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THE BEST PRACTICE GUIDE TO:

Wire and Cable Marking

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Please feel free to share this with someone else who could use it.

Thank you!

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INTRODUCTION

It's easy to spot a quality wiring job. When wiring installations are done correctly from the outset, workers are afforded efficient access, and the design eliminates future questions and misidentifications. A well-designed layout mimics the schematic as closely as possible and provides adequate space for existing and future strands.

Few non-professionals understand the deliberation that goes into creating a well-organized system. Besides arranging and bundling cables in an efficient fashion, each bundle, harness, and cable must be clearly and properly marked. Combined with proper documentation, a well-marked wiring system is the hallmark of quality work.

Depending on whether the wires and cables to be marked are for electrical current or data streams/telecommunication, those doing the installation generally follow standards written by professional organizations. This guide focuses primarily on electrical conductors that do not carry data. Standards for circuits that carry telecommunications data are published by the Telecommunications Industry Association (TIA). The most up-to-date standards provided by TIA are found in TIA-606-B; TIA standards are not covered in this guide.

Wire- and cable-marking standards for circuits that conduct current are found in the following documents:

- National Electrical Code® (NEC) or NFPA 70: Published by the National Fire Protection Association (NFPA), the NEC is generally considered an electrical installation document and protects employees under normal circumstances. Most authorities having jurisdiction adopt NEC as mandatory, sometimes with local changes.
- NFPA 70E: Also published by the National Fire Protection Association, NFPA 70E focuses on safe work practices. It's not considered mandatory but many contractors have adopted these standards.
- NFPA 79: This book of standards by the NFPA addresses electrical work for industrial machinery. Like other NFPA standards, NFPA 79 is not considered law but has been widely adopted.
- National Electric Safety Code (NESC): NESC standards, developed by the Institute of Electrical and Electronics Engineers (IEEE), apply to the installation, operation or maintenance of electric supply and communication lines, as well as associated equipment. Its provisions protect the safety of employees and the public and have been adopted by utility companies in most states.

We recommend that anyone doing electrical wiring purchase and follow the applicable NFPA standards—or NESC, in the case of utility workers or others functioning as utility workers. You may purchase NFPA standards at NFPA.org. For NESC users, we recommend the National Electrical Safety Code 2012 Handbook by David J. Marne, P.E., available through McGraw-Hill.



Use wire and cable markers to clearly label your facility and to keep electrical systems organized.

NEC STANDARDS FOR WIRE AND CABLE MARKING

The NEC has many standards for wire and cable marking, but most refer to the manufacturer's marking printed on the cable itself. There are some categories of conductor covered in the NEC where electrical workers are required to add labels or markers beyond what is pre-printed on the cable.

NEC 250.119: Equipment Grounding Conductors

Equipment grounding conductors

Unless required elsewhere in the NEC, equipment grounding conductors can be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors should have a continuous finish of either green or green with one or more yellow stripes. Do not use conductors matching this description for ungrounded or grounded circuit conductors.

For equipment conductors larger than 6 AWG, identify as an equipment grounding conductor at each end and at every point where the conductor is accessible (although if it's in a conduit body containing no splices or unused hubs, marking is not required). Also, identification should encircle the conductor by any of the following means:

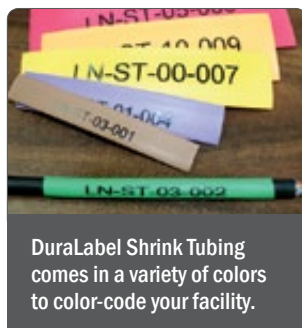
- Stripping the insulation or covering from the entire exposed length
- Coloring the insulation or covering green at the termination
- Marking the insulation or covering with green tape or green adhesive labels at termination

For multiconductor cable, in conditions where maintenance and supervision ensure that only qualified persons service the installation, at least one insulated conductor in a multiconductor cable may be permanently identified as an equipment grounding conductor at each end and at every point where it is accessible, by any of the following means:

- Stripping insulation from the entire exposed length
- Coloring the exposed insulation green
- Marking the exposed insulation with green tape or adhesive labels

For flexible cord, uninsulated equipment grounding conductor is permitted. However, if individually covered, either of the following colors may be used:

- Green
- Green with one or more yellow stripes



504.80: Intrinsically Safe Wiring Systems

504.80: Intrinsically safe systems

Labels for intrinsically safe systems must be suitable for the environment where they are installed with respect to exposure to chemicals and sunlight.

