2. Insert the braid terminators into the tap body as shown in Figure 80.

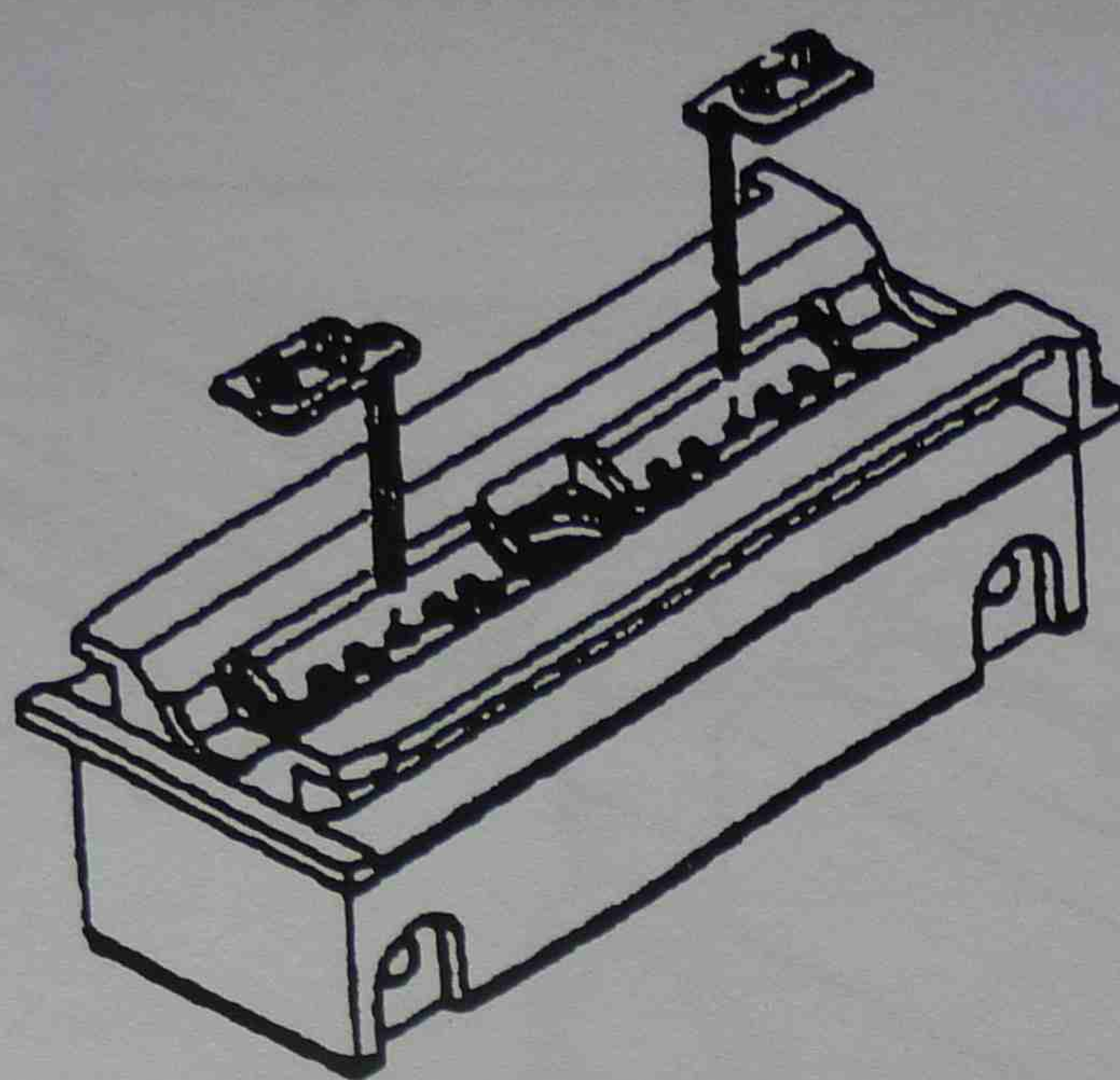


Figure 80 Assembling plug body (picture courtesy of AMP)

3. Place the cable into the tap body as shown in Figure 81.

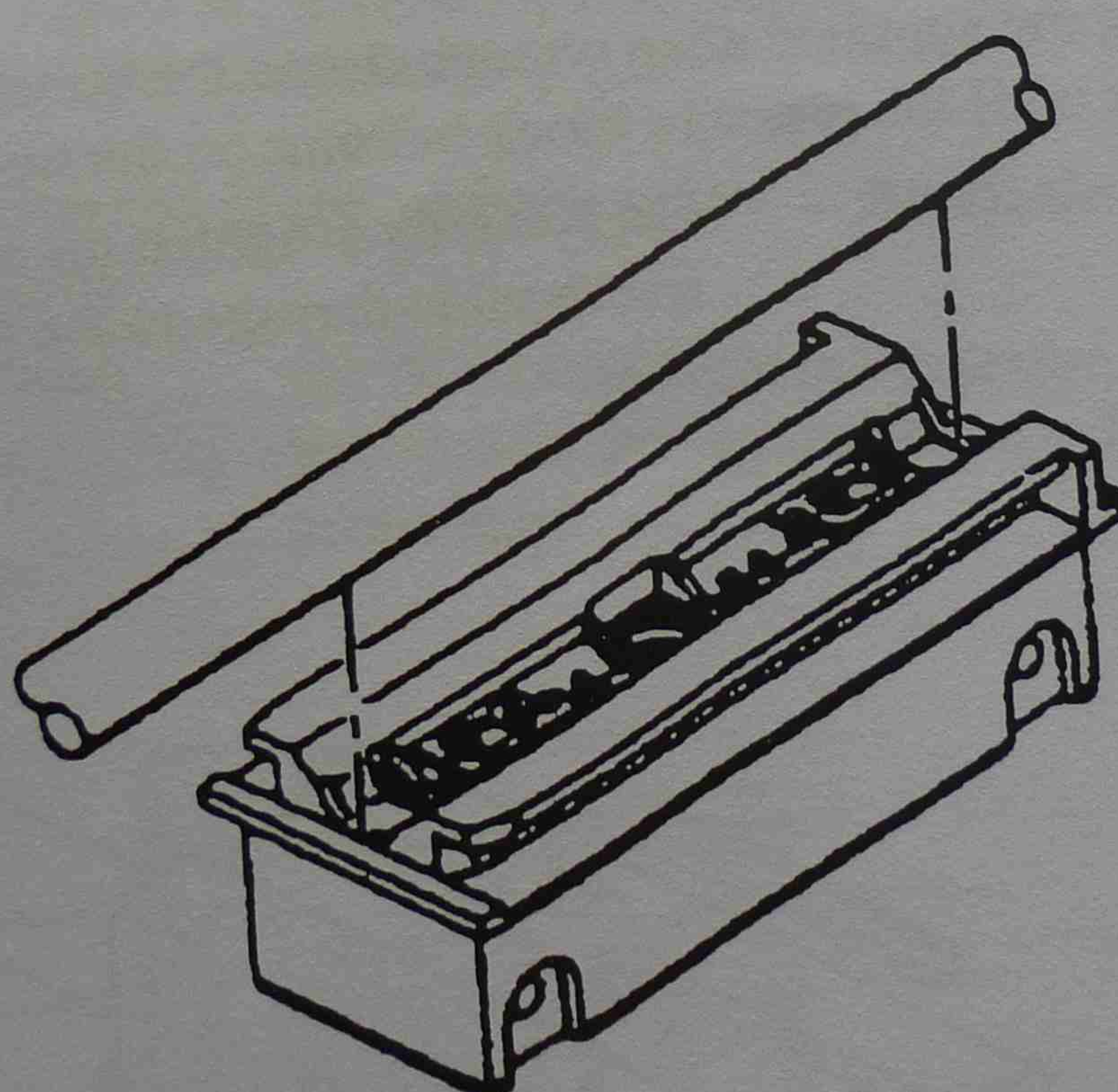


Figure 81 Assembling Plug Body (picture courtesy of AMP)

4. Slide the clamp assembly onto the tap body as shown in Figure 82.

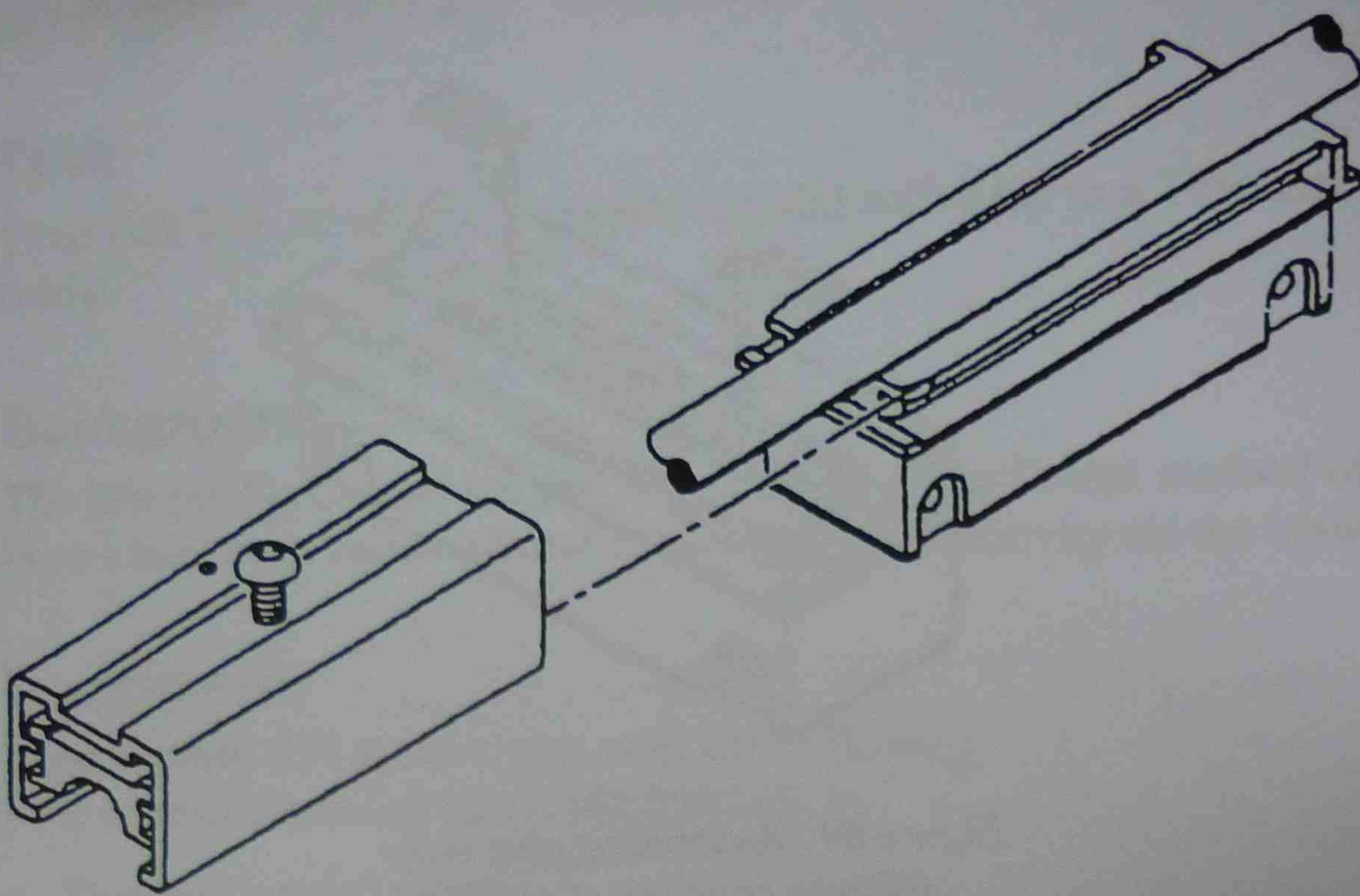
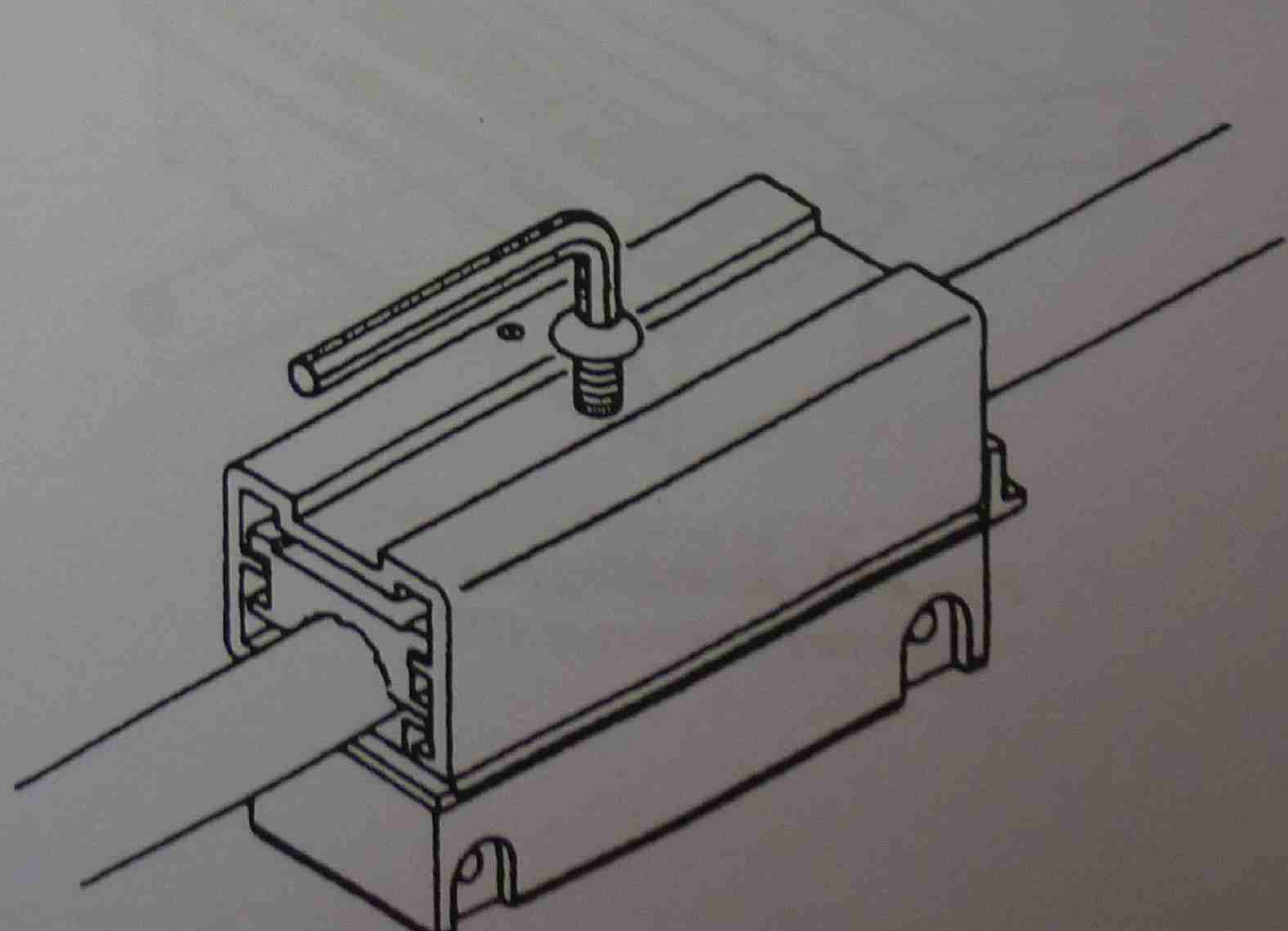


Figure 82 Assembling plug body
(picture courtesy of AMP)

5. Using the supplied allen wrench thread the button head screw into the frame until the pressure block bottoms on the track and secures the cable.

Note: Do **NOT** over-tighten the screw as this may cause irreversible damage to the tap.



6. Drill through the cable using the application tool. Figure 84 details this procedure. Clean away any debris from the hole.

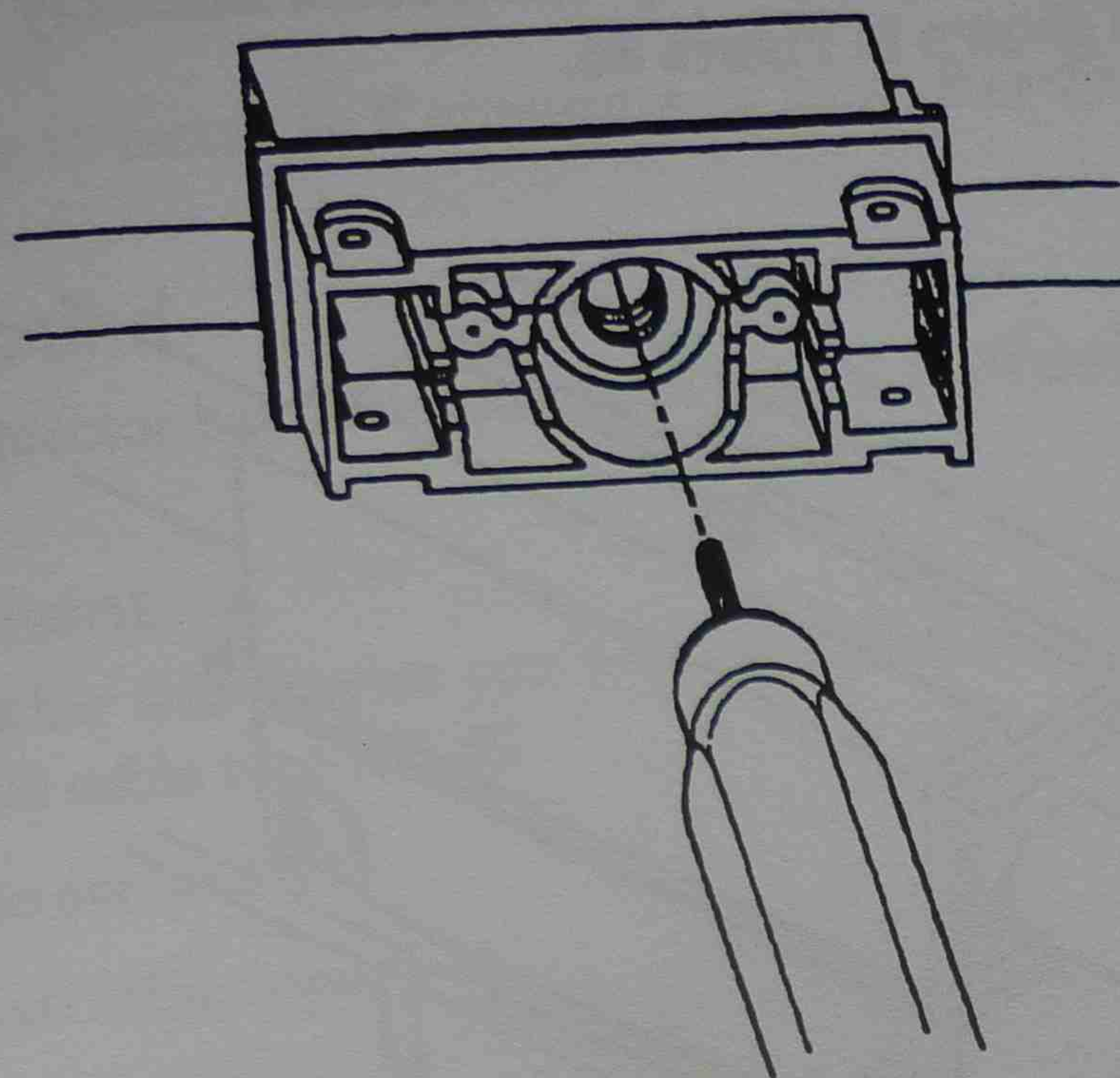
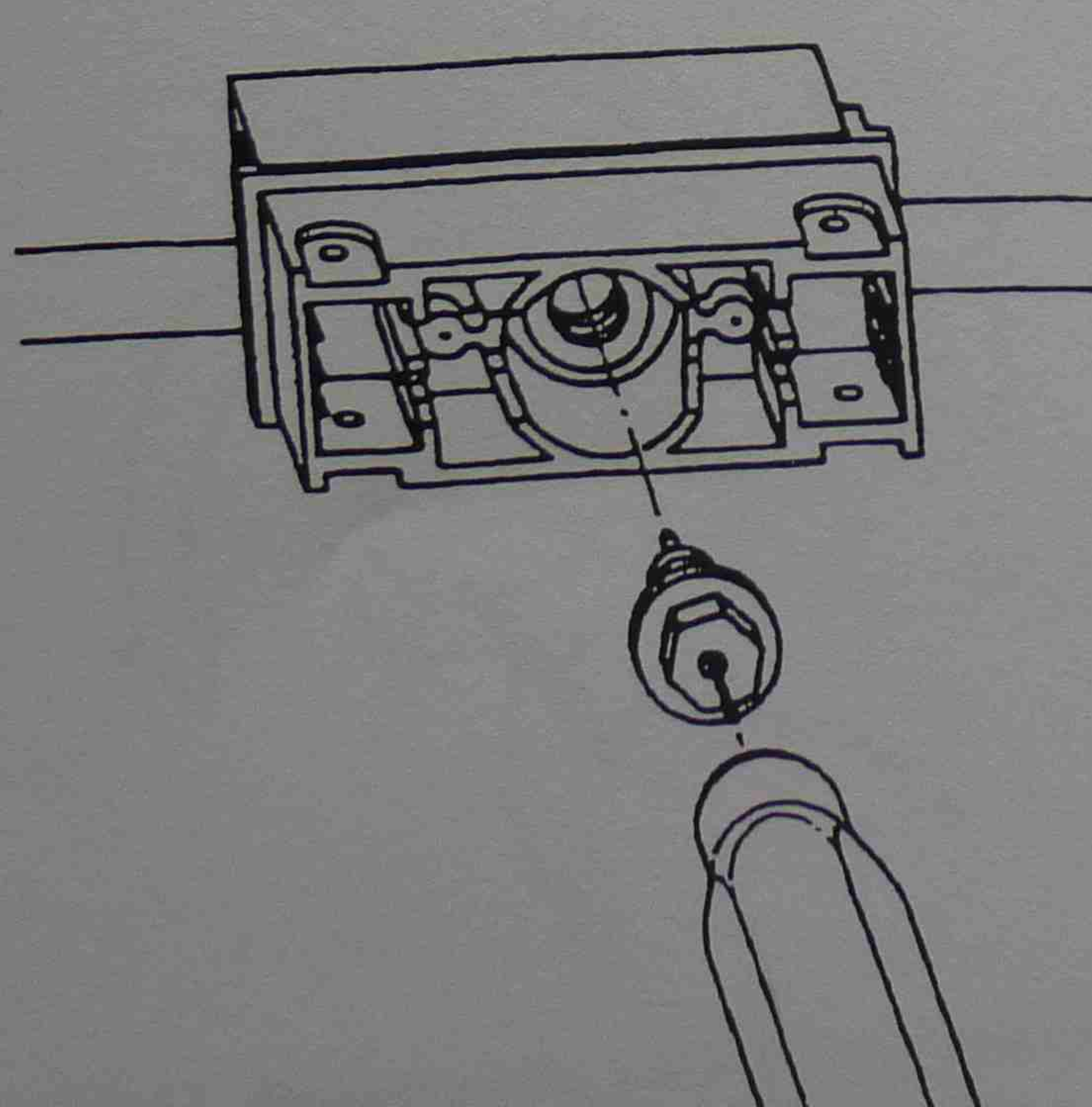


Figure 84 Assembling plug body
(picture courtesy of AMP)

7. Use the socket end of the application tool to thread the probe into the tap until it bottoms.

Note: Do **NOT** over-tighten the probe as this may cause irreversible damage to the tap. Hand tighten the probe only.



The following steps apply if you are installing the transceiver.

8. Align the probe and terminator posts with the contacts on the printed board assembly and place the tap onto the printed board assembly.
9. Attach the tap body onto the printed board assembly using suitable hardware as shown in Figure 86.

