BUILDING ELECTRICAL INSTALLATION

LEVEL III

Based on November 2018, Version 5 Occupational standards (OS)

Module Title: - Installing and Maintaining Cabling for Multiple Access to Telecommunication Services

LG Code: EIS BEI3 M09LO (1-4)-LG (32-35)

TTLM Code: EIS BEI3TTLM 1220v1

December 2020

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LG #34	LO #1-Prepare to install and maintain cabling

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying, obtaining and understanding OHS procedures
- Identifying and establishing health and safety risks
- Identifying and establishing remote power feeding risk control measures
- Determining the nature and location of the work
- Planning cable routes within the constraints
- Determining earthling requirements
- Requiring advice from appropriate persons
- Establishing sources of materials.
- Obtaining and checking *Tools, equipment and testing devices*

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify OHS procedures
- Obtain OHS procedures
- understand OHS procedures
- Identify health and safety risks
- establish health and safety risks

- Identify remote power feeding risk control measures
- establish remote power feeding risk control measures
- Determine the nature and location of the work
- Plan cable routes within the constraints
- Determine earthling requirements
- Require advice from appropriate persons
- Establish sources of materials.
- Obtain *Tools, equipment and testing devices*
- checking *Tools, equipment and testing devices*

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Identifying, obtaining and understanding OHS procedures

1.1 Introduction

The purpose of the Health and Safety policies and procedures is to guide and direct all employees to work safely and prevent injury, to themselves and others. All employees are encouraged to participate in developing, implementing, and enforcing Health and Safety policies and procedures.

A health and safety program is a definite plan of action designed to prevent accidents and occupational diseases. Some form of a program is required under occupational health and safety legislation in most Canadian jurisdictions. A health and safety program must include the elements required by the health and safety legislation as a minimum.

Because organizations differ, a program developed for one organization cannot necessarily be expected to meet the needs of another. This document summarizes the general elements of a health and safety program. This approach should help smaller organizations to develop programs to deal with their specific needs.

Governmental health and safety regulations represent minimum requirements. In almost all cases, organizations will have to augment these regulations with specific rules.

We need rules – to protect the health and safety of workers – but there are dangers in having either too few or too many rules. Too few rules may be interpreted as a sign that health and safety are not important, or that common sense is all that is required to achieve them. Too many rules may be seen as not treating employees as thinking adults and makes enforcement of all rules less likely. Following are some guidelines for establishing rules:

- Rules should be specific to health safety concerns in the workplace.
- The joint health and safety committee should participate in their formulation.
- Rules should be stated in clearly understandable terms.
- Rules are best stated in positive terms ("employees shall" not "employees shall not").
- The reasons for the rule should be explained.
- Rules must be enforceable, since disregard for one rule will lead to disregard for others.

- Rules should be available to all employees in written form, in the languages of communication of employees.
- Rules should be periodically reviewed to evaluate effectiveness and to make changes for improved effectiveness.

Compliance with health and safety rules should be considered a condition of employment. Rules must be explained to new employees when they start work or if they are transferred or retrained. After a suitable interval, these employees should be briefed to ensure they understand the rules applicable to their work.

The employer must establish procedures for dealing with repeat rule violators. Supervisors are responsible for correcting unsafe acts, such as a breach of rules, and they must be supported in this duty. Points that should be considered in establishing procedures on this issue are:

- Ensure that employees are aware of the rule.
- Ensure that employees are not encouraged, coerced, or forced to disregard the rule by fellow employees.
- All rules are to be observed.
- No violation will be disregarded.
- The role of discipline is that of education, not punishment.
- Action is taken promptly.
- While having guidelines for penalties for the first offence or infractions may be desirable, some flexibility is required when applying the guidelines since each case will vary in its circumstances.
- Action is taken in private, and recorded

Correct work procedures are the safest way of doing a job, job instruction, monitoring performance, and accident investigation.

Job safety analysis (JSA), also known as "job hazard analysis", is the first step in developing the correct procedure. In this analysis, each task of a specific job is examined to identify hazards and to determine the safest way to do the job. Job safety analysis involves the following steps:

1. Select the job.

2. Break down the job into a sequence of steps.

3. Identify the hazards.

4. Define preventive measures.

The analysis should be conducted on all critical tasks or jobs as a first priority. Critical jobs include:

- Those where frequent accidents and injuries occur.
- Those where severe accidents and injuries occur.
- Those with a potential for severe injuries.
- New or modified jobs.
- Infrequently performed jobs, such as maintenance.

Job safety analysis is generally carried out by observing a worker doing the job. Members of the joint health and safety committee should participate in this process. The reason for the exercise must be clearly explained to the worker, emphasizing that the job, not the individual, is being studied. Another approach, useful in the analysis of infrequently-performed or new jobs, is group discussion.

A work procedure may consist of more than one specific task. In such cases, each separate task should be analyzed to complete a job safety analysis for that procedure. The final version of the correct work procedure should be presented in a narrative style format that outlines the correct way to do the job in a step-by-step outline. The steps are described in positive terms, pointing out the reasons why they are to be done in this way. Reference may be made to applicable rules and regulations and to the personal protective equipment required, if any. Employees who carry out the tasks should be consulted in developing the procedure.

Table .1 work procedure

Example **Job Safety Analysis (JSA) Worksheet** **Industry: Construction** **Operation: Ethical installation**			
Task	Who does it	Hazards	How to prevent injury/accident
Operating jack-hammer	Joe Doe	- noise - vibration	- ear protectors - vibration absorbing gloves

Applicable Legislation:

OH&S Act and Regulations: _____

(refer to the act and regulations in your jurisdiction)

Date: _____

Developed by: _____

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction: - choose and write the letter of the correct answer on the space provided. (3 each)

_____1. Unsafe work activity in terms of personal safety, work shop safety, tools and equipment safety leads to _____?

A. Accident B. Damage C. All D. None

_____2. From the given alternatives which one is personal protective equipment?

A. Safety goggles B. Safety shoes C. Clothes D. gloves

E. ear protection F. all

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 2- Identifying and establishing health and safety risks

2- 1. Identifying and establishing health and safety risks

When we refer to risk in relation to occupational safety and health the most commonly used definition is 'risk is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard.

In order to control workplace hazards and eliminate or reduce the risk, you should take the following steps:

1. Identify the hazard by carrying out a workplace risk assessment;
2. Determine how employees might be at risk;
3. Evaluate the risks;
4. Record and review hazards at least annually, or earlier if something changes.

There are basically three different types of inspection you can undertake in your workplace, namely:

- **General inspections**. Using a checklist, such as the COSHE checklist on the webpage, allows for a thorough look at all aspects of the workplace and the working environment.

Inspect

Fig.1 inspection

- **Special inspections.** These concentrate on a particular hazard, work area or system of work. You might feel that it is necessary to examine noise problems in detail, for example, or the use of a particular new chemical about which you are concerned.
- **Accident inspections.** These are inspections of particular accidents (or dangerous incidents), and usually part of the accident investigation. Some unions may already be involved in this type of inspection because of their work in compensation cases. These inspections are aimed at finding the real causes of an accident so that further accidents can beprevented.

Hazard identification is part of the process used to evaluate if any particular situation, item, thing, etc. may have the potential to cause harm. The term often used to describe the full process is risk assessment:

- Identify hazards and risk factors that have the potential to cause harm (hazard identification).
- Analyze and evaluate the risk associated with that hazard (risk analysis, and risk evaluation).
- Determine appropriate ways to eliminate the hazard, or control the risk when the hazard cannot be eliminated (risk control).

Overall, the goal of hazard identification is to find and record possible hazards that may be present in your workplace. It may help to work as a team and include both people familiar with the work area, as well as people who are not – this way you have both the experienced and fresh eye to conduct the inspection.

- The Health and Safety Executive's **five steps** to **risk assessment**.

  Step 1: Identify the hazards.

  Step 2: Decide who might be harmed and how.

  Step 3: Evaluate the risks and decide on precautions.

  Step 4: Record your findings and implement them.

  Step 5: Review your risk assessment and update if necessary

There are many definitions for hazard but the most common definition when talking about workplace health and safety is “A hazard is any source of potential damage, harm or adverse health effects on something or someone.”

The CSA Z1002 Standard "Occupational health and safety - Hazard identification and elimination and risk assessment and control" uses the following terms:

- Harm – physical injury or damage to health.
- Hazard – a potential source of harm to a worker.

Basically, a hazard is the potential for harm or an adverse effect (for example, to people as health effects, to organizations as property or equipment losses, or to the environment).

Please see the OSH Answers on Hazard and Risk for more information.

- Telephone installation work is generally safe provided you follow these guidelines:
  Do not work with outlets and wires that you are not sure are telephone facilities. If you are unsure which facilities are or are not telephone facilities, you should consult with an experienced professional.
- Do not connect household electrical power to telephone lines.
- Do not work on any telephone wires (or any wires) during a thunderstorm.

- Work with insulated tools.
- Touch only one wire at a time.

  Note: When working with telephone wires and connections, there is always the possibility of an electrical shock. It is generally recommended that premises wiring be disconnected from incoming telephone lines. Do this at the NID. You may also choose to lift the handset of one telephone connected to the line as a means of avoiding electrical power surges which occur when your telephone rings.

2.2 Compliance with Local Building and Safety Codes

When planning and installing your telephone wiring and outlets, you must observe and comply with any applicable state and local codes. Before doing any significant wiring work, you may want to consult with your municipal government to determine if permits are necessary for the work you plan to do. Before starting any telephone installation work, familiarize yourself with the products, procedures and safety precautions outlined in this brochure. Be sure to review the safety precautions included with any equipment you have purchased as well. As you work on your telephone wiring (or any wiring) the “safety first” should be your guide. The telecommunications industry has become increasingly diverse with the types and number of services that are available, as well as the types and number of service providers. This information is intended to be a guide for the “typical” situation involving telephone wiring. However, depending on the type of service you are using (i.e., cable modem, digital subscriber line (DSL) or any high-speed internet service, VoIP etc…) you may need to refer to other materials.

This guide will be particularly helpful if you wish to change phones, add an extension, or install your own wiring system using the safety outlined.

Self-Check -2	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below

Instruction I: - choose and write the letter of the correct answer on the space provided. (3 each)

_____1. Working on telephone wire during raining may cause.

A. Electric shock B. Thunderstorm C. Fire

INSTUCTON II: - Give short answer for the following questions and writ the answer on the space provided?

1. Define by what mean risk?

_____

_____

_____

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 3- Identifying and establishing remote power feeding risk control Measures

3.1 Identifying and establishing remote power feeding risk control Measures

Electrical risks are risks of death, electric shock or other injury caused directly or indire by electricity. The most common electrical risks and causes of injury are

- Electric shock causing injury or death. The electric shock may be received by direct orindir ect contact cking through or across a medium, or by arcing. For example, electric Shock may result from indirect contact where a conductive part that is not normally
- Energised becomes energised due to a fault (e.g. metal toaster body, fence)
- Arcing, explosion or fire causing burns. The injuries are often suffered because arcing
- or explosion or both occur when high fault currents are present
- Electric shock from 'step-and-touch' potentials
- Toxic gases causing illness or death. Burning and arcing associated with electrical
- equipment may release various gases and contaminants
- Fire resulting from an electrical fault.

