm to 3.810 mm)	+/- 0.004 in (0.1016 mm)

Thickness	Tolerance
0.0010 in to 0.0014 in (0.0254 mm to 0.0356 mm)	+/- .0002 in (.0051 mm)
0.0015 in to 0.0019 in (0.0381 mm to 0.0483 mm)	+/- .0003 in (.0076 mm)
0.0020 in to 0.0049 in (0.0508 mm to 0.1245 mm)	+/- .0004 in (.0102 mm)
0.0050 in to 0.0100 in (0.1270 mm to 0.2540 mm)	+/- .0005 in (.0127 mm)

1/ ETP, OF, HPC-35EF®, and HPC-80EF® will meet RoHS compliance requirements.

2/ Alternate dimensions and sizes available for quote upon request

- IWG HPC manufactures to the following applicable ASTM Standards:

  B971 Silver-Coated Braid and Ribbon Flat Copper Wire intended for use in Electronic Application

  B972 Nickel-Coated Braid and Ribbon Flat Copper Wire Intended for use in Electronic Application

  B973 Tin-Coated Braid and Ribbon Flat Copper Wire intended for use in Electronic Application

- HPC offer 1 lbs. to 30 lbs. per spool depending on size. All wire offered on biconical spools.

Revision 02/2016

IWG High Performance Conductors LLC
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HIGH PERFORMANCE CONDUCTORS LLC

Aluminum Conductors

Our 1350 EC Aluminum products have a wide use in the military and commercial aerospace industry where specific applications require light weight properties.

Our common products are bare rope-stranded conductors based on 24 AWG strand size, which meets aerospace industry standards such as MIL-DTI-29606A.

Contact our Sales Department for custom construction availablility of conductors based on bare 1350 Aluminum.

Rope Stranded: Aluminum Specifications - Lightweight Conductors

AWG	CONST	TYPE	DIAMETER				WEIGHT				RESIST (@20C)	
			INCHES		(MM)		LBS/MFT		(KG/KM)		Ω/MFT	Ω/KM
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX	MAX
4/0	523/24	CONC	0.563	0.587	14.3	14.9	182.9	205	272	305	0.085	0.279
3/0	427/24	CONC	0.511	0.535	13.0	13.6	158	169	235	251	0.109	0.358
2/0	334/24	CONC	0.454	0.478	11.5	12.1	116.9	136	174	202	0.132	0.433
1/0	259/24	CONC	0.4	0.418	10.6	10.6	90.4	106	135	158	0.169	0.554
1	219/24	CONC	0.353	0.368	8.97	9.35	76.7	87.1	114	130	0.214	0.702
2	168/24	CONC	0.315	0.33	8.0	8.38	58.6	66.9	87.2	100	0.268	0.879
4	107/24	CONC	0.248	0.262	6.30	6.65	37.8	42.6	56.3	63.4	0.427	1.4
6	70/24	CONC	0.201	0.211	5.11	5.36	24.7	27.9	36.8	41.5	0.641	2.1
8	41/24	CONC	0.150	0.160	3.81	4.06	14.5	16.3	21.6	24.3	1.09	3.58

HIGH PERFORMANCE CONDUCTORS LLC

Copper-Clad Steel Wire (Class 40A and Class 40HS)

Copper-clad steel (CCS) is a bi-metallic conductor that has a low carbon steel core surrounded by copper. The most common CCS used for electronic applications is 40% nominal conductivity, which is categorized as class 40A for annealed and class 40HS for hard-drawn.

Our copper-clad steel products combine the properties of high tensile strength, corrosion resistance, and decreased electrical resistance when compared to steel. Typical applications would be for the inner conductors of coaxial cables. We offer CCS (40 %) in stranded or single end constructions as bare or plated conductors.