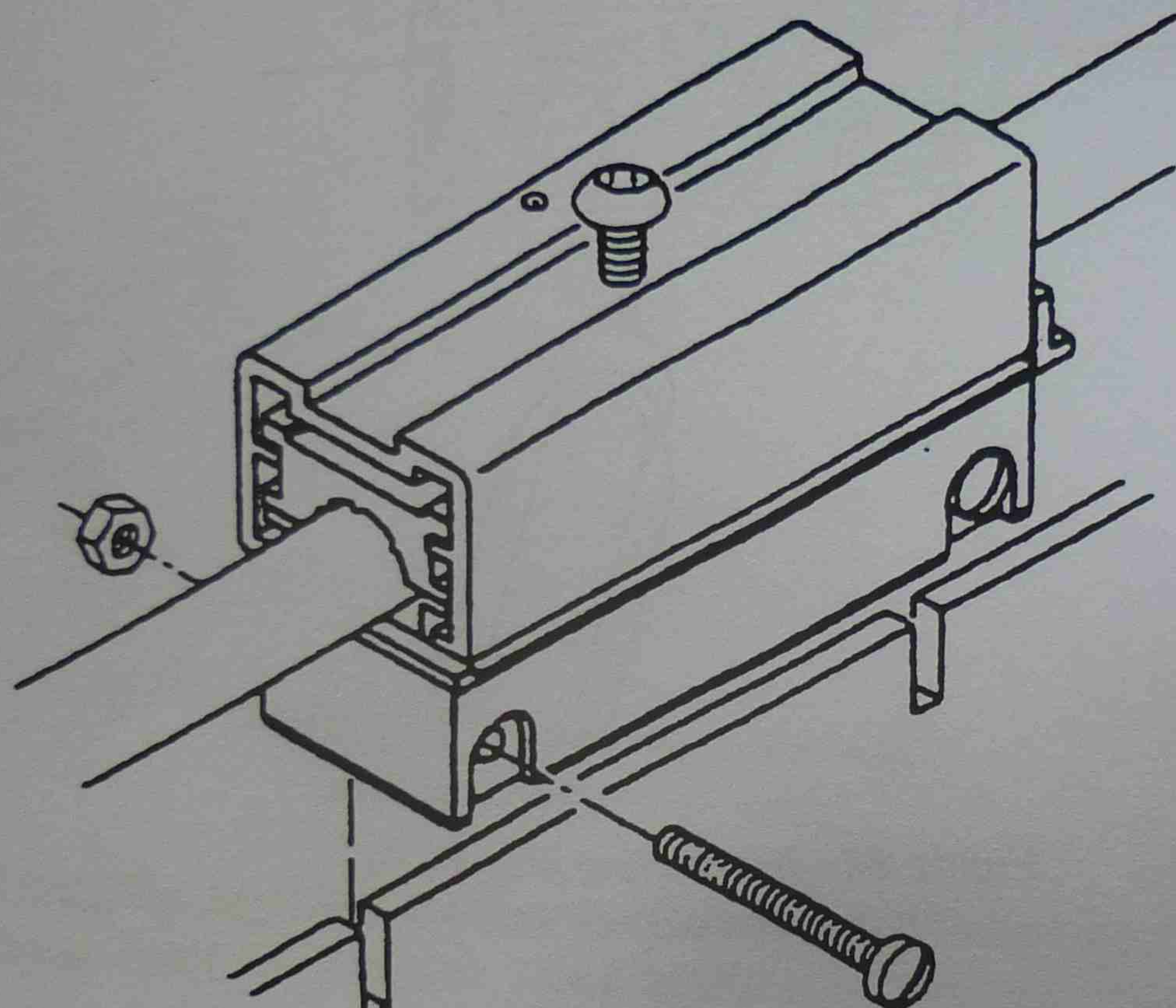


Figure 86 Assembling plug body (picture courtesy of AMP)

Practical exercise 15.2 Coaxial cable F connector

Task

Your task is to install an F connector on to an RG-59 coaxial cable.

Background

The F connector has common use in CATV applications.

Equipment

Your teacher will provide you with the following:

- coaxial cable type RG-59
- F type connector
- coaxial cable tripper
- crimping tool

Procedure

1. Determine how much of the sheath to remove. Generally the centre conductor should extend past the end of the connector about 3mm.
2. Select a coaxial cable stripping tool or adjust a tool, following the manufacturer's specifications, to the above requirement. Using the stripping tool prepare the coaxial cable for termination. Avoid cutting any of the strands in the shield. Cutting too many strands could cause a poor connection. Adjust the tool if necessary.

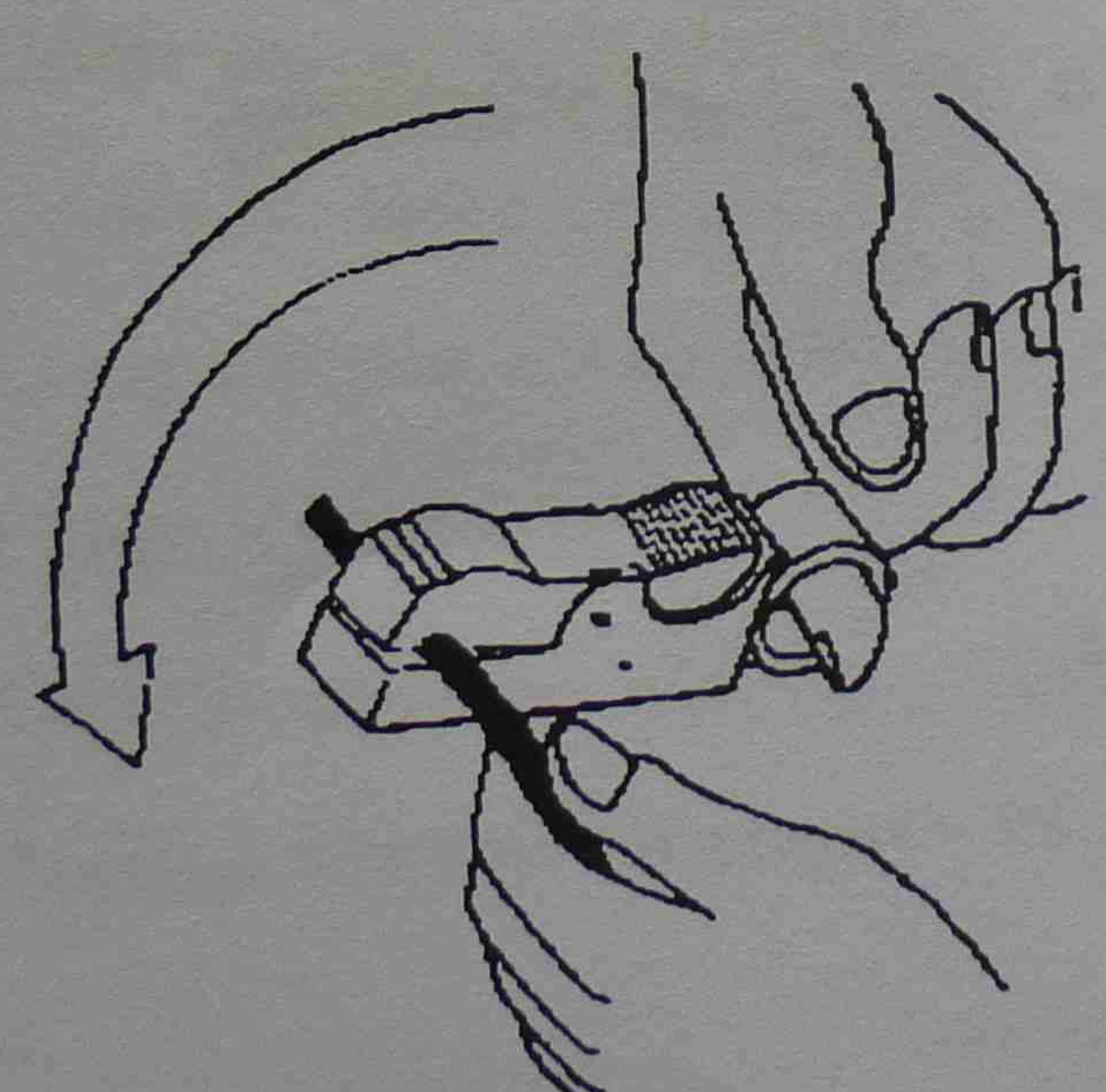


Figure 87 Preparing the cable using a stripping tool

3. Remove the sheath, shield and dielectric.
4. Inspect the stripped area for any nicks, gouges, or stray strands from the braided shield. Clip or otherwise remove stray strands away from the centre conductor. Re-strip the cable if necessary.
5. Slide the F connector onto the cable as shown in Figure 88, until the dielectric is even with the shoulder of the attachment nut. Ensure that the connector completely covers all the exposed braid.

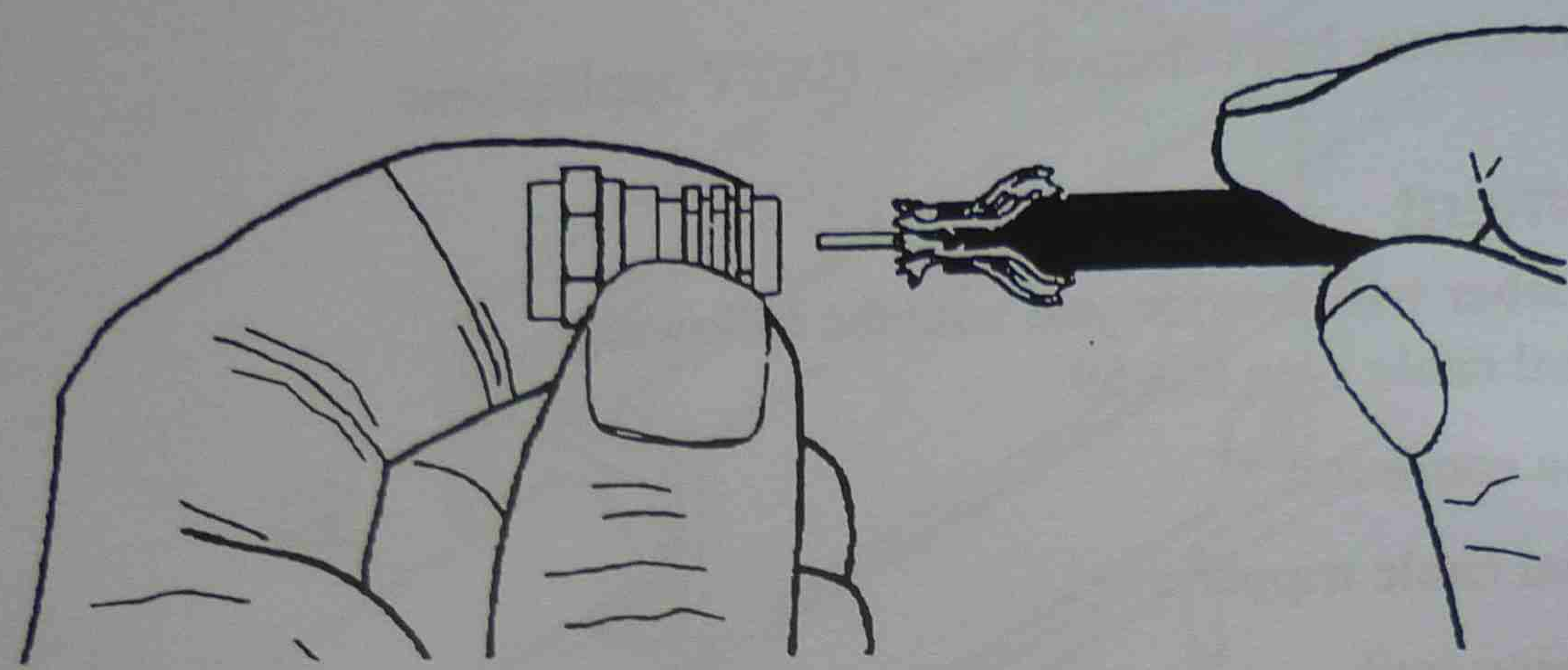


Figure 88 Fitting connector to cable

6. Using the proper crimp port on the crimping tool, crimp the body of the connector as shown in Figure 89.

   Note: If it is not clear which port is the proper one, start with the largest one and work down.

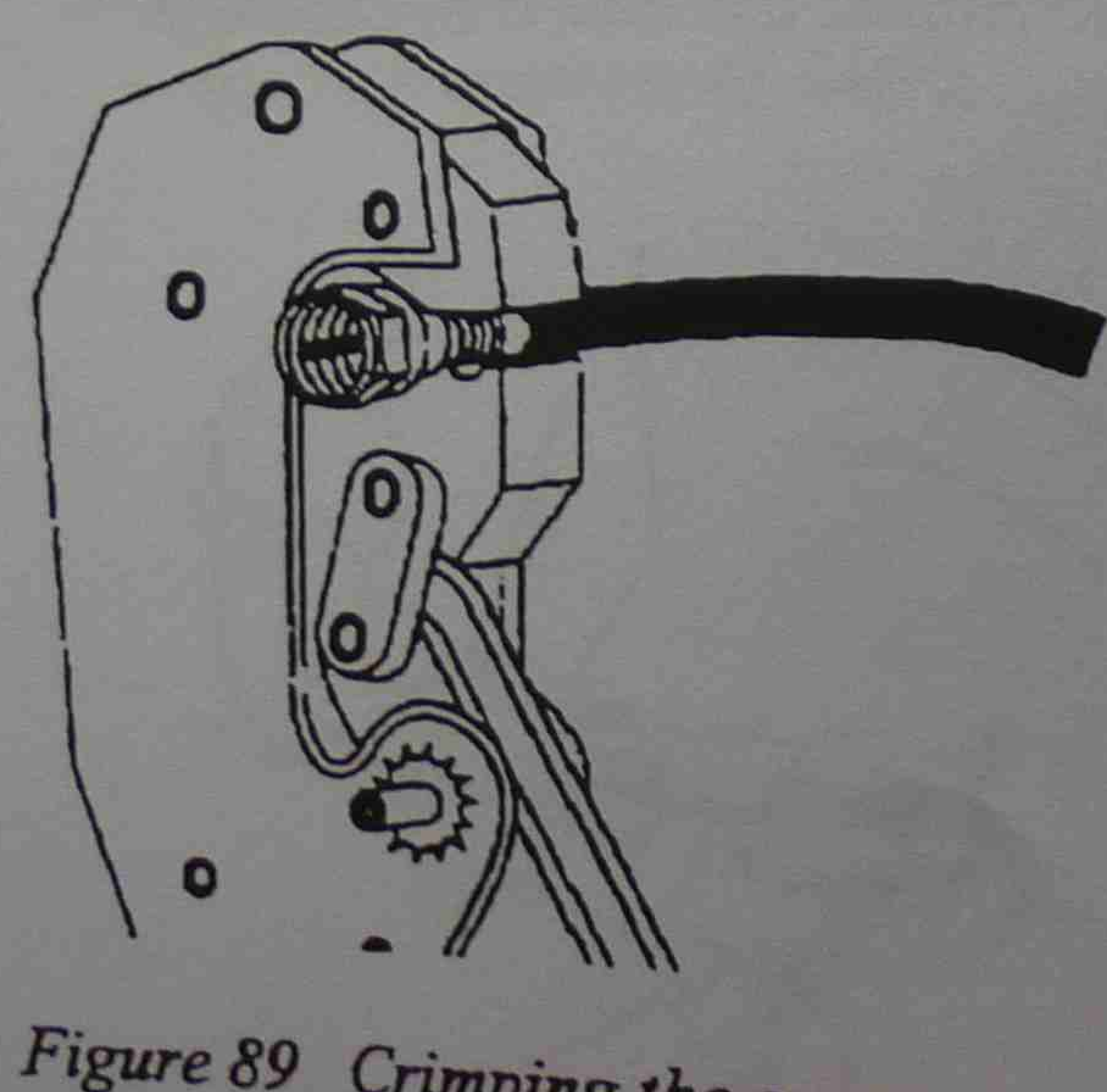


Figure 89 Crimping the connector

7. Inspect the connector to ensure that:
   - ☐ connector attaches securely to the cable
   - ☐ no strands of the braid are touching the centre conductor
   - ☐ centre conductor extends about 3mm beyond the end of the connector

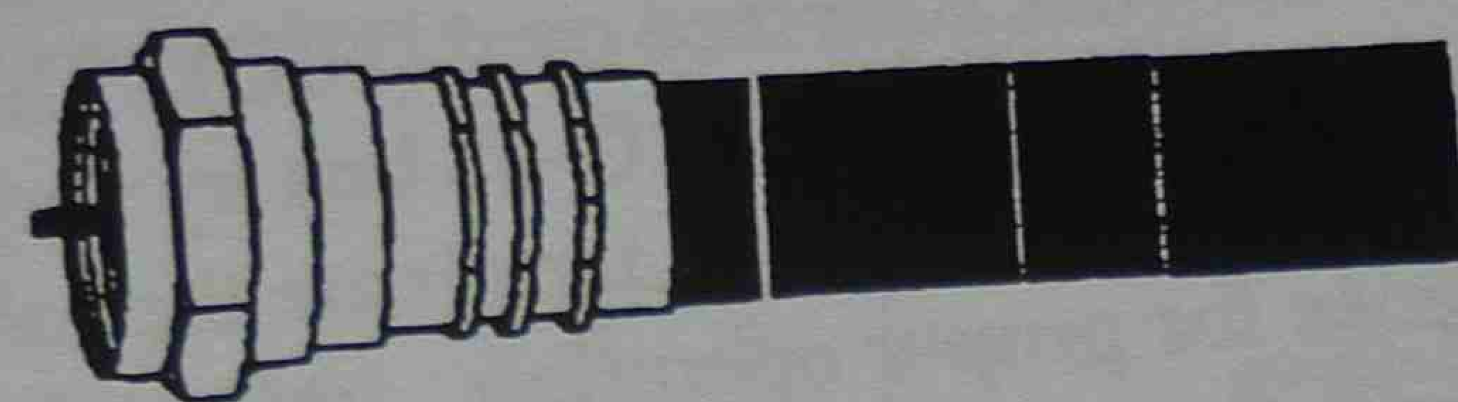


Figure 90 Finished termination

8. Test your cable using an MTDR or similar.
9. Complete the following Test Results Check List.

Test Results Check List

1. **Visual Inspection**
   - ☐ Wire is visible through the centre
   - ☐ Shield is not visible
   - ☐ Centre conductor clear of braid
   - ☐ Centre conductor extends about 3mm
   - ☐ Crimp effected without excessive distortion

2. **Cable Test**
   - ☐ Cable passes cable test (either MTDR or Scanner)

3. **Certification**

Participant: ____________________ **Teacher:** ____________________

Practical exercise 15.3 Installing a 10 Base2 LAN

Introduction

IEEE 802.3 local area networks use a bus topology that can be implemented on RG-58 "thin" coaxial cable. The IEEE designation for this implementation is 10 Base2. This 10Mb/s LAN allows 185 metres of coaxial cable and 30 connections per segment. Each work station connects to the network bus through a Medium Attachment Unit or transceiver that is normally on board the network interface card (NIC). The NIC has a 50 ohm BNC jack that connects directly to the RG-58 bus by way of a 'T' connector. At each end of the bus, it is necessary to terminate the cable with its characteristic impedance for proper operation. 10 Base2 networks commonly use a multi-port repeater for connecting multiple bus segments together.

Task

Your task is to install a typical 10 Base2 LAN system.

Equipment

Your teacher will provide you with the following:

- basic hand tool kit
- coaxial cable RG-58/U
- connector 50 ohm BNC
- crimping tool for BNC connector
- face plates to suit taps (AMP 222754-1)
- standard mounting blocks
- terminator 50 ohm (AMP 222504-1)
- Thinnet taps (AMP 222503-1)

Procedure

1. Mount the two mounting blocks at suitable locations on the work board. Make sure the minimum distance between the two is 0.5 metres.
2. Install a run of RG-58/U coaxial cable from the multi-port repeater (absent) through the first mounting block and finishing with approximately 100mm spare at the second mounting block. Use Figure 91 as a guide.

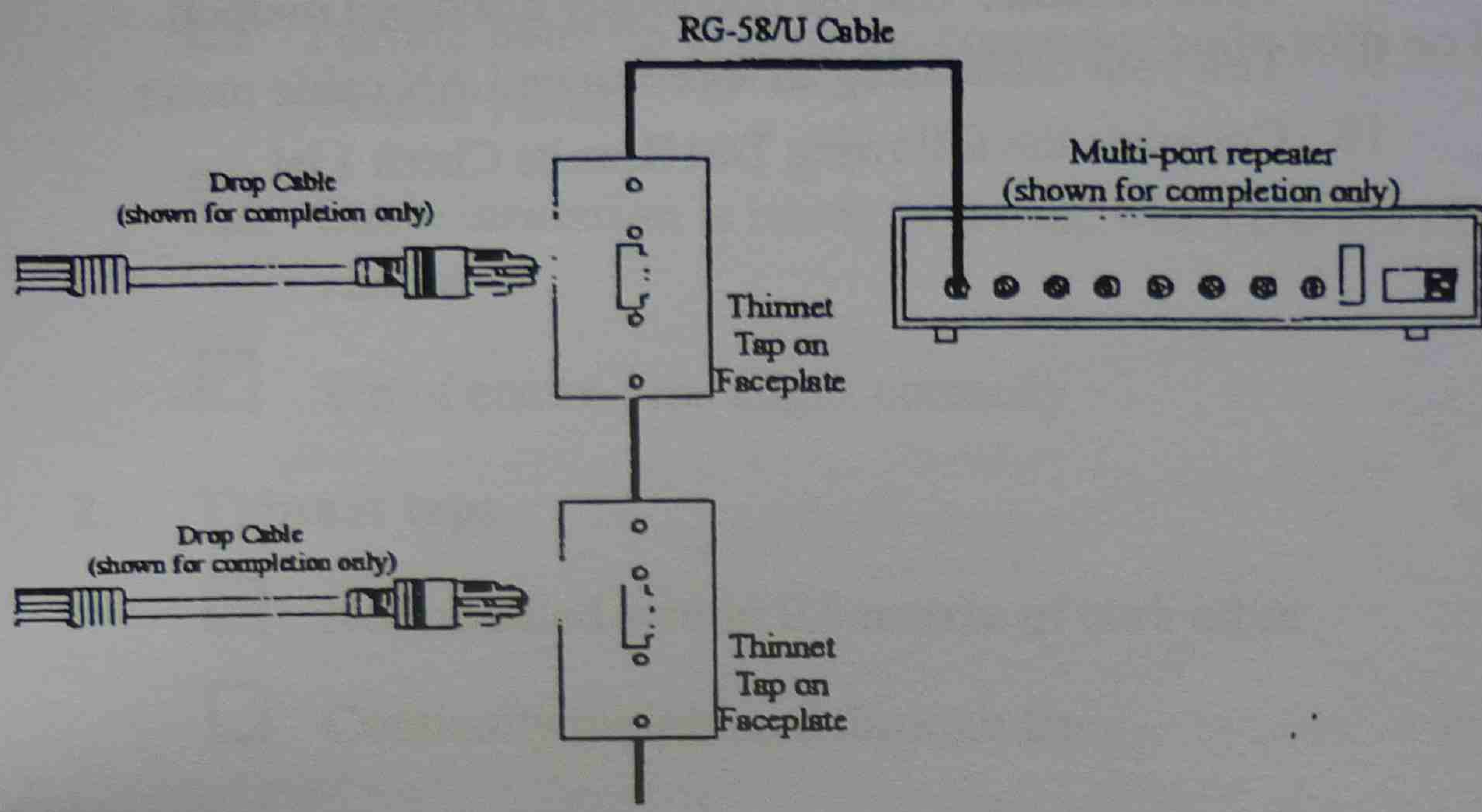


Figure 91 Layout of Practical exercise 15.3

3. Install the first Thinnet tap following the manufacturer's instructions and using Figure 92 as a guide.

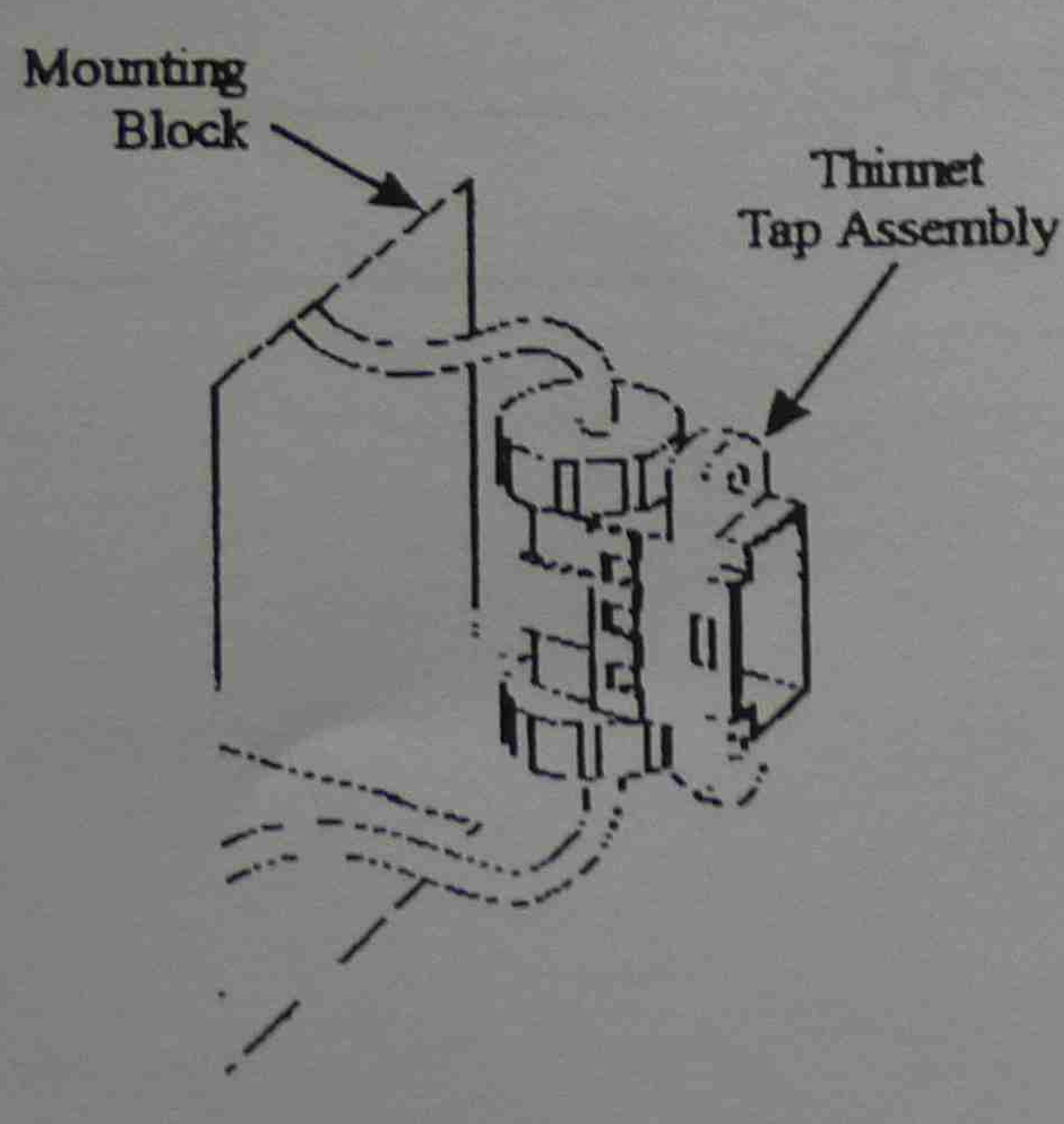


Figure 92 Installing the Thinnet tap

4. Fix the tap to the face plate and then fix the faceplate to the mounting block.
5. Install the second Thinnet tap following the manufacturer's instructions using Figure 92 as a guide.
6. Install the 50 ohm terminator to the bottom end of the tap.
7. Fix the tap to the face plate and then fix the faceplate to the mounting block.
8. Install a BNC connector to the multi-port repeater (absent) end of the Thinnet cable. Use the previously discussed method.
9. Test your cable using an appropriate LAN cable meter.
10. Complete the following Test Results Check List.