A person conducting a business or undertaking has the primary duty under the WHS Act to ensure, so far as is reasonably practicable, that workers and other persons at the workplace are not exposed to electrical risks arising from the business or undertaking. This duty requires eliminating electrical risks or, if that is not reasonably practicable, minimising the risks so far as is reasonably practicable.

The WHS Regulations include more specific requirements for managing electrical risks at the workplace. For example, all persons conducting a business or undertaking have duties to ensure, so far as is reasonably practicable, that electrical equipment and installations at the work place are without risks to health and safety of persons.

Persons conducting a business or undertaking with management or control of a workplace

have a duty to ensure effective Residual Current Devices (RCDs) are used in certain high-risk environments as defined in the regulations and explained in more detail below.

Persons conducting a business or undertaking carrying out electrical work must comply with the prohibition on electrical work on energised electrical equipment subject to certain exceptions. These persons may also have duties under local electrical safety laws.

Persons conducting a business or undertaking should ensure electrical installation work is Carried out by qualified persons and testing and compliance requirements are met.

Inspection and testing of electrical equipment must be carried out by a person who has acquired, through training, qualification or experience, the knowledge and skills to carry out the task ('competent person'). Inspection and testing of electrical equipmentmust be carried out by a competent person who has the relevant knowledge, skills and test instruments to carry out the relevant inspection and testing.

Once hazards have been identified and the risks assessed, appropriate control measure must be put in place. Electrical safety generally depends on appropriate training, work planning, and correct testing procedures and techniques.

The ways of controlling risks are ranked from the highest level of protection and reliability tot he lowest. This ranking is known as the hierarchy of risk control. You must work through this hierarchy to choose the control that most effectively eliminates or minimises the risk in thecir cumstances, so far as is reasonably practicable.This may involve a single control measureor a combination of two or more different controls.

Elimination

The most effect control measure is to remove the hazard or hazardous work practice. example,working de.energised rather than energised eliminates significant electrical risk That is why the WHS Regulations prohibit energised electrical work subject to certain exceptions.

Substitution

Replacing a hazardous process or material with one that is less hazardous will reduce Thehazard, and hence the risk. For example, it may not be reasonably practicable to elimina teenergised electrical work altogether; however, even if it is necessary (for one of the legally permissible reasons) to work on an energised electrical part,it may be possible to de-energise the surrounding parts.

Isolation

Preventing workers from coming into contact with the source of the electrical hazard will reduce the relevant risks.

Personal protective equipment (ppe)

PPE includes protective eyewear, insulated gloves, hard hats, aprons and breathing protection. The PPE should be rated for the work to be done. If working on energised equipment, the PPE must be able to protect the user from the maximum prospective energy available at the work site.

Remote power feed

Registered cables working with telephone lines carrying broadband services need to take precautions to avoid electric shock. Carriage service provider (CSP) broadband equipment within the customer's premises requires increased voltage, which is called power feeding. The risk of electric shock increases when working with these higher voltages. Network cables carrying power feeding circuits may bypass the main distributor frame (MDF) to extend through to the CSP's equipment or they may be installed on the MDF. Usually the power feeding network cable will be laid in areas accessed by cablers. With broadband services, carriers and CSP's may install terminal equipment that is remotely fed using a current limited circuit. This has an open circuit voltage which is higher than normal telecommunications network voltage. (TNV) limit. (See below for a definition of TNV).Authorisation from the relevant carrier of CSP is required to work on these network cables and should exercise caution when working near any accessible termination.

The increased voltage also has the capacity to damage test equipment.

The ACMA makes the following recommendation:

The ACMA wiring rules AS/CA S009:2013 prevent the use of customer cabling for any service that exceeds TNV limits, such as remote feeding telecommunications current (RFTC) circuits. Consequently carriers and CSP's using RFT-C should cable directly to the terminal equipment bypassing the existing customer cabling infrastructure. The power-fed terminal equipment must be network equipment between the carrier or CSP and the customer. The Communications Alliance Ltd. Has developed an industry code that specifies a maximum voltage of 300Vdc and the current limitation parameters that carriers and CSP's should observe when power-feeding within their networks. CSP's and carriers are required

to provide separation, barriers and warning labels to identify potential hazards. Holding a cabling provider registration does not permit a cable to work on or interfere with any carrier equipment or cables on the carrier side of the network boundary. RFT-C cables and carrier terminations are all part of the carriers network.What is a TNV?

Telecommunications Network Voltage (TNV) a voltage not exceeding -

(a) When telephone ringing signals are not present

(i) 71 V a.c. peak or 120 V d.c. or

(ii) if a combination of AC voltage and DC voltage is present, voltages such that the sum of the AC peak voltage divided by 71 and the DC voltage divided by 120 does not exceed '1' and

(b) When telephone ringing signals are present, voltages such that the signal complies with the criteria of either Clause M.2 or Clause M.3 of AS/NZS 60950.1 (the signal is required to be current limited and cadenced).

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below

Instruction I: - choose and write the letter of the correct answer on the space provided. (3 each)

_____1.The most effect control measure to remove the hazard work practiceis

A.Elimination B. Substitution C.All

_____2.Preventing workers from coming into contact with the source of electrical hazard is

A. Elimination B. Substitution C. All

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____3.Electrical risks are risks of death, electric shock or other injury caused directly or indirectly by electricity .

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 43points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 4- Determining the nature and location of the work

4.1 Determining the nature and location of the work

The nature of an employee's work is best defined as the type of work that he does. This can refer to the basic daily tasks carried out as part of a job and can refer to other non-routine tasks that may be required

Absolute location describes the location of a place based on a fixed point on earth. The most common way is to identify the location using coordinates such as latitude and longitude. Lines of longitude and latitude crisscross the earth

Location definition is - a position or site occupied or available for occupancy or marked ... that want to work with an Android phone for Bluetooth, camera or location access. ... the act of finding where something or someone is : the act of locating

- Reactionary Work. In the modern age, most of our day is consumed by Reactionary Work, during which we are focused only on responding to messages and requests emails, text messages, Facebook messages, tweets, voicemails, and the list goes on.
- Planning Work
- Procedural Work
- Insecurity Work
- Problem-Solving Work

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

1. The nature of an employee's work is best defined as the type of work that he does.

2.The most common way to identify the location using coordinates is latitude and longitude.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 5- Planning cable routes within the constraints

5.1 Planning cable routes within the constraints

Designing cable and wire layouts is often a complex and tedious process in building construction. Incorrect cable and wire layouts can be costly due to poor planning and may require significant mod-incautions and design reviews. Current practices include scaled pro-to types onto which the cable (or wire) layout is constructed by using route planning algorithms for motionless rigid cable segments.

CAD systems are often used to assist the process during the early design stage. In these systems, the paths of the cables or wires are first calculated, then rigid segments are put through these paths to simulate cable or wire layout. However, current CAD systems do not take into account the cable's or wire's dynamics properties and their interaction with the environment. It should be noted that in some applications dynamic, or even quasi-static, simulation may not be necessary. But, while actually laying a cable or simulating the process, forces such as friction or gravity may influence the path taken to arrive at the goal configuration. For instance, in pulling or pushing a long cable toward a goal configuration, the friction of the cable with a passage or corner may influence what path is taken. Or, if an interactive visualization for rapid prototyping is required, it would be important to model the bending or sagging of the cable between supports due to gravity. In these cases, dynamics is necessary to generate physically plausible paths, configurations, and motion.

Our route planning algorithm is based on a variant of PRM that samples near the surfaces of the obstacles in the workspace. It initially generates random samples at the corners and edges of the environment. If a path cannot be found, it samples on the obstacles by using a ray shooting approach. During the simulation phase, whenever a collision occurs between the first link of the cable and the environment, the initial path is adjusted based on "constrained sampling", which recomputes a new node near the contact space. Our method expands the initial roadmap from a node belonging to the contact space (computed from a contact point) and finds a new node around the neighborhood of the contacting node using the projection method In order to simulate cable dynamics, we use an adaptive forward dynamics algorithm numerical integration that selects the most important joints to perform

bounded error dynamic simulation in a hierarchical manner.

The quasi-static integration removes unnecessary oscillation due to inertia which helps provide smoother robot motion. Moreover, we develop efficient collision handling techniques to resolve the contacts for the remaining links during the simulation.

Preparing Cable routes plan based on building structure and regulations.

As is true with most home improvement projects, a good plan is the foundation for success. Before purchasing any telephone wire and accessories, carefully plan the installation job to determine which components you will need. You will need to consider where you want to locate modular jacks for greatest convenience and ease of use. You will also want to consider your telecommunications needs for both now and the future since this could affect your choice of wire, which comes in various categories (CAT 1, 2, 3, 4 and 5 (For additional information about the various types of wire see below chart).

Telephone wire: CAT 5 cable is the most commonly used today and is recommended. You are encouraged to use CAT 3 cable at a minimum to allow for the best service quality. Additionally, you will need to decide which type of jack is best for the particular location. One thing to consider is the use of outlets with protective covers in areas where there may be excessive exposure to dust or moisture.

5.2. Cable color and marking

There are no mandatory requirements for cable sheath colors. However, cables with red sheath should not be used, as red is normally associated with fire detection/alarm systems. Also, cables with orange, white, pink or violet sheath should be avoided as they may be mistaken for power cabling or cabling associated with power control (“home automation”). It may be beneficial to the installer to use cables with different sheath colors (e.g. blue, grey, yellow, green) to cable different sockets on the same TO. Alternatively, the cable sheaths may be marked at each end with the TO socket colors, e.g. “Blue” and “White”, for the corresponding socket colors if different coloured sockets are to be used at each TO. In addition, mark the TO cables at each end by room designation (e.g. “Kitchen”, “Family”, Bed 1”, etc.) or in numerical sequence (i.e. “1”, “2”, “3”, and so on). The TO wall plates and the corresponding patch panel sockets at the CCP should be coloured and

designated in the same manner so that the end-user will be able to readily identify them

Cable casing colors

You may see network cables that are gray, while others are yellow, some are blue, and then there are white ones. Why? Most networking professionals will tell you that the cable jacket color has no meaning; it is just a question of aesthetics. They are partially right. The contents of the cable are exactly the same no matter what the plastic jacket color is. However, cable manufacturers don't just produce different colored cable jackets for the fun of it.

Fig.2 cable routes

There is an industry standard to which these colors are meaningful. Whether you choose to follow that convention is up to you – most sites don't pay attention to the standard. The Building Industry Consulting Service International (BICSI) propagates standards for integrating IT services in structures. Among the standards that it promotes is EIA-568. Another standard is the Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, also known as ANSI/TIA/EIA-606-B. This is where those cable colors originate.

