Building Twisted Pair Cables

Note: This is just one of many different styles and types of termination.

Introduction

Category 5e (CAT5e) twisted pair cable is becoming the mainstay for today’s data transfer needs. Twisted pair cable can transfer both voice and data up to 100 Megabits per second (mbps) if installed correctly.

In this section you will learn how to terminate twisted pair cables that maintain a Category 5e rating.

Objectives

At the end of this section, you should be able to:

• List the tools required to assemble a twisted pair cable
• Describe the assembly process
• Identify the importance of maintaining the correct number of twists
• Identify four items you should check before crimping the cable
• Test cable segments for continuity

Twisted Pair Overview

In this section you will learn how to build and test a twisted pair cable for use with Honeywell Security products.

Twisted pair cable is generally rated in four categories, with the difference between them based primarily on performance:

• Category 3 (CAT3)
• Category 5 (CAT5)
• Category 5e (CAT5e)
• Category 6 (CAT6)

All four categories are the same gauge of wire with the same number of pairs; however, the type of connector, twist ratio and quality of connection determines whether or not the cable meets CAT5e specifications.

CAT3, CAT5, CAT5e and CAT6 all have a different twist ratio. The cable can be de-rated with the type of connector and quality of controls.
Tools for Twisted Pair Cable Construction

The following basic tools are required to terminate twisted pair cable:

- PVC Coating Stripper
- 4' Wire Strippers/Cutters
- Continuity Tester
- RJ45/RJ11 Crimp Tool

Other materials that we will be using:

- CAT5e Twisted pair cable
- CAT5e Inserts for panels and receptacles (Keystone jacks)
- RJ45 Male connectors (Modular ends)

Installation Overview

It is important that the color-coded pairs are properly installed to maintain the proper functioning of the cable. There are two standards that govern the order of pairs, 568A and 568B. In this course, we will use the 568A standard.

The cable segment you will build represents the cable that runs between a Receptacle and a Panel.

The basic steps for building a CAT5e connection are:

- Cut the cable to uniform length
- Strip PVC coating back 3/4" (1.5 centimeters)
- Carefully order the cable pairs
- Insert into female connector
- Visually inspect to ensure that the cable is inserted all the way into the connector so that it will make a connection when seated
- Press the connector lid to seat the wire
- Re-inspect the cable
- Step-by-step directions are provided below

Connecting CAT5e TP Modules

The following steps will guide you through the process of installing a CAT5e Insert (Part # ML5N/R).

1. Strip back ¾ " to 1" of the outer PVC jacket of CAT5e Cable
2. Carefully arrange the individual conductors so they match the 568A color schematic shown on the CAT5e inserts. **Note:** Do not unravel a wire pair more than ½ inch. Doing so will cause the cable to drop to CAT3 performance level.

3. Once your individual conductors are arranged, trim them with the wire strippers/cutter to square off the end.

4. At the rear of each channel, you will notice a razor blade style post which the conductors must seat into. These razor blade posts pierce the PVC jacket of each conductor and make contact with the wire, eliminating the need to strip back each individual conductor.

5. Insert the conductors into the channels on the CAT5e inserts, making sure they are pushed in far enough to hold the conductors in place while you insert the rest. (see figure 4-2)

![Figure 4-1: Cable Stripped and Pairs Aligned](image)

![Figure 4-2: Inserting conductors into the channels of the CAT5e Inserts](image)
The picture below is the new connector with the color code on the connector.
6. Once you have inserted the conductors into the channels, install the blue termination cap. The termination cap forces the conductors down and insures that they make contact with the razor blade posts. Once the termination cap has been installed the cable will stay in place.

**Terminating an RJ45 Connector**

The RJ45 connector is the male component of the cabling system. As with the female connector, it is important that the individual pairs are not unraveled more than ½” (approximately 1 centimeter), keeping the pair twist as close to the termination point as possible.

This cable represents the patch cable you will need to connect PANEL components and test cable segments.

The following is a step-by-step installation procedure:

1. Take a section of twisted pair cable
2. Trim the end of the cable using diagonal wire cutters
3. Strip off ¾” to 1” of the outer PVC jacket
4. Carefully align the pairs of wires to line up with the connector as illustrated in Figure 4-4

![Figure 4-4: 568A Standard](image)

5. Cut off the excess beyond ½”

6. Insert the cable into the connector making sure the individual wires are inserted all the way to the rear of the RJ45 connector and will make contact with metal points on the RJ45 connector.
7. Inspect the wire and connector carefully. Make sure the pairs are aligned properly inside the connector and inserted completely into the connector.

**Note:** Once the connector is crimped, it cannot be removed.

8. Insert the RJ45 connector into the crimp tool and crimp the connection.

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8. Brown
7. White/Brown
6. Orange
5. White/Blue
4. Blue
3. White/Orange
2. Green
1. White/Green
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![Figure 4-5: Completed RJ45 Connector](image)

9. Check the connection again for any loose wires.

**Testing for Continuity and Cross Wiring**

To this point you have created a cable with RJ45 connectors to be used for a patch cable and a cable segment equipped with full-duplex female connectors that represent the connection between a receptacle outlet and a panel.

**Cable Testing Overview**

There are two basic tests we will perform on the cable in this lab:

- Continuity
- Matching pairs

**Continuity**

When inserting the individual wires into the connector, especially a CAT5e insert, a wire that is not fully seated will cause an interruption of the signal.
Matching Pairs

Transmission of data is not possible if the pairs are not in the correct order (for example, not lined up according to the 568A color-code). When inserting the wire into the RJ45 connectors, it is easy to mix up the order of the wires or to get two wires into the same slot.

The following testing procedure will help you assess cables that have problems.

Required materials

You will need the following materials to test cable:

- A completed section of cable
- Two patch cables
- Continuity tester

Testing a Patch Cable

Follow these step-by-step instructions to test your cable segment:

1. Connect either end of your patch cable to the 568A port, as illustrated in Figure 4-6. This connection tests for continuity and verifies that the pairs are matched correctly.

2. If the cable is wired correctly, the Master tester will display each pair in sequence

3. If the test failed, the lights will not flash in sequence and/or the remote tester will indicate a fault.
Testing a Cable Segment

In this activity you will be testing the cable segment used between the receptacle and panel. For this test, you will use two patch cables, the cable segment and the continuity testers. (Testing an actual installation is faster with two people.)

To test a cable segment attach the patch cables and cable segment to the tester indicated in Figure 4-7.
All the tests should prove positive. If any do not, inspect the connectors on the cable segment, correct the problem, and retest.

At this point, we have determined that the cable is not shorted and that all pairs are aligned correctly.

Certification of CAT5e Cable

CAT5e cable performance can be hard to maintain if not installed correctly. In some installations, you may be required to certify each cable segment for CAT5e performance.

CAT5e certification is done using a sophisticated set of testing instruments. For information on CAT5e Certification equipment, contact your local distributor.

It is recommended to certify CAT5e and document the certification on each CAT5e run.
Summary

This section has guided you through the installation and testing of CAT5e twisted pair cable. The major problems with cable connections are listed below:

- Individual Pairs are untwisted more than ½"
- Pairs are not ordered properly
- Wires are not seated into connectors properly
- Nicks on conductors during PVC stripping

There are facets to twisted pair cable that we have not covered, such as performance testing and segment certification.

Cable certification is critical in larger installations. A savvy network administrator or MIS director will require certification of each cable segment in a commercial installation.

In the next section, you will learn how to build coaxial cable connections.