TERMINALS: Identify intrinsically safe systems in a manner that will prevent unintentional interference with the circuits during testing and servicing.

WIRING (also see entry under Raceways, wireways, gutters, trays, and other enclosures): Intrinsic safety circuit labels shall appear in every section of the wiring system separated by enclosures, walls, partitions or floors. Spacing between labels should not exceed 7.5 m (25 feet).

EXCEPTION: Circuits run underground can be identified where they become accessible after emergence from the ground.

NOTES: Wiring methods permitted in unclassified locations may be used for intrinsically safe systems in hazardous (classified) locations. But without labels to identify the application of the wiring, enforcement authorities can't determine that an installation is compliant with NEC. In unclassified locations identification is necessary to ensure that nonintrinsically safe wire doesn't get inadvertently added to existing raceways at a later date.

Raceways, Wireways, Gutters, Trays, and Other Enclosures

504.80[B]: Intrinsically safe systems

Raceways, cable trays, and other wiring methods for intrinsically safe system wiring must be identified with permanently affixed labels with the wording "Intrinsic Safety Wiring" or equivalent. The labels should be located such that they are visible after installation and placed such that they may be readily traced through the entire length of the installation. Intrinsic safety circuit labels must appear in every section of the wiring system that is separated by enclosures, walls, partitions, or floors. Spacing between labels should not exceed 7.5 m (25 feet).

390.10: Underfloor raceways

Include a suitable marker at or near the end of each straight run of raceways to locate the last insert.

NFPA 70E STANDARDS FOR IDENTIFYING CABLES

NFPA 70E is primarily concerned with safety issues and doesn't have much to say regarding wire and cable marking. However, the standards listed below may apply to some jobs:

110.5: Underground Electrical Lines and Equipment

Employers are required to contact appropriate owners or authorities to identify and mark location of electrical lines or equipment, if excavation or other activity may lead to contact with that equipment. This must be done before any excavation begins. A hazard analysis also must be performed to identify appropriate safe work practices to be used during excavation.

205.10: Identification of Components

According to 205.10, all components and safety-related instructions (operating or maintenance) need to be securely attached and always legible wherever posted.



Proper marking of electrical lines and equipment is vital to workplace safety during construction/excavation projects.

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NFPA 79 STANDARDS FOR IDENTIFYING CABLES

NFPA 79 relates to industrial machinery, and includes a few standards that deal with wire and cable marking. They are cited below:

13.2.3: Identification of the Grounded Circuit Conductor

13.2.3.1: Conductors can be any of the following colors where an AC circuit includes a grounded conductor:

- White
- Gray
- Three continuous white stripes along entire length, on insulation that is not green, blue, or orange

EXCEPTION: Multicolored grounded conductor cables can be permanently identified at their termination at the time of installation by a distinctive white marking or other “equally effective means.”

13.2.3.2: You can use other colors for the following applications, as follows:

- White with blue stripe for grounded (current-carrying) DC circuit conductor
- White with orange stripe for grounded (current-carrying ac circuit conductor, which remains energized when the main supply circuit disconnecting means is in the OFF position)
- Whichever color stripe is selected, that color stripe must be consistent with the ungrounded conductor of the excepted circuit described in NFPA 79 5.3.5 (not included in this guide)

EXCEPTION 1: Multicolored cables can be permanently re-identified at the time of installation.

EXCEPTION 2: Where the identification of machine power and control wiring makes compliance with the mandatory color codes too restrictive for specific applications, you can use additional identification at selected locations as an alternative. This means of identification can be by separate color coding, marking tape, tagging, or other approved means, and must be permanently posted on the inside of the main electrical control panel enclosure in a visible location.