The meanings of cable colors are as follows:

- Orange: Demarcation point
- Green: Network connection
- Purple: Common equipment

- Red: Key system
- White: First level backbone
- Gray: Intra-building backbone (MC-IC or IC-HC)
- Brown: Inter-building backbone (IC-HC)
- Blue: Horizontal
- Yellow: Other

Here is an image of the color coding section of the EIA-606-B standards document where these colors are defined

Telephone Wiring

Telephone wire normally used for inside installation contains four individually colored conductors. The wire is solid copper in either 22 or 24 gauge. See Tables A and B for wire color codes and spacing from other wire conductors.

Table2. Telephone wiring

Tip Wire	Ring Wire
Green	Red
Black	Yellow
Blue	White
Secondary Color with Primary Color Stripes	Primary Color with Secondary Color Stripes

Primary Colors: blue, orange, green, brown, and slate.

Secondary Colors: white, red, black, yellow, and violet.

Pr	Tip	Ring
1	blue/white	blue
2	orange/white	orange
3	green/white	green
4	blown/white	brown

Self-Check -5	Written Test

Directions: Answer the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1. There are no mandatory requirements for cable sheath colors.

_____2. Telecommunications recommends the installation of Category 6 Cable as a minimum.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

Score = _____

Rating: _____

Information Sheet 6- Determining earthling requirements

6.1 Determining earthling requirements

Earthing is used to protect you from an electric shock. It does this by providing a path (a protective conductor) for a fault current to flow to earth. A protective device (fuse or circuit-breaker) in the consumer unit switches off the electrical supply to the cooker

The electrical earthing is done by connecting the non-current carrying part of the equipment or neutral of supply system to the ground. Mostly, the galvanized iron is used for the earthing. The earthing provides the simple path to the leakage current.

Fig3. Earthing system symbol

The five types earthing systemBS 7671 lists five types of earthing system: TN-S, TN-C-S, TT, TN-C, and IT. T = Earth (from the French word Terre) N = Neutral S = Separate C = Combined I = Isolated (The source of an IT system is either connected to earth through a deliberately introduced earthing impedance or is isolated from Earth.

Earthing, also known as grounding, is a fundamental and essential part of an electrical system. Despite not being a visible element, the earthing system is of vital importance for the safety of people and equipment, as it protects against dangerous potential differences

Use two earth leads with each earth plate (in case of two earth plates) and tight them. To protect

the joints from corrosion, put grease around it. Collect all the wires in a metallic pipe from the earth electrode(s). Make sure the pipe is 1ft (30cm) above the surface of the ground

Purpose of Earthing

1. Safety for Human life / Building /Equipment

To save human life from danger of electrical shock or death by blowing a fuse i.e. To provide an alternative path for the fault current to flow so that it will not endanger the user

To protect buildings, machinery & appliances under fault conditions.

To ensure that all exposed conductive parts do not reach a dangerous potential.

To provide safe path to dissipate lightning and short circuit currents.

To provide stable platform for operation of sensitive electronic equipment i.e. To maintain the voltage at any part of an electrical system at a known value so as to prevent over **current or excessive voltage on the appliances or equipment .**

2. Over voltage protection

Lightning, line surges or unintentional contact with higher voltage lines can cause dangerously high voltages to the electrical distribution system. Earthing provides an alternative path around the electrical system to minimize damages in the System.

3. Voltage stabilization

There are many sources of electricity. Every transformer can be considered a separate source. If there were not a common reference point for all these voltage sources it would be extremely difficult to calculate their relationships to each other.

The earth is the most omnipresent conductive surface, and so it was adopted in the very beginnings of electrical distribution systems as a nearly universal standard for all electric systems.

There are three methods of earthing widely used,

- Pipe earthing. Pipe earthing is best form of earthing. ...
- Plate earthing: In this type of earthing plate either copper or G.I is buried into the ground at depth of not less than 3meter from the ground level. ...
- Strip earthing:

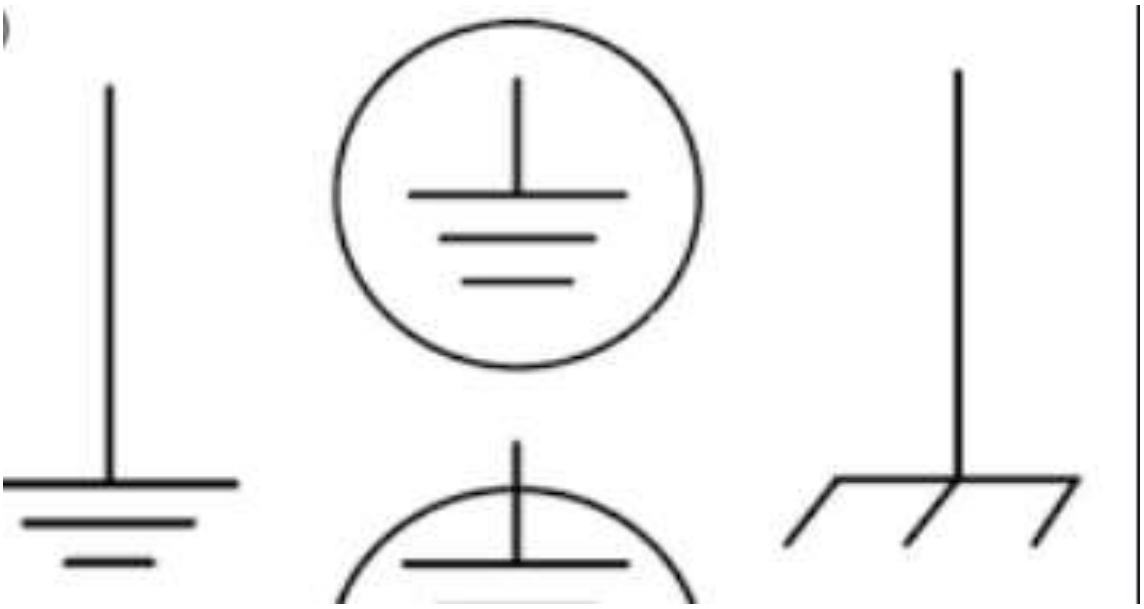


Fig4. Types of earthing system

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____ **1.** Earthing is used to protect you from an electric shock.

_____2. The earthing provides the simple path to the leakage current.

_____**3.** Earthing, also known as grounding, is a fundamental and essential part of an electrical system.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 7- Require advice from appropriate persons

Require advice from appropriate persons

Electrical wiring needs expertise attention to every building projects. It directly related to the safety of human beings and utilities / equipment people handle. The scope of electrical wiring shall cover supply, installation, testing and commissioning of all conduits and accessories, wiring, switches, socket outlets, spur outlets, junction boxes / pull boxes, GI pull wires, ceiling roses making connections etc. Unless otherwise indicated wiring shall consist of PVC insulated, copper conductor wires installed in heavy gauge steel galvanized conduits.

Inspection requests

You must request inspection prior to covering any electrical work, no later than 3 business days after completing the work or 1 business day after any part of the installation has been energized, whichever occurs first. Failure to request an inspection may result in civil penalties.

A permit is a vital step to a safe installation

A permit will ensure the work done on your property conforms to current safety codes. Your best protection is purchasing an electrical permit and having your electrical work inspected, as required by law.

A permit will ensure the work done on your property conforms to current safety codes. Your best protection is purchasing an electrical permit and having your electrical work inspected, as required by law.

If a permit is not purchased before work is started

You could be subject to civil penalties if you do not obtain a permit before the electrical work is started. By not purchasing a permit, you might incur additional penalties that could:

- Affect your ability to obtain financing or sell your property.
- Prevent you from obtaining insurance or collect on insurance claims.
- Bring a fine of up to $2,000 for each day a violation occurs.
- Result in a disconnection of your electrical power.

Each day at each location a violation occurs constitutes a separate violation. Additional penalties can be levied for failure to correct any violations noted during an electrical inspection

When a permit is not required

Certain projects do not require a permit. They include:

- Travel trailers.
- Plug-in household appliances.
- The like-in-kind replacement of lamps; a single set of fuses; a single battery smaller than 150 amp hour; contactors, relays, timers, starters, circuit boards, or similar control components; one household appliance; circuit breakers; single-family residential luminaires; up to five snap switches, dimmers, receptacle outlets, thermostats, heating elements, luminaire ballasts with an exact same ballast; component(s) of electric signs, outline lighting, or skeleton neon tubing when replaced on-site by an appropriate electrical contractor and when the sign, outline lighting or skeleton neon tubing electrical system is not modified; one ten horsepower or smaller motor.
- For the purposes of this section, "circuit breaker" means a circuit breaker that is used to provide overcorrect protection only for a branch circuit, as defined in NEC 100.
- A list of example electrical work that either requires or does not require a permit and inspection.
- Helpful suggestions about how to protect yourself, your home and your property investment by getting the proper electrical work permits and inspections.
- Detailed instructions and helpful hints about the electrical permit and inspection process

Approved products and materials

Products used in home remodeling projects must be listed by a nationally recognized independent agency. Agency listings include fire rated assemblies, prefabricated fireplaces and stoves, furnaces and heaters, insulation, etc. When you have identified a specific brand and model you want to install, check with your District Inspector to see if it has been approved for use in the City and County of San Francisco. In most cases, the brand and listing must be shown on the plans to be approved

Electrical Permit Information

The-Electrical-Code

The purpose of the electrical code is to provide practical safeguards to persons and property from hazards arising from the use of electricity. The code contains provisions considered necessary for safety.

What is the electrical code? The National Electrical Code covers installations of electric conductors and equipment within or on public and private buildings and structures, installations of conductors that connect to the supply of electricity, and installations of other outside conductors on the premises. Presently, the State Electrical Code consists of the National Electrical Code with Part 8 technical amendments. Provisions for one- and two-family dwellings are included in the Michigan Residential Code.

Are electrical- permits required? A person shall not equip a building with electrical conductors or equipment or make an alteration of, change in, or addition to, electrical conductors or equipment without receiving a permit to do the work described

Do you need a license to do electrical work? To obtain electrical permits, an applicant shall be an electrical contractor or specialty contractor licensed by a municipality or by the State Electrical Administrative Boar dora homeowner performing electrical work in a single family home and accompanying outbuildings owned and occupied, or to be occupied, by the person performing the installation.

Electrical Permit ApplicationElectrical Inspector Region Map

Prior to applying for an electrical permit, it is suggested the applicant review the Statewide Jurisdiction List. This information is updated regularly due to changes in the electrical code enforcement that may be conducted by either the state, county or local unit of government. An electrical permit application must be submitted to the appropriate enforcing agency. Pre-qualify

Electrical Plans Develop a process for pre-qualification of standard plans Pre-qualification of plans typically works as follows:

- An installer has a typical template approach or “plan” for installing a solar panel system.
- The installer meets with local permitting staff to review this plan in terms of system design and components.
- If the permitting staff finds that the plan is compliant with all relevant codes, they approve it.
- If the installer intends to install a system conforming to the approved plan, therefore incorporating the approved system design and using the approved components, they inform the permitting department.
- The permitting department then immediately issues an electrical permit.
- During project inspection, the inspector confirms that the system design and components are the same as originally approved.

