
Worksheet 7

Introduction:

Through this worksheet, first you will learn what is an ethernet cable, why need it in networks and how can we use it in a network. It also includes information about **Unshielded twisted pair cable (UTP)** and **Shielded twisted pair cable (STP)**, ethernet cable categories like Cat 3, Cat 5, Cat 5e, Cat 6, Cat 6a, Cat 7 and Cat 8, and 2 types of ethernet cables called Crossover cable and Straight through cable.

In this Lab, you will analyze the Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) 568-A and 568-B standards and how they apply it to Ethernet cables. You will then construct an Ethernet crossover cable and test it with a Cable Tester. Finally, you will learn to use that cable to setup a connection between two devices.

Objectives:

- Understand what is an ethernet Cable.
- Understand the difference between UTP and STP cables.
- Understand the uses of Crossover Cable and Straight through Cable.
- Understand the Ethernet Cable Categories. (Cat 3, 5, 5e, 6, 6a, 7)
- Analyze Ethernet Cabling Standards and Pinouts. (TIA/EIA 568-A & 568-B)
- Understand the required tools to build an ethernet cable.
- Build an Ethernet Crossover Cable.
- Test the Ethernet Crossover Cable using a Cable Tester.

What is an ethernet Cable?

Ethernet is a way of connecting computers and other network devices (Eg: Switches, Routers) in a physical space to share files, information and data between each other efficiently. Ethernet was released in 1980. By 1982, the Institute of Electrical and Electronics Engineers (IEEE) standardized the format, so all networking and computer devices would use the same ports/structure. All Ethernet cable manufacturers must adhere to these strict standards to ensure quality and safety.

Ethernet cables are a type of network cable which was designed to work with Ethernet ports.



Ethernet
Cable



RJ45
Connector

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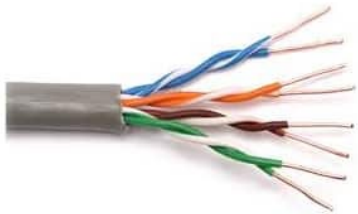
Ethernet Port on
a Laptop



There are several different structures in ethernet cables. The most common structure is the **Twisted Pair cable**.

In a Twisted Pair Cable, two wires inside the cable are twisted together. Twisted pair can be unshielded or shielded.

- Unshielded twisted pair cable (UTP)
- Shielded twisted pair cable (STP)



UTP Cable



STP Cable

Unshielded don't have foil or braided shielding around the cable. While unshielded cables are much cheaper, the signal quality decreases through electrical noise.

Shielded cables come with braided or foil shielding, which is usually made of copper or another conductive polymer. Shielding reduces electrical noise and improves connection quality.

Types of Ethernet Cables**Straight-Through Cables**

Used to connect different types of devices. For example, a computer to a router.

Cross Over Cables

Used to connect two devices of the same kind, for example, connecting two computers

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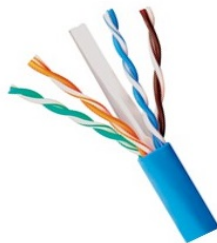
Ethernet Cable Categories

Ethernet cables come in different variations, known as Categories or Cat. Each category refers to a different set of standards.

	Category 3	Category 5	Category 5e	Category 6	Category 6a	Category 7
Cable Type	UTP	UTP	UTP	UTP or STP	STP	S/FTP
Max. Data Transmission Speed	10 Mbps	10/100/1000 Mbps	10/100/1000 Mbps	10/100/1000 Mbps	10,000 Mbps	10,000 Mbps
Max. Bandwidth	16 MHz	100 MHz	100 MHz	250 MHz	500 MHz	600 MHz



Cat5e



Cat6



Cat6a



Cat7

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Part A: Analyze Ethernet Cabling Standards and Pinouts.

The Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) has specified unshielded twisted pair (UTP) cabling standards for use in LAN cabling environments. TIA/EIA **568-A** and **568-B** stipulates the commercial cabling standards for LAN installations; these are the standards most commonly used in LAN cabling for organizations, and they determine which color wire is used on each pin.