13.2.4.(1-4): Other color uses:

ORANGE (13.2.4.1): Use orange to identify ungrounded conductors that remain energized when the main supply circuit disconnecting means is in the OFF position. Two exceptions:

EXCEPTION 1: Internal wiring on individual devices purchased completely wired

EXCEPTION 2: Where insulation used is not available in the colors required, such as with high-temperature insulation or chemically-resistant insulation.

13.2.4.2: When using color for identification, you must use the color throughout the length of the conductor either by the color of the insulation or by color markers.

EXCEPTION: Multicolored grounded conductor cables can be permanently re-identified at the time of installation.

13.2.4.3: When utilizing color for identification of conductors, you may use the following color code:

- Black for ungrounded AC and DC power conductors
- Red for ungrounded AC control conductors
- Blue for ungrounded DC control conductors

13.2.4.4: When the means of identification is different from what is permitted in 13.2.4.3, the means of identification must be permanently posted on the inside of the main electrical control panel enclosure in a visible location.

EXCEPTION: Internal wiring on individual devices purchased completely wired are not subject to this standard.



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NESC STANDARDS FOR IDENTIFYING CABLES

NESC doesn't have as many standards for cable marking as NEC, as there are many more classes and utilization types for wires and cables once they are "in the building." The dividing line between NESC and NEC is typically the conductor splice at the weatherhead—in other words, the transition between electric utility and electric utilization. It can also be an overhead or underground communications service, (e.g., phone or cable TV).

Below you'll find pertinent standards from NESC regarding identifying and marking cables.

NESC Rule 341B3: Cables in Manholes and Other Access Openings

Cables found in manholes or other access openings of a conduit system need to have corrosion-resistant tags and be suitable for the typical environmental conditions of the location. The tag must be legible with portable lighting—brass tags and plastic compounds are typically used. If maps or diagrams including cable positions are available, such tags are not required.

Joint-use manholes or vaults: A cable identification tag or marker of some type must denote the utility name and type of cable used, if multiple utilities of the same kind (i.e., power and power) or joint-use (power and communication) are involved. See rule 341-7 for identification requirements.

NESC Rule 350F: Direct-Buried Supply and Communication Cable

According to Rule 350F, direct-buried supply and communication cable, as well as cable in duct that is not part of a conduit system, must be marked with a "lightning bolt" and a "telephone handset" symbol. The handset is used for all communications, including data and cable TV.

Cables installed in conduit systems are exempt from this requirement, and so are any cables included in NESC Section 32, "Underground Conduit Systems."

If the installer employs color coding as an additional method of cable identification, NESC recommends the standard adopted by the American Public Works Association in its Uniform Color Code. According to this standard, the following colors are used accordingly:

- White—Proposed excavation
- Pink—Temporary survey markings
- Red—Electric power lines, cables, conduit, and lighting cables

- Yellow—Gas, oil, steam, petroleum, or gaseous materials
- Orange—Communication, alarm or signal lines, cables, or conduit

NOTE: NESC does not recommend color coding; it only recommends that if color coding is to be used, that it follows the standard outlined above.

NESC Rule 381G2: Pad-Mounted and Other Above-Ground Equipment

When a first door or barrier to pad-mounted or other above-ground equipment is opened or removed, a safety sign compliant with ANSI Z535 should be visible.

A warning sign can be used on the outside of the pad-mounted enclosure, and a danger sign on the inside of the pad-mounted enclosure, accurately reflecting the relative danger expressed in the signage. NESC 381G2 doesn't require a safety sign on the outside, although it is recommended.

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EASY WIRE MARKING

For larger circuits, where serialized connections are used, you can save hours of time by using a DuraLabel printer and supplies to batch-print bar-coded or numbered markers. Simply merge an Excel spreadsheet with all the serial numbers, connections, barcodes, etc., onto a Word document, and print onto either wire wrap, or shrink tube supply. Within minutes you can print all the wire markings for any large job.