Learning notes

Cable hauling

Cable hauling is one of the most important aspects of any successful system installation. Some cable installers incorrectly believe that coaxial cable is virtually indestructible as it appears bulky and well protected in comparison to the devices it interconnects. There are many factors to consider before and during any cable hauling operation. You need to examine some of these factors.

Before cable haul

Before starting a cable hauling operation it is important to make the following tests and inspections:

- ❑ Check the label on the cable reel or box to verify the cable is the proper type and size.
- ❑ Inspect the cable dispenser for damage during transport, or from rough handling.
- ❑ Do a continuity and decibel loss test on the cable to verify the manufacturer's certification data.

After the above checks you should walk the cable route and take the following steps:

- ❑ Locate all haul points and remove the draw- box covers, if applicable.
- ❑ Check that draw-box locations allow sufficient room to meet the cable's minimum bend radius. (As a rule, ensure that the box opening and haul point locations are at least four times the minimum cable bend radius.)
- ❑ Identify all locations where it may be necessary to use special rigging to complete the hauling operation.
- ❑ For cable trays, verify enough space is available within the cable tray.
- ❑ For open or free-air installations, verify installation of hangers are of appropriate size.

Pull marker strings through the cable pathway to obtain the actual length of cable before cutting the cable.

Obtain a copy of the engineering specification or manufacturer's specification for the relevant cable hauling parameters. The data should at least include:

- ❑ maximum hauling tension for the cable
- ❑ minimum bend radius for the cable
- ❑ rigging calculations and restrictions

During cable hauling

During the cable haul it is important to follow the following guidelines:

- ❑ Before removing the cable from the dispenser, inspect the dispenser for nails or other objects that could damage the cable
- ❑ Ensure that the cable feeds into the haul smoothly and without tangles by using:
  - ◊ appropriately sized cable reel stands
  - ◊ correctly positioned cable boxes
- ❑ As the cable feeds from the dispenser, inspect the cable sheath carefully for deep cuts or deformities. Deformities include:
  - ◊ bulging sections of sheath. A bulge usually indicates an inner shield splice. Although this usually does not harm the signal transmission, it may hamper the installation due to space limitations.
  - ◊ reduced-diameter (constricted) sections of sheath. Reduced-diameter sections usually indicate either a poor inner shield splice or no shielding in the constricted section. Avoid using cable with reduced-diameter sections.

After completing the quality inspection, prepare the cable end for installation. Affix a unique identification number (from the Administration specifications) to the cable ends and seal them to keep out moisture or contaminants. Whenever possible, avoid hauling pre-connectorised cable.

Whenever possible, rig and haul the cable manually to ensure its maximum hauling tension is not exceeded. Do not use a power winch to haul a cable without also using a dynamometer. Place the dynamometer between the cable head and the power winch, and monitor it at all times during the power haul.

Never violate the maximum hauling tension specified for the cable by its manufacturer or by the project engineer, whichever is smaller.

If the installation requires a power winch, most cable manufacturers recommend using a wire-mesh Hauling grip to hold the cable. The grip ensures even distribution of the hauling tension over a greater area of the cable sheath. Use a swivel link to keep the cable from spiralling within the duct. After slipping the grip over the cable, tape the back end of the grip to secure the grip to the cable.

Be careful to keep the cable from contacting sharp edges. If possible, provide permanent protection from sharp edges. Without protection, sharp or jagged metal protrusions often cut the soft cable sheath.

After the haul is complete, lay the cable in its final installed position.

Installation specifications often list two separate minimum bend radius requirements, including a:

- "Minimum bend radius" that applies during installation
- "Minimum installation radius" that applies when the cable is tied down to its final position

When fixing the cable, ensure proper support where the cable makes transitions from the horizontal support system to vertical risers. Installation specifications should list the maximum unsupported drop a cable can make in a riser. Regardless of the specifications, it is good practice to provide support at the horizontal-to-vertical transition. This keeps the weight of the hanging cable from degrading the junction. If a cable tray or duct supports the horizontal cable, the transition support can be by way of a roll-out.

After installation of the cable, seal all fire-wall breaks and access holes that penetrate designated fire barriers. All seals and fire-stops must conform to applicable codes.

Consider affixing an identification tag to a cable any time the cable:

- enters or exits a fire seal
- traverses a cable tray junction
- passes through a junction box

The time and effort required for this tagging is not much when compared to the time and effort saved during future repairs.

If the finished cable routing differs from the specified route, note the deviation on the as built drawings.

On completion of the cable hauling operation return all draw-box covers and access panels to their "as-found" positions.

Useful tools

The following are some useful termination tools for coaxial cables.

cable stripper

A dedicated coaxial cable stripper matched to the cable and connector type allows quick and consistent termination preparation. A coaxial cable stripping tool is much safer than a utility knife. The draw-back is that a dedicated stripping tool may be expensive. You may need several tools — one for each type of cable and connector combination.

utility knife

Utility knives are often used for preparing coaxial cables for termination as they are cheap and readily available. However, a knife requires skill and accuracy to avoid nicking the centre conductor and shield. *When using a knife always cut away from your body. Retract the blade when not in use.*

A nicked centre conductor weakens the conductor mechanically and greatly reduces the available bandwidth. (Skin effect — majority of electrons are on the outside 'skin' of the conductor at higher frequencies). Nicked braid reduces the effect of the shield.

crimping tools

It is important to match crimping tools to both the cable and connector types. There are two styles of crimp: hexagonal and circular. General purpose tools are not recommended.

ractical exercise 14.1 Coaxial patch cord

Task

Your task is to construct a coaxial cable patch cord using RG 58 coaxial cable and BNC connectors.

Equipment

Your teacher will provide you with the following:

- 2 x RG 58 crimp connectors
- 1.5 metre of RG 58 coaxial cable
- various coax cable strippers
- set of hand tools
- hand crimping tool for RG 58
- 50 ohm BNC coaxial cable connector

Procedure

1. Using suitable tools carefully prepare the cable to the dimensions shown in the manufacturer's instructions. If no instructions use Figures 73 and 74 as a guide. It is preferable to use a proprietary stripping tool as this removes sheath, shield and dielectric to the correct dimensions. Follow the tool manufacturer's instructions.

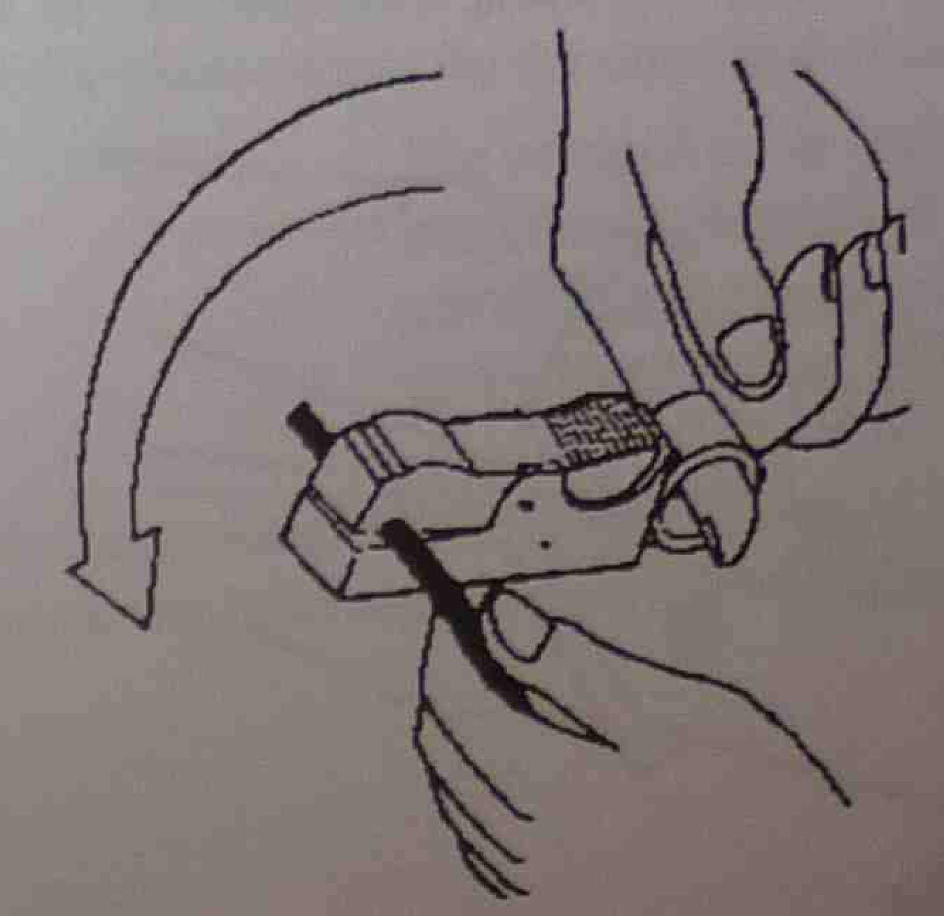


Figure 73 Stripping coaxial cable

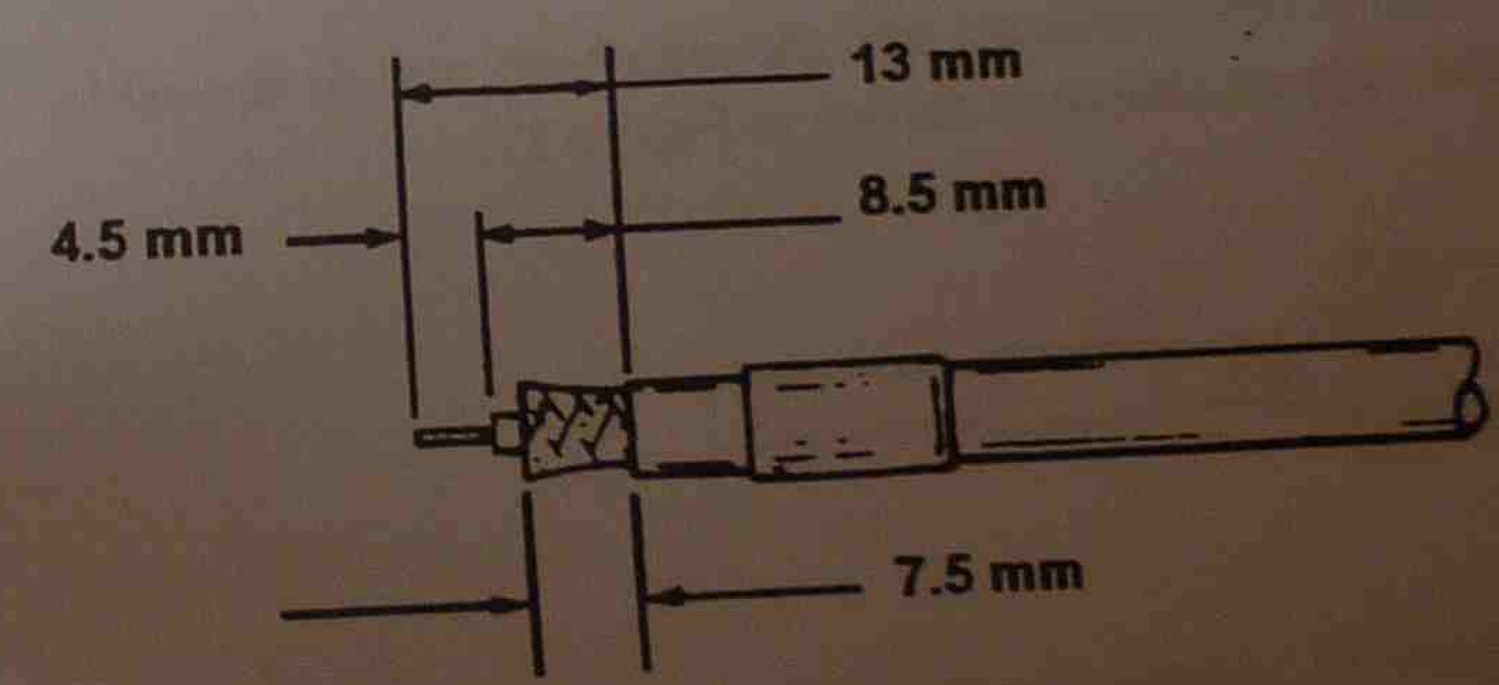


Figure 74 Stripping dimensions

2. Slide the centre contact (crimp pin) onto the centre cable conductor tightly (see Figure 75)

Figure 75 Assembling centre pin

3. Crimp the contact in place using a suitable tool as shown in Figure 76.

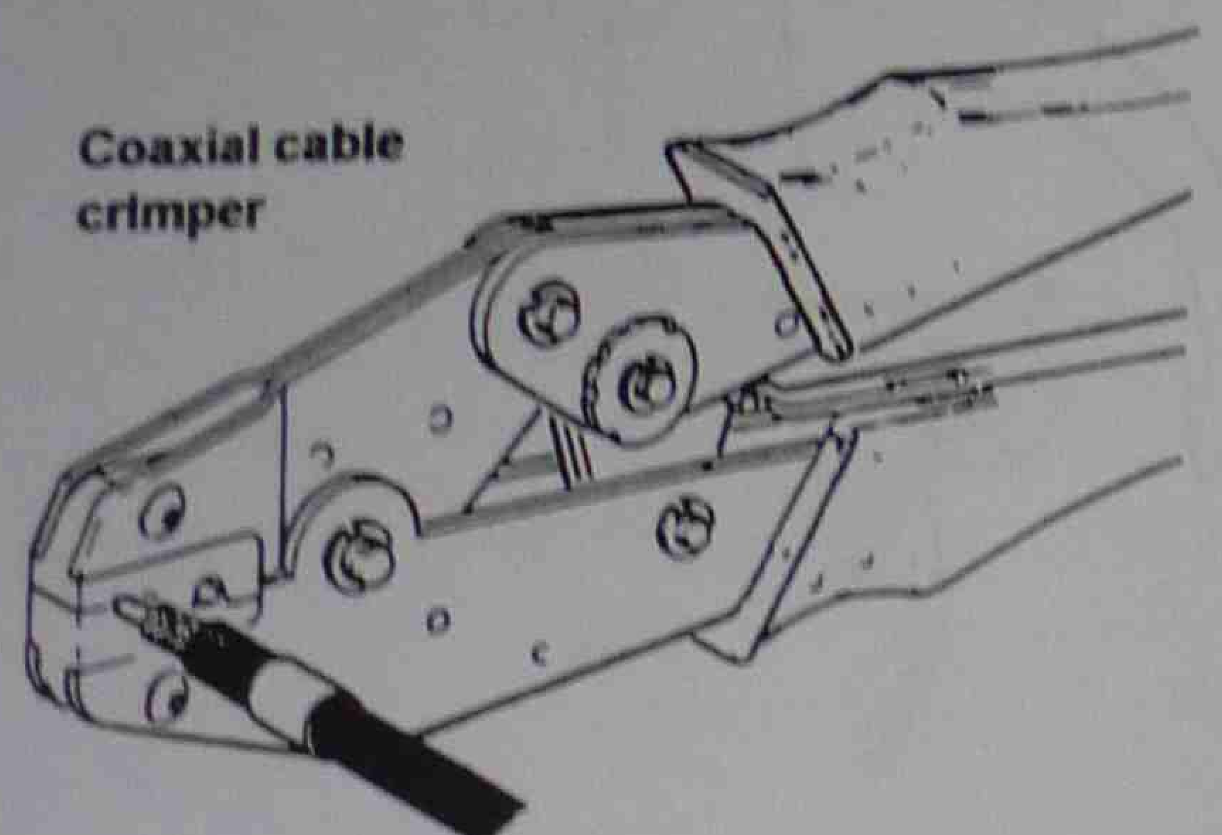


Figure 76 Crimping centre pin

4. Insert the crimped centre contact into the plug body and fit the cable braid over the support sleeve as shown in Figure 77.

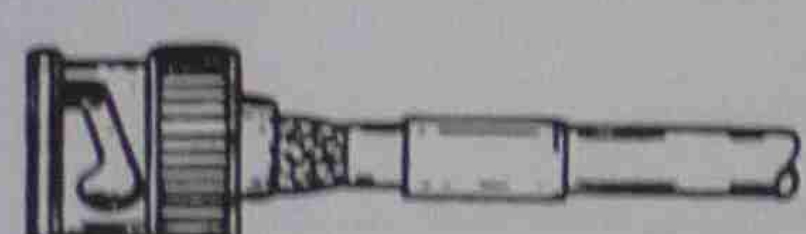


Figure 77 Assembling plug body

5. Slide the ferrule over the braid and support sleeve, insert the connector into the crimper and crimp the ferrule down as shown in Figure 78.

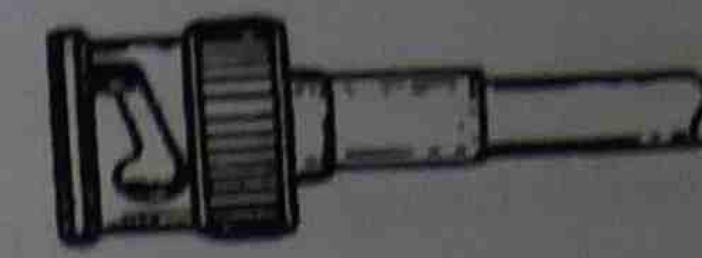


Figure 78 Finishing plug assembly

6. Repeat the above steps for the other end of the cable.

   Note: The crimped cable braid provides the total mechanical strength of the connector. Please do not disturb the braid weaving. Ensure the braid is undamaged before crimping.

7. Test the completed cable using either an MTDR or coaxial cable tester. Complete the following test results check list.

Cable scanners or meters

Cable scanners are high technology devices used to certify LAN cabling. They can perform a large number of tests as well as monitoring of active LANs.

Activation of the scanner's auto test function can perform the following tests on a cable:

- wire map — polarity of wires at connectors both ends
- length
- near end crosstalk
- attenuation
- attenuation to crosstalk ratio (ACR)
- impedance
- capacitance
- loop resistance

The cable scanner will repeat these tests at 100, 200, or 500kHz frequency increments up to a maximum of 100MHz. The scanner will indicate a pass or indicate where the cable has failed. Thorough testing requires checking the cable from both ends. It is possible to do each of the above tests individually to analyse a fault more closely.

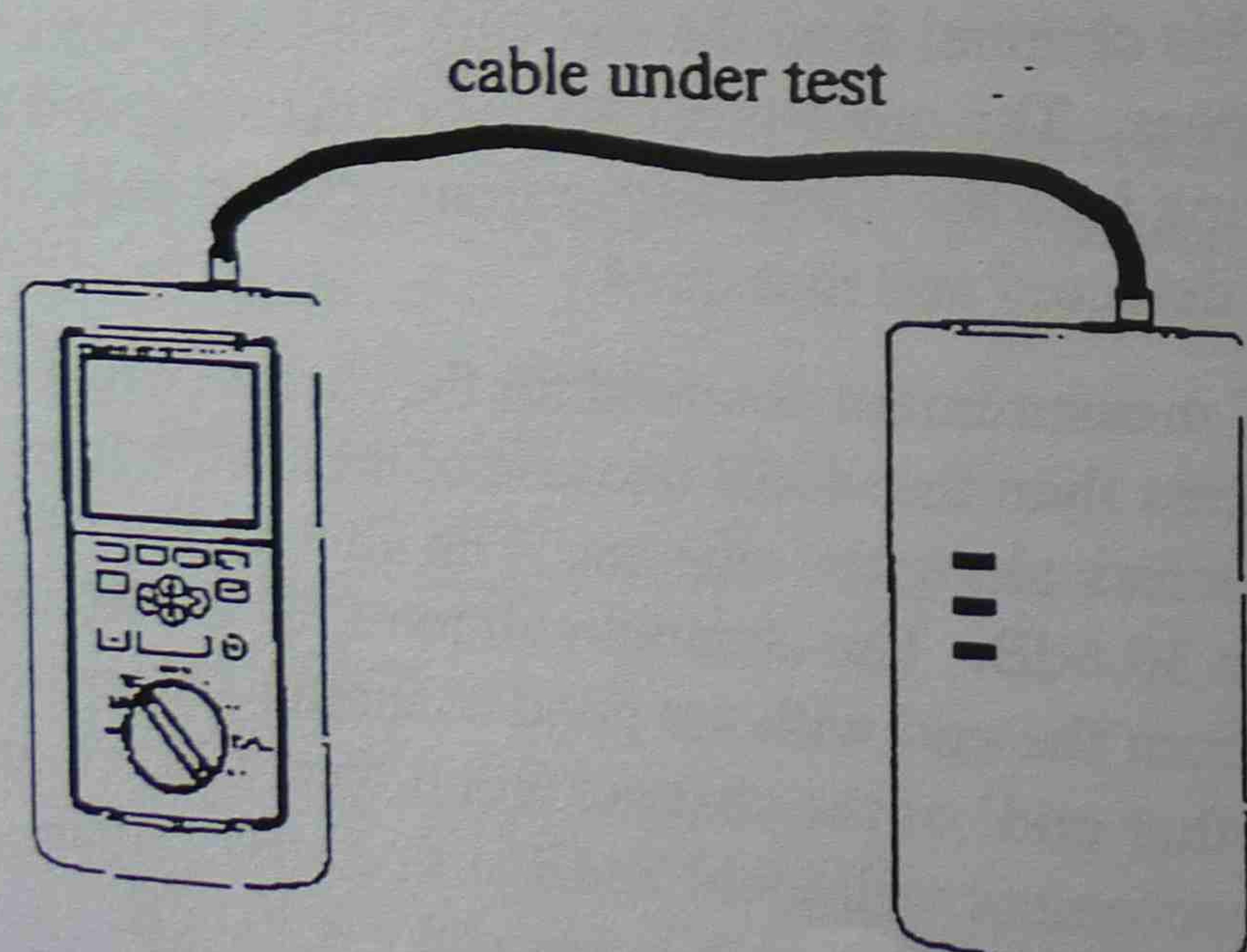


Figure 9 Using a cable scanner

The acceptance levels for each test vary with the different LAN cable requirements. It is possible to program the scanners to suit a particular LAN condition. The scanner can save information obtained in its memory for printing out later. The user receives the information in a report format that provides a permanent hard copy of each individual cable. The category 5 scanners can hold about 500 hundred auto test reports.