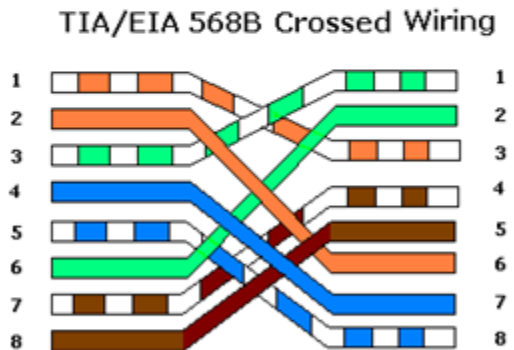
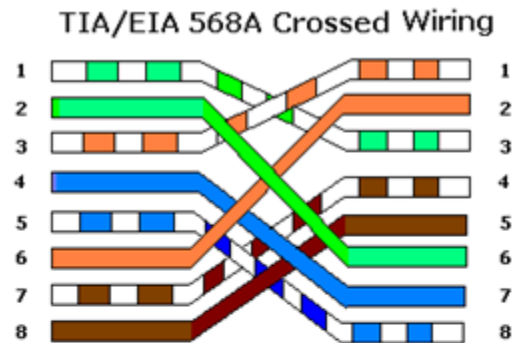


Figure A

Figure B

Shows the Pin Out of Straight through Cables

Shows the Pin Out of Crossover Cables

With a crossover cable, the second and third pairs on the RJ-45 connector at one end of the cable are reversed at the other end, which reverses the send and receive pairs. The cable pinouts are the 568-A standard on one end and the 568-B standard on the other end.

Step 1: Analyze diagrams and tables for the TIA/EIA 568-A standard Ethernet cable (Crossover Cables).

The following table and diagrams display the color scheme and pinouts, as well as the function of the four pairs of wires used for the 568-A standard.

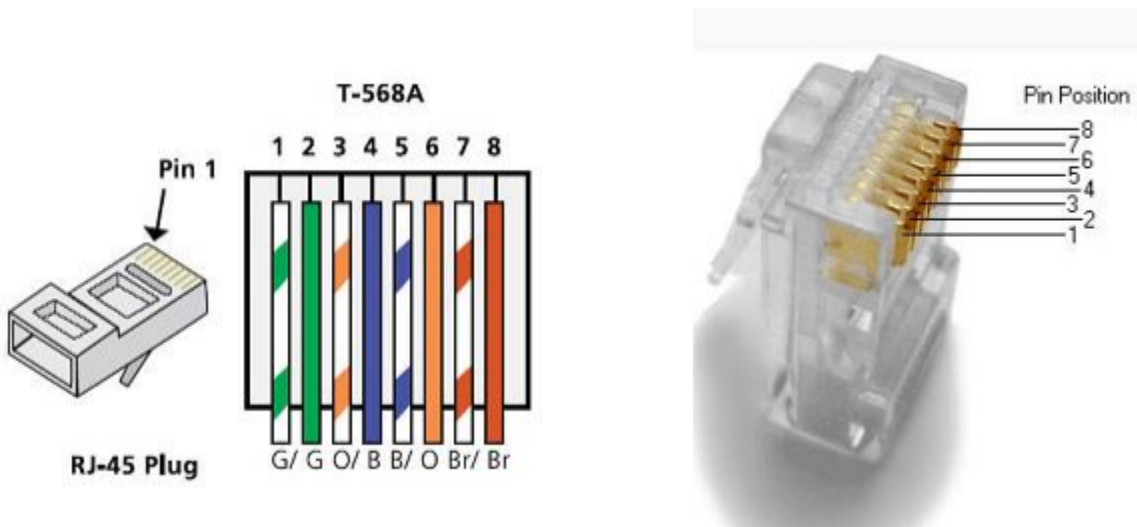
Note: In LAN installations using 100Base-T (100 Mb/s), only two pairs out of the four are used.

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568-A 10/100/1000Base-TX Ethernet

Pin Number	Pair Number	Wire Color	10Base-T Signal 100Base-TX Signal	1000Base-T Signal
1	2	White/Green	Transmit	BI_DA+
2	2	Green	Transmit	BI_DA-
3	3	White/Orange	Receive	BI_DB+
4	1	Blue	Not Used	BI_DC+
5	1	White/Blue	Not Used	BI_DC-
6	3	Orange	Receive	BI_DB-
7	4	White/Brown	Not Used	BI_DD+
8	4	Brown	Not Used	BI_DD-

The following diagrams display how the wire color and pinouts align with an RJ-45 jack for the 568-A standard.



