

WIRING GUIDE – PRIMARY WIRE & BATTERY CABLE

Using an automotive wiring guide is critical to help determine the correct wire or cable gauge for 12-volt systems. The selection of the correct gauge for automotive or other low voltage applications is extremely important to maximize safety and performance. Voltage drop or a loss of candlepower can occur if an insufficient gauge is used.

Always consider the total amperage and length of wire in each circuit when selecting an adequate gauge. Allow for the return circuit, including the grounded return, when estimating the length.

USING THE CHART

1. Measure the length of wire in the circuit including the ground return. A two-wire circuit will be the total lengths of both the wires. Account for both vehicles on auto and trailer applications.
2. Find the total amperes, watts, or candlepower and choose the nearest number in Circuit Amperes column.
3. Look across for proper footage to find nearest wire gauge.

Note:

18-gauge applications outside of the shaded area could be 20-gauge for electrical purposes. However, it is recommended to use 18-gauge for the tensile strength of the wire. Chart is based on maximum 10% voltage drop @ 100°F (in free air).

TOTAL APPROX. CIRCUIT AMPERES	WIRE GAUGE (FOR LENGTH IN FEET)												
	12V	3	5	7	10	15	20	25	30	40	50	75	100
1	18	18	18	18	18	18	18	18	18	18	18	18	18
1.5	18	18	18	18	18	18	18	18	18	18	18	18	18
2	18	18	18	18	18	18	18	18	18	18	18	16	16
3	18	18	18	18	18	18	18	18	18	18	18	14	14
4	18	18	18	18	18	18	18	18	18	18	16	16	12
5	18	18	18	18	18	18	18	18	18	18	16	14	12
6	18	18	18	18	18	18	18	16	16	16	14	12	10
7	18	18	18	18	18	18	18	16	16	16	14	14	10
8	18	18	18	18	18	18	16	16	16	16	14	12	10
10	18	18	18	18	18	16	16	16	14	12	12	10	10
11	18	18	18	18	18	16	16	14	14	12	12	10	8
12	18	18	18	18	18	16	16	14	14	12	12	10	8
15	18	18	18	18	18	14	14	12	12	12	10	8	8
18	16	16	16	16	16	14	14	12	12	10	10	8	8
20	16	16	16	16	16	14	12	10	10	10	10	8	6
22	14	14	14	14	14	12	12	10	10	10	8	6	6
24	14	14	14	14	14	12	12	10	10	10	8	6	6
30	12	12	12	12	12	10	10	10	10	10	6	4	4
40	10	18	18	18	18	18	18	18	18	6	6	4	2
50	8	8	8	8	8	8	8	8	8	6	6	2	2
100	4	4	4	4	4	4	4	4	4	4	2	1	1/0
150	2	2	2	2	2	2	2	2	2	2	1	2/0	2/0
200	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	4/0	4/0

TYPICAL AMPERAGE GUIDE

EQUIPMENT	AVG. AMPS*
Power Antenna	6 to 10
Electric Wiper	3 to 6
Electric Clock and Light	0.3
Radio/CD Player	2 to 5
Cigarette Lighter/Power Outlet	10 to 12
Gauges	0.7 to 1
Dome Light	1
Power Sunroof	20 to 25
Dash lights	1.5 to 3
Trunk Lights	0.5
License Lights	0.5
Power to Trailer Hitch if Equipped	20 to 30
Stop Lights (2)	3.5 to 4
Tail Lights (2)	0.5
Reverse Lights (2)	3.5 to 4
Rear Window Defogger	20 to 25
Power Door Locks	3 to 5
Power Seats	25 to 50
Power Windows	2 to 20
Headlight Dimmer	2.2
Anti-lock Brake Module	2 to 6
Starter Motor	75 to 300
Starter Solenoid	12 to 20
Side Marker Lights (2)	1.3
Parking Lights (2)	1.3
Headlights - Low Beams	8 to 9
Headlights - High Beams	13 to 15
Fog Lights	8 to 9
Horns (2)	18 to 20
Alarm System	18 to 20
Ignition	1.5 to 3.5
Heater/Defroster	6 to 10
Air Conditioner	13 to 20

*Based on a typical 12-volt system.