MATERIAL PROPERTIES		
Composition	Carbon steel core with copper cladding	
Density	0.2975 lbs/in^3 @68F (8.24 gm/cm^3 @20C)	
PHYSICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Elongation, min	10%	1%
Tensile, min	50,000 PSI (345 MPa)	110,000 PSI (758 MPa)
ELECTRICAL PROPERTIES		
	Soft Temper	*Hard Temper*
Resistivity, max	26.45 cmil-Ω/ft (1.72 mΩ-cm)	26.45 cmil-Ω/ft (1.78 μΩ-cm)
Conductivity	39 % IACS	39 % IACS
Temp. Coeff of Resist	0.00378 / °C	0.00378 / °C
AVAILABILITY		
Coatings [1]	Silver - ASTM B501, Nickel - ASTM B559, Tin - ASTM B520	
Constructions [2, 3, 4]	Solid: 19 - 38 AWG	
	Stranded: 20 - 30 AWG (7, 19 Conc.)	

1 – Tin plating availability for hard temper only.

2 – Solid construction may vary from stated tensile properties due to size (per ASTM B452)

3 - Some solid sizes aren't available for soft temper CCS

4 – Alternative constructions available for quote upon request

Revision: 10//2014

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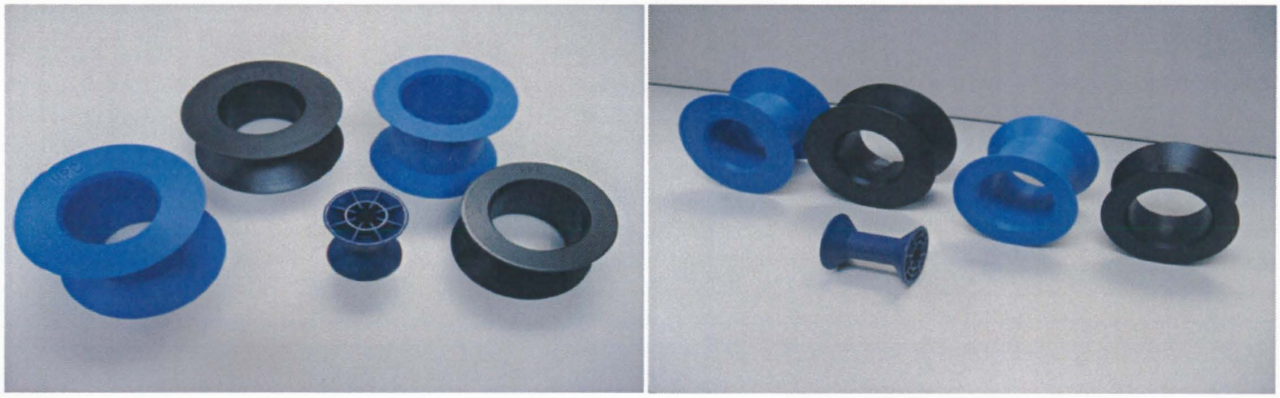
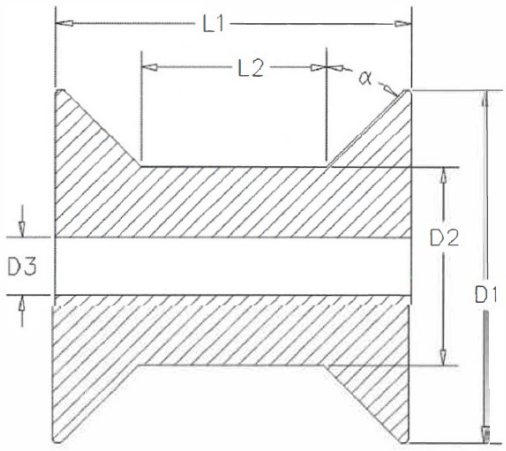
HPC Biconical Spools





Spool Code	Spool Color	Max Wt		Tare Wt		D1		D2		D3		L1		L2		Degree
		lbs	kg	lb	gm	in	mm	in	mm	in	mm	in	mm	in	mm	
115	dark blue	2	0.91	0.14	64	2.6	66	1.4	35.5	0.65	16.5	3.25	82.6	1.75	44.5	45
120	black	4	1.81	0.75	342	5	127	3.5	88.9	3.02	76.6	2.75	69.9	1.15	29.2	45
121	sky blue	7	3.18	0.91	412	5	127	3.5	88.9	3.02	76.6	4.2	106.7	2.6	66	45
126	black	7.6	3.45	1.11	503	6	152.4	3.5	88.9	3.02	76.6	2.75	69.9	1.21	30.7	30
128	sky blue	12.5	5.67	1.28	580	6	152.4	3.5	88.9	3.02	76.6	4	101.6	2.46	62.4	30