It is important to note that the steps outlined above typically apply only to an electrical permit process, not to the building permit process. The building permit process would still be required, since the pre-qualification of the standard plan does not address the specific site or structure the system is located on.

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____ *1.* Electrical wiring needs expertise attention to every building project.

_____2.A permit will ensure the work done on your property conforms to current safety codes.

_____3. The code contains provisions considered necessary for safety.

Note: **Satisfactory rating – 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 8- Establishing sources of materials

8.1 Establishing sources of materials

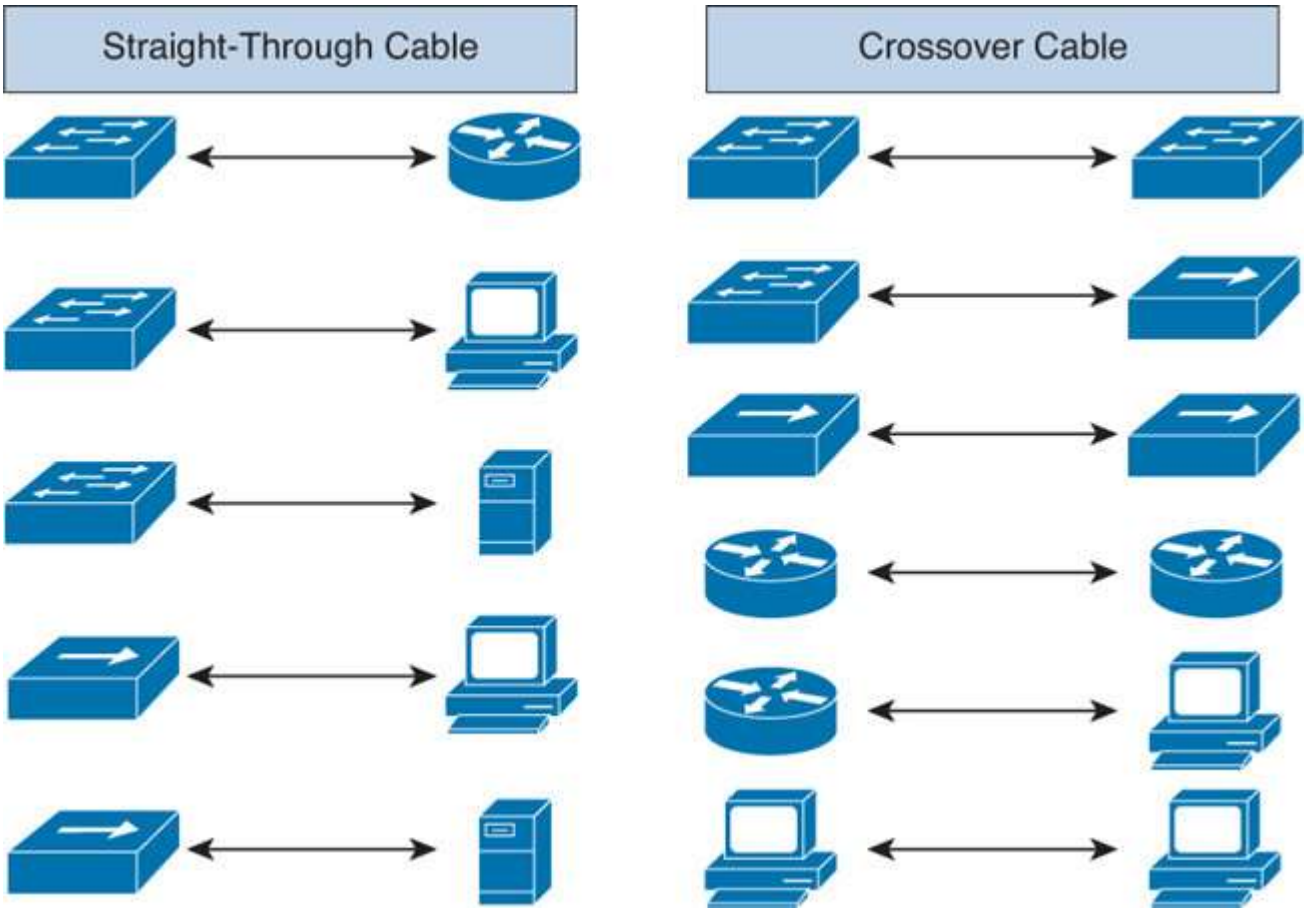
Telecommunications, also known as telecom, is the exchange of information over significant distances by electronic means, referring to all types of voice, data and video transmission. The free space transmission and reception of data by means of electromagnetic fields is called wireless communications.

Telecommunication networks are transmission systems enabling information to be transmitted in analogue or digital form between various different sites by means of electromagnetic or optical signals. The information may consist of audio or video data or some other type of data.

Telecommunication equipment is any hardware used for telecommunication purposes. Examples of telecommunications equipment include switches, telecom towers, fiber-optic cables, routers, voice over internet protocol (VoIP), and smartphones

Modes of telecommunication

- E-mail.
- Fax.
- Instant messaging.
- Radio.
- Satellite.
- Telegraphy.
- Telephony.
- Television broadcasting.



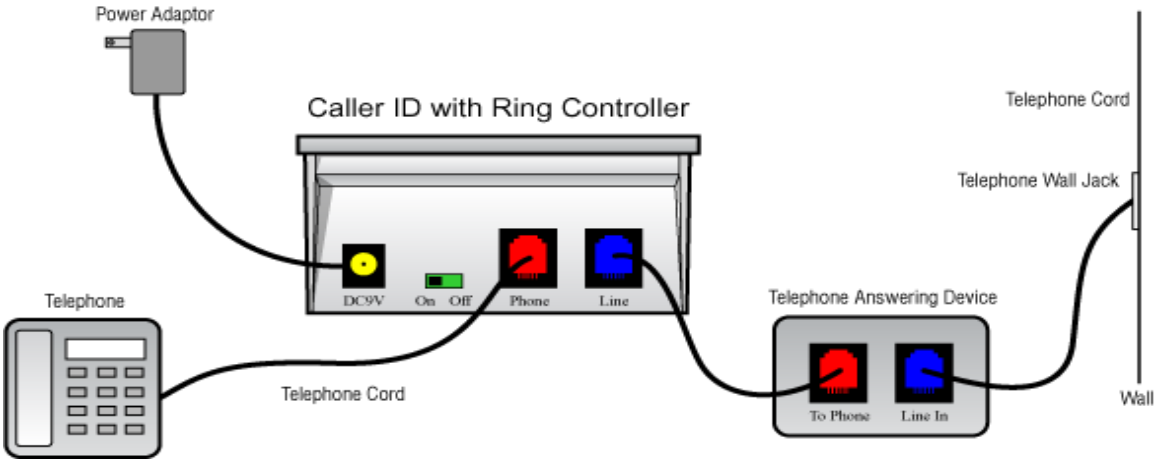


Fig 5 types of equipment

Self-Check –8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____ 1. Telecom, is the exchange of information over significant distances by electronic means

_____2. Telecommunication networks are transmission systems enabling information to be transmitted in analogue

Note: **Satisfactory rating - 45points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information Sheet 9- Obtaining and checking Tools, equipment and testing devices

9.1 Obtaining and checking Tools, equipment and testing devices

Tools are particularly important in construction work. They are primarily used to put things together (e.g., hammers and nail guns) or to take them apart (e.g. jackhammers and saws). Tools are often classified as hand tools and power tools. Hand tools include all non-powered tools, such as hammers and pliers.

Each tool is precisely designed for a specific purpose, so choosing the correct tool will also decrease the amount of effort required to get a job done right without causing damage to either the equipment or the surface being worked on.

MATERIALS, TOOLS, EQUIPMENT and TESTING DEVICES

- LAN CARD. It is a network interface card. ...
- SERVER. It is a part of a network. ...
- HUB / PORT. It is a connector on the back of a computer or other device. ...
- MODEM. The modem is a device that allows a given computer to share data or otherwise a device which let computers exchange information.
- SCANNER. ...
- FLAT SCREW DRIVER. ...
- USB. ...
- PRINTER

Tools

- Cutters, Scissors, Pliers.
- Cable Tie Tools.
- Compression and Crimp Tools.
- Fiber Optic Tools.
- Insertion - Extraction Tools.
- Manual/Automatic Switch Boxes.

- Network Testers.
- Punch down Tools

The following are some helpful tips on how to clean and properly store your tools.

1. Keep Power tools Clean. Dust and grime can bring your power tools to a grinding halt if left unchecked over time. ...
2. Store Power Tools Correctly. ...
3. Inspect for Wear or Damage
4. Lubricate Moving Parts
5. Keep Batteries in Shape.
6. *Selecting Tools, equipment and testing devices*

Socket type

8-position 8-contact (8P8C) modular sockets (commonly called “RJ45”) should be used for all voice/data TOs to ensure compatibility with consumer Ethernet equipment (other types of socket are available but may not be compatible with RJ45 plugs). The TO sockets should be rated to match or exceed the cable rating (e.g. if Category 6 cable is installed, the sockets should be rated at Category 6 or Category 6A).

Notes:-

1. 6-position (6P) modular sockets (commonly called “RJ11” and used for telephone equipment connections) should not be used as these will negate the generic nature (flexibility) of the cabling system.

2. If the cable runs will not exceed a length of, say, 30 m, if necessary it may be possible to use a socket with a lower rating than the cable (e.g. Category 5/5e sockets on Category 6 cable) and still achieve the higher performance class for the permanent link. If a TO has more than one socket, each socket should be colour-coded as shown in Figure above to compatibility with the decor) or marked in a way that its corresponding socket at the CCP can be readily identified. The sockets should be mounted on their wall plates with the contacts at the top and should be fitted with a shutter to minimize the exposure of contact surfaces to dust and other airborne particles. Any 8P8C (“RJ45”) socket that is within the reach of small children should be fitted with a shutter to prevent access or discourage them from probing the socket with their fingers.

Note: The socket aperture is large enough to enable a child to touch the contacts with a finger. It is possible to get a small electric shock from these contacts under certain conditions. Fitting of mechanical protection to prevent finger access to the socket contacts is recommended in homes.