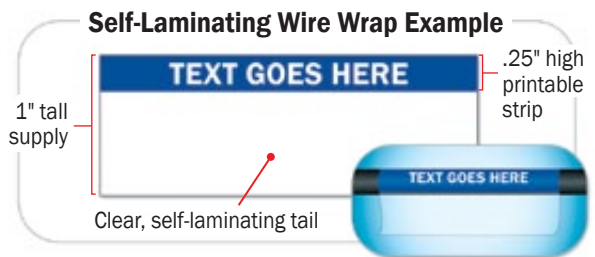
How to Apply Wire Wrap

DuraLabel self-laminating wire wraps are easy to apply and available in many colors and sizes. Comes on a continuous roll to allow for custom sizes and less waste than experienced with die-cut wire wraps.



Steps to apply wire wrap

1. Print identifying information on printable area.
2. Apply to wire/cable starting with the printable strip.
3. Wrap the clear tail around cable; over printable area to cover and protect the identifying information.



How to Apply Shrink Tubing

DuraLabel shrink tubing is perfect for marking and identifying your wires and cables. This very flexible material is a specially formulated cross-linked polyolefin which has a low recovery temperature of a 3:1 ratio with a thin wall, and is highly flame-retardant (VW-1).

Steps to apply shrink tube

1. Print identifying information on shrink tube.
2. Slip shrink tube over cable.
3. Use heat shrink gun to secure.



Graphic Products has the supplies to support your cable marking needs.

Shrink Tube Sizes

Shrink tube sizes are based on the diameter of the open tube before shrinking. When laying flat for printing, the shrink tube will be approximately 1.5 times as wide as it's open diameter.



Cable Shrink Tube Size Chart

If you have:	Use:
8 Conductor Flat Silver Satin	1/4"
Duplex Fiber Cord (Zipcord)	3/8"
RG59 Coaxial Cable	1/2"
Category 5 4-pair Twisted Pair	1/2"
AWG 16-22G	1/8"
AWG 12-18G	3/16"
AWG 10-16G	1/4"
AWG 4-14G	3/8"
AWG 1-12G	1/2"

What size shrink tube or wire wrap is right for my gauge?
See Cable/Wire Size Chart on the following page.

CABLE/WIRE SIZE CHART

What size shrink tube or wire wrap is right for my gauge?

NOTE: Area left blank does not have values assigned.