To order please contact:
IWG High Performance Conductors LLC
1570 Campton Road Inman, SC 29349 Phone (864)472-9022 Fax (864)472-3381

Contact Us

HIGH PERFORMANCE CONDUCTORS LLC

1570 Campton Road
Inman, SC 29349
United States
+1-864-472-9022
+1-864-472-2727 Fax

Our corporate headquarters in Inman, South Carolina is home to support personnel for our Engineering, Quality Assurance, Research, and Development, Sales and Customer Service, Information Technology Departments.

HPC Engineering

HPCEng@iwghpc.com

HPC Quality

HPCQA@iwghpc.com

General Inquiries

HPCInfo@iwghpc.com

HPC Sales Team

Jason Bagwell
Sales Manager
1-864-472-9022
jason.bagwell@iwghpc.com

Sue Trout
Customer Service
1-864-472-0422
sue.trout@iwghpc.com

Lindy Gaulden
Customer Service
1-864-472-0419
lindy.gaulden@iwghpc.com

Vicky Segarra
Customer Service
1-864-472-0408
vicky.segarra@iwghpc.com

Anja Geerst
Customer Service - Europe
+32-3-860-91-91
anja.geerst@iwghpc.com

Glossary of Terms & Conductor Information for Wire & Cable

Alloy: A combination of a metal with one or more elements to form a new material with different properties.
Attenuation: Weakening or reduction of the strength of a transmitted signal through a cable or circuit. It is also a measure of a cable's efficiency to transmit a signal at a given frequency.
Anneal: To subject a material to a heat treatment to remove the effects of cold work, lowering its tensile strength, rendering it softer with greater elongation.
AWG (American Wire Gauge): A standard used to specify the physical size of a solid or stranded conductor primarily used in the United States. Originally called the Brown and Sharpe Gage.
Bird-caging: A phenomenon that occurs during stranding or insulating where the conductor enters a restriction such as a die or extrusion tip. The outer layers of strands back-up, spread out, or otherwise separate away from the core strands. The problem has been attributed to poor stranding techniques and improper tensions during processing.
Break Strength: The maximum load that a specimen attains when tested in tension to fracture.
Bunch Construction: A stranded construction in which the individual strands are randomly laid and twisted in the same lay direction and same length of lay. The strands do not follow a geometric arrangement or pattern.
Capacitance: A measure of a component's opposition to a change of voltage in a circuit, specified in farads.
Cast: The natural curvature of a wire when in an unrestrained state.
CMA (Circular Mil Area): A measure of a round wire's cross-sectional area, calculated by squaring the diameter (in mils) of a strand and multiplying the result by the number of strands. One circular mil (cmil) is equivalent to the area of a circle 0.001 inch in diameter, equal to 7.854 X 10-7 in2.
Concentric Construction: A central wire surrounded by one or more layers of helically laid wires in a geometric pattern. Concentric constructions have 7, 19, 37, 61, etc. strands.
Conductivity: The inverse of resistivity and a measure of a material's ability to conduct electric current. It is usually compared to that of annealed copper, and is generally stated in terms of %IACS.
Elongation: A measure of a material's ability to stretch or elongate prior to fracture. It is expressed as a percentage (increase in length) over a specified gauge length (typically 10 inches for wire).
Equilay Concentric: A central wire surrounded by one or more layers of helically laid wires in a geometric pattern, with alternately reversed lay direction and the same lay length.
Flex Life (or Flex Fatigue Life): The number of cycles a sample can withstand when subjected to a repetitive stress or strain mode before failure.
Flexibility: The capability of being bent when an external force is applied, its pliability or limberness. Low flexibility translates to being more rigid or stiff.
Gauge (or Gage): A term used to designate the physical size of a wire or strand. Some definitions specify "Gage" as a size designation and "Gauge" as a measuring device (such as pressure gauge). These terms are often used interchangeably.
Hard Drawn: A term referring to the temper of conductors that are drawn without annealing to the finish temper.
IACS: International Annealed Copper Standard
Impedance: The analog of resistance in an AC (alternating current) circuit. Impedance depends upon the resistance, inductance, capacitance and frequency of the circuit. The unit of impedance is the ohm.
Inductance: A measure of a component's opposition to a change in the current of a circuit, specified in henries.
Inter-metallic Compound: Two or more metals with a chemical composition based on a definite atomic formula. Inter-metallics may have a fixed stoichiometric or a very narrow range of chemical composition.