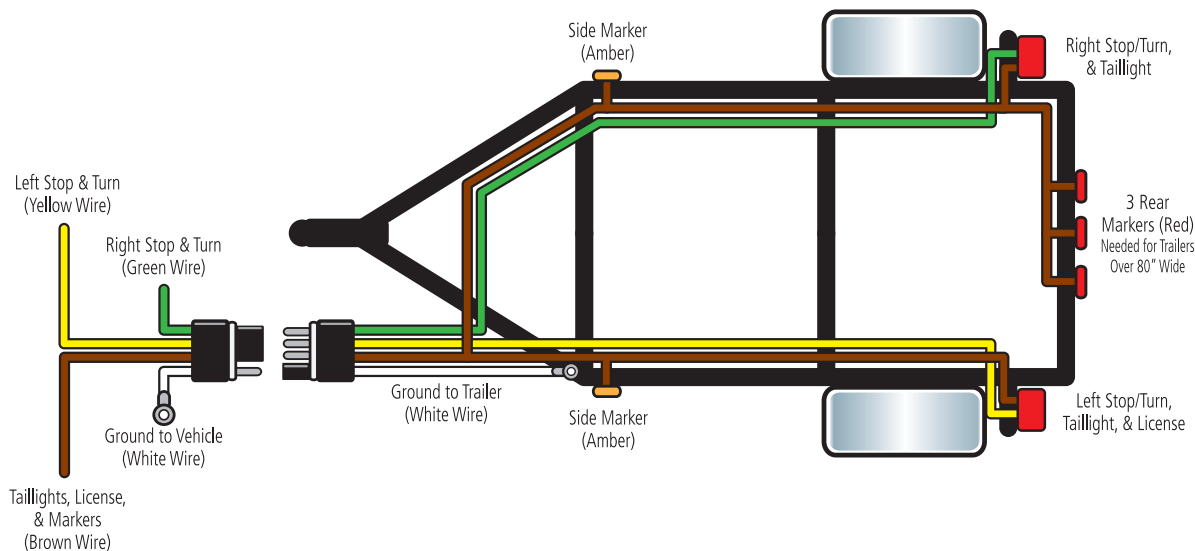
MARINE WIRE & CABLE COLOR CODING

Color	Item	Use
Red	DC positive conductor	Positive mains
Black or yellow	DC negative conductor	Return, negative mains
Green or green w/ yellow stripe	DC grounding conductor	Bonding system Bonding wires (if insulated)
Light blue	Oil pressure	Oil pressure sender to gauge
Dark blue	Cabin & instrument lights	Fuse or switch to lights
Brown	Generator charge light	Generator armature to regulator
	Alternator charge light	Generator, terminal/alternator, auxiliary terminal to light regulator
	Pumps	Fuse or switch to pumps
Gray	Navigation lights	Fuse or switch to lights
	Tachometer	Tachometer sender to gauge
Orange	Accessory feed	Ammeter to alternator of generator output and accessory fuses or switches
Pink	Fuel gauge	Fuel gauge sender to gauge
Purple	Ignition	Ignition switch to coil & electrical instruments
Brown w/yellow stripe	Bilge blowers	Fuse or switch to blower
Yellow w/red stripe	Starting circuit	Starting switch to solenoid
Tan	Water temperature	Water temperature sender to gauge
Green/stripe (G/x) (except G/Y)	Tilt down and/or trim in	Tilt and/or trim circuits
Blue/stripe (BI/x)	Tilt up and/or trim out	Tilt and/or trim circuits

NOTE: If yellow is used for DC negative, blower must be brown with yellow stripe.