Typical modular sockets and a typical TO with two colour-coded sockets

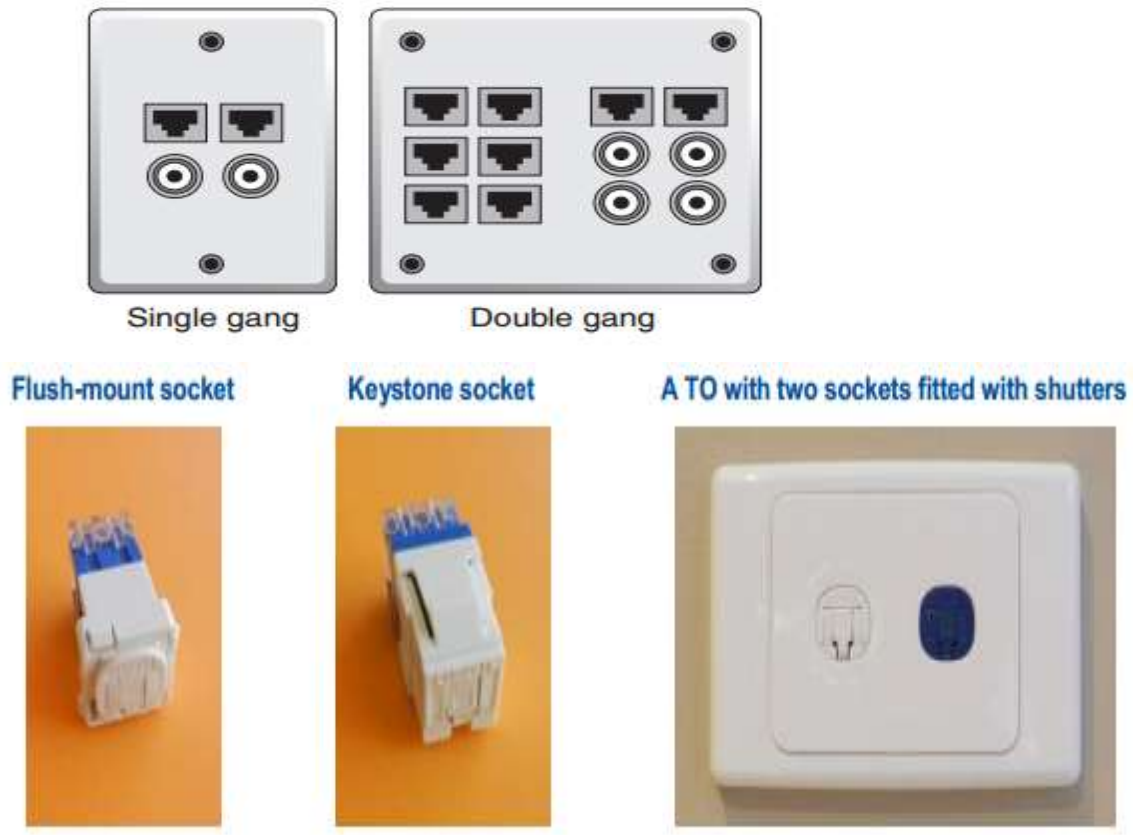


Fig 6.Typical cable Installation Tools

Fig 7. Typical cable Installation Tools

Cable Strippers

Cable strippers themselves are inherently relatively safe due to their design. Only use them on the materials they are intended to strip and they will last a long time.

Cable strippers designed for use on coax can be used on structured cables with care.

Fig 8. Cable Strippers

Wire-Map Tester

Fig 9. Wire-Map Tester

Pair Continuity tester

Fig 10. Pair Continuity tester

Voltage Meter

There is a right way and a wrong way to determine if an electrical circuit has a live voltage on it. Touching it is the wrong way. A simple voltage meter such as the one pictured in Figure 6.18 is a much better solution, and it won't put your health plan to work. Though not absolutely necessary in the average data-cabling tool kit, a voltage meter is rather handy.

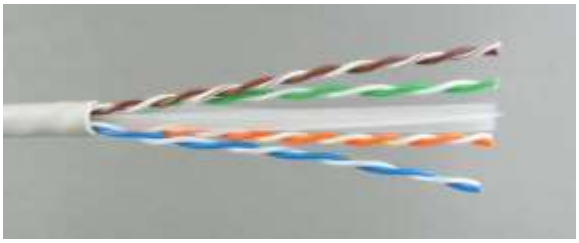
Fig11. Voltage Meter

4-pair Unscreened Twisted Pair (UTP) data cables Category 5 (“5e”)

- approx. 5 mm diameter
- 0.51 mm diameter (24 AWG) conductors
- rated to 100 MHz
- supports Gigabit Ethernet
- cheap
- obsolescent, not recommended

Category 6

- approx. 6 mm diameter
- 0.57 mm diameter (23 AWG) conductors
- higher pair twist rate
- pair separator
- rated to 250 MHz
- supports 10G Ethernet to 50 m
- slightly dearer than Category 5
- recommended for homes



Category 6A

- up to 8.5 mm diameter
- 0.59 mm diameter (23 AWG) conductors
- even higher pair twist rate
- pair separator
- rated to 500 MHz
- supports 10G Ethernet to 90 m

- expanded sheath, elliptical or special core configuration to reduce alien crosstalk
- expensive, not worth the extra cost for most homes

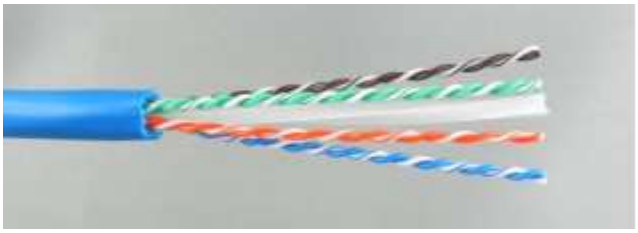


Fig 12.Twisted Pair

Punch down Tool or Insertion Tool

A punch down tool, also called a punch down tool or a krone tool (named after the KRONE LSA-PLUS connector), is a small hand tool used by telecommunication and network technicians. It is used for inserting wire into insulation-displacement connectors on punch down blocks, patch panels, keystone modules, and surface mount boxes (also known as biscuit jacks).

Fig 13. Punch down Tool or Insertion Tool

Fig 14. Terminating tool

Test equipment

Test equipment must be in correct operating order. To maintain insulation resistance insulation must be clean and in very good condition. Ensure that any calibrated equipment is in current test date.

Fig 15. Test equipment

Test equipment is generally more fragile than ordinary hand tools and more care must be taken. Always return it to its protective case, keep clean and dry and do not use cleaning chemicals as this may damage the plastic and seals, use a clean dry cloth.

Terminating Category 5 or Category 6 cable on a socket

Fig 16. 6 cable on a socket

Tone Generators and Amplifier Probes

Fig 17. Tone Generators and Amplifier Probes

Coaxial cable elements

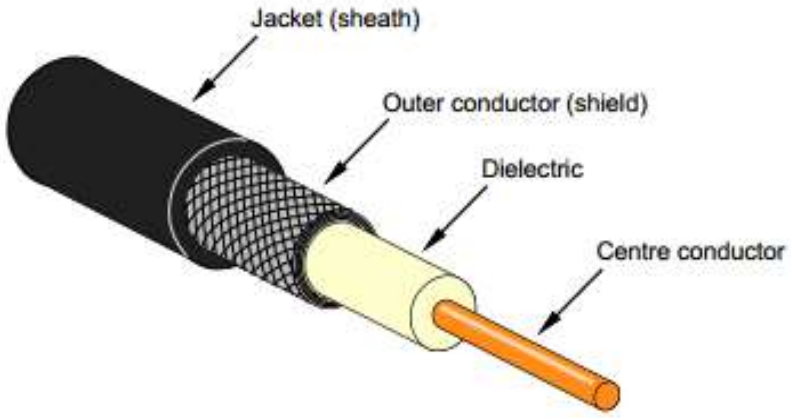


Fig 18.Coaxial cable elements

Figure: Two TV outlets connected to an FTTP NTD or external TV antenna and Four TV outlets connected to an FTTP NTD or external TV antenna

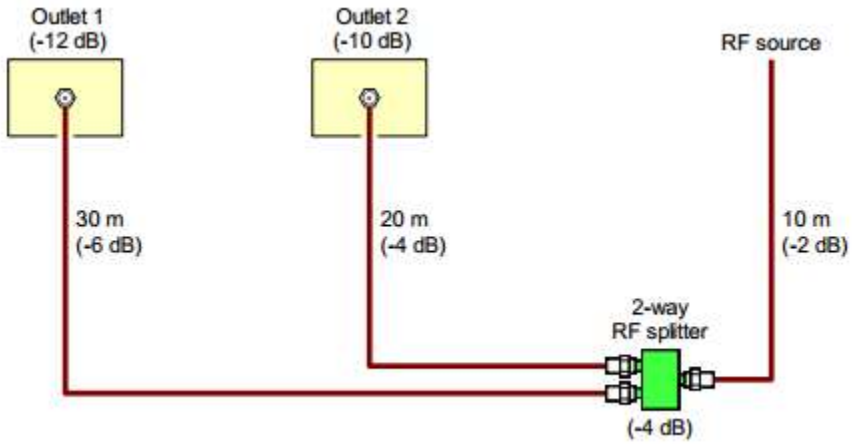


Fig 19. Two TV outlets connected

Cabling tools and practices

RF field strength meter

RF field strength meters are an essential tool to test signal strength ("RF power level") and signal quality at the RF source, wall plates and intermediate points where necessary. Different meters are generally required to measure HFC (Cable internet/pay TV), TV antenna (and FTTP NTD) and satellite signals — although some meters are available that are capable of testing more than one type of RF source.

Fig 20. RF field strength meter

Cable cutter

Coaxial cable should be cut squarely prior to termination using a cutting tool that does not

appreciably distort the end of the cable so that it may be properly prepared using a cable stripper designed for the purpose. Caxial cable cutters have concave cutting jaws that tend to slice, rather than crush, the cable.

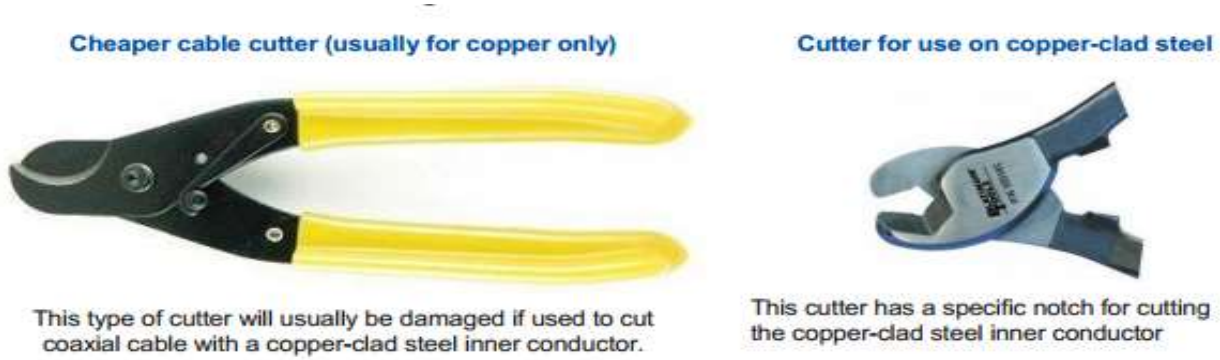


Fig 21. Cable cutter

Cable stripper

A coaxial cable stripper has two appropriately spaced cutting blades to prepare the cable for termination in the connector. A coaxial cable stripper may have adjustable blades for use with different types of cable. A stripper with incorrect blade settings can score the center conductor or remove excess outer conductor and degrade cabling performance. A stripper with fixed blades designed exclusively for use on the type of cable being installed is recommended. Figure A typical coaxial cable stripper

Fig 22. Cable cutter

Coaxial Cable selection:-The two types of cable that may be used for coaxial cabling installations are

commonly referred to as “RG6” (7 mm - 8 mm diameter) and “RG11” (10 mm – 11 mm diameter). Like the “RJ” (Registered Jack) designations used for modular plugs and sockets, the “RG” (Radio Guide) designations have no formal status and care needs to be exercised when selecting cables purported to
be “RG6” or “RG11”. (The use of RG11 coaxial cable is not recommended in homes.)