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Glossary of Terms & Conductor Information for Wire & Cable

Lay Direction: The helical direction of the strands or members in any layer of a stranded construction. The two lay directions are usually denoted as "S" (left hand lay) or "Z" (right hand lay).
Lay Factor: The ratio of the lay length to the external diameter of the corresponding layer of wires or members in the stranded conductor.
Lay Length (length of lay): The axial length for one revolution of a strand or member in any layer of a stranded or rope stranded construction.
MCM: An area unit equivalent to 1,000 circular mils. MCM may also be referred to as kcmil.
Ohm: A unit of electrical resistance defined as the resistance necessary to produce 1 ampere of current to flow in a circuit with an applied potential of 1 volt.
Plating Percentage: See Volume Percentage of Plating and Weight Percentage of Plating.
Plating Thickness: The measured thickness of the plated coating on a wire strand. Measurements are usually in micro-inches (millionths of an inch) or microns (millionths of a meter).
Polysulfide Testing: A test method that exposes a sample to a sodium polysulfide solution to qualitatively determine the continuity of the plating on a wire strand. The test method is specified in ASTM B 298 and B 355.
Resistance: A measure of a component's opposition to the flow of electric current, specified in ohms.
Resistivity: The characteristic of a material to impede the flow of electrons (electrical current). It is the material's electrical resistance for a unit volume. This value is specific to a material and not its geometry.
Rope Construction: A conductor composed of separate stranded constructions that are then twisted into the final construction.
Rope Member: A bunched or concentric stranded construction subsequently stranded again to form a rope construction.
Stranding Factor: The increase in weight and electrical resistance of a conductor due to the lay length of the strands or members.
Temperature Coefficient of Resistance: The change in a material's electrical resistance (resistivity) due to a change of one degree in temperature. It is expressed in units per ^{o}C (or units per ^{o}F).
Tensile Strength: The maximum longitudinal tensile stress that may be applied to a material without fracturing or rupturing, calculated to a reference unit (lbs/in2, kg/mm2, etc.) by dividing the breaking load by the cross-sectional area.
Tensile Stress: Force per unit cross-sectional area applied to a material.
True Concentric: A central wire surrounded by one or more layers of helically laid wires in a geometric pattern, with alternately reversed lay direction and increasing lay length.
Tubular Strander: A type of twisting machine where the payoffs are located inside the tube and the take-up is external.
Unidirectional Concentric: A central wire surrounded by one or more layers of helically laid wires in a geometric pattern, with the same lay direction and an increasing lay length.
Unilay (Unidirectional Equilay Concentric): A central wire surrounded by one or more layers of helically laid wires in a geometric pattern, with the same lay direction and the same lay length.
Volume Percentage of Plating: The ratio of the volume of the plated material to the total volume of the conductor. **Weight Percentage of Plating:** The ratio of the weight of the plated material to the total weight of the conductor. Conductor plating percentages usually refer to weight percentage when a distinction is not made.
Weight per Unit Length: A method of specifying the weight of conductor or wire using a standard length. Common lengths of 1,000 feet or 1,000 meters are used, however other lengths may also be specified.