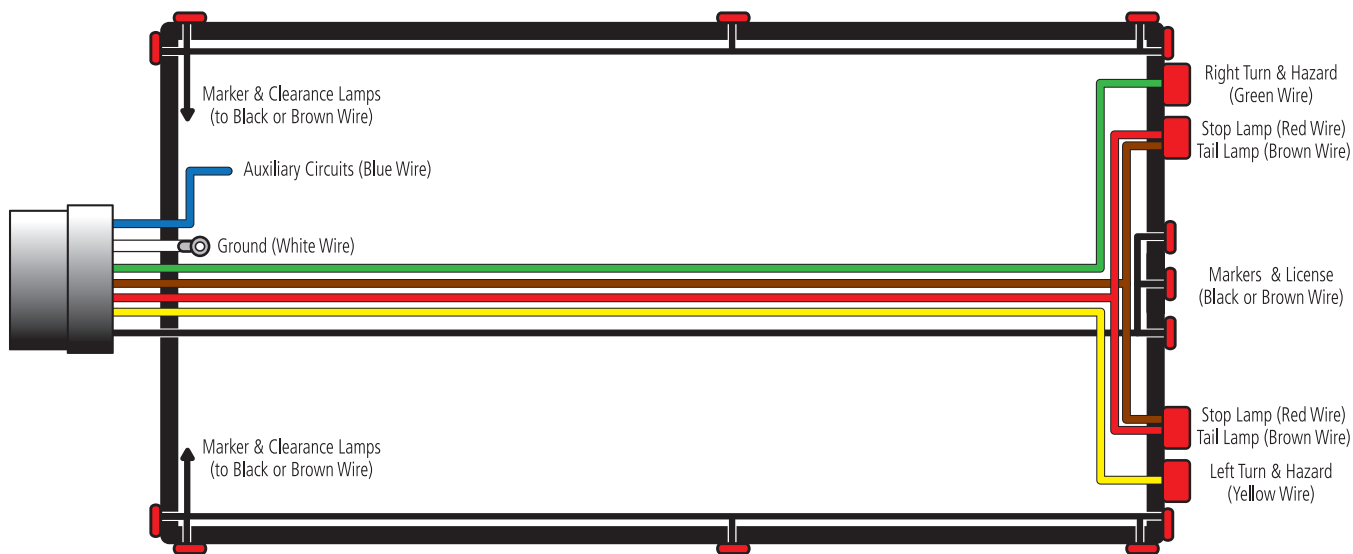


TRAILER WIRING RECOMMENDATIONS



Blue - Electric Brakes/Aux. Power	4-WAY CONNECTOR	5-WAY CONNECTOR
White - Ground		
Brown - Tail & Markers		
Yellow - Left Turn & Brakes		
Green - Right Turn & Brakes		

TRACTOR TRAILER WIRING RECOMMENDATIONS (RCCC & A.T.A.)



(RCCC Recommended)

White	Ground return to towing vehicle (8 AWG)
Black*	ICC required marker identification and clearance lamps (12 AWG)
Yellow	Left-hand directional and hazard signal (12 AWG)
Red	Stop lamp and anti-wheel lock devices (10 AWG)
Green	Right-hand directional and hazard signal (12 AWG)
Brown*	Tail, license and clearance lamps (12 AWG)
Blue	Auxiliary circuits (12 AWG)

(A.T.A. Recommended)

White	Ground return to towing vehicle (10 AWG)
Black	ICC required marker and clearance lamps (12 AWG)
Yellow	Left-hand directional signal (12 AWG)
Red	Stop lamp (12 AWG)
Green	Right-hand directional signal (12 AWG)
Brown	Tail, 3-bar marker and clearance lamps other than ICC Req. (12 AWG)
Blue	Auxiliary circuits (12 AWG)

*Leads should be balanced

MODERN METRIC CONVERSION FACTORS

Symbol	When You Know...	Multiply By	To Find	Symbol
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LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km

AREA				
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m ²
yd ²	square yards	0.836	square meters	m ²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²

VOLUME				
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	l
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³