CCTV-Cable:-Another type of coaxial cable that may be used specifically for connection of closed circuit television (CCTV) cameras is RG59. This type of cable has only one layer or two layers of shielding (outer conductor) and is quite thin (5 mm – 6 mm diameter), which makes it easier to terminate on a BNC type connector commonly used for domestic CCTV cameras. These cameras usually operate on a single
analogue VHF or UHF channel and don’t require the higher performance RG6 coaxial cable. RG59 cable should not be used for any other part of the coaxial cabling system.

Coaxial Cable Connectors

Coaxial connectors should be suitable for the type of cable used.

The standard connector for use with RG6 and RG11 cables used for generic cabling systems is the F-type connector (“F-connector”). This connector has a threaded body (for the outer conductor connection) and uses the center conductor of the coaxial cable as the center pin of the male connector. The body of the female connector is threaded while the center pin connection comprises a pair of “fingers” designed to clasp onto the center conductor of the cable terminated in the male connector.

Only the male connector is designed to terminate coaxial cable. The female connector is usually mounted on a wall plate or on the equipment or forms part of an adaptor. There are two styles of male F-connector commonly available — the newer compression type connector and the older hex-crimp type connector. Hex-crimp connectors are fastened to the cable by a tool that produces a six-sided crimp, applying pressure at six points around the cable. A compression connector uses a conical compression technique that provides even pressure around the entire circumference of the cable, maintaining the integrity of the cable structure and the impedance of the connection while providing superior pull-out resistance and shielding performance.

There are also two connector categories — internal and external (indoor and **outdoor).** External type connectors must be used for outdoor connections such as at a TV antenna, satellite dish or

within any outdoor enclosure. External rated connectors have special seals to inhibit the entry of moisture. However, irrespective of the connector design, any connection that may be exposed to the weather or moisture should be further protected against the ingress of water (particularly around the threaded section) by the use of self-amalgamating tape that is stretched and wrapped around the connection and covered by a suitable rubber boot or UV-resistant heat-shrink tubing.

F-type coaxial connectors (F-connectors)

Fig 23. F-type coaxial connectors (F-connectors)

Splitters and diplexers

Splitters are used to provide two or more access points (outlets) in the home. Cables to multiple outlets cannot be simply connected together like telephone cables, as this will cause impedance mismatches, signal reflections and excessive signal loss. Splitters provide a proper termination for each cable, maintain impedance balance and also provide some isolation (called “RF isolation” or “mutual isolation”) between the outputs of the splitter to prevent mutual interference between the output cables and the equipment connected to them.

Because splitters divide the signal, they incur signal loss between the input and each output leg. For example, if the signal is split two ways, each output leg should get half the input signal level, which equates to a 3 dB loss between the input and the output

Typical RF splitters

Fig 23 Typical RF splitters

Self-Check -9	Written Test

Directions: Answer all the questions listed below.

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1. Keeping tools properly storing, cleaning, and maintaining is **not** saves time and money **(3 points)**

Instruction II: - choose and write the letter of the correct answer on the space provided.

_____2. Which one of the following is **not** maintenance of plate compactor? **(2 points)**

A. Changing oil
B. Changing grease
C. Changing blade
D. All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

LG #33	LO #2- Install and maintain cabling

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Following established OHS risk control measures and procedures
- Checking installed support structure to the cable
- Securing catenaries supports to building structure
- Installing protective earthling of metal work
- Handling cables/wires
- Allowing sufficient excess at cable ends to facilitate termination
- Labeling telecommunication outlet ends of cable
- Placing and securing cable
- Trimmed flush cable ties
- Installing cables as catenaries
- Fitting over-voltage protection devices to all cable pairs
- Fitting Over-voltage protection device to all cable pairs earthed in accordance with standard
- Protecting TRC/CES/Earth wire insulation against damage
- Following procedures for referring non-routine events
- Installing cabling without waste of materials and energy
- Carrying out routine quality checks

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Follow established OHS risk control measures and procedures
- Check installed support structure to the cable
- Secure catenaries supports to building structure
- Install protective earthling of metal work
- Handle cables/wires
- Allow sufficient excess at cable ends to facilitate termination
- Label telecommunication outlet ends of cable
- Place and securing cable
- Trim flush cable ties
- Install cables as catenaries
- Fit over-voltage protection devices to all cable pairs
- Fit Over-voltage protection device to all cable pairs earthed in accordance with standard
- Protect TRC/CES/Earth wire insulation against damage
- Follow procedures for referring non-routine events
- Install cabling without waste of materials and energy
- Carry out routine quality checks

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Following established OHS risk control measures and procedures

1. 1. Safety of telecommunication

For new buildings, all service cables, conduits and pipes are usually exposed at the time of installation of the lead-in cabling, minimizing the hazards for the installer and the risk of damage to other services. Ideally, the lead-in cabling should be installed in the trench being dug for the electricity mains. For established premises, the location of other underground services may be unknown. Accordingly, the trench should be dug by an experienced person who is familiar with underground service arrangements and who is suitably accredited or licensed where required by the relevant authority. Careless excavation work may result in personal injury (e.g. through contact with live underground power cables) or costly damage to underground conduits, pipes and cables. Service providers may seek to recover their entire repair and associated costs in the event that any damage is caused to their assets.

1.2.Locating existing underground services

In order to avoid personal injury or damage to property, existing underground services should be located and identified by an experienced, suitably accredited or licensed person.

1.3.Install Cables in accordance with telecommunication regulation

Requirement

a) All cabling shall be installed in full accordance with the manufacturer's recommendations. Cables shall be installed with due skill and care so that:

1. Maximum permitted hauling tension is not exceeded
2. Minimum bending radius of the cable is not exceeded
3. Maximum permitted crush rating is not exceeded

b) Cable bundles shall not obstruct the installation and removal of equipment within equipment enclosures.

c) Jumper wires on wiring frames shall follow clear paths to minimize jumper lengths and avoid obstructing jumper fields.

d) Equipment and patch panels shall be laid out to minimize patch cord length. Patch cords shall follow clear paths to avoid patch field obstruction.

Self-Check – 1	Written test

Name…… ID…… Date…….

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

.

1. Cabling shall be installed in accordance to with the manufacturer's recommendations.(3 points)
2. Cable bundles shall rub on or be unduly compressed against or by any cable tray,

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 2- Checking installed support structure to the cable

2.1 Checking installed support structure to the cable

The cable tray system shall be installed in accordance with the project specification, manufacturer's instruction and the referenced standard installations details. Locate the area where cable tray shall be installed as per the Issued For Construction (IFC) drawings.

Prepare the required tools and materials to be used for the installation of the cable tray. Inspect tools for proper working condition. Install cable tray supports for the stability of the cable tray. Ensure sufficient space provided and maintained for cable tray to permit adequate access for installing & maintaining the cable. Ensure that cable trays are exposed and accessible for installation. Cable tray sections, fittings and connected raceways shall be bonded using bolted mechanical connectors or bonding jumpers Used within an electrical installation to restrain cables in a manner that can withstand external structure and are not normally supplied by the cable support to design a safe system it is necessary to check each element in turn to ensure

In the electrical wiring of buildings, a cable tray system is used to support insulated electrical cables used for power distribution, control, and communication

Typical cable-support systems include cable trays, ladder racks, enclosed wire pathways, clamps, rings, and fasteners

Total Area of Cable:

- Total Area of Cable = Final width of Cables X Maximum Height Cable.
- Total Area of Cable = 493 X 69.6 =28167 Sq.mm.
- Taking 20% Spare Capacity of Cable Tray.
- Final Area of all Cables = 1.2%X28167.
- Calculated Area of all Cable =33801 Sq.mm

2.2. Use of PVC trucking

The selection and use of PVC trucking shall comply with the following;

a) All PVC trucking to be used shall be manufactured in accordance with BS 4678 where applicable;

b) All necessary trucking fittings, i.e. Tees, bends, end-caps shall be used. Such fittings shall be of proprietary manufacture and installed to manufacturer's instructions;

c) In corridors where installed PVC trucking is visible, every effort shall be made to conceal individual cable exit points by making such exit points through the rear of the trucking;

d) Horizontal trucking runs in decorated areas shall be located at ceiling level where fixed ceilings exist

e) PVC trucking (including mini-trucking) shall be securely fixed with screws as per the manufacturer's instructions.

f) The of use self-adhesive trucking is not recommended unless compelling reasons exist

g) New PVC pathways shall not be more than 50% occupied at installation

h) Newly installed PVC trunk should be selected to have 50% spare capacity after completion of the works.

2.3. Use of Steel Conduit

While using steel conduits ensure that:

a) All bends, tees, etc. shall be radius or gusset type suitable to allow the installation of the cables without exceeding the cable bending radii.

b) All lengths of Conduit shall be earth bonded to meet the 16th Edition IEE wiring Regulations.

c) New steel conduits are able to accommodate a 50% increase in occupancy at installation.

d) Newly installed conduits should be selected to have 50% spare capacity after completion of the works.

2.4. **Use of Steel Trucking**

While using steel trucking it is important to ensure that:

a) All trucking is free from sharp edges and projections likely to cause damage to the cables contained.

b) All bends, tees, etc. is of radius or gusset type suitable to allow the installation of the cables

without exceeding the cable bending radii.

c) Fixings are spaced according to the manufacturer's recommendations.

d) All lengths of Steel trucking are earth bonded to meet the 16th Edition IEE Regulations.

e) New steel conduits should be able to accommodate a 50% increase in occupancy at installation.

f) Newly installed steel trucking shall be selected to have 50% spare capacity after completion of the

Fig 24. Checking cables

Self-Check –2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction I: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1. All lengths of Cable Tray shall be earth bonded :**(3 points)**

_____2. Cable trays shall be perforated galvanized mild steel sheet **(2 points)**

_____3. All lengths of Steel trucking are earth bonded

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Score = _____

Rating: _____

Information Sheet 3- Securing catenaries supports to building structure

3.1 Securing cables correctly in the locations

- Before any earth breaking activity is contemplated, contact the Dial beforeYou Dig call for information for the site to municipal. information about anyunderground services that may be in the vicinity (note that while planssupplied information about underground services on public not required todig the trench outside the boundary of your premises, e.g. in public footways, roadways or in neighboring premises).
- Review any property documentation (e.g. building plans, electrical specifications, and plumbing plan).
- Visually inspect the site noting the location of conduits, pipes or cablesemerging from the ground at buildings, sheds, swimming pools, fountains, electric barbecues, garden lights, external power outlets, etc.
- Visually inspect the footway and verge for the location of any power, water,gas, sanitation, storm water, drainage or telecommunications facilities (e.g.pedestals, pits, poles, meters, kern markers, drains, conduits/pipes, cables).
- Ascertain the likely path of underground services using the above indicators.
- The location of services using a cable locator or similar equipment, ifavailable (note that existing services may not have been installed in a straight line).
- Verify the presence or absence of underground services at appropriatepoints along the chosen trenching route by careful hand digging.Where there is evidence of underground services along the chosen trenchroute but their position cannot be verified with reasonable accuracy, look for amore suitable route or excavate by careful hand digging where uncertainty exists.