WIRE GAUGE CONVERSION TABLE Dimensions are in inches.							
GAUGE NO.	AWG American Wire Gauge (Brown & Sharpe)	W & M Washburn & Moen (Steel wire gauge)	SWG Imperial Standard Wire Gauge	BWG Birmingham or Stubs Wire Gauge	US STAND. United States Standard (Revised)	SHRINK TUBE	WIRE WRAPS
7/0	.6513	.490	.500		.5000	1" - 3/4"	2" x 1/2"
6/0	.5800	.460	.464		.4688	1" - 3/4" - 1/2"	2" x 1/2"
5/0	.5165	.430	.432		.4375	1" - 3/4"	2" x 1/2"
4/0	.4600	.3938	.400	.454	.4063	1" - 3/4"	2" x 1/2"
3/0	.4096	.3625	.372	.425	.3750	1" - 3/4" - 1/2" - 3/8"	2" x 1/2"
2/0	.3648	.3310	.348	.380	.3438	1" - 3/4" - 1/2" - 3/8"	2" x 1/2"
1/0	.3249	.3065	.324	.340	.3125	3/4" - 1/2" - 3/8"	1" x 1/4"
1	.2893	.2830	.300	.300	.2813	3/4" - 1/2" - 3/8"	1" x 1/4"
2	.2576	.2625	.276	.284	.2656	3/4" - 1/2" - 3/8"	1" x 1/4"
3	.2294	.2437	.252	.259	.2391	1/2" - 3/8" - 1/4"	1" x 1/4"
4	.2043	.2253	.232	.238	.2242	1/2" - 3/8" - 1/4"	1" x 1/4"
5	.1819	.2070	.212	.220	.2092	1/2" - 3/8" - 1/4"	1" x 1/4"
6	.1620	.1920	.192	.203	.1943	1/2" - 3/8" - 1/4"	1" x 1/4"
7	.1443	.1770	.176	.180	.1793	1/2" - 3/8" - 1/4" - 3/16"	1" x 1/4"
8	.1285	.1620	.160	.165	.1644	3/8" - 1/4" - 3/16"	1" x 1/4"
9	.1144	.1483	.144	.148	.1495	3/8" - 1/4" - 3/16"	1" x 1/4"
10	.1019	.1350	.128	.134	.1345	3/8" - 1/4" - 3/16"	1" x 1/4"
11	.0907	.1205	.116	.120	.1196	3/8" - 1/4" - 3/16" - 1/8"	1" x 1/4"
12	.0808	.1055	.104	.109	.1046	1/4" - 3/16" - 1/8"	1" x 1/4"
13	.0719	.0915	.092	.095	.0897	1/4" - 3/16" - 1/8"	1" x 1/4"
14	.0641	.0800	.080	.083	.0747	3/16" - 1/8"	1" x 1/4"
15	.0571	.0720	.072	.072	.0673	3/16" - 1/8"	1" x 1/4"
16	.0508	.0625	.064	.065	.0598	1/8"	1" x 1/4"
17	.04526	.054	.056	.058	.0538	1/8"	1" x 1/4"
18	.04030	.0475	.048	.049	.0478	1/8"	1" x 1/4"
19	.03589	.0410	.040	.042	.0418	1/8"	1" x 1/4"
20	.03196	.0348	.036	.035	.0359		1" x 1/4"
21	.02846	.03175	.032	.032	.0329		1" x 1/4"
22	.02535	.0286	.028	.028	.0299		1" x 1/4"
23	.02257	.0258	.024	.025	.0269		1" x 1/4"
24	.02010	.0230	.022	.022	.0239		1" x 1/4"
25	.01790	.0204	.020	.020	.0209		1" x 1/4"
26	.01594	.0181	.018	.018	.0179		1" x 1/4"
27	.01420	.0173	.0164	.016	.0164		1" x 1/4"
28	.01264	.0162	.0148	.014	.0149		1" x 1/4"
29	.01126	.0150	.0136	.013	.0135		1" x 1/4"
30	.0103	.014	.0124	.012	.0120		1" x 1/4"
31	.00893	.0132	.0116	.010	.0109		1" x 1/4"
32	.00795	.0128	.0108	.009	.0102		1" x 1/4"
33	.00708	.0118	.0100	.008	.0094		1" x 1/4"
34	.00630	.0104	.0092	.007	.0086		1" x 1/4"
35	.00561	.0095	.0084	.005	.0078		1" x 1/4"
36	.00500	.0090	.0076	.004	.0070		1" x 1/4"
37	.00445	.0085	.0068				1" x 1/4"
38	.00396	.0080	.0060				1" x 1/4"
39	.00353	.0075	.0052				1" x 1/4"
40	.00314	.007	.0048				1" x 1/4"
41	.00279	.0066	.0044				1" x 1/4"
42	.00249	.0062	.0040				1" x 1/4"
43	.00221	.0060	.0036				1" x 1/4"
44	.00198	.0058	.0032				1" x 1/4"
45	.00176	.0055	.0028				1" x 1/4"
46	.00157	.0052	.0024				1" x 1/4"
47	.00140	.0050	.0016				1" x 1/4"
48	.00124	.0048	.0012				1" x 1/4"
49	.00111	.0046	.0010				1" x 1/4"
50	.00099	.0044					1" x 1/4"
51	.00088						1" x 1/4"
52	.00078						1" x 1/4"
53	.00070						1" x 1/4"
54	.00060						1" x 1/4"
55	.00050						1" x 1/4"
56	.00040						1" x 1/4"



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