NOTE: Volumes greater than 1000 l shall be shown in m³

MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg

TEMPERATURE (exact)				
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C

ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²

FORCE and PRESSURE or STRESS				
lbg	poundforce	4.45	newtons	N
psi	pounds per square inch	6.89	kilopascals	kPa

ELECTRICAL				
	Ohms/Kilofeet	3.2808	Ohms/Kilometer	
Insulation Resistance:				
	Megohms-Kilofeet	0.3048	Megohms-Kilometer	

Symbol	When You Know...	Multiply By	To Find	Symbol
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LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi

AREA				
mm ²	square millimeters	0.0016	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	ac
ha	hectares	2.47	acres	mi ²
km ²	square kilometers	0.386	square miles	

VOLUME				
ml	milliliters	0.034	fluid ounces	fl oz
l	liters	0.264	gallons	gal
m ³	cubic meters	35.71	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yard	yd ³

MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg	megagrams	1.103	short tons (2000 lb)	T

TEMPERATURE (exact)				
°C	Celsius temperature	1.8°C +32	Fahrenheit temperature	°F

ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl

FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	pounds per square inch	psi

ELECTRICAL				
	Ohms/Kilometer	0.3048	Ohms/Kilofeet	
Insulation Resistance:				
	Megohms-Kilometer	3.2808	Megohms-Kilofeet	



GLOSSARY

A	Common abbreviation for ampere.
ABRASION RESISTANT	Ability to resist surface wear.
ABS	Anti-lock Brake System.
ABYC	American Boat and Yacht Council.
AC	Alternating Current.
ACID-RESISTANT	Ability to resist acid corrosion.
Al	Period Table of Elements abbreviation for Aluminum.
ALLOY	A substance having metallic properties and being composed of an elemental metal and one or more chemical elements.
AMP	Common abbreviation for ampere.
AMPACITY	The RMS current which a device can carry within specified temperature limitations in a specified environment: dependent upon temperature rating, power loss or heat dissipation.
AMPERE	The SI unit used to measure electric current. Electric current through any given cross-section (such as a cross-section of a wire) may be measured as the amount of electrical charge moving through that cross-section in one second. One ampere is equal to a flow of one coulomb per second, or a flow of 6.28×10^{18} electrons per second.
ANNEALED	An object that is free from internal stress by heating and gradually cooling.
ANTIMONIAL LEAD	A lead alloy that contains antimony.
ANTIMONY	A brittle, lustrous, white metallic element occurring in nature free or combined, used chiefly in alloys.
APPROVED	Formally confirmed or sanctioned.
ASTM	American Society for Testing and Materials.
AUXILIARY	A secondary or supplementary wire.
AWG	American Wire Gauge. A wire diameter specification. The lower the AWG number the larger the wire diameter.
AWM	Appliance Wiring Material.
BARE CONDUCTOR	A conductor having no insulation or jacket.
BUNCH STRANDING	Conductors twisted together with the same lay and direction without regard to geometric pattern.
°C	Common abbreviation for Celsius.
CABLE	A conductor or group of conductors for transmitting electric power or telecommunication signals from one place to another.
CABLE ASSEMBLY	A string of cables and/or wires which transmit informational signals or operating currents. The cables are bound together by clamps, cable ties, lacing, sleeves, electrical tape, conduit, or a combination there of.
CAPACITY	A measurement of the ability to store electrical charge.
CCA	Copper Clad Aluminum.
CERTIFICATE OF COMPLIANCE	A document certified by a competent authority that the supplied good or service meets the required specification. Also called certificate of conformance, certificate of conformity.
CIRCULAR MILS	A unit of area equal to the area of a circle with a diameter of one mil (one thousandth of an inch).
CLADDING	The bonding together of dissimilar metals often achieved by extruding two metals through a die as well as pressing or rolling sheets together under high pressure
COAST GUARD APPROVED	Meets or exceeds operating equipment requirements as set by the Coast Guard.
COLD TEST	A type of test performed using colder than average temperatures to determine certain characteristics of an object or material.
COMEX	Primary market for trading metals such as gold, copper, silver and aluminum.
COMPLIANT	Conforming to requirements.
CONDUCTANCE	Measure of how well a material will conduct electricity. Measured in siemens.
CONDUCTIVITY	The ability of a material to allow electrons to flow, measured by the current per unit of voltage applied.
CONDUCTOR	A material suitable for carrying an electric current.
CONNECTOR	A metallic device of suitable electric conductance and mechanical strength, used to splice the ends of two or more cable conductors, or as a terminal connector on a single conductor.
COPPER-CLAD ALUMINUM	Aluminum and copper bonded together by extruding two metals through a die or pressing or rolling sheets together under high pressure.
CORE	The center of an object.
CORROSION	The disintegration of an engineered material into its constituent atoms due to chemical reactions with its surroundings.
CORRUGATED	Shaped into folds or parallel and alternating ridges and grooves.
CRIMP	A connection typically used to terminate stranded wire. Attached by inserting the stripped end of stranded wire into a portion of the terminal, which is then mechanically deformed/compressed tightly around the wire.
CROSS-LINK	A special purpose high temperature automotive wire with cross-linked polyethylene (XLPE) insulation. Typically used in high heat applications such as the engine compartment.