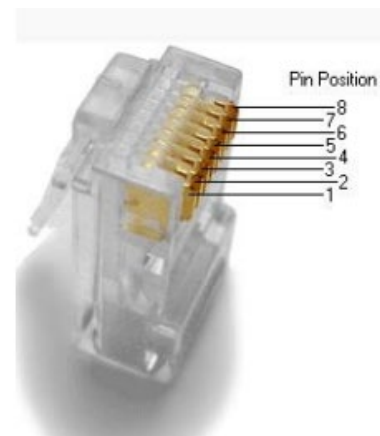
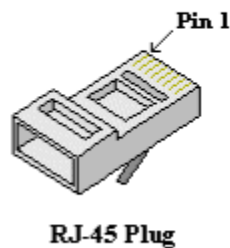
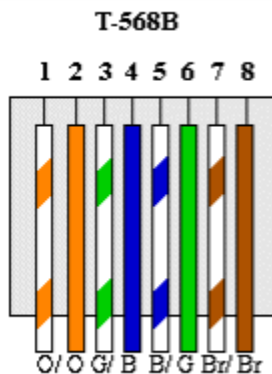
Step 2: Analyze diagrams and tables for the TIA/EIA 568-B standard Ethernet cable (Crossover Cables).

The following table and diagram display the color scheme and pinouts for the 568-B standard

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568-B 10/100/1000-BaseTX Ethernet

Pin Number	Pair Number	Wire Color	10Base-T Signal 100Base-TX Signal	1000Base-T Signal
1	2	White/Orange	Transmit	BI_DA+
2	2	Orange	Transmit	BI_DA-
3	3	White/Green	Receive	BI_DB+
4	1	Blue	Not Used	BI_DC+
5	1	White/Blue	Not Used	BI_DC-
6	3	Green	Receive	BI_DB-
7	4	White/Brown	Not Used	BI_DD+
8	4	Brown	Not Used	BI_DD-



Part B: Analyze the required tools to build an ethernet cable.

One length of cable, either Category 5 or 5e. Cable length should be 0.6 to 0.9m (2 to 3 ft.)



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2 RJ-45 connectors



RJ-45 crimping tool



Wire cutter



Wire stripper

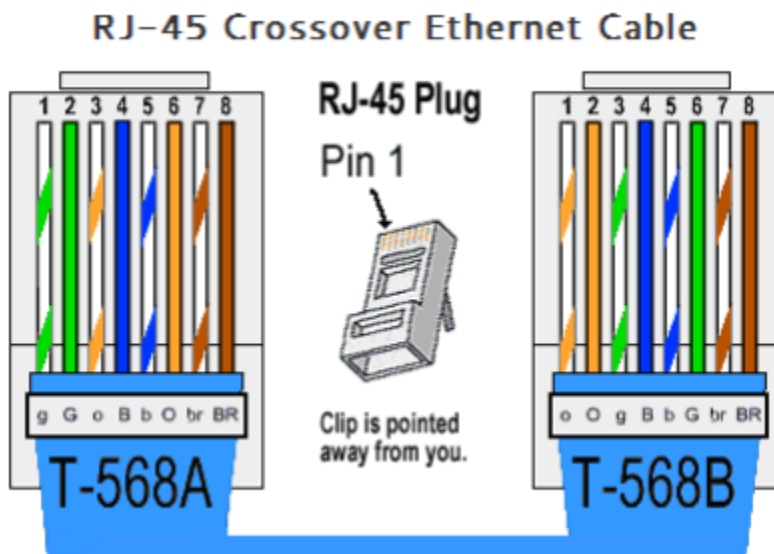


Ethernet cable tester



Worksheet 7**Part C: Build an Ethernet Crossover Cable**

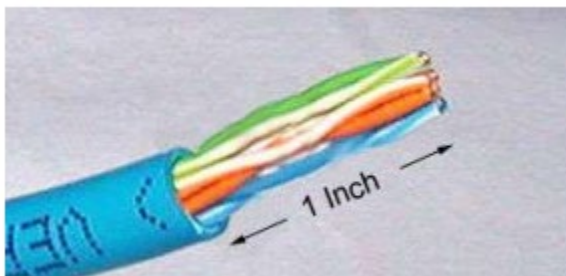
A crossover cable has the second and third pairs on the RJ-45 connector at one end, reversed at the other end (refer to the table in Part 1, Step 2). The cable pinouts are the 568-A standard on one end and the 568-B standard on the other end. The two following diagrams illustrate this concept.

**Step 1: Build and terminate a TIA/EIA 568-A cable end.**

1. Determine the cable length required.

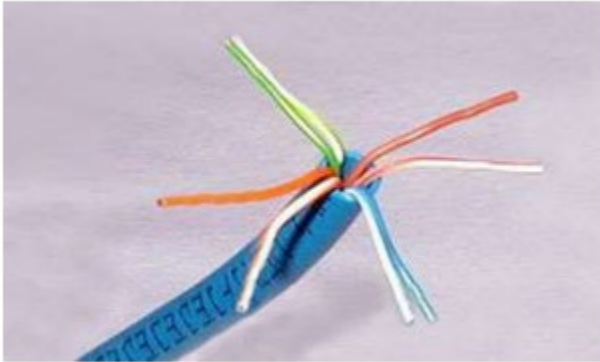
Note: If you were making a cable in a production environment, the general guideline is to add another 12 in. (30.48 cm) to the length.