Wire map

The cable scanner tests and displays the wire connections between the near and far ends of a cable on all four pairs. If STP cable is used the tester also tests the continuity of the shield. The wire map test detects and reports *opens*, *shorts*, *crossed pairs*, *split pairs* and *reversed pairs*. The tester will display the wire map at completion of the test. Following are sample displays from a Fluke DSP-100 Cable Meter.

Open

Possible causes of open circuits in a cable include:

- ❑ wires connected to wrong pins at connector or terminating modules
- ❑ faulty connections
- ❑ cables routed to the wrong location
- ❑ wires broken by stress at connections
- ❑ damaged connector
- ❑ cuts or breaks in cable

```
              Wire Map

RJ45 pin: 1 2 3 4 5 6 7 8 S
          o | | | | | | | o
RJ45 pin: 1 2 3 4 5 6 7 8 S
              FAIL
```

This display indicates an open on wire 1. The shield is also open.

Figure 10 Sample wire map showing open circuit

Short

Possible causes of short circuits in a cable include:

- wires connected to wrong pins at connector or termination modules
- conductive material caught between pins at a connection
- damage to cable insulation

```
Wire Map

RJ45 pin: 1 2 3 4 5 6 7 8 S
          s s | | | | | | o
RJ45 pin: 1 2 3 4 5 6 7 8 S
          FAIL
```

This display indicates a short between wires 1 and 2.

Figure 11 Sample wire map showing short circuit

Crossed pairs

Possible causes of crossed pairs in a cable include:

- wires connected to wrong pins at connector or termination modules

```
Wire Map

RJ45 pin: 1 2 3 4 5 6 7 8 S
          x x x | | x | | o
RJ45 pin: 3 6 1 4 5 2 7 8 S
          FAIL
```

This display indicates crossed pairs on 1,2 and 3,6.

Figure 12 Sample wire map showing crossed pairs

Split pairs

Possible causes of split pairs in a cable include:

- ❑ wires connected to wrong pins at connector or termination modules

```
Wire Map

RJ45 pin: 1 2 3 4 5 6 7 8 S
          | | | | | | | | o
RJ45 pin: 1 2 3 4 5 6 7 8 S
FAIL
Split Pairs Detected
Pairs 3,6 - 4,5
```

This display indicates split pairs on 3,6 and 4,5.

Figure 13 Sample wire map showing split pairs

Reversed pairs

Possible causes of reversed pairs in a cable include:

- ❑ wires connected to wrong pins at connector or termination modules

```
Wire Map

RJ45 pin: 1 2 3 4 5 6 7 8 S
          x x | | | | | | o
RJ45 pin: 2 1 3 4 5 6 7 8 S
FAIL
```

This display indicates a reversed pair on pair 1,2.

Figure 14 Sample wire map showing reversed pairs

Time domain reflectometer

Quality cable testers include a time domain reflectometer (TDR). The TDR is a measurement technique for determining the length of a cable as well as its characteristic impedance. If a signal travelling through a cable meets an abrupt change in the cable's impedance, some or all of the signal is reflected back to the source. The timing, size and polarity of the reflected signals indicate the location and nature of the impedance discontinuities in the cable.

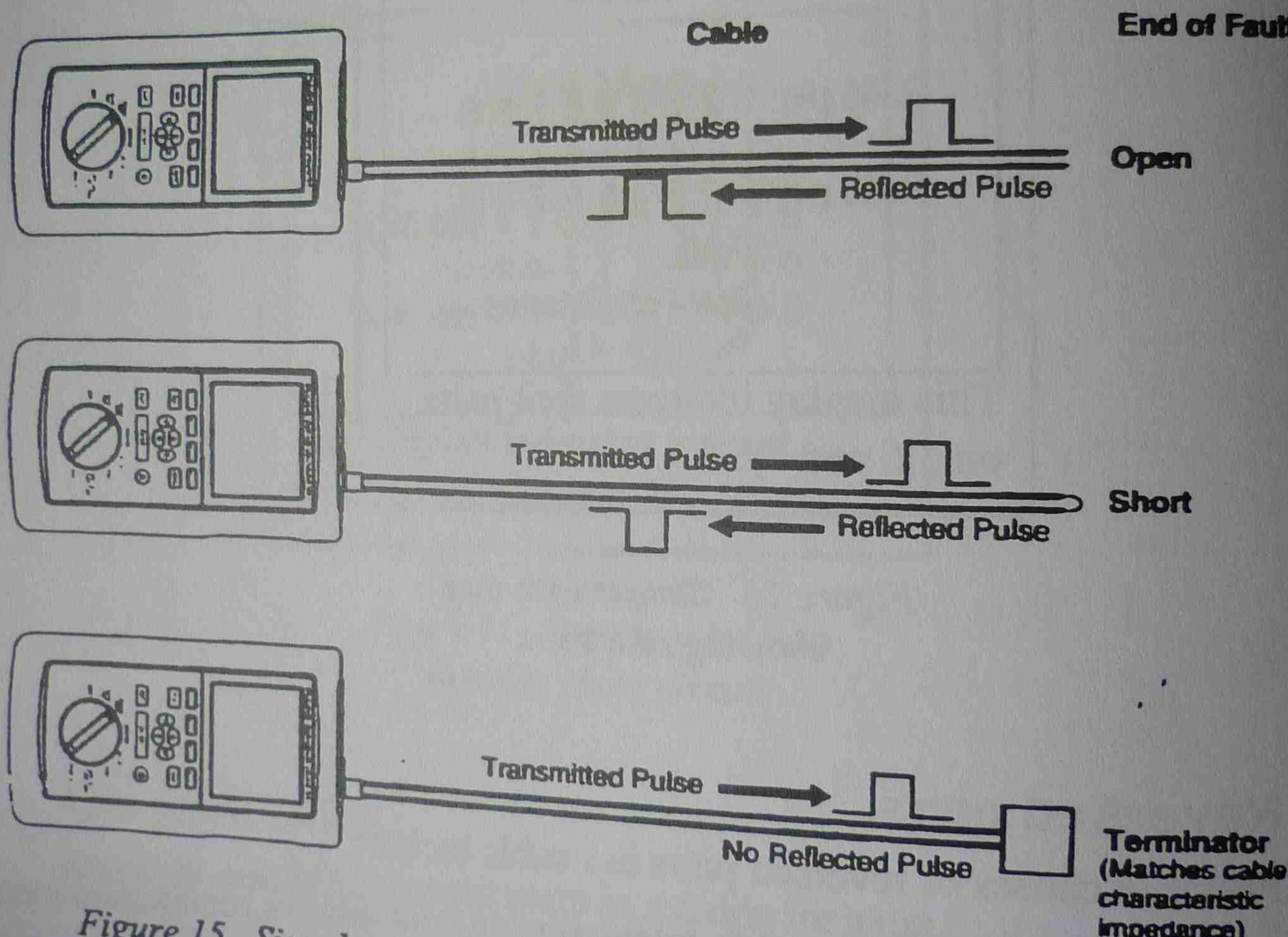


Figure 15 Signals reflected from open, short and terminated cable (picture courtesy of the Fluke Corporation)

Following are sample displays from a Fluke DSP-100 CableMeter.

Open circuit

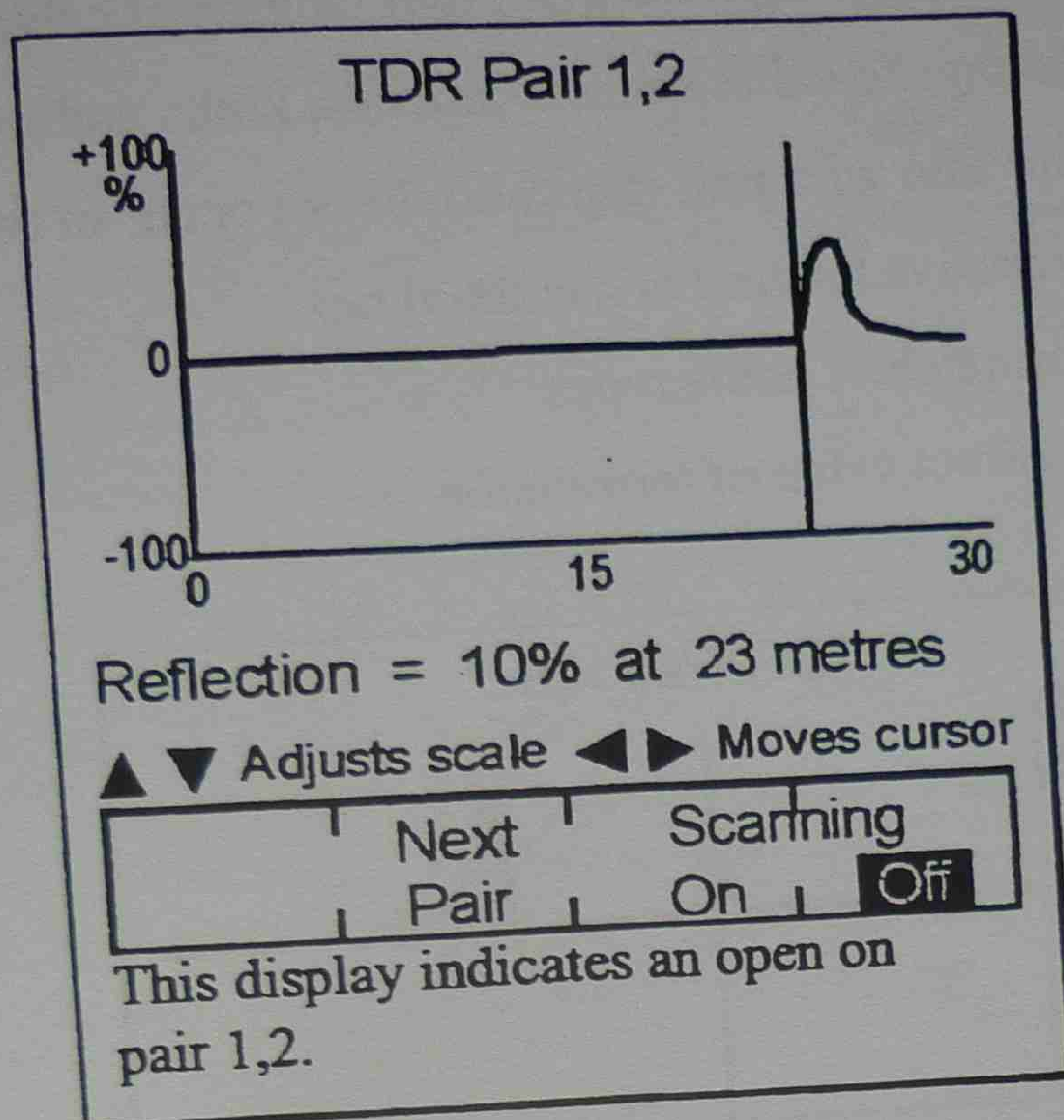


Figure 16 Sample TDR showing open wire

Short circuit

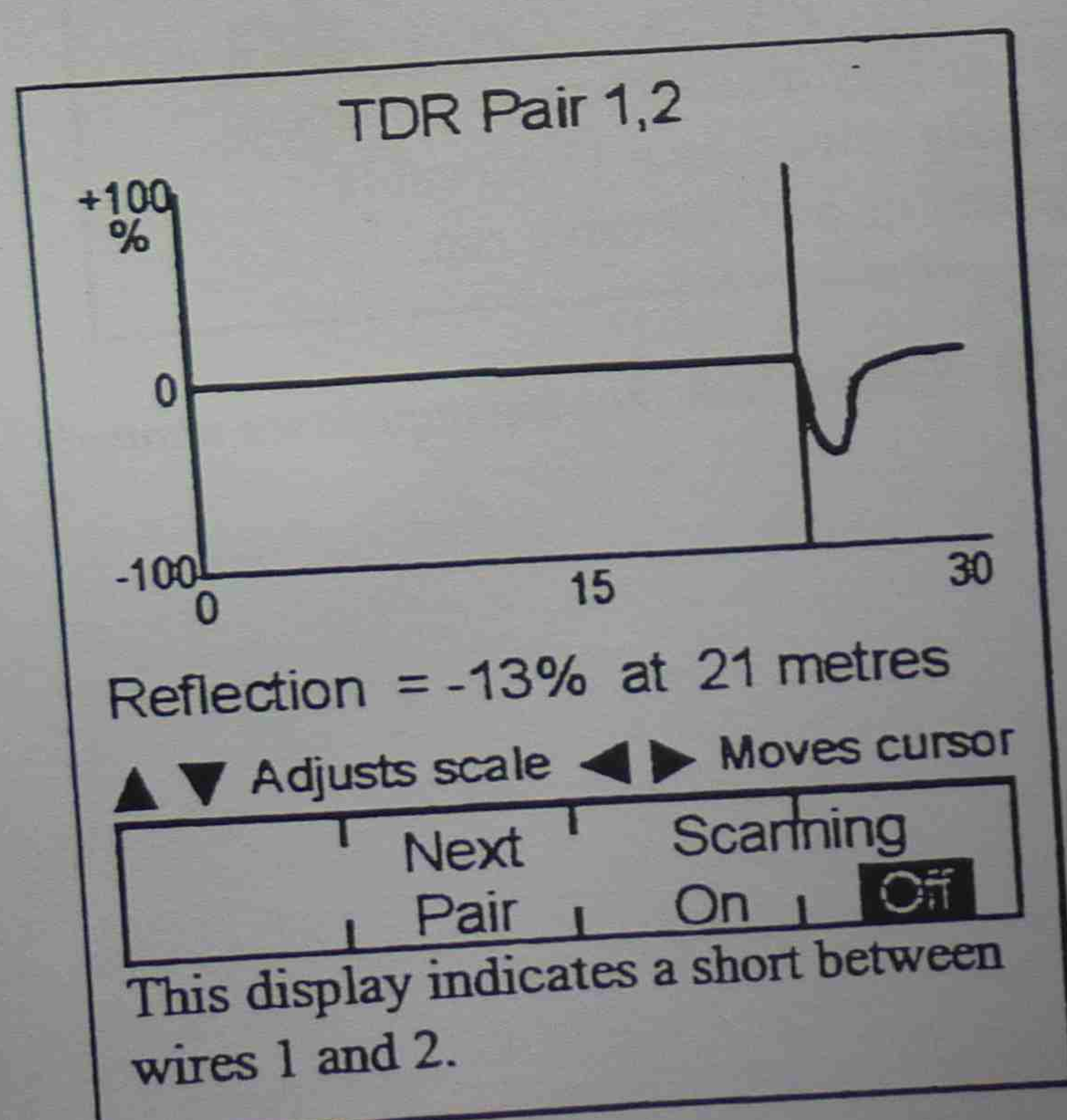


Figure 17 Sample TDR showing shorted wires

Impedance anomaly

Possible causes of reversed pairs in a cable include:

- poor connection between two lengths of cable
- damage to cable such as pinches, kinks and the like
- taps into wire pair (taps should not occur in twisted pair segments)
- excessive loading at a coaxial tap
- mismatch of cable types
- incorrect value of terminator

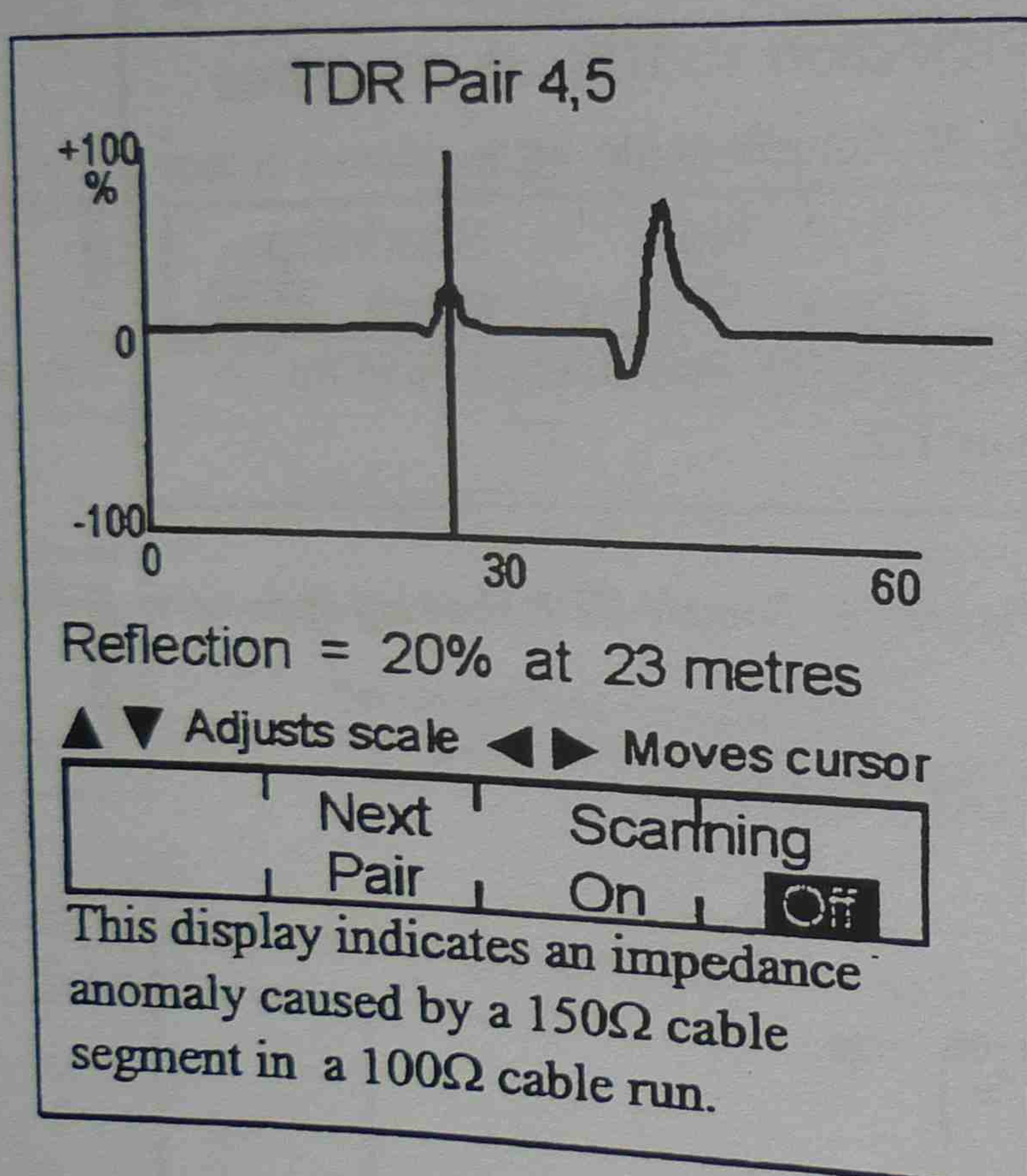


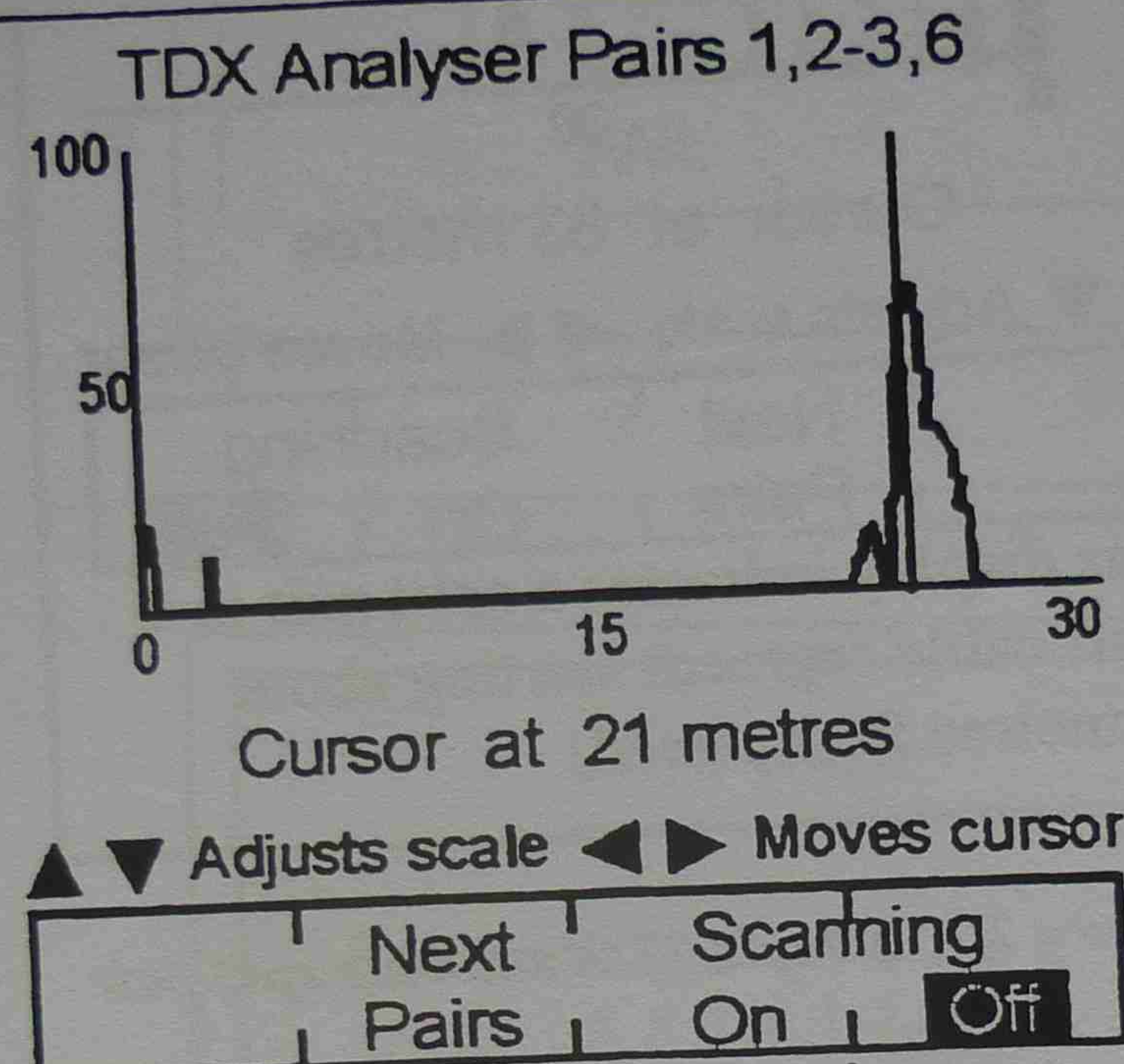
Figure 18 Sample TDR showing impedance anomaly

Time domain crosstalk analyser

The Time Domain Crosstalk (TDX) analyser displays the locations where cross-talk is occurring on the cable. The purpose of the TDX analyser is to assist in the location of sources of cross-talk on the cable.

Following are sample displays from a Fluke DSP-100 CableMeter.