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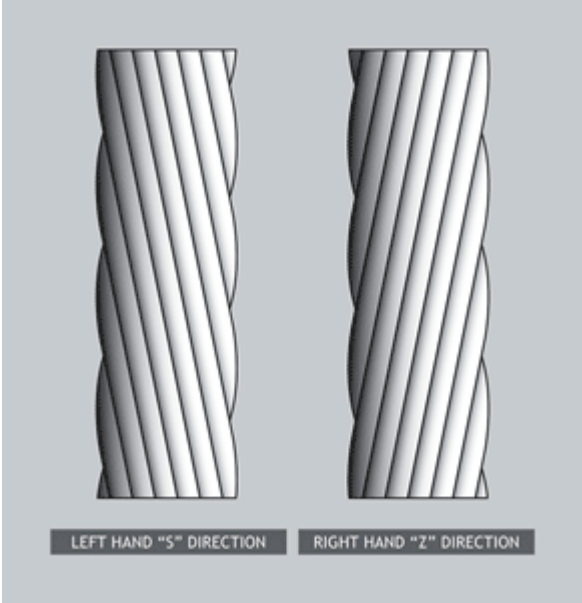
Wire and Cable Facts - Lay Direction and Length

Lay Direction

Stranded conductors are manufactured by twisting strands of non-insulated wire. The direction of twisting is designated as the "lay direction". The degree of twist per unit length defines the "lay length".

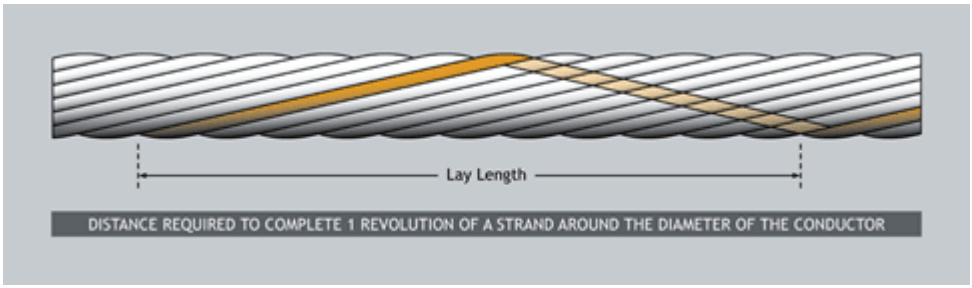


The lay direction is determined by the direction the machine is turning during the stranding operation. The conventional method to determine the lay direction is to observe the upper surface of the stranded conductor with one end pointing toward you and the wire leading away from you:

If the strands turn left leading away from the observer and have the same slant as the middle of the letter "S", the convention denotes an "S" lay direction.
If the strands turn right leading away from the observer and have the same slant as the middle of the letter "Z", the convention denotes a "Z" lay direction.

Lay Length

Lay length is defined as the distance required to complete one revolution of the strand around the diameter of the conductor.



When a conductor has more than one layer, it usually refers to the lay length of the outer layer. In the case of Unilay, Equilay and bunch, the lay length of all layers is equal. In True Concentric and Unidirectional, the lay lengths of the inner layers are less, this also holds true for rope constructions.

General Practices

There are some general practices that pertain to the lay direction and lengths of conductor as specified by industry standards such as ASTM, NEMA and military, however, requirements for specific applications vary.

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Wire Facts / Lay Direction and Length

Direction of the outer layer

The direction away from the outer layer of strands or members is usually S. Inner layer directions depend upon the construction (True concentric, Unilay, etc).The lay length of the outer layer of strands or members varies with different applications.

Length of the outer layer

For most conductor applications, lay lengths of between 8 – 16 times the outer diameter of a given layer are specified in ASTM B 286. In general, lay lengths in the range of 12 – 15 times the outer diameter are used for tighter tolerance and geometric pattern control. Shorter lay lengths of 12 times or less have the disadvantage of slightly higher weight per unit length.

For 7 strand and bunch applications, where tight diameter tolerance is less of a concern, lay lengths in excess of 30 times the outer diameter are common. Longer lay lengths are sometimes preferred by customers for cost, yield and weight considerations.

Stranding Factors

The increase in weight and resistance due to stranding can be calculated mathematically. ASTM refers to this increase as the stranding or "k-factor", defined as "incremental percentage (increase) of weight and electrical resistance." ASTM B 8, B 229, B 231, and others give a method of calculating the "**k**":

$$\mathbf{k = 100\ (m - 1)}$$

Where **k** is the incremental (increase) in mass and electrical resistance, the factor **m** is the ratio of the mass or electrical resistance of a unit length of the stranded conductor to that of a conductor monofilament of the same section or that of the stranded conductor with an infinite length of lay (all the strands run parallel to the axis). The factor **m** of the strand is the average of the factors for each of the individual wires in the conductor including the straight wire core, if any (for which the lay factor is unity).