2. Cut off a piece of cable to the desired length and using your wire stripper, remove 5.08 cm (2 in.) of the cable jacket from both ends.

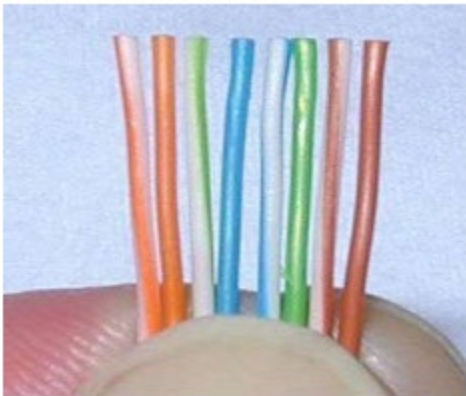


3. Hold the four pairs of twisted cables tightly where the jacket was cut away. Reorganize the cable pairs into the order of the 568-A wiring standard. Refer to the diagrams, if necessary. Take as much care as possible to maintain the twists in the cable; this provides noise cancellation.

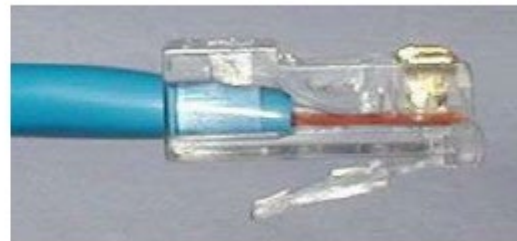
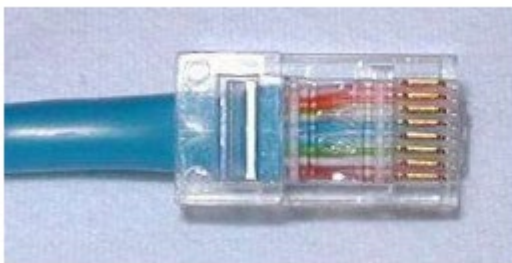
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4. Flatten, straighten, and line up the wires using your thumb and forefinger.

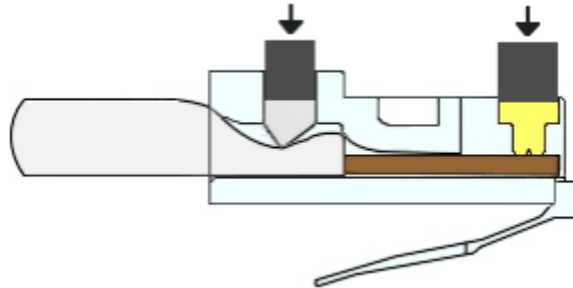


5. Ensure that the cable wires are still in the correct order for the 568-A standard. Using your wire cutters, trim the four pairs in a straight line to within 1.25 to 1.9 cm (1/2 to 3/4 in.).
6. Place an RJ-45 connector on the end of your cable, with the prong on the underside pointing downward. Firmly insert the wires into the RJ-45 connector. All wires should be seen at the end of the connector in their proper positions. If the wires are not extending to the end of the connector, take the cable out, rearrange the wires as necessary, and reinsert the wires back into the RJ-45 connector.



7. If everything is correct, insert the RJ-45 connector with cable into the crimper. Crimp down hard enough to force the contacts on the RJ-45 connector through the insulation on the wires, thus completing the conducting path. See the following diagram for an example.

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**Step 2: Build and terminate a TIA/EIA 568-B cable end.**

Repeat steps 1.1 to 1.7 using the 568-B color wiring scheme for the other end.

Reference:

- <https://sites.google.com/site/pnutpck11/making-ethernet-cables>
- <https://www.youtube.com/watch?v=LKxzJk08Ma8>
- <https://www.youtube.com/watch?v=Uw8FSXx4dnU>

Part C: Test an Ethernet Crossover Cable

Many cable testers will test for length and mapping of wires. If the cable tester has a wire map feature, it verifies which pins on one end of the cable are connected to which pins on the other end.

Reference:

- <https://www.youtube.com/watch?v=bApjA6td8qw>