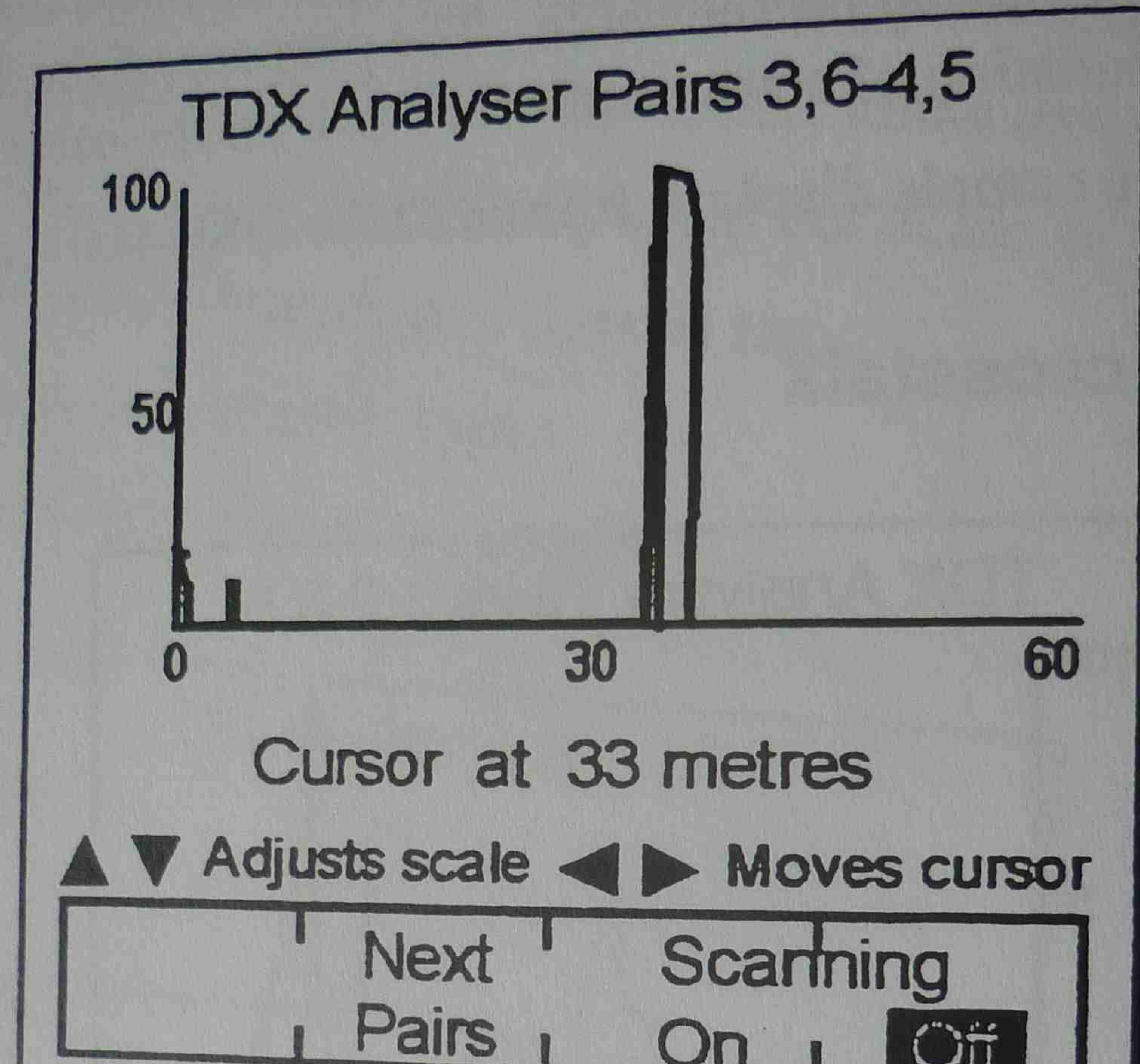
Near end crosstalk



This display indicates excessive untwisting of cable pair at far-end connector.

Figure 19 Sample TDX showing NEXT fail

Split pairs



This display indicates a split pair in a short cable segment starting about 33 metres from tester.

Figure 20 Sample TDX showing split pair

Practical exercise 9.1 Installing horizontal cabling to 110 wiring block

Background

The 110 wiring block is a Category 5 termination block utilising a quick clip connection. This quick clip connection forms a gas-tight connection that prevents corrosion between the clip and the conductor.

The fixed cabling terminates in the base of the 110 wiring blocks while the cross connects terminate in the top of the connecting block. This method is different to the Krone system where incoming circuits terminate at the top of the wiring module and outgoing circuits originate at the bottom of the module.

Task

Your task is to install a 100 pair floor distributor using the 110 wiring blocks, several telecommunications outlets and associated cabling.

Procedure

1. Secure the mounting blocks, skirting trunking and plastic trunking to the work board using Figure 39 as a guide.
2. Fix one 100 pair 110 wiring block onto the left side of the work board using the necessary tools and hardware. Use Figures 39 and 40 as a guide for positioning the blocks.

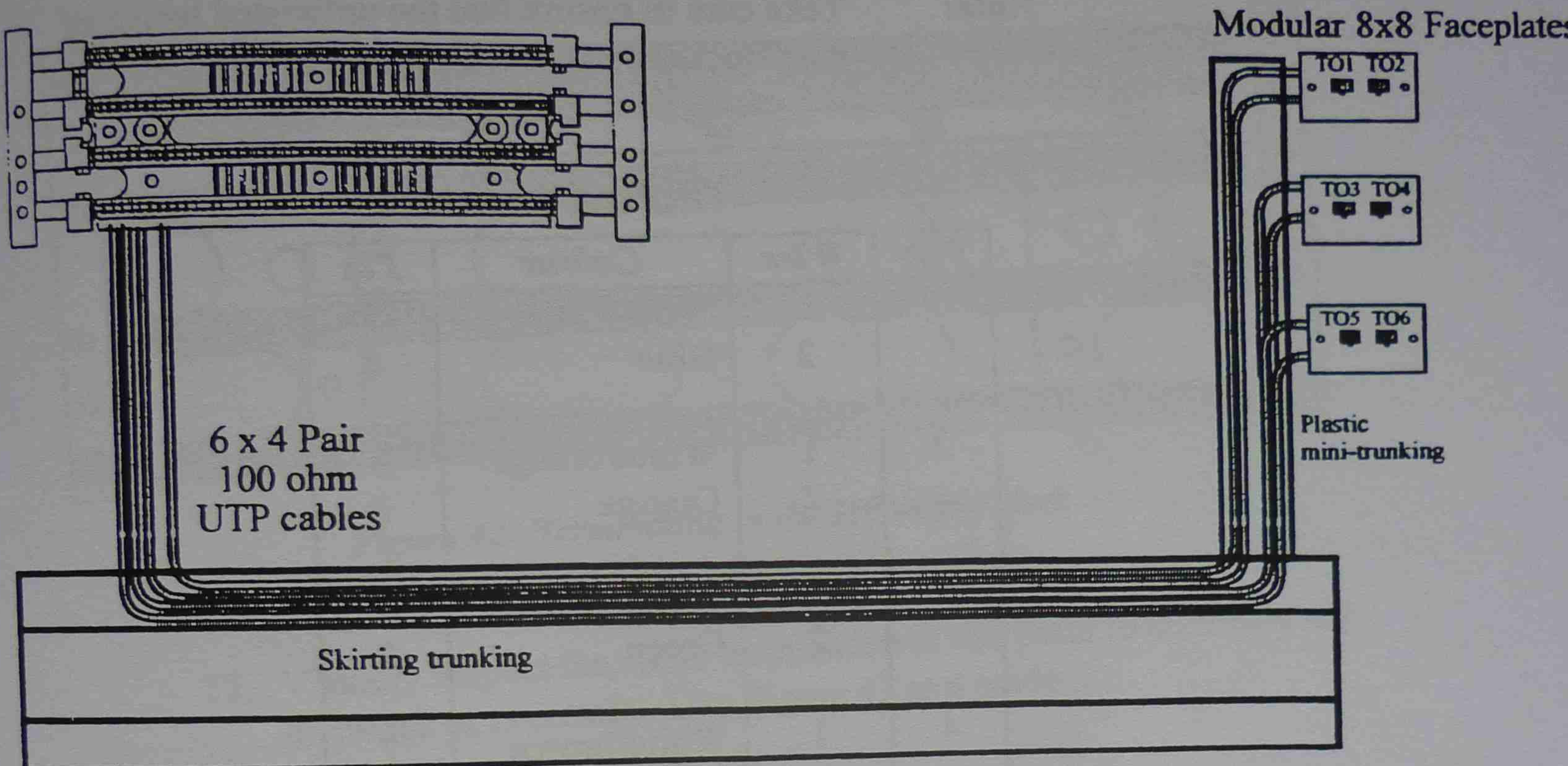


Figure 39 Setting out the work board

3. Ensure secure fixing of the plastic frame to the mounting surface. Use Figure 40 as a guide.

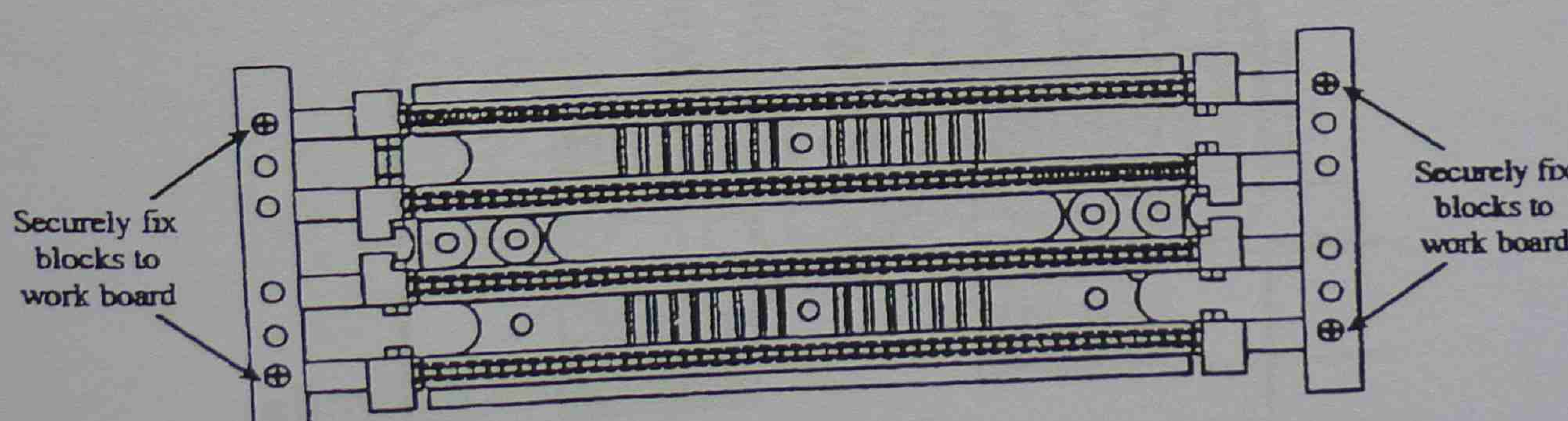


Figure 40 Installing the frame

4. Install two 4 pair Category 5 cables between each mounting ... the 110 Block. Use Figure 39 as a guide.

Terminating at each telecommunications outlet

5. Remove about 75mm of sheath from the first 4 pair cable.
6. Install each wire into the appropriate termination of the 8 x 8 modular connector port. Use Figure 41 and Table 4 as a guide.

Note: Take care to ensure that the untwisted length of wire does not exceed 13mm.

Table 4

Pair	*Wire*	*Colour*	*Pin*
1	1	White/blue	5
	2	Blue	4
2	1	White/orange	3
	2	Orange	6
3	1	White/green	1
	2	Green	2
4	1	White/brown	7
	2	Brown	8

Category 5 cable colour code

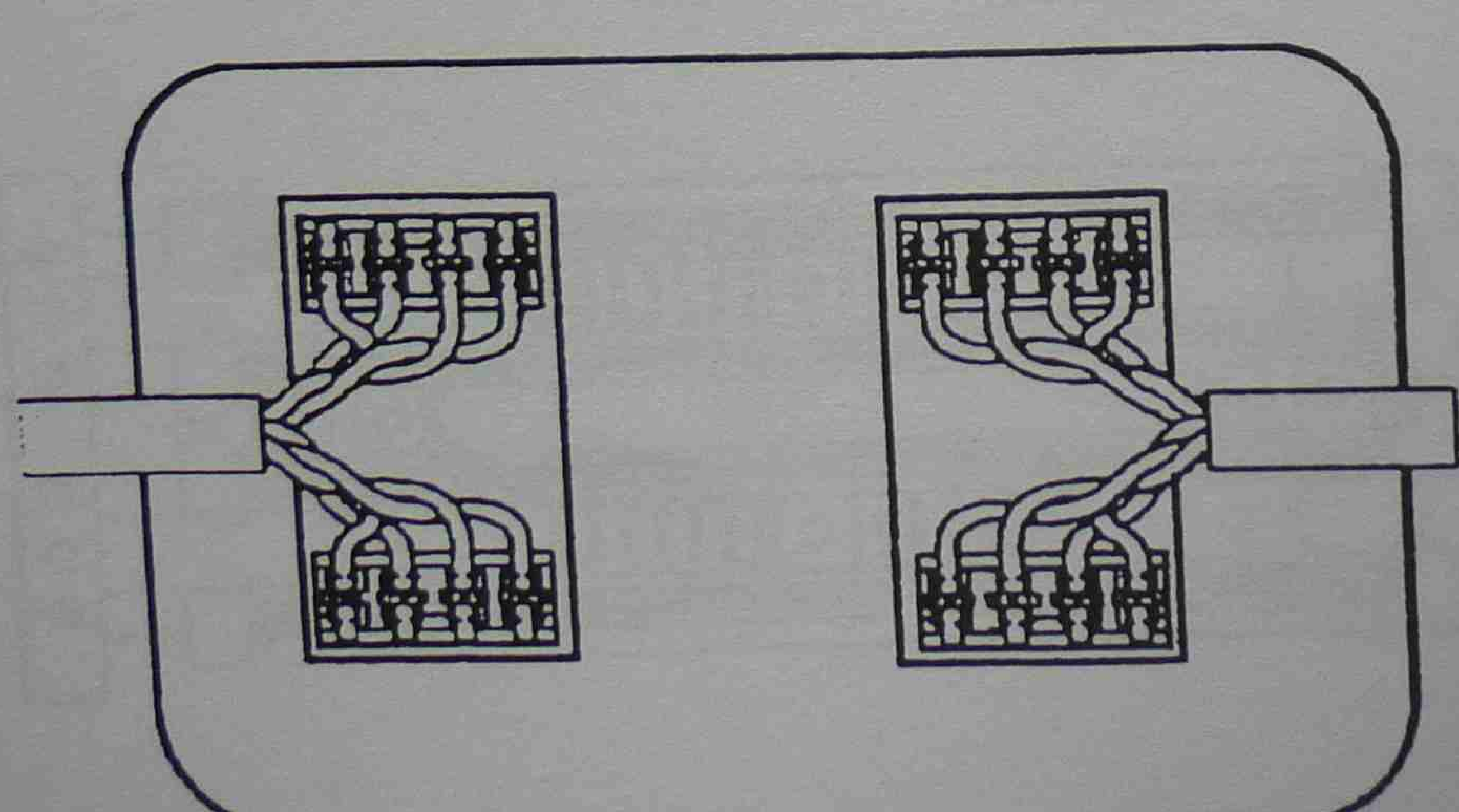


Figure 41 Termination at Modular 8 x 8 faceplate

7. Check the wire colour code and position in the modular connector and if this is correct then use the *'punch down'* tool to terminate the wires.

Terminating at 110 blocks

9. Lace the cables through the correct openings in the 110 wiring blocks.
10. Remove about 75mm of sheath from the first cable.
11. Lace the wires into the appropriate positions in the 110 wiring block. Be careful to ensure the untwisted length does not exceed 13mm. The cable sheath should finish as close as possible to the point of termination. Use Figures 42 and 43 as a guide.

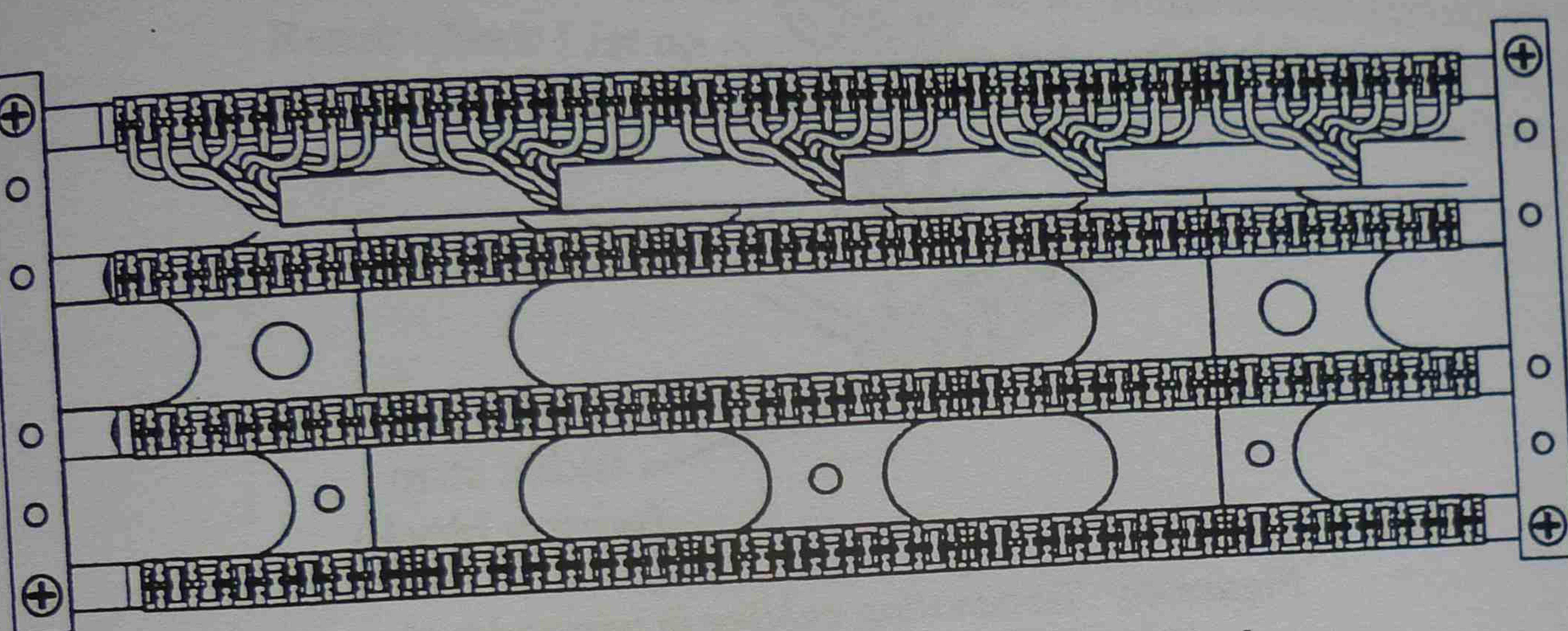
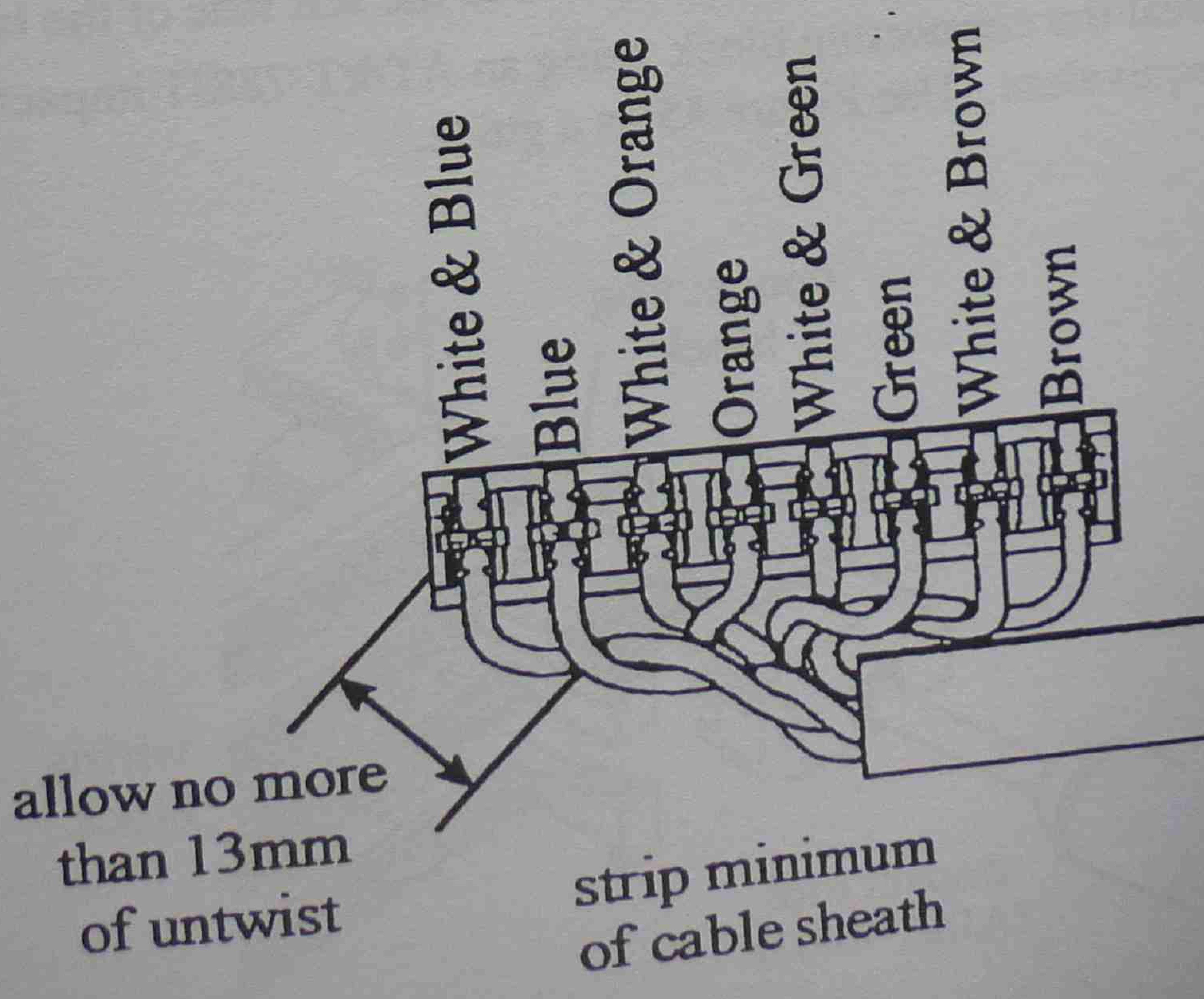


Figure 42 Terminating in the 110 wiring block

12. Visually inspect the cable termination at this point to eliminate any miswires or reversals. Use Figure 43 as a guide.



13. Seat the conduct... impact tool or equivalent. Use Figure 4...

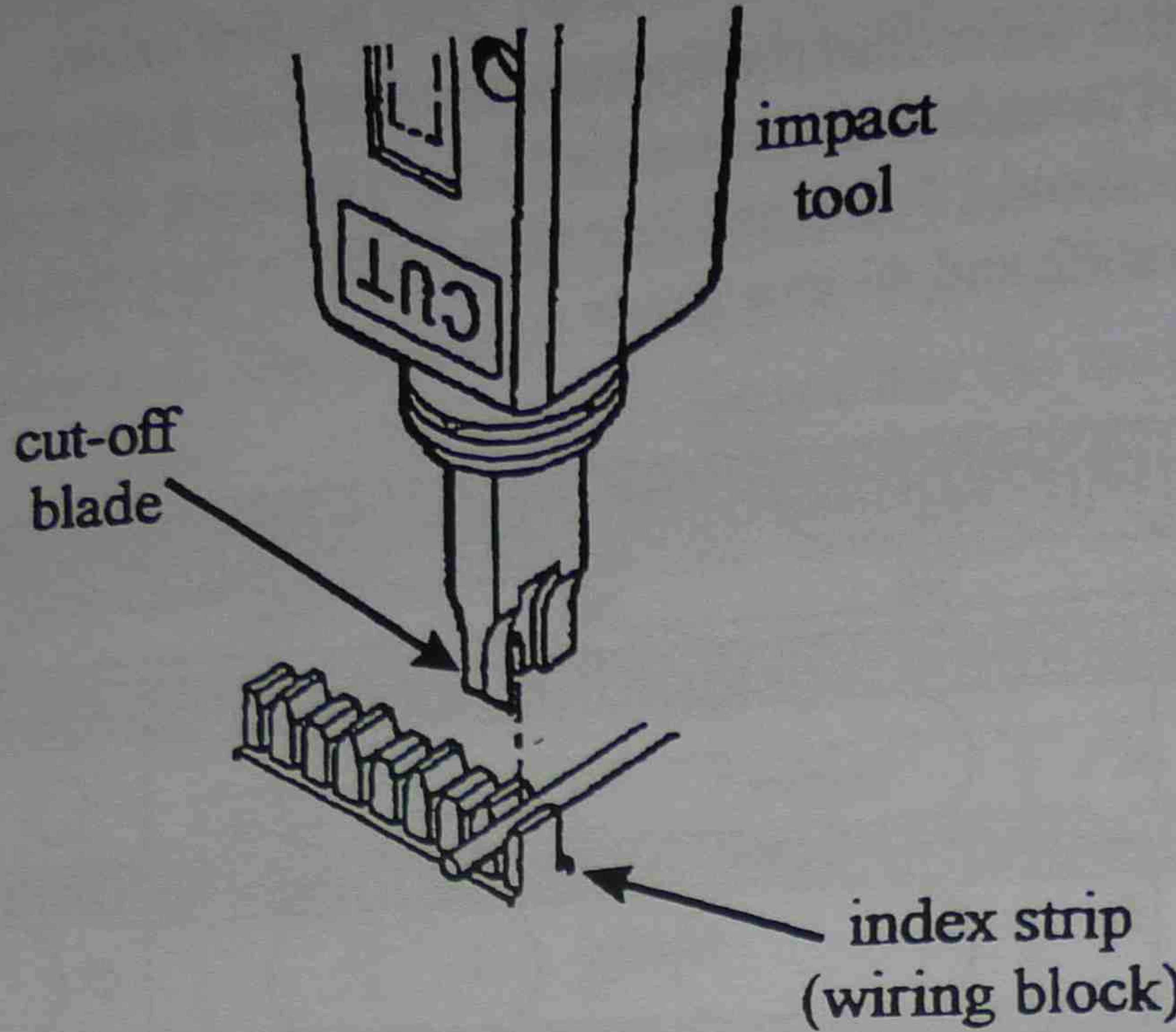


Figure 44 Terminating cabling in wiring block (picture courtesy of AMP)

14. Visually inspect the cable termination at this point to eliminate any miswires reversals or sheared conductors.
15. Carefully position a 4 pair connecting block (or biscuit) over the wiring base. The blue marking must be to the left side of the block.
16. Seat the connecting block using an AT&T 788J1 impact tool or equivalent. Use Figure 45 as a guide.