GLOSSARY

CSA	Canadian Standards Association. Similar to UL in the United States.
Cu	Abbreviation for Copper in accordance with the Periodic Table of Elements.
CURRENT	The rate of transfer of electricity. The unit of current is the ampere, rate of one coulomb per second.
DC	Direct current. Electrical current whose electrons flow in one direction only. It may be constant or pulsating as long as their movement is in the same direction.
DIAMETER	A straight line passing through the center of a circle or sphere and meeting the circumference or surface at each end.
DIE	A metal block that is used for forming materials.
DIE CAST	A metal casting process that is characterized by forcing molten metal under high pressure into a mold cavity. The mold cavity is created using two hardened steel dies which have been machined into shape and work similarly to an injection mold during the process.
DIELECTRIC	An electrical insulator that can be polarized by an applied electric field.
DOT	Department of Transportation.
DRAWING	A technical drawing used to fully and clearly define requirements for engineered items.
DRAWING, WIRE	A metal working process used to reduce the cross-section of a wire by pulling the wire through a single, or series of drawing dies. Although similar in process, drawing is different from extrusion, because in drawing the wire is pulled, rather than pushed, through a die.
DUAL EXTRUSION	involves combining two or more extruders to produce wire with two or more colors.
ELASTOMER	Any material that will return to its original dimensions after being stretched or distorted.
ELECTRO-TINNED	To plate or coat (a base metal) with tin by electrolysis.
ELECTROLYSIS	Is a process by which electrical energy is used to produce a chemical change.
EPDM	(Ethylene Propylene Diene Monomer (M-class) rubber) A type of synthetic rubber.
EXTRUSION	The act or process of shaping by forcing through a die.
°F	Common abbreviation for Fahrenheit.
FERROUS	Composed of and/or containing iron. A ferrous metal exhibits magnetic characteristics.
FILLER	Something added to augment weight or size or fill space.
FLAME RETARDANT	Chemicals used in thermoplastics, thermosets, textiles and coatings that inhibit or resist the spread of fire.
FLANGE	Disc shaped collar on the end of a spool or reel to prevent wire from sliding off barrel.
FLEXIBILITY	The distance of motion.
FLEXIBLE	Capable of being bent, usually without breaking. Susceptible of modification or adaptation. Pliable.
GAUGE	A standard of measure or measurement.
GOLD-PLATED	A base metal coated with gold through an electroplating process.
GPT	General Purpose Thermoplastic.
GRAVITY CAST	A manufacturing process utilizing the force of gravity instead of high pressure to fill a permanent mold, or die, with molten material. The molten material is then allowed to solidify within that mold, and is then ejected or broken out to make a fabricated part.
GROUND	A voltage reference point that is the same as earth or chassis ground.
GXL	General purpose Cross-linked polyethylene insulated wire. Intended for use in engine compartments where higher heat resistance is required.
ID	Inside Diameter.
INSULATION	A material having good dielectric properties which is used to separate close electrical components, such as cable conductors and circuit components.
ISO	International Organization for Standardization.
JACKET	Pertaining to wire and cable, the outer sheath which protects against the environment and may also provide additional insulation.
LAY	The length measured along the axis of a wire or cable required for a single strand (in stranded wire) or conductor (in cable) to make one complete turn about the axis of the conductor or cable.
LAY DIRECTION	The twist in the cables as indicated by the top strands while looking along the axis of the cable away from the observer. Described as right-hand or left hand.
LME	London Metal Exchange.
MC	Master Carton.
MIL	Military specification.
MTW	Machine Tool Wire.
NAFTA	North American Free Trade Agreement.
NATIONAL ELECTRICAL CODE (NEC)	A U.S. consensus standard published by the National Fire Protection Association (NFPA) and incorporated in OSHA regulations.
NEGATIVE	A polarity of electrical charge.
NEUTRALIZE	A chemical reaction in which an acid and a base react to form a salt. Water is frequently, but not necessarily, produced as well.
NM-B	A UL Cable type, non metallic-sheathed cable.