The lay factor m_{ind} for any given wire in a concentric stranded conductor is calculated as follows:

$$m_{ind} = \sqrt{1 + \left(\frac{9.8696}{n^2}\right)}$$

Where n = (length of lay) + (diameter of helical path of wire)

Example: the lay factor for a 19 strand conductor is the numerical average of the 19 individual strands:

$$\mathbf{m = (1 + 6}m_6 \mathbf{= 12}m_{12}\mathbf{) \div 19}$$

Where $m_6 = m_{ind}$ calculated for each of the 6 strands of the inner layer

and $m_{12} = m_{ind}$ calculated for each of the 12 strands of the outer layer

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Wire and Cable Facts / Strand Configurations

Stranded conductors are composed of un-insulated strands of wire twisted together. The advantages of stranded conductor over a single strand of equal cross-section are increased flexibility and flex-fatigue life. Stranded conductor can be manufactured in a variety of configurations, the most common being concentric, bunched and ropes.

Concentric

When the term "concentric stranding" is used, it refers to the definition of the word "concentric", which is having a "common center".

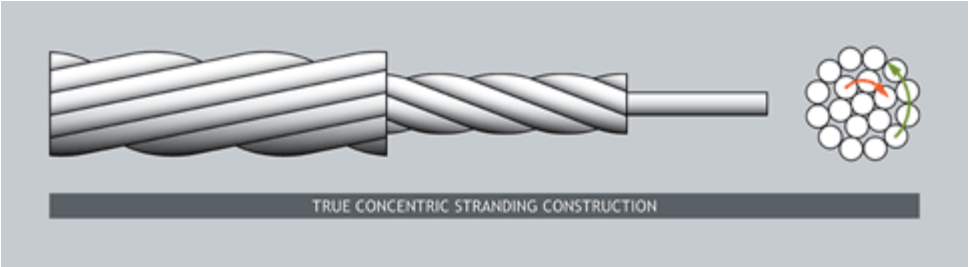
Concentric conductor may be defined as:**"*A central wire* (*strand*) *surrounded by one or more layers of helically laid wires in a geometric pattern*."**

The geometric pattern requires that concentric constructions can only be produced with 7, 19, 37, 61, (etc.) strands or members, following the pattern that each successive layer has 6 more strands than the layer below it. In all types of concentric constructions, the geometric pattern of the strands is consistent for the entire length of the conductor. That is, the central strand, and the strands in each layer remain in their respective positions from the beginning to the end of its length.

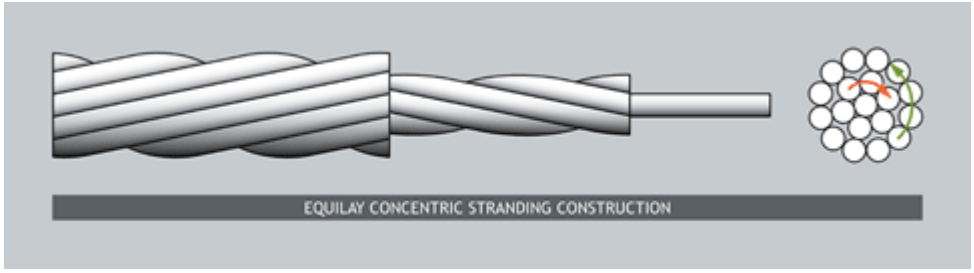
The main advantage of concentric constructions is the close/tight diameter tolerances that can be maintained on the conductor. Concentric constructions have very smooth uniform surfaces that are suited for thin wall insulation in high performance applications.

Concentric Stranding

There are four common types of concentric constructions manufactured for the high performance wire and cable industry. Although there are 4 distinct types, the industry normally refers to "Concentric" as "True Concentric" and will use the terms interchangeably. The other types are referenced as noted.