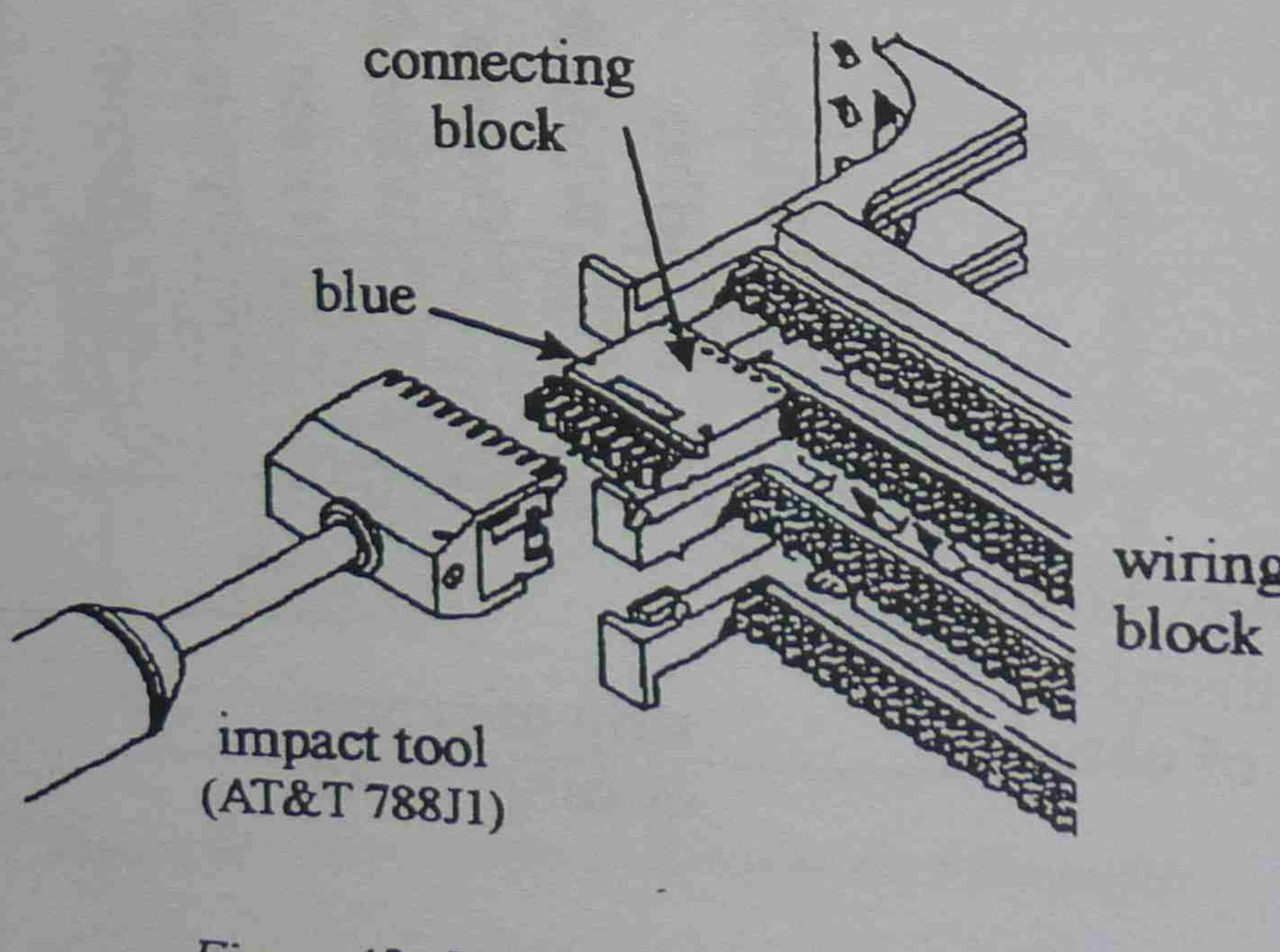


Figure 45 Installing cabling blocks (picture courtesy of AMP)

Learning notes

When designing floor distributors it is necessary to provide a solution that best meets each specific site requirement. It is desirable to design the distributor so it comprises discrete fields. You can achieve this by for example, positioning the work area field in the centre area of the distributor to segregate the vertical cabling and data ports. Figure 49 shows this arrangement.

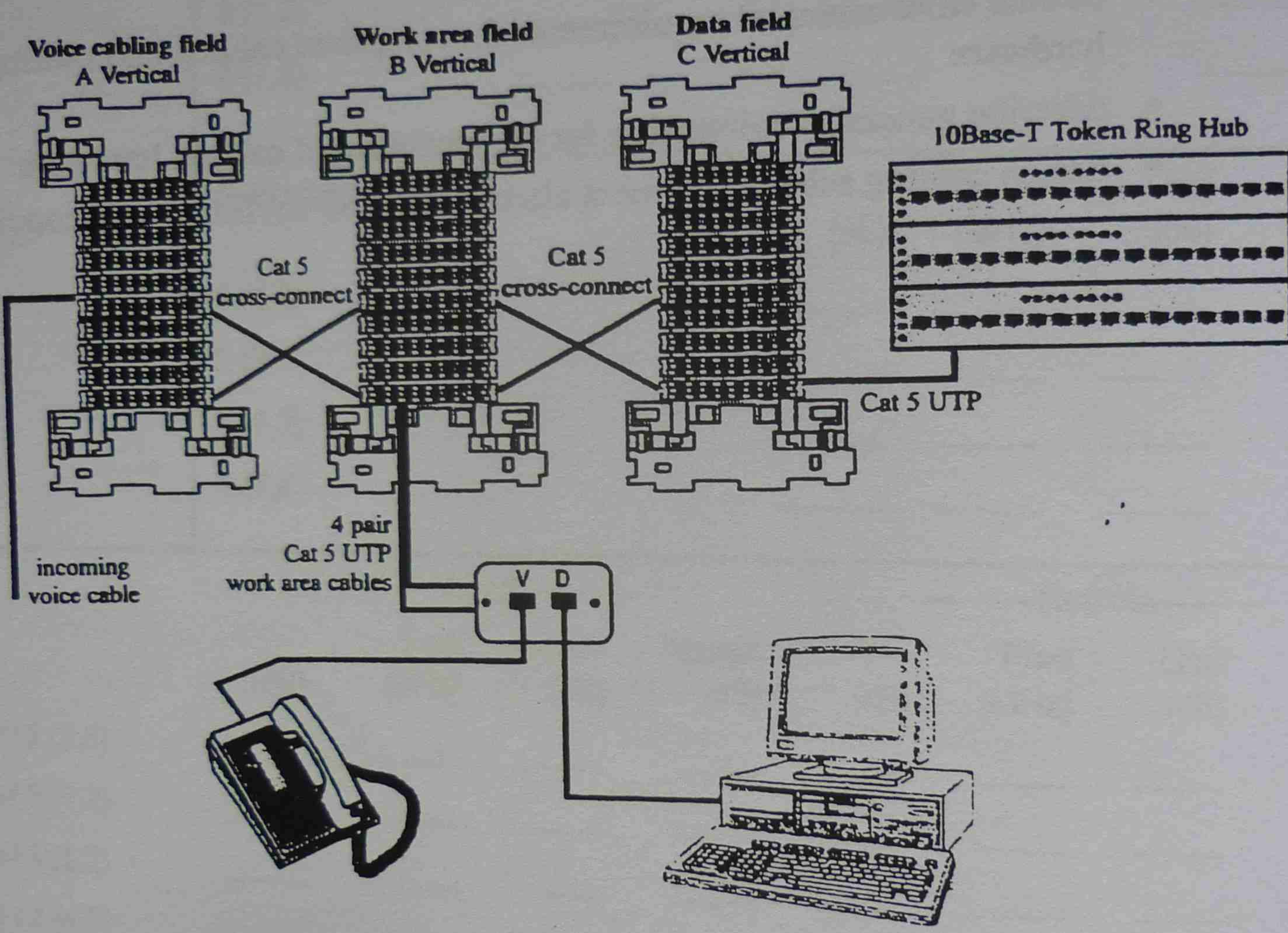


Figure 49 Dividing floor distributor into fields

Configuration

Figure 50 shows the configuration of the distributor.

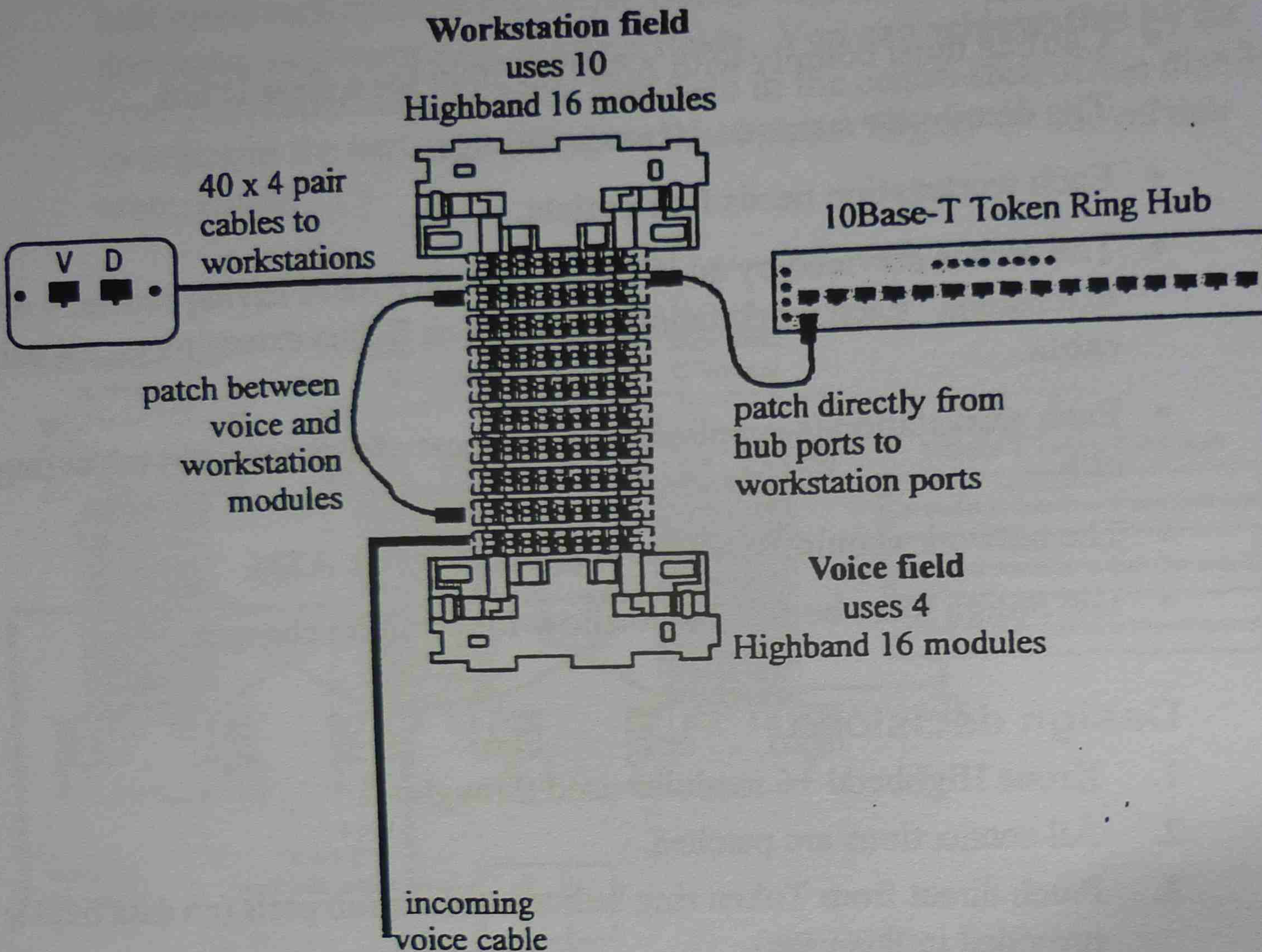


Figure 50 Configuration of floor distributor

Configuration

Figure 51 shows the configuration of the distributor.

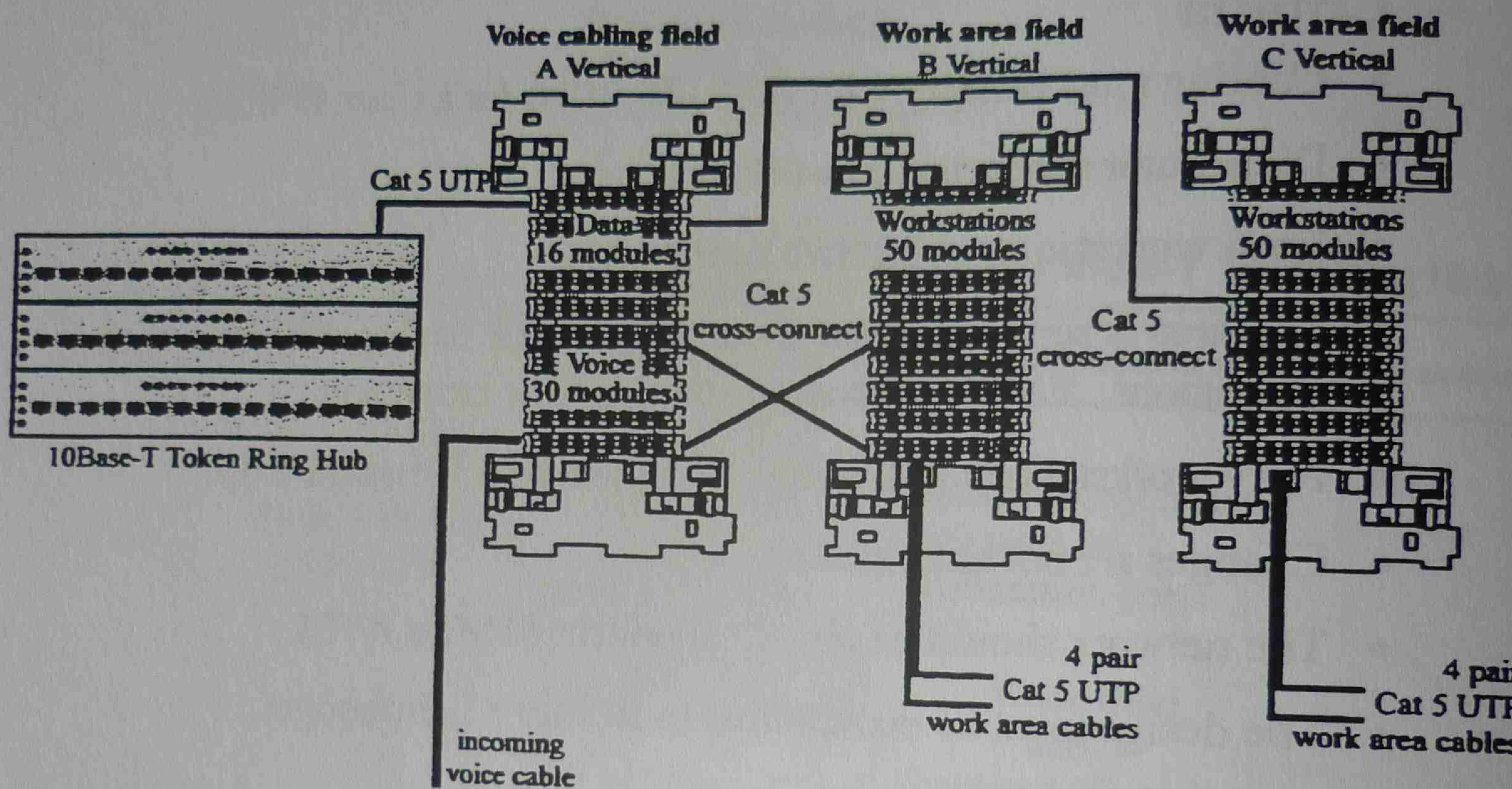


Figure 51 Configuration of floor distributor

Connectors for coaxial cable

The more common connectors for coaxial cables are:

- BNC
- TNC
- N
- F

Figure 63 shows the plug form of these connectors.

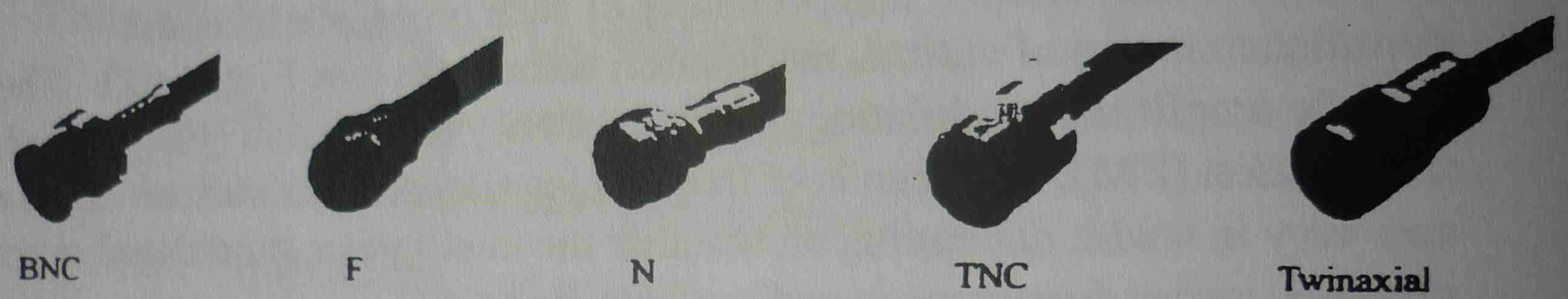


Figure 63 Connector types for coaxial cables

BNC connector

The BNC connector offers easy engagement and disengagement using bayonet couplings and overlapping dielectrics. They are most useful for frequently coupled and uncoupled RF connections with frequencies below 4GHz. The main applications for BNC connectors are in flexible computer networks, instrumentation and computer peripheral interconnections.

Ethernet

Ethernet is a baseband network that has dominated the LAN scene over the years and become an accepted standard. Development of the Ethernet was in 1980 by the combined efforts of Xerox Corporation, Digital Equipment corporation and Intel Corporation. The IEEE 802.3 specification recognises the Ethernet system.

Ethernet's rise in popularity stems from its simplicity. It is easy to set-up, flexible, and readily extendable. Due to its popularity and acceptance as a standard, many manufacturers provide capabilities for connecting their devices to Ethernet. This includes a broad range of devices from mainframes and PCs to mass storage devices. Figures 64 to 66 illustrate examples of small, medium, and large scale Ethernet configurations.

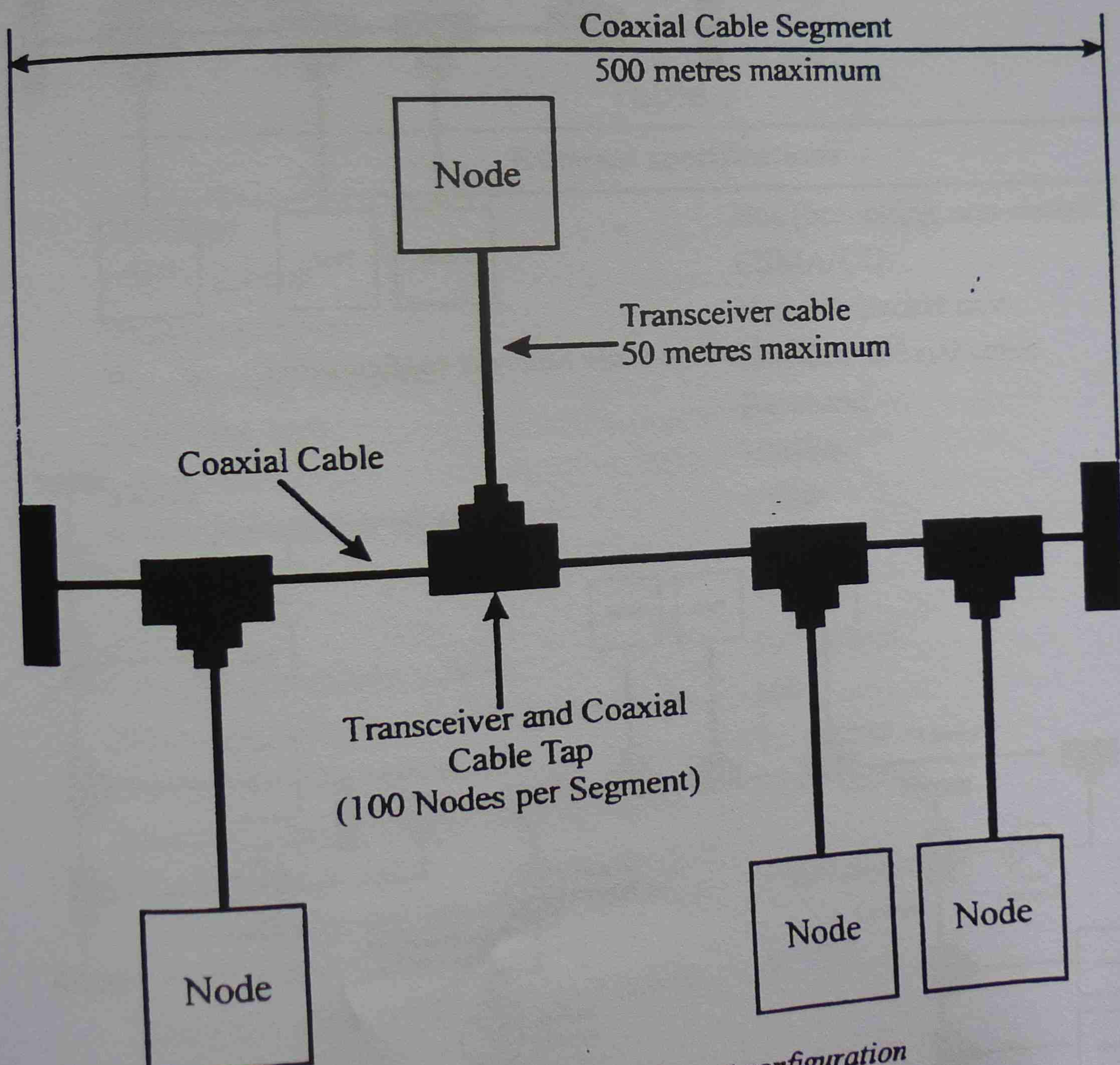


Figure 64 Small-scale Ethernet configuration

Transmitter

The transmitter's primary function is to buffer the signals ***Transmit (+)*** and ***Transmit (-)*** from the transceiver cable and transmit them onto the Ethernet cable. Timing circuits in the transmitter limit the length of time the transmitter may be on. This prevents signals from inadvertently locking in the on condition beyond the maximum packet length. The transmitter also includes a circuit to verify the collision detector circuit is operational during the transmission. The transmitter includes a protective circuit to prevent electrical damage between Ethernet and the transmitter.