Apply the following precautions when digging the trench:

•Allow for at least one 1 m separation from any suspected underground service.

•Except where otherwise required by this document, keep at least one 1 m away from any pole (to avoid disturbance of the pole footings and to allow for future replacement of the pole without disturbing the lead-in cabling that will be installed in the trench).

•When hand digging, use non-conductive tools (e.g. with wooden handles) and wear insulating (rubber) boots.

•Do not dig the trench any deeper than the recommended depth (see Table below)

Table 2.Trench depth required telecommunication cable wiring:

		Urban area	Rural area (cable directly buried without conduit)	
		For 23 mm ID conduit	Soil & non-continuous rock (Note 2)	Continuous rock (Note 3)
Non-trafficable area, driveway or private footway (Note 4)	Minimum	350 mm	500 mm (where deep cultivation ploughing is not likely)	250 mm
	Maximum	550 mm	650 mm	650 mm
	Recommended (Note 5)	400 mm	550 mm	300 mm
Private roadway (Note 4)	Minimum	500 mm under the lowest point	500 mm under the lowest point (usually the gutter or kerb)	

Notes:

1. If it is not possible to provide the required depth due to ground conditions, seek advice from the carrier.

2. “Soil” means sand, gravel, clay, loam or silt. “Non-continuous rock” means stones and boulders (“floaters”) set in soil.

3. “Continuous rock” means rock in continuous strata or prevailing on a massive scale. It can only be removed by blasting and ripping or by using a rock breaker or a rock saw.

4. The recommended depth allows for fluctuations in ground conditions and for the use of bedding material, if required, to ensure that the minimum depth of cover above the conduit or cable is achieved.

3.2. Telephone cable wiring method on Retaining walls and embankments:

3.2.1 Lead-in conduit arrangement where a retaining wall or embankment does not exceed a vertical height of 1 m

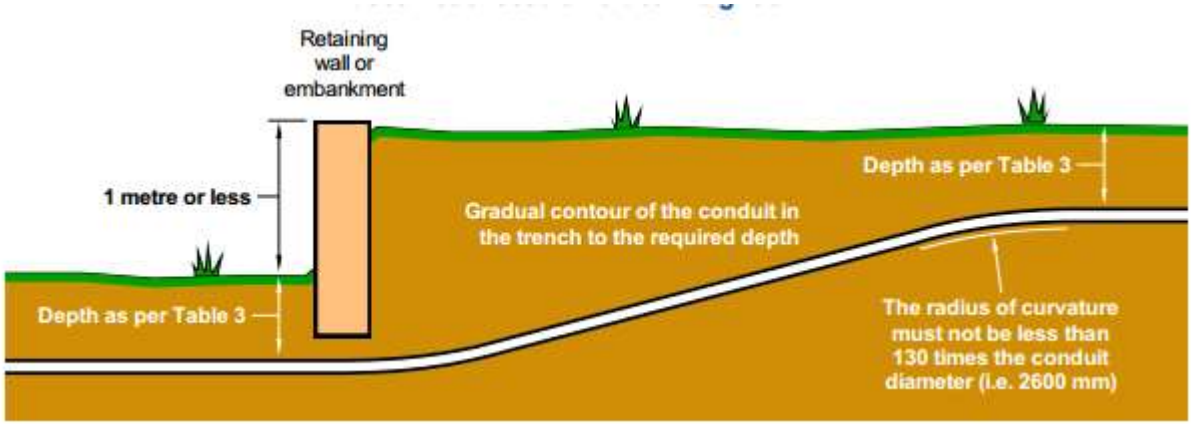
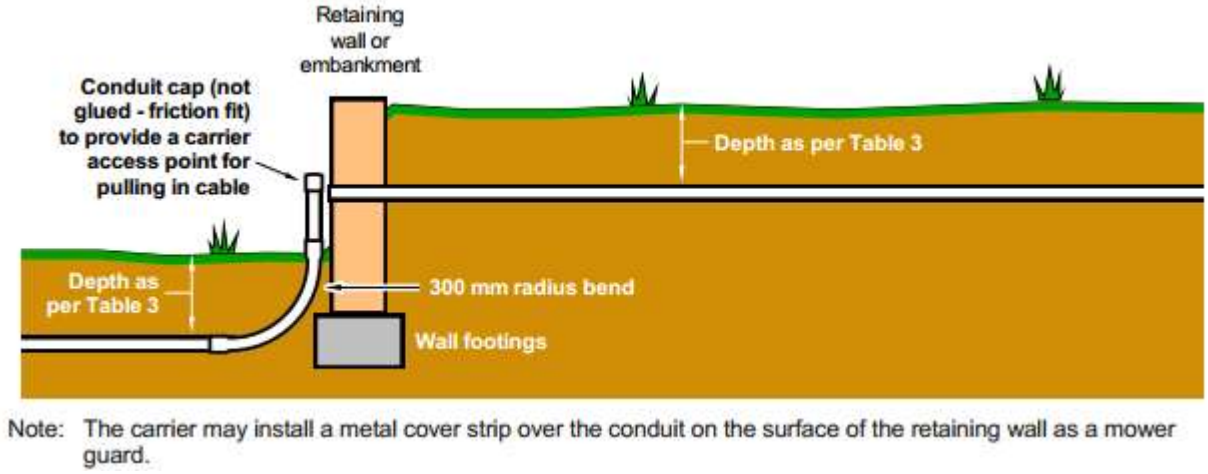


Fig 25.conduit arrangement

Notes:

1. The technique may be applied either before or after the retaining wall is installed or an embankment is created.
2. For an existing retaining wall or embankment, the technique shown in Figure below may be applied**.**

3.2.2. Lead-in conduit arrangement where a retaining wall or embankment exceeds a vertical height of 1 m



Note: The carrier may install a metal cover strip over the conduit on the surface of the retaining wall as a mower guard.

Fig 26.Conduitcabling

3.5. Building entry conduits

Building entry conduits are the conduits that provide for the penetration of the telecommunications cables into the building. The conduits must allow cables to be pulled through them while preventing the entry of water or vapour into the building or the covert entry of termites. For some types of building construction (e.g. brick veneer), conduits may be partially concealed inside the wall cavity; otherwise they may be fastened to the surface of the external wall. Each method has its advantages and disadvantages. Concealed conduits produce a neater result — as long as the conduits
are positioned correctly.

3.5.1. Conduit type

For homes, white, rigid (UPVC) plastic conduit and fittings with an inside diameter (ID) of 23 mmused.For installation of the lead-in cable(s) between the property entry point and the PCD. No more than the equivalent of two 90° bends is permissible at the building, comprising**:**

•one 300 mm radius bend (or equivalent where composite bends are used over the footings) in the underground portion; and

•one 100 mm radius bend in the aboveground portion (e.g. within the wall cavity).

Flexible conduit with a minimum outside diameter (OD) of 25 mm may be used on the external wall to protect the cable between the point where the rigid conduit terminates on the external wall and the PCD, as long as the flexible conduit can be separated from the rigid conduit for future access. This is for information only — the carrier will install any flexible lead-in conduit that is required on the external wall.

Self-Check -3	Written Test

Directions: Answer all the questions listed below

Instruction: - choose and write the letter of the correct answer on the space provided.

_____1. Which of the following statement is TO's Conduit <u>True</u> **(3 points)**

A. Only pre-formed bends may be used.

B. Conduit must not be bent on site

C. All of them

_____2 .The Conduit installed over building footings radius is----- **(2 points)**

A. 1oomm

B. 45mm

C. 300mm

D. All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 4- Installing protective earthling of metal work

4.1 Installing protective earthling of metal work

Earthing protection System:- Earthing systems play a vital role in a coordinated lightning and surge protection system. It is responsible for safely dissipating the lightning currents to ground The earthing wires are essentially made from best quality copper or GI that can be used in various electrical, electronic and automobile instruments. They are made from top quality galvanized metals that provides high durability and great shock resistance

Consequently, the earthing continuously performs its function during the operation of the power system, while the lightning protection functions only for the duration of the overvoltage, and the grounding only for the duration of insulation failure.

As a general term, a lightning arrester or lightning arrestor is a conductive device that allows lightning to ground quickly with the help of low resistance earthing. It has the ability to ground the potential charges which occur during lightning

At the very least, the arc current will damage the lightning conductor and can easily find another conductive path, such as building wiring or plumbing, and cause fires or other disasters. Grounding systems without low resistivity to the ground can still be effective in protecting a structure from lightning damage

Introduction

Mostly, the galvanized iron is used for the earthing. The earthing provides the simple path to the leakage current. The short-circuit current of the equipment passes to the earth which has zero potential

In a TN-C-S system the neutral and earth are combined within the supply and separate within the installation. The means of earthing is provided from the combined protective and neutral conductors of the supply i.e. a PME earthing terminal

The four earthing systems:

- TT: The protective earth connection is independent from that of the installation.
- IT: Neutral is isolated to the protective earth or connected by impedance.
- TN-C: Neutral and protective earth are combined.
- TN-S: Neutral and protective earth are independent

A conductive part of equipment which can be touched and which is not normally live, but which may become live when basic insulation fails

Fig 27. Earthing equipment

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided

1. Earthing systems play a vital role in a coordinated lightning and surge **protection system**.
2. What are the common causes of grinding accidents?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 5- Handling cables/wires

5.1 Handling cables/wires

The primary cable handling equipment of a typical cable-layer is designed to load cable from ashore into cable tanks and discharge it from the tanks onto the seabed. Central to effective cable handling is the wheel pair – two tires on wheel rims mounted on hydraulically operated arms opposed to each other.