Concentric or True Concentric characterized by a central wire surrounded by one or more layers of helically laid wires in a geometric pattern, with alternately reversed lay direction and increasing lay



Equilay or Equilay Concentric characterized by a central wire surrounded by one or more layers of helically laid wires in a geometric pattern, with alternately reversed lay direction and the same lay length

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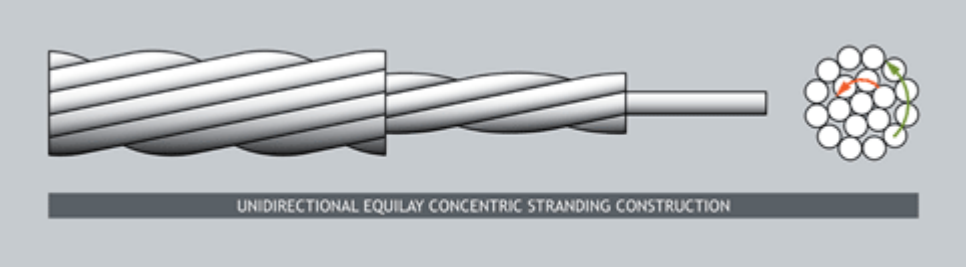
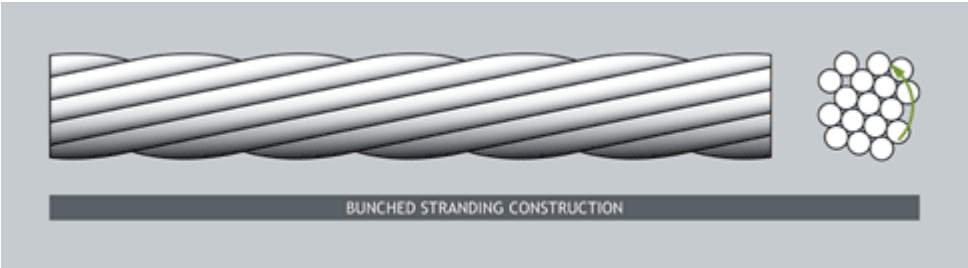
Wire and Cable Facts / Strand Configurations

Unidirectional or Unidirectional Concentric
Wire is characterized by a central wire surrounded by one or more layers of helically laid wires in a geometric pattern, with the same lay direction and an increasing lay length.



Unilay **or Unidirectional Equilay Concentric**
Wire is characterized by a central wire surrounded by one or more layers of helically laid wires in a geometric pattern, with the same lay direction and the same lay length.

Bunched Stranding
Bunch strand wire contains any number of strands in random pattern. Twisted in one operation, all strands have the same lay direction and same lay length, however, the result is a rougher surface and lower dimensional tolerance than the concentric constructions. The number of strands is determined by the size of the individual strands and the total cross-sectional area required.



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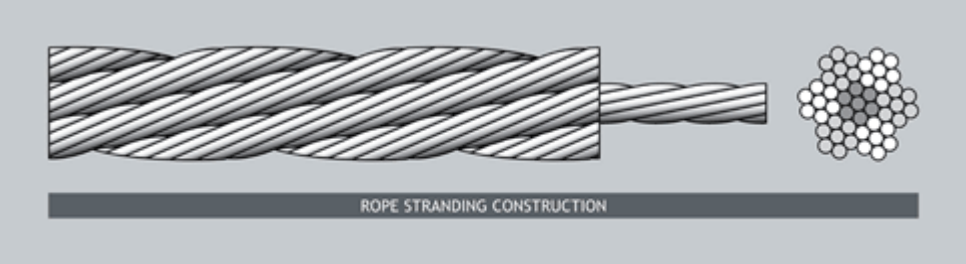
Wire and Cable Facts / Strand Configurations

Rope Stranding

Wire constructions consist of single strands assembled together into concentric or bunched configurations. Rope constructions consist of concentric or bunched members stranded together into the final concentric or bunched configuration.



Rope stranding has the advantage of increasing flexibility by using a larger number of finer strands while maintaining a tighter diameter tolerance than a simple bunched construction. Ropes are more evident in the larger AWG sizes, such as 8 AWG and larger, but there also many applications that require the flexibility of rope constructions in the smaller gauges. Constructions vary and can contain hundreds or thousands of strands.

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