Receiver

The receiver section couples the signals from the Ethernet coaxial cable to the receiver buffer circuit. ***Receive (+)*** and ***Receive (-)*** are generated and sent to the transceiver cable pair, provided the signals on the Ethernet cable exceed the average dc threshold for a valid signal. The average dc value of the signal and a collision threshold are sent to the collision detector circuit. The receiver includes a protective circuit to prevent electrical damage between Ethernet and the receiver interface.

Collision detector

The collision detector circuit monitors the average dc value from the Ethernet coaxial cable indirectly through the receiver circuit. Two stations transmitting at the same time on Ethernet increase the average dc value beyond the collision threshold, thus turning on the collision detect signals: ***Collision Presence (+)*** and ***Collision Presence (-)***. These signals are sent onto the transceiver cable to notify the transmitting nodes of a collision. The collision detector circuit also responds to the collision test from the transmitter.

dc to dc converter

The dc to dc converter circuit generates the required dc voltages to power the transceiver circuits. It is sourced from the ***Power*** and ***Power Return*** signals from a node through the transceiver cable.

Thinnet

Thinnet system uses RG-58/U cable having a characteristic impedance of 50 ohms and an attenuation of about 5dB/100 metres @ 100MHz. The maximum distance of this configuration is 185 metres. The topology is the same as for the Thicknet. BNC connectors are the termination medium for this system. BNC 'T' adaptors connect the cable to the nodes.

Figure 68 shows a Thinnet (10 Base2) application. Network devices attach to the bus segment through transceivers (MAUs) much like in Thicknet systems. The transceivers are spaced at 5 metre intervals with a maximum of 30 per cable segment. The BNC connector is the interface for transceivers, splices and terminators. The transceiver tap has either a BNC 'T' or BNC vertical adaptor. It is necessary to place a 'T' in the cable segment when using the vertical adaptor. The out leg of the 'T' then connects to the vertical BNC of the transceiver tap adaptor.

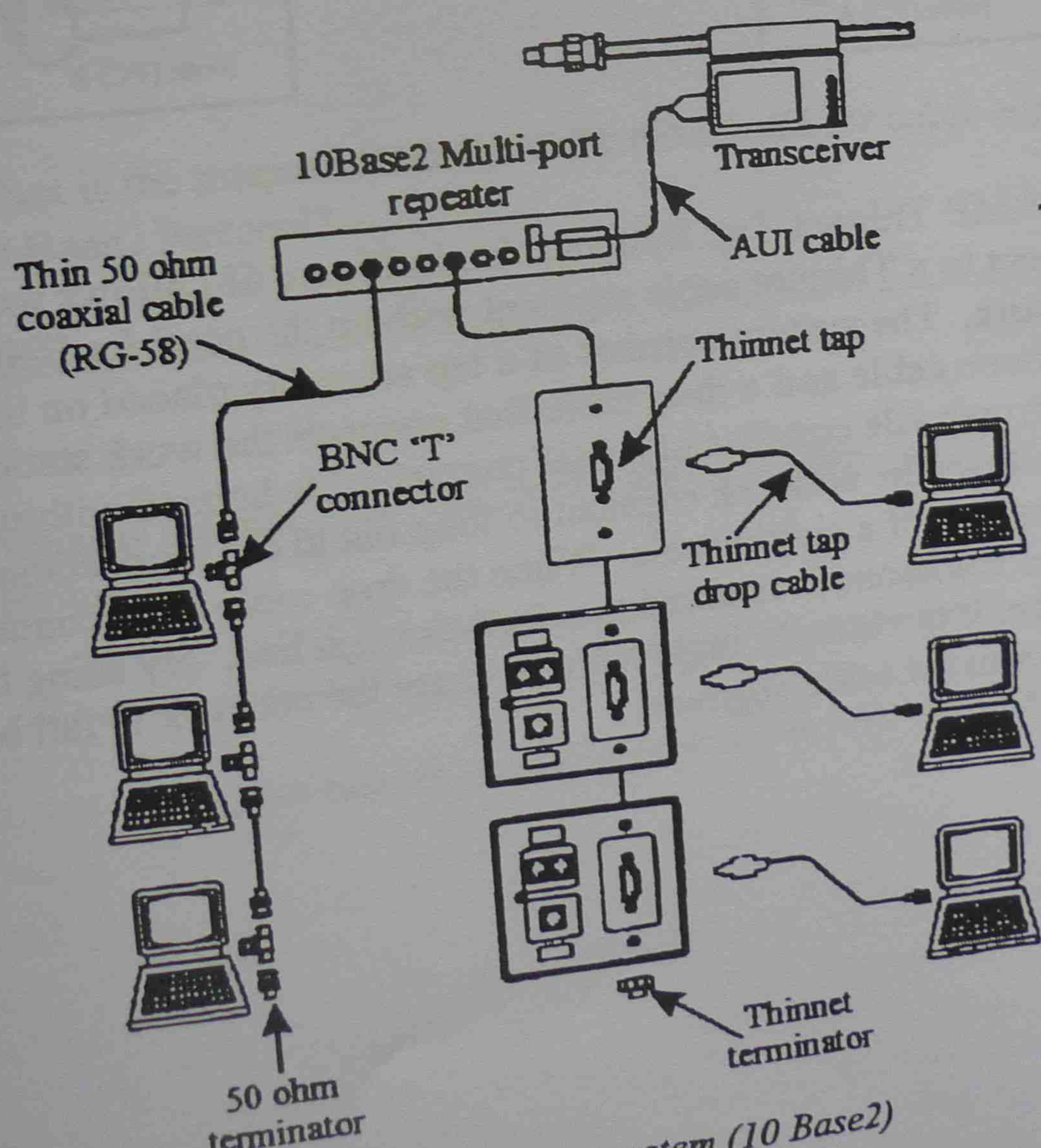


Figure 68 Thinnet system (10 Base2) (picture courtesy of AMP)

Technology has allowed the manufacturing of transceivers small enough to fit on the network interface card inside the work station (see Figure 69). Therefore, most interface cards now provide both an AUI port and a BNC port. The BNC port connects to the internal transceiver allowing the RG-58 backbone to connect directly to the work station with a BNC 'T' connector, eliminating the external transceiver and AUI cable. Multiple segments of 10 Base5 and 10 Base2 may connect as a single network using repeaters. The four-repeater rule and the maximum of five cable segments apply.

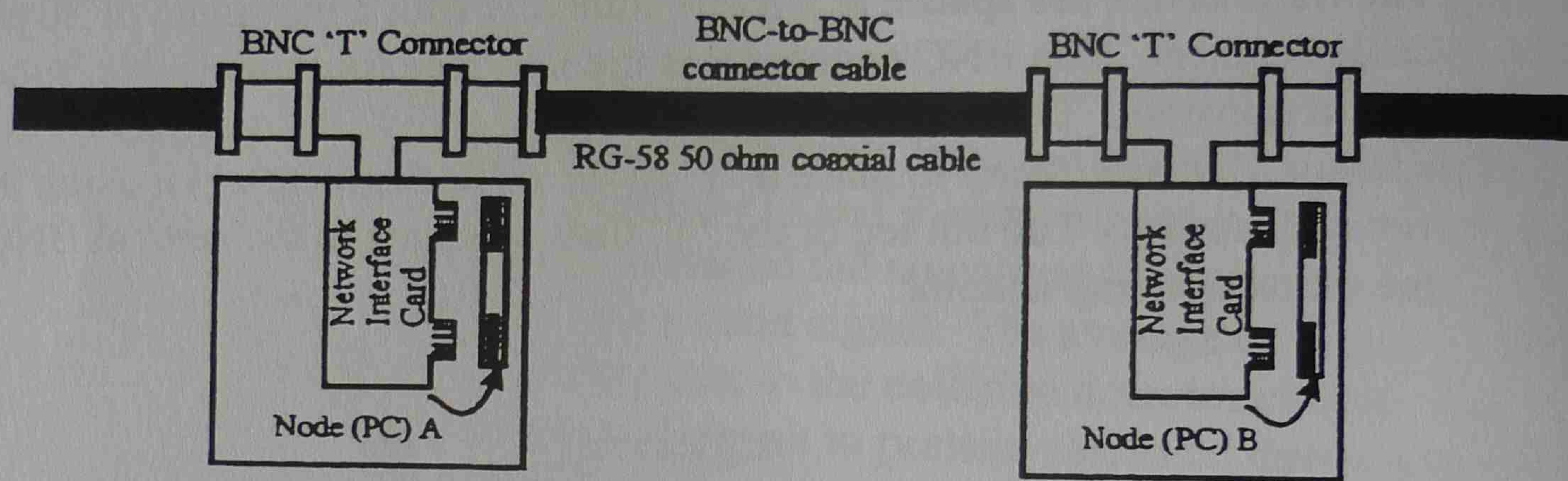


Figure 69 10 Base2 LAN set-up

The AMP Thinnet Tap System (also in Figure 68) allows work stations to connect to a Thinnet cable segment without the need for BNC plugs and 'T' adaptors. The system consists of a tap assembly placed on the RG-58 backbone cable and a drop cable that connects the work station to the tap. The drop cable consists of a dual coaxial cable housed within a single sheath that allows the network segment to loop out to the work station with the appearance of a single cable. When the drop cable is disconnected from the tap the backbone is restored to a feed-through line. By using the Thinnet Tap System, it is virtually impossible to cause the network to fail because of an unterminated cable segment.

ARCnet

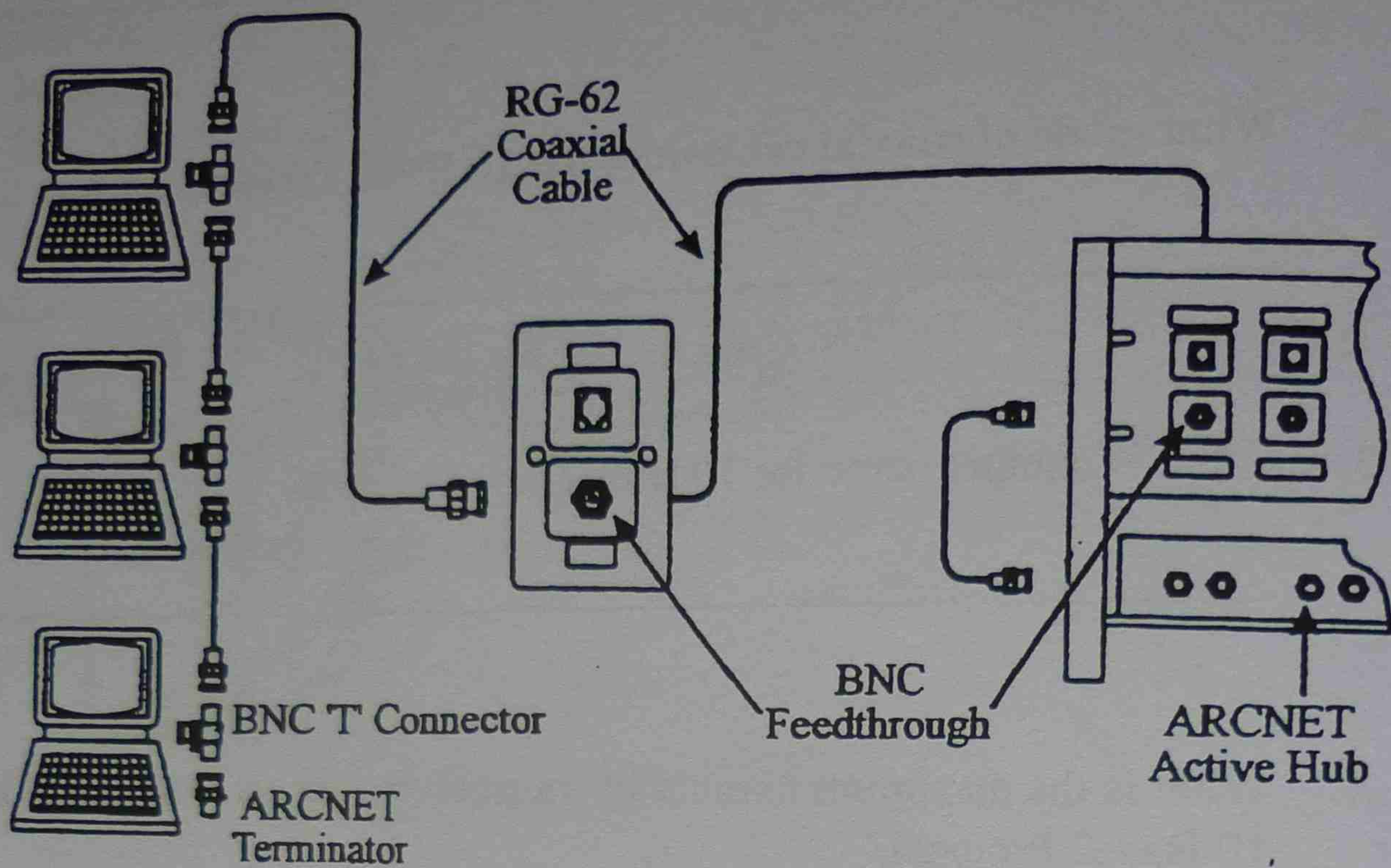


Figure 70 Standard Arcnet set-up
(picture courtesy of AMP)

ARCnet is a 2.5Mb/s token passing network originally developed by Datapoint Corporation as a hard disk interface. A wide range of hubs and interface cards is available which allow implementation of the ARCnet network on either RG-62 coaxial or twisted pair star or bus topologies. It is possible for networks to combine both media and topology types.

Figure 70 shows a combination of coaxial bus and star configuration. An ARCnet active coaxial hub in the telecommunications closet connects to a BNC feed-through in the distribution panel with an RG-62 cable assembly. The distribution panel connects to another feed-through in the work station outlet with RG-62 cable. The work station attaches to the outlet with another BNC cable assembly. Using the appropriate interface card it is possible to daisy-chain additional work stations from the first using BNC 'T' connectors. The last device on the chain receives a 93Ω terminating resistor.

The maximum distance between an active hub and a node in a coaxial ARCnet system is 610 metres. It is important for all hnused passive hubs to terminate at an RG-62 terminator.

IBM 3270

IBM's System Network Architecture (SNA), including both the 3270 and System/3x environments, is perhaps the most prevalent mainframe network. In its raw form, non-intelligent video display units attach to either a terminal controller or directly to the mainframe computer. The mainframe contains all data files and processing capability. The communications path exists between the mainframe and each terminal. This is in contrast to the PC to PC path of the local area network.

In the traditional 3270 system terminals attach to the SNA systems with 93 ohm (RG-62) coaxial cable. Figure 71 shows the traditional system on RG-62 cable. IBM 3270 devices use a BNC interface to connect to the cabling system. Terminal controllers (terminals or multiplexers) connect to the mainframe through a telephone line with modem hook-up.

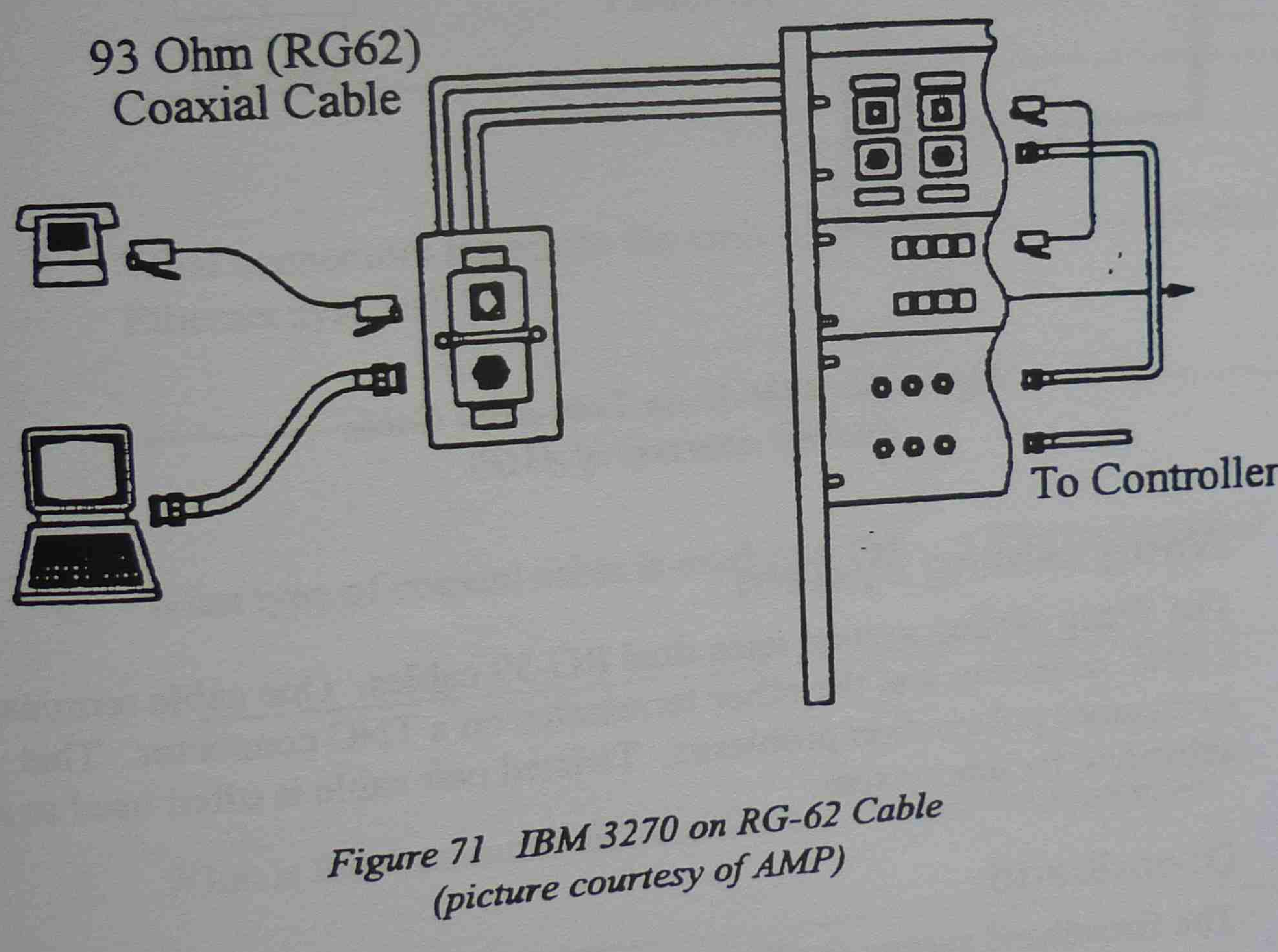


Figure 71 IBM 3270 on RG-62 Cable
(picture courtesy of AMP)

IBM System/ 34, 36, 38

Along with the 3270 System, IBM's SNA environment includes the midrange computer Systems/ 34, 36, 38 and AS/400. These systems also use 'dumb' terminals that attach to a controller or CPU containing all of the system's processing capability.

In its original format terminals and peripherals connect to CPU channels through 100 ohm twin-axial cable. Groups of up to seven devices daisy-chain to each port of the CPU as shown in Figure 72.

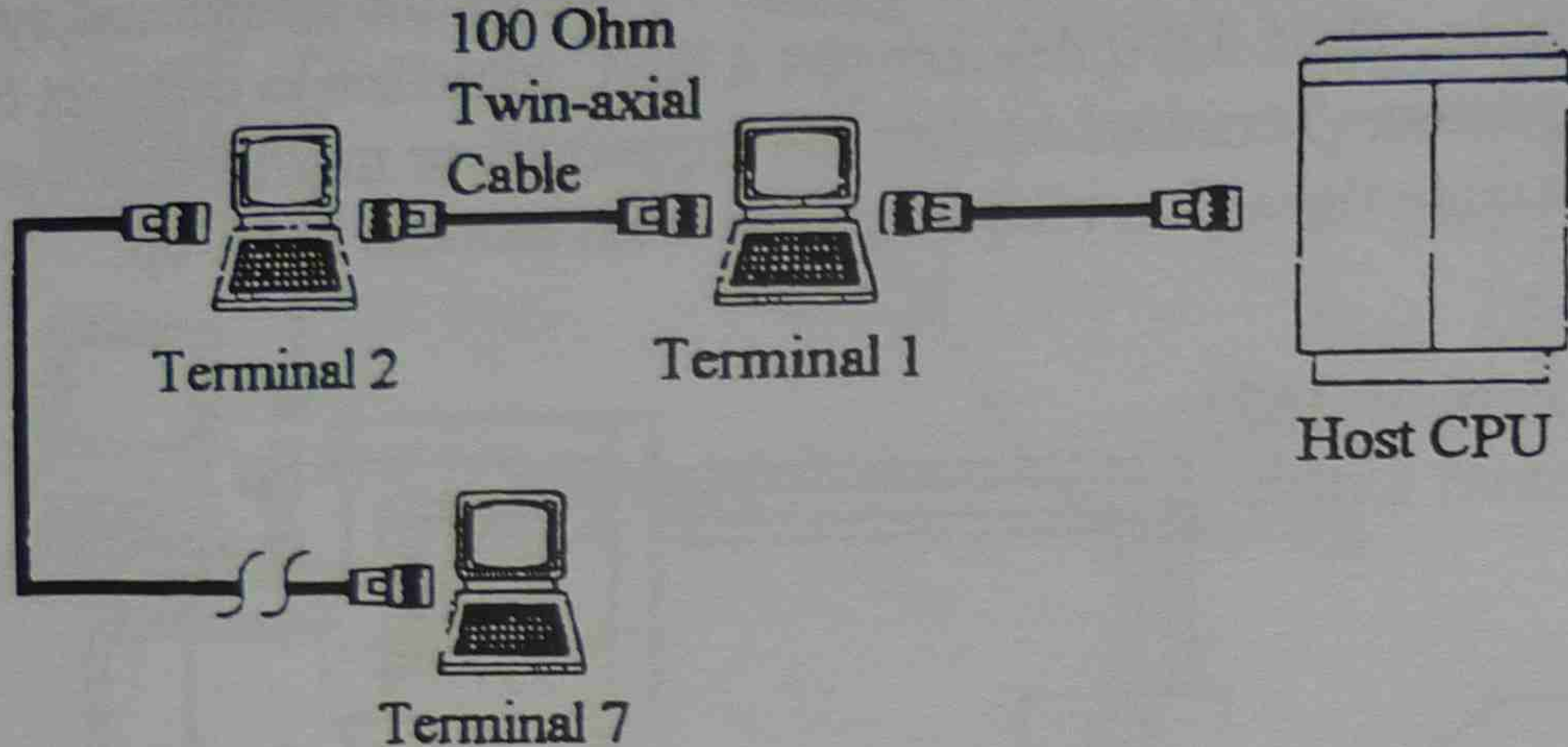


Figure 72 IBM 3x on Twin-axial Cable
(picture courtesy of AMP)

Wang cabling system

The Wang cabling system uses dual RG-59 cables. One cable terminated on a BNC connector and the other terminates on a TNC connector. This overcomes polarisation problems. Twisted pair cable is often used as a substitute for this system.

Broadband

The Broadband system facilitates MAP Network architecture. An example of this is AMP's broadband star wiring system which is IEEE 802.7 compatible (IEEE 8022.7 Broadband Standards). The system uses RG-11 coaxial cable. The maximum distance is 100 metres. The connectors are RG-11 75 ohm N-series. The user connections utilise RG-6 cable (sometimes RG-59) to a maximum length of 36 metres. The 'F' series connector terminates the user connections.

Learning notes

Cable hauling

Cable hauling is one of the most important aspects of any successful system installation. Some cable installers incorrectly believe that coaxial cable is virtually indestructible as it appears bulky and well protected in comparison to the devices it interconnects. There are many factors to consider before and during any cable hauling operation. You need to examine some of these factors.

Before cable haul

Before starting a cable hauling operation it is important to make the following tests and inspections:

- ❑ Check the label on the cable reel or box to verify the cable is the proper type and size.
- ❑ Inspect the cable dispenser for damage during transport, or from rough handling.
- ❑ Do a continuity and decibel loss test on the cable to verify the manufacturer's certification data.

After the above checks you should walk the cable route and take the following steps:

- ❑ Locate all haul points and remove the draw- box covers, if applicable.
- ❑ Check that draw-box locations allow sufficient room to meet the cable's minimum bend radius. (As a rule, ensure that the box opening and haul point locations are at least four times the minimum cable bend radius.)
- ❑ Identify all locations where it may be necessary to use special rigging to complete the hauling operation.
- ❑ For cable trays, verify enough space is available within the cable tray.
- ❑ For open or free-air installations, verify installation of hangers are of appropriate size.

