CONTROL CABLES COLOR CODES

Standardized wire and cable color codes are essential in complex applications. Color codes decrease potentially hazardous confusion by ensuring cables are in compliance with applicable codes and providing a quick visual assurance that cables are connected correctly.

The most common standard used for control cables is ICEA (Insulated Cable Engineers Association) Standard S-73-532, NEMA (National Electrical Manufacturers Association) Standard WC57, *Standard for Control, Thermocouple Extension, and Instrumentation Cable*. This standard describes different methods of identification and provides tables of color sequences to use with these methods.

The ICEA/NEMA methods describe the way conductors are identified, for example using different insulation color combinations or using a single insulation color with printed numbers on each conductor. It is important to specify both the method and color sequence (if the selected method uses different insulation colors).

METHODS

Although there are many methods and color sequences within ICEA S-73-532 / NEMA WC 57, only a few are commonly used in industry. Methods 1, 3, and 4 are the most widely used:

- **Method 1** – Different color insulation with tracers
- **Method 3** – Single color insulation with surface printing of number and color designations
- **Method 4** – Single color insulation with surface printing of numbers only

COLOR SEQUENCES

Color sequences are the base and/or stripe colors that are assigned to each conductor in the cable. The two most common sequences are in Tables 1 and 2 of Appendix E of the ICEA/NEMA standard and are therefore referred as E-1 and E-2. It is important to note that in earlier editions of the ICEA S-73-532 / NEMA WC 57 the color sequences were located in Appendix K and were referred to as K-1 and K-2. Older wire and cable specs may reference K1 or K2 color codes, but they are the same as E-1 and E-2.

E-1 consists of six basic colors (black, white, red, green, orange, blue). The colors then repeat with a colored band or tracer. The color sequence starts at the center and works outward in a circular pattern. The color sequence is clockwise when viewed from one end of the cable and counter clockwise when viewed from the other.

Color sequence E-1 cannot be used in all applications since the National Electrical Code (NEC) 2014 specifies that a conductor colored white can only be used as a grounded/neutral conductor (Section 200.6 Means of Identifying Grounded Conductors) and that a conductor colored green can only be used as an equipment grounding conductor (Section 250.119 Identification of Equipment Grounding Conductors). The use of Table E-1 color coding would therefore be in violation of the NEC in a cable having more than six conductors.

To address this issue, a different color coding sequence was developed by ICEA for cables that are used in NEC application. Table E-2 (formerly K-2) of the ICEA/NEMA standard provides this color sequence. If a white conductor is required the standard allows one to be inserted into Table E-2 as the second conductor in the sequence. If a green insulated conductor is required, it likewise can be introduced into the table. However, the white and green colors may only appear once.

INDUSTRIES COMMON PRACTICES

Although there are eleven different ICEA/NEMA methods and seven different ICEA/NEMA color sequences for conductor identification, only three combinations are in common use as shown in Table 1.

ICEA/NEMA Method	ICEA/NEMA Color Sequence	Type of User
1	E-1 (formerly K-1)	Utilities (non-NEC)
1	E-2 (formerly K-2)	Industrial/Commercial (NEC)
4	Not applicable	Miscellaneous

Table 1: Standard color code practices per industry

The most common multiconductor control cables sized at 14 AWG–10 AWG use Method 1, Table E-2 color coding. The cables do not contain a white or green conductor. Control cables sized 8 AWG and larger typically contain three conductor cables having black insulation surface ink printed with the numbers 1, 2 and 3; also known as Method 4 color coding in the ICEA standards.

The electric utility industry often specifies control cables with the E-1 color coding sequence. For applications where the NEC is applicable, such as in industrial and commercial applications, the E-2 color sequence is normally used.

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CONTROL CABLES COLOR CODES

Although it is important to specify the method and color sequence for control cables in all types of applications, specifying the individual colors is recommended. This is especially necessary for NEC applications that involve a ground and/or neutral in order to ensure the correct colors are applied during manufacturing.

INSTRUMENTATION AND THERMOCOUPLE WIRE COLOR CODE

There used to be a separate standard for instrumentation and thermocouple cables, ICEA S-82-552 (NEMA WC55) Instrumentation and Thermocouple Wire. It contained methods and color sequence tables for instrumentation and thermocouple cables. This standard was withdrawn in 2002 and instrumentation and thermocouple wires were moved into the ICEA S-73-532 / NEMA WC 57 control cable standard.

The ICEA instrumentation and thermocouple standard contained tables titled E-1 through E-4 as well, but in a different order so the tables did not match the ICEA control cable standard. This confusion no longer exists since instrumentation and thermocouple were moved into the control cable standard. The changes with the color sequence tables are shown in Table 2.

S-82-552 (Old)	Description	S-73-532 (New)
E-1	Color sequence without white and green (NEC applications)	E-2
E-2	Color sequence with white and green	E-1
E-3	Shades of color	E-6
E-4	Thermocouple extension color	E-8

Table 2: S-82-552 Color Code Notation

REFERENCES

1. "Standard for Control, Thermocouple Extension, and Instrumentation Cables." ANSI/ICEA S-73-532 NEMA WC 57: n. pag. Print.

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