GLOSSARY

NOMINAL	Name or identifying value of a measurable property by which a conductor or component or property of a conductor is identified, and to which tolerances are applied.
NON-FERROUS	Indicates metals other than iron and alloys that do not contain an appreciable amount of iron.
OD	Outside diameter.
OE	Original Equipment.
OEM	Original Equipment Manufacturer.
OHM	The electrical unit of resistance.
OSHA	U.S. Occupational Safety and Health Administration.
Pb	Abbreviation for Lead in accordance with the Periodic Table of Elements.
PIES	Product Information Exchange Standard.
PLASTICIZER	A chemical agent added to plastics to make them softer and more pliable.
POLARITY	Present in every electrical circuit. Electrons flow from the negative pole to the positive pole. In a direct current (DC) circuit, one pole is always negative, the other pole is always positive and the electrons flow in one direction only. In an alternating current (AC) circuit the two poles alternate between negative and positive and the direction of the electron flow continually reverses.
POLYETHYLENE (PE)	A thermoplastic material having excellent electrical and physical properties.
POLYMER	A substance made of many repeating chemical units or molecules. The term polymer is often used in place of plastic, rubber, or elastomer.
POLYPROPYLENE (PPE)	A thermoplastic similar to polyethylene but stiffer and having a higher softening point (temperature).
POSITIVE	A polarity of electrical charge.
POLYVINYL CHLORIDE (PVC)	A general-purpose thermoplastic used for low voltage wire and cable insulation, and for jackets.
REEL DRUM DIAMETER	Diameter of the drum (or hub) of the reel.
REEL FLANGE DIAMETER (REEL HEIGHT)	Diameter of the reel flanges.
REEL TRAVERSE	Width of space between reel flanges.
REEL WIDTH	Overall width of reel.
RESISTANT	Impervious to the action of corrosive substances.
Root Mean Square (RMS)	The effective value of an alternating current or voltage.
RoHS	Restriction of Hazardous Substances.
ROPE LAY CONDUCTOR	A conductor composed of a central core surrounded by one or more layers of helically laid groups of wires used in portable cables.
SAE	Society of Automotive Engineers.
SGT	Starter or Ground, general purpose, thermoplastic insulated cable.
SGX	Starter or Ground, general purpose, Cross-linked polyethylene insulated cable.
SINTERED METAL	Metal created from powder. Advantages include very high levels of purity and controlled, uniformed porosity.
SLEEVING	An extruded tube.
SOLDER	A fusible metal alloy used to join together metal workpieces and having a melting point below that of the workpiece(s).
SPECIFIC GRAVITY	The ratio of the density (mass per unit volume) of a material to that of water.
SPLICE	The physical connection of two or more conductors to provide electrical continuity.
STANDARD	Something established by authority, custom, or general consent as a model or example. Something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality.
STRANDED CONDUCTOR	A conductor composed of a group of wires, usually twisted, or of any combination of such groups of wire.
SXL	Special purpose, Cross-linked polyethylene insulated wire. Used in engine compartments where higher heat resistance is required.
TEMPERATURE RATING	A measure of the highest (or occasionally lowest) temperature at which it is safe to use a product for a particular purpose. For example, temperature ratings are often quoted for electrical insulators, specifying the maximum temperature at which they provide adequate protection against electrical breakdown.
TEMPERED STEEL	A heat treatment technique that is done to "toughen" the metal by transforming brittle martensite or bainite into a combination of ferrite and cementite or sometimes Tempered martensite. Tempering is accomplished by a controlled reheating of the work piece to a temperature below its lower critical temperature.
TENSILE STRENGTH	The maximum load per unit of original cross-sectional area that a conductor attains when tested in tension to rupture.
TERMINAL	A device for joining electrical circuits together.
TEW	Thermoplastic Equipment Wire. Canadian Standards Association type appliance wires. Solid or stranded single conductor, plastic insulated, 105°C, 600V.
THERMOPLASTIC	A material that can be softened repeatedly by heating and hardened by cooling through a temperature range characteristic of the plastic, and that in the softened state can be shaped by molding or extrusion.