Pull marker strings through the cable pathway to obtain the actual length of cable before cutting the cable.

Obtain a copy of the engineering specification or manufacturer's specification for the relevant cable hauling parameters. The data should at least include:

- ❑ maximum hauling tension for the cable
- ❑ minimum bend radius for the cable
- ❑ rigging calculations and restrictions

During cable hauling

During the cable haul it is important to follow the following guidelines:

- ❑ Before removing the cable from the dispenser, inspect the dispenser for nails or other objects that could damage the cable
- ❑ Ensure that the cable feeds into the haul smoothly and without tangles by using:
  - ◊ appropriately sized cable reel stands
  - ◊ correctly positioned cable boxes
- ❑ As the cable feeds from the dispenser, inspect the cable sheath carefully for deep cuts or deformities. Deformities include:
  - ◊ bulging sections of sheath. A bulge usually indicates an inner shield splice. Although this usually does not harm the signal transmission, it may hamper the installation due to space limitations.
  - ◊ reduced-diameter (constricted) sections of sheath. Reduced-diameter sections usually indicate either a poor inner shield splice or no shielding in the constricted section. Avoid using cable with reduced-diameter sections.

After completing the quality inspection, prepare the cable end for installation. Affix a unique identification number (from the Administration specifications) to the cable ends and seal them to keep out moisture or contaminants. Whenever possible, avoid hauling pre-connectorised cable.

Whenever possible, rig and haul the cable manually to ensure its maximum hauling tension is not exceeded. Do not use a power winch to haul a cable without also using a dynamometer. Place the dynamometer between the cable head and the power winch, and monitor it at all times during the power haul.

Never violate the maximum hauling tension specified for the cable by its manufacturer or by the project engineer, whichever is smaller.

If the installation requires a power winch, most cable manufacturers recommend using a wire-mesh Hauling grip to hold the cable. The grip ensures even distribution of the hauling tension over a greater area of the cable sheath. Use a swivel link to keep the cable from spiralling within the duct. After slipping the grip over the cable, tape the back end of the grip to secure the grip to the cable.

Be careful to keep the cable from contacting sharp edges. If possible, provide permanent protection from sharp edges. Without protection, sharp or jagged metal protrusions often cut the soft cable sheath.

After the haul is complete, lay the cable in its final installed position.

Installation specifications often list two separate minimum bend radius requirements, including a:

- ❑ "Minimum bend radius" that applies during installation
- ❑ "Minimum installation radius" that applies when the cable is tied down to its final position

When fixing the cable, ensure proper support where the cable makes transitions from the horizontal support system to vertical risers. Installation specifications should list the maximum unsupported drop a cable can make in a riser. Regardless of the specifications, it is good practice to provide support at the horizontal-to-vertical transition. This keeps the weight of the hanging cable from degrading the junction. If a cable tray or duct supports the horizontal cable, the transition support can be by way of a roll-out.

After installation of the cable, seal all fire-wall breaks and access holes that penetrate designated fire barriers. All seals and fire-stops must conform to applicable codes.

Consider affixing an identification tag to a cable any time the cable:

- ❑ enters or exits a fire seal
- ❑ traverses a cable tray junction
- ❑ passes through a junction box

The time and effort required for this tagging is not much when compared to the time and effort saved during future repairs.

If the finished cable routing differs from the specified route, note the deviation on the as built drawings.

On completion of the cable hauling operation return all
access panels to

Useful tools

The following are some useful termination tools for coaxial cables.

cable stripper

A dedicated coaxial cable stripper matched to the cable and connector type allows quick and consistent termination preparation. A coaxial cable stripping tool is much safer than a utility knife. The draw-back is that a dedicated stripping tool may be expensive. You may need several tools — one for each type of cable and connector combination.

utility knife

Utility knives are often used for preparing coaxial cables for termination as they are cheap and readily available. However, a knife requires skill and accuracy to avoid nicking the centre conductor and shield. *When using a knife always cut away from your body. Retract the blade when not in use.*

A nicked centre conductor weakens the conductor mechanically and greatly reduces the available bandwidth. (Skin effect — majority of electrons are on the outside 'skin' of the conductor at higher frequencies). Nicked braid reduces the effect of the shield.

crimping tools

It is important to match crimping tools to both the cable and connector types. There are two styles of crimp: hexagonal and circular. General purpose tools are not recommended.

Practical exercise 14.1 Coaxial patch cord

Task

Your task is to construct a coaxial cable patch cord using RG 58 coaxial cable and BNC connectors.

Equipment

Your teacher will provide you with the following:

- 2 x RG 58 crimp connectors
- 1.5 metre of RG 58 coaxial cable
- various coax cable strippers
- set of hand tools
- hand crimping tool for RG 58
- 50 ohm BNC coaxial cable connector

Procedure

1. Using suitable tools carefully prepare the cable to the dimensions shown in the manufacturer's instructions. If no instructions use Figures 73 and 74 as a guide. It is preferable to use a proprietary stripping tool as this removes sheath, shield and dielectric to the correct dimensions. Follow the tool manufacturer's instructions.

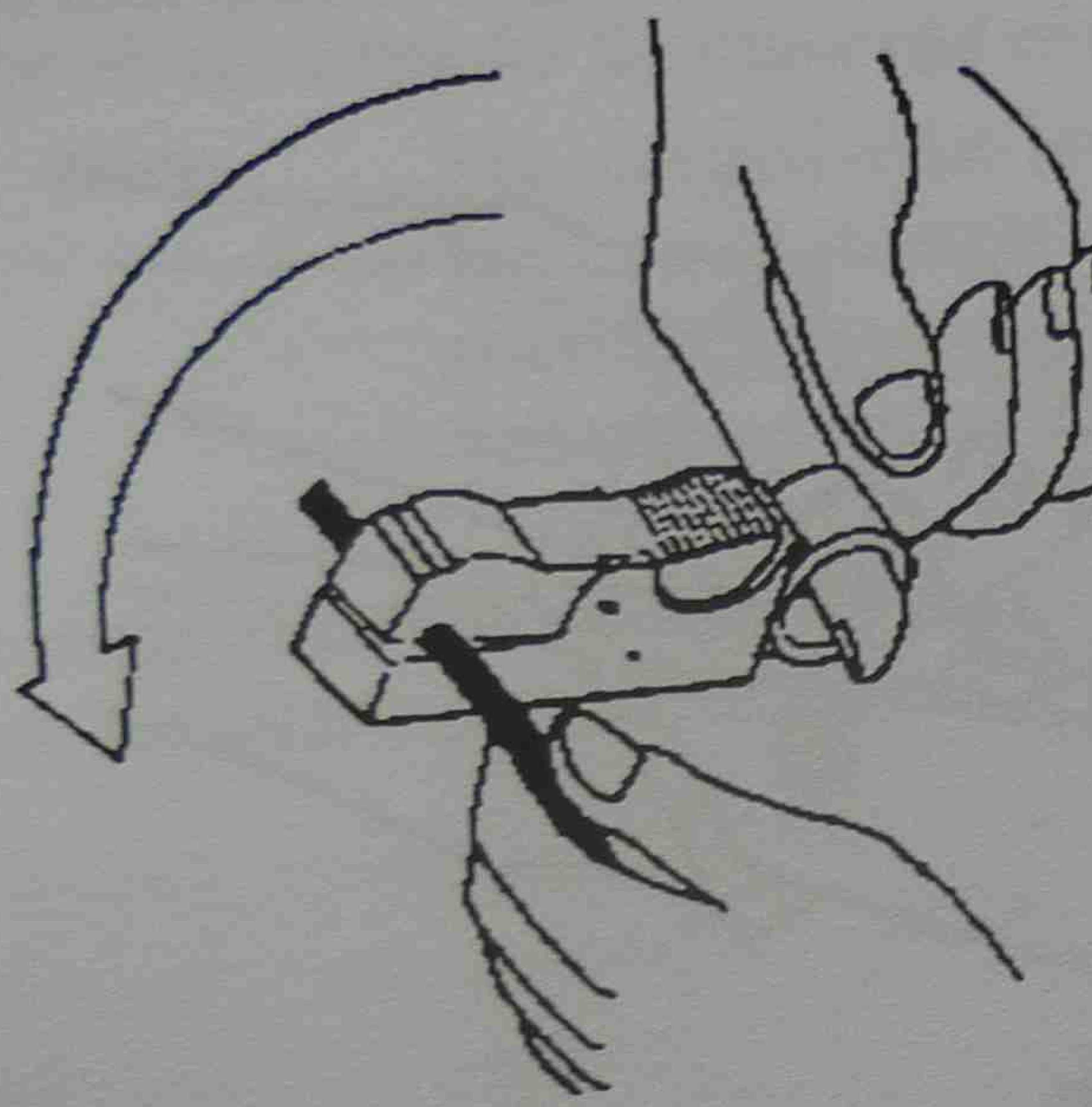


Figure 73 Stripping coaxial cable

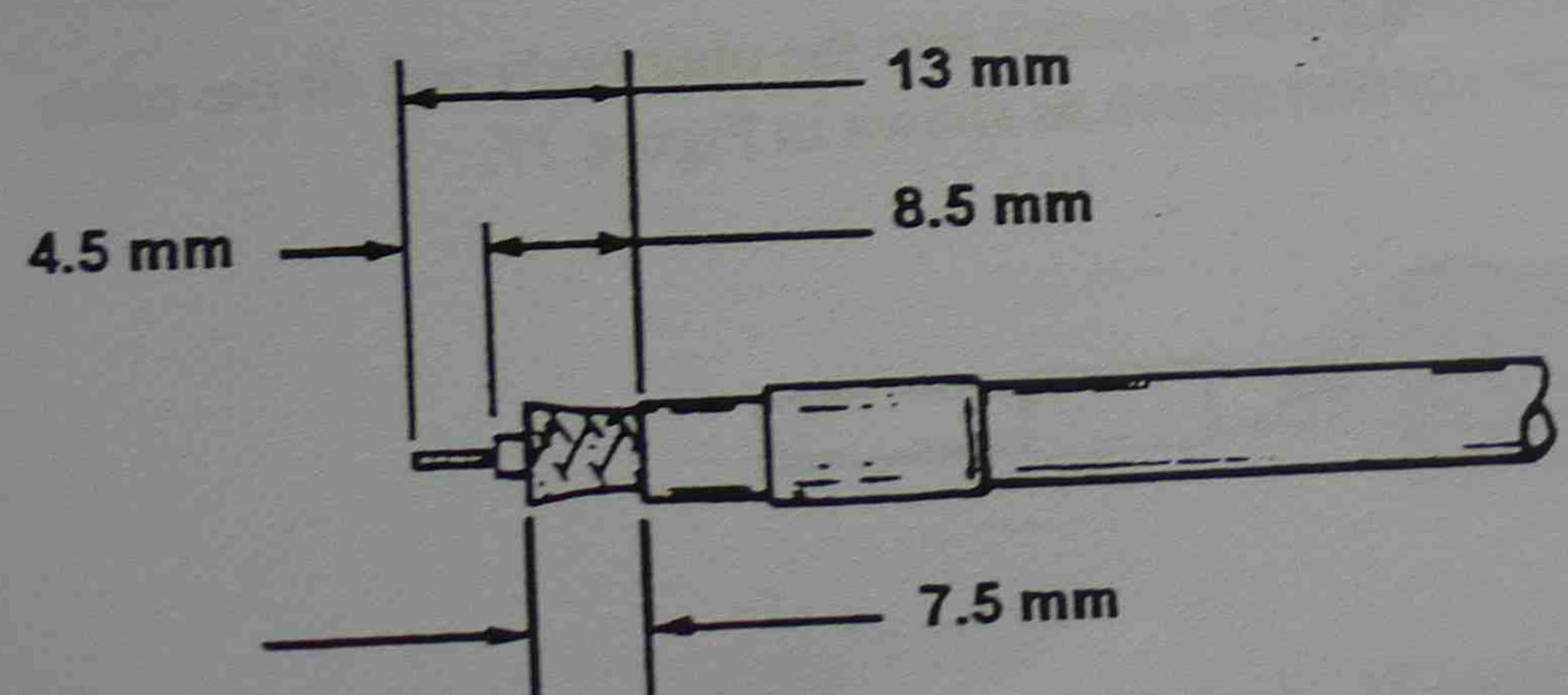


Figure 74 Stripping dimensions

2. Slide the centre contact (crimp pin) onto the centre cable conductor tightly (see Figure 75)

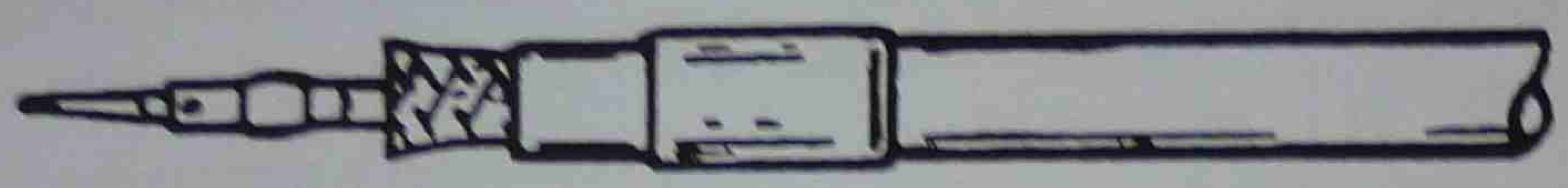


Figure 75 Assembling centre pin

3. Crimp the contact in place using a suitable tool as shown in Figure 76.

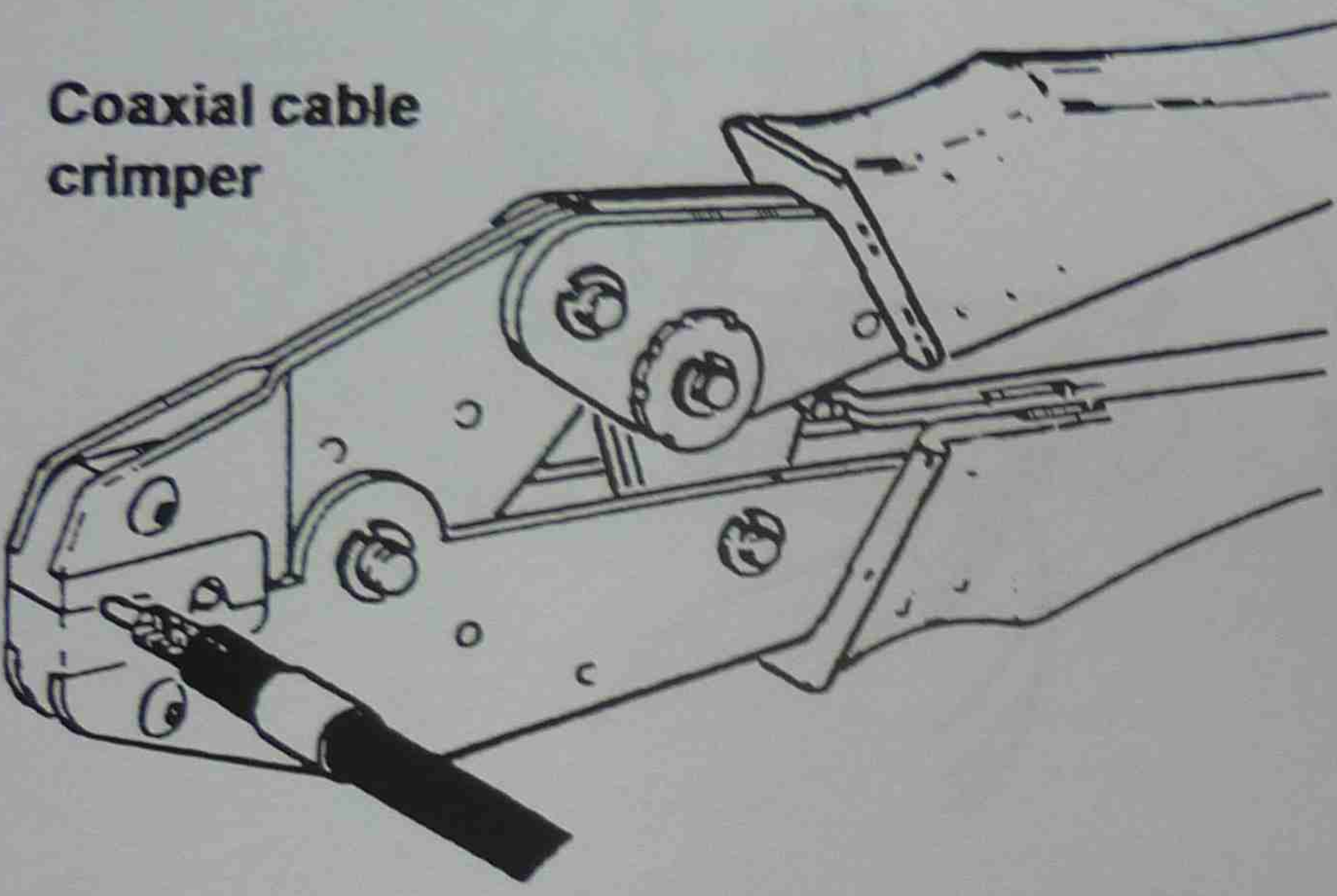


Figure 76 Crimping centre pin

4. Insert the crimped centre contact into the plug body and fit the cable braid over the support sleeve as shown in Figure 77.

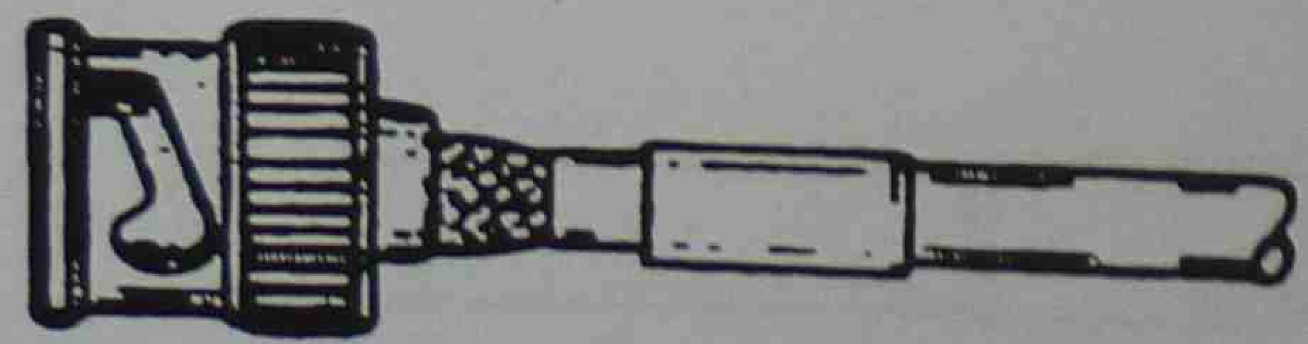


Figure 77 Assembling plug body

5. Slide the ferrule over the braid and support sleeve, insert the connector into the crimper and crimp the ferrule down as shown in Figure 78.

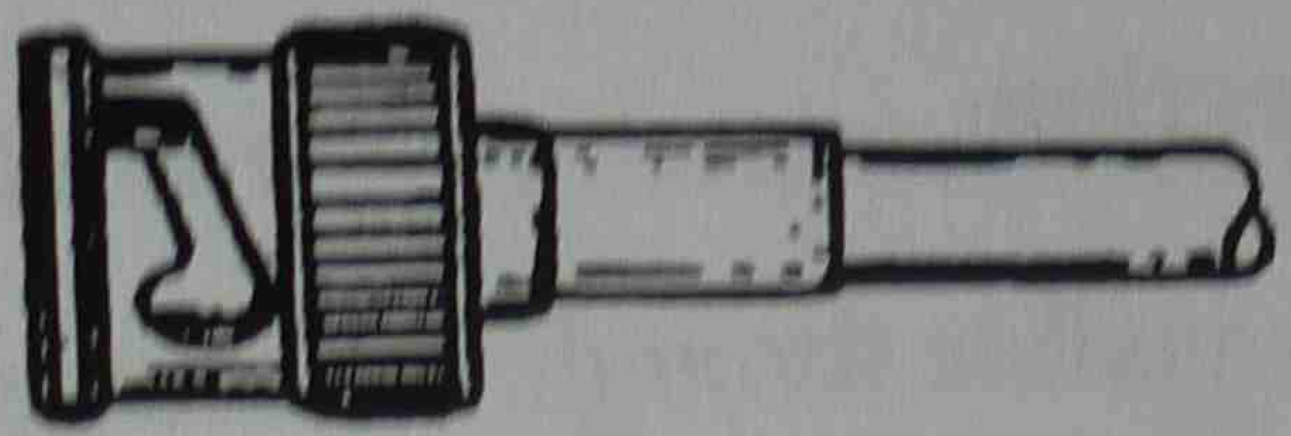


Figure 78 Finishing plug assembly

6. Repeat the above steps for the other end of the cable.

   Note: The crimped cable braid provides the total mechanical strength of the connector. Please do not disturb the braid weaving. Ensure the braid is undamaged before crimping.

7. Test the completed cable using either an MTDR or coaxial cable tester. Complete the following test results check list.

Practical exercise 15.1 Coaxial cable active tap

Task

Your task is to attach a low-profile coaxial active tap to a Thicknet coaxial cable.

Background

The low profile coaxial tap provides a quick and efficient method of tapping in to a backbone cable without interrupting user activity on the network.

Equipment

Your teacher will provide you with the following:

- low profile coaxial tap (AMP 228752-1)
- Thicknet coaxial cable
- hand tool (AMP 228917-1)

Procedure

Ideally the room will have a loop of Thicknet cable, suitable for tapping in to, installed on cable tray around the room.

1. Determine the position of the coaxial tap on the backbone cable as marked by the manufacturer (see Figure 79). In the absence of any marks ensure all taps are located at 2.5 metre intervals..

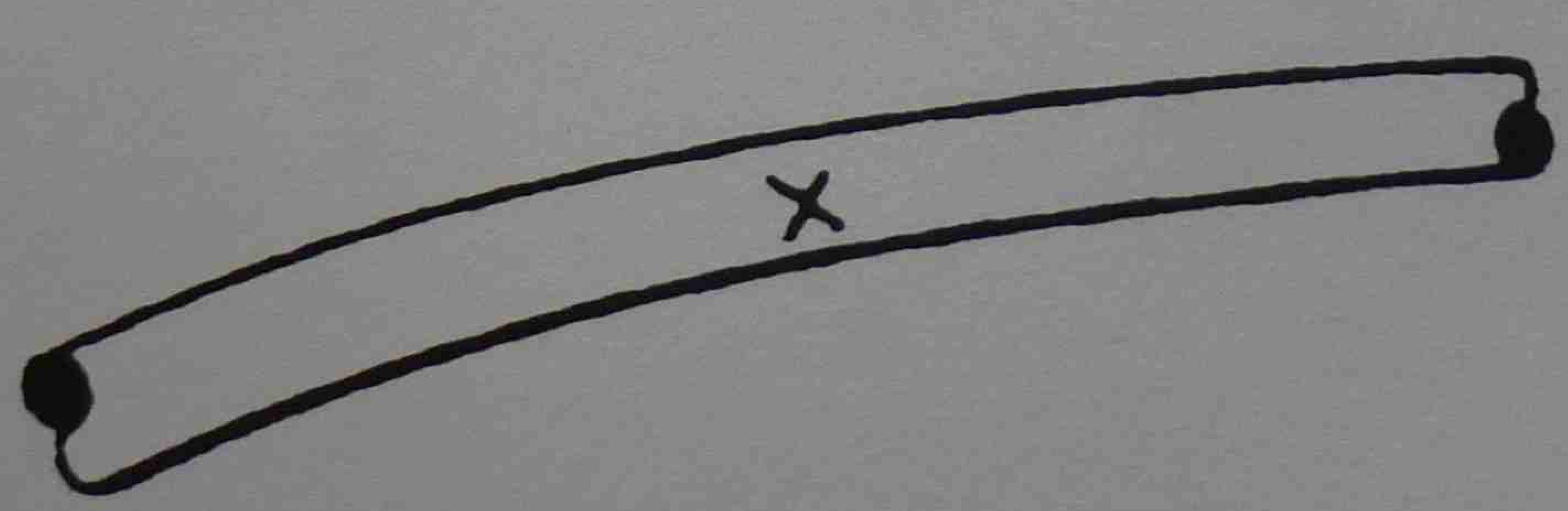


Figure 79 Location of tap