GLOSSARY

THERMOSET	A material that has been vulcanized by heat or by other means and is substantially infusible and insoluble.
THERMOSETTING INSULATION	A polymer material that irreversibly cures. The cure may be done through heat (generally above 200 °C (392 °F)), through a chemical reaction, or irradiation such as electron beam processing. Thermoset materials are usually liquid or malleable prior to curing and designed to be molded into their final form, or used as adhesives.
THHN	600 volt 90°C nylon jacketed building wire.
TIN-PLATED	The resulting product of a process of thinly coating sheets of wrought iron or steel with tin. Often to prevent rust and corrosion.
TINNED COPPER	Tin coating added to copper to aid in soldering and inhibit corrosion.
TPE	Thermoplastic Elastomer.
TRAVERSE	The length of the barrel of a reel or spool from flange to flange.
TWP	Thin-wall PVC Wire.
TXL	Thin-wall cross-link polyethylene insulated wire. Used in automotive applications where small diameter and minimal weight is desirable.
UL	Underwriters Laboratory. A non-profit independent organization, which operates a listing service for electrical and electronic materials and equipment. (Canadian counterpart is CSA).
UNILAY	A conductor with more than one layer of helically laid wires with the direction of lay and length of lay the same for all layers.
UNIVERSAL	Adapted or adjustable to many sizes or mechanical uses. Can be used in both positive and negative applications.
UV RESISTANT	Being resistant to ultra violet (UV) light or sunlight. UV light, or sunlight, will cause non-resistant materials and surfaces to fade or discolor.
VINYL	Any of various compounds containing the vinyl radical, typically highly reactive, easily polymerized, and used as basic materials for plastics.
VOLT	The International System unit of electric potential and electromotive force, equal to the difference of electric potential between two points on a conducting wire carrying a constant current of one ampere when the power dissipated between the points is one watt.
VOLTAGE	Electromotive force or potential difference, usually expressed in volts.
VOLTAGE DROP	A voltage loss occurring between any two points in a power circuit.
VULCANIZED	To improve the strength, resiliency, and freedom from stickiness and odor of (rubber, for example) by combining with sulfur or other additives in the presence of heat and pressure.
VW-1	The flammability rating established by Underwriters Laboratories for wires and cables that pass a specially designed vertical flame test, formerly designated FR-1, Similar to CSA designation FT1.
WIRE	A usually pliable metallic strand or rod made in many lengths and diameters, sometimes clad and often electrically insulated, used chiefly for structural support or to conduct electricity.
XLPE	Cross-linked polyethylene.
ZINC-PLATED	The product of a electroplating, the practice of putting an object in a solution and using electricity to coat it. Zinc plating is commonly used on steel to provide corrosion resistance.