- The electric power line enters our house through three wires- namely the live wire, the neutral wire and the earth wire.
- To avoid confusion we follow a colour code for insulating these wires.
- The red wire is the live wire, and the black wire is neutral.
- The earth wire is given green plastic insulation

The most common type of wiring in modern homes is in the form of nonmetallic (NM) cable, which consists of two or more individual wires wrapped inside a protective plastic sheathing. NM cable usually contains one or more “hot” (current-carrying) wires, a neutral wire, and a ground wire

Fig 28.RG6 coaxial cable

fig 28. Wires and cables

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided

1. The primary cable handling equipment of a typical cable-layer is designed to load
2. The electric power line enters our house through three wires- namely the live wire, the neutral wire and the earth wire.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 6- Allowing sufficient excess at cable ends to facilitate termination

6.1 Allowing sufficient excess at cable ends to facilitate termination

Cable Termination is the connection of the wire or fiber to a device, such as equipment, panels or a wall outlet, which allows for connecting the cable to other cables or devices. The three main areas we will discuss are termination used in Telecom, Dotcom and Fiber Optic industries
The electrical cable termination is the physical and electrical connection of a cable end that connects to another cable, or to the terminal of the equipment. ... The methods used to terminate the cables vary according to the type of cable, type of connector and application.

Allowing sufficient cable ends to facilitate termination and tie Cable safely without damage the sheath.

a) The cable interconnecting distributors or between a telecommunication outlet and a horizontal distribution panel or patch panel shall be one continuous length with no intermediate joints, splices or taps. Mid-run joints of cables are not permitted except for the use of consolidation points.

b) Where two or more cables share a pathway the cables shall be tied together at 1.2m intervals to create a trunk effect.37

c) When installing and terminating cable runs, 0.5m of slack shall be provided at a suitable location in the cable pathway. The preferred location is within the ceiling space, under raised floors, or on the side of the cabinet (in a cavity created between the wall and the cabinet).

d) A loop of cable shall be left in the cable trunking on the approach to each telecommunication outlet to facilitate re-termination of the cable in the future, should this be required. The preferred length of this loop is about 0.5m but the final determination as to the required length shall be made by the site representative.

e) For Cat 5 E cable, a bend radius of at least 25mm (4 times the cable diameter) shall be used when being pulled through conduits, or as specified by the cabling manufacturer. The cables shall be anchored immediately before the start and after the finish of the bend.

f) To preserve the electrical characteristics of the balanced cable, the outer insulation of the cable shall not be stripped back unnecessarily, and shall be left intact up to a point as close as possible

to where the individual pairs are terminated to the IDC connector.

g) Sufficient cable slack shall be provided at telecommunications outlets to allow removal of faceplates and associated the RJ45 socket for servicing.

Data cables must be installed with care to ensure maximum performance. Stretching, sharp bending, kinking, crushing or jointing of the cable must be avoided to ensure that the pair twist and conductor spacing are maintained for the full length of the cable.

When installing data cables:

- Keep at least 50 mm (preferably more) away from power cables and appliances whether or not there is an interposing barrier.When it is necessary to cross power cables, cross at right angles.
- Avoid excessive tension when pulling cables in and don't allow any kinks or knots to form in the cable.
- Ensure that a bend radius of at least 8 times the cable diameter (for UTP cable) or 10 times the cable diameter (for STP cable) is maintained while pulling in cables(e.g. through conduits or around corners) and a bend radius of at least 4 times the cable diameter (for UTP cable) or 5 times the cable diameter (for STP cable) is maintained in the installed cable.
- Ensure that the cable is evenly supported, protected from crushing or trampling during and after installation, and that the cable sheath is not appreciably distorted by mechanical protrusions, cable ties, clips or other securing devices.
- Do not staple the cable using conventional staples. If the cable needs to be supported or restrained within a building cavity (e.g. to keep it out of harm's way or to maintain separation from other services), use loose fitting devices such as conduit or conduit saddles. For surface runs on walls, use plastic trucking, conduit, plastic clips or insulated staples to support the cable.
- Make each run of cable as short and direct as possible while ensuring that the above requirements are met. Allow for 200 mm to 500 mm of slack cable to be left at each end after termination of the cable.
- joint/splice the cables. If any cable is damaged or too short, replace the full length of cable rather than repairing/extending with a joint/splice.
- Don't tee or tap off any cable. Only connect one socket to each end of the cable.

Use conduit to protect cables in accessible roof space or for pulling additional or replacement cables through inaccessible areas

Self-Check -6	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided

_____1. In data cabling Keep at least 50 mm (preferably more) away from power cables (3 points)

_____2. Where two or more cables share a pathway the cables shall be tied together at 1.2m intervals to create a trunk effect. (2 points)

Note: **Satisfactory rating - 5 points Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 7- Labeling telecommunication outlet ends of cable

7.1 Labeling telecommunication outlet ends of cable

Patch Panel Labels are used for identifying network cabling, recording studio layouts, and radio and television panels for connecting the appropriate cables to jacks

Properly labeling your network cables can be critical for a successful installation, as well as for your network in the long run. Using labeled cables helps prevent people from unplugging the wrong cable at the wrong time, which means you lose money and face downtime (which nobody wants).

Cable management is essential to create a visually pleasing and clean work environment. Managing cables or wires helps to maintain basic functionality and also protect the devices from the clogged airflow due to unorganised and disordered wires. Tangled Wires or Cables are generally time-consuming to untangle.

Types of Cable Trays and Uses

- Aluminum Cable Trays. Cable trays manufactured with aluminum by cable tray manufacturers in India are known as aluminum cable trays. ...
- Steel Cable Trays. Cable tray manufacturers also recommended using steel cable trays.
- Stainless Steel Cable Trays. ...
- Ladder Type Cable Trays. ...
- Solid Bottom Cable Trays

Cable Tray Sizes and Cable Tray Types

There are two types of trays are used in the electrical construction. Ladder is mainly used to lay the power cables. 150 mm and 300 mm sizes of ladder is mostly used in the electrical construction

Properly labeling your network cables can be critical for a successful installation, as well as for your network in the long run. Using labeled cables helps prevent people from unplugging the wrong cable at the wrong time, which means you lose money and face downtime (which nobody wants).

Brown – Underbuilding backbone cables (across a campus) Blue – Termination of horizontal cabling at the closet end only. Purple – Common equipment: PVBX, LANs, and individual computers. Yellow – Auxiliary circuits, such as alarms and security systems

The following sections discuss the types of cables used in networks and other related topics**.**

- Unshielded Twisted Pair (UTP) Cable.
- Shielded Twisted Pair (STP) Cable.
- Coaxial Cable.
- Fiber Optic Cable.
- Cable Installation Guides.
- Wireless LANs.
- Unshielded Twisted Pair (UTP) Cable

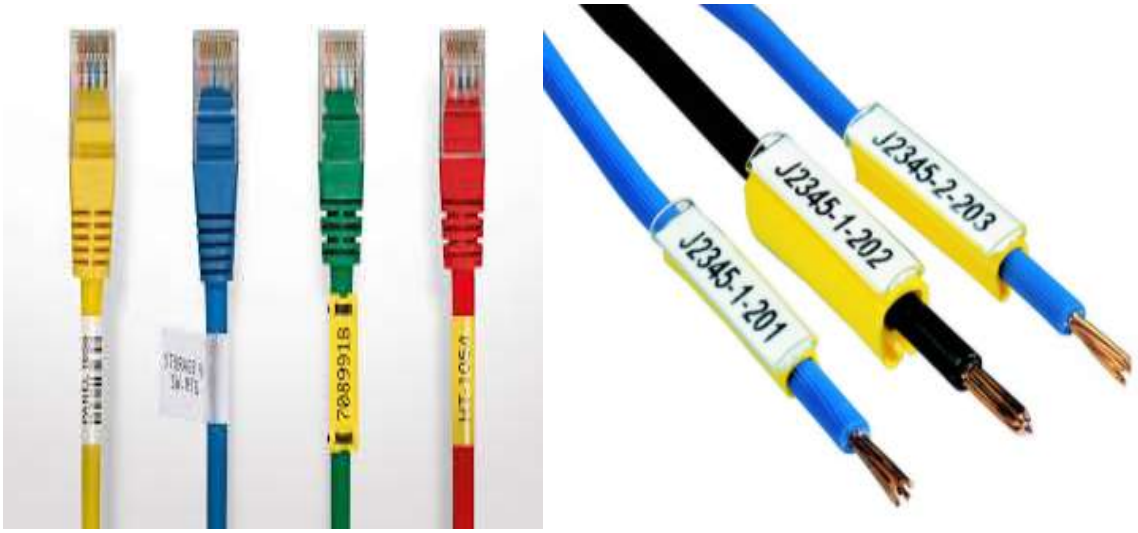


fig 29. Types of cables

The CP should be located a minimum of 15 meters from the telecommunications room to reduce the effects of NEXT and return loss. The CP should be located in a fully accessible and permanent location. Administration of the CP should follow ANSI/TIA/EIA 606.

Self-Check -7	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction I:-give short answer for the following questions not more than one page (5pts)

1.How many types of trays are used in the electrical construction?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 8-Placing and securing cable

8.1 Placing and securing cable

The simplest way to bond your coaxial cable to the rest of the house is to run the cables through a grounding block, and then run a wire from the block to the grounding electrode (ground rod) or other qualifying grounding connection point

Securing Cables

1. Use the proper size of fastener for the size and number of cables being secured.
2. Use insulated staples and fasteners. ...
3. Position cables flat against framing before securing them; do not fasten cables on-edge.
4. Secure cables snugly but not so tightly that the cable is damaged or indented from the fastener.

Cable management refers to management of electrical or optical cable in a cabinet or an installation. The term is used for products, workmanship or planning. Cables can easily become tangled, making them difficult to work with, sometimes resulting in devices accidentally becoming unplugged as one attempts to move a cable. Such cases are known as "cable spaghetti", any kind of problem diagnosis and future updates to such enclosures could be very difficult.

Cable management both supports and contains cables during installation, and makes subsequent maintenance or changes to the cable system easier. Products such as cable trays, cable ladders, and cable baskets are used to support a cable through cabling routes

Measure: Measure the wall to determine the length of the cords you want to cover.

- Cut: Cut the base and cord cover to match the length you just measured.
- Mark anchor points: Use a pencil to mark the anchor points on the wall. ...
- Mount base: ...
- Lay the cables: ...
- Paint:

Color-coding of cables is sometimes used to keep track of which is which. For instance, the wires coming out of ATX power supplies are color-coded by voltage. Documenting and labeling cable runs, tying related cables together by cable ties, cable lacing, rubber bands or other means, running them through cable guides, and clipping or stapling them to walls are other common

methods of keeping them organized. Above drop ceilings, hooks or trays are used to organize cables and protect them from electrical interference

fig 30. Placing and securing cable

To do that, you need to use waterproof cable cap to make sure you cover the jack and the port with protective cover. As for the cable exposing outside, use protective tape to make sure the cable is not easily exposed to the element but not too much to cause heat.

Self-Check -8	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction I:-give short answer for the following questions not more than one page (5pts)

1. Write the steps to Measure and to determine the length of the cords you want to cover

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

InformationSheet 9- Trimmed flush cable ties

9.1 Trimmed flush cable ties

Strong scissors, a knife (cut away from yourself), diagonal cutters, or any other durable cutters will work. The thicker the cable tie, the tougher the tool needed to cut through it

All you need is a knife with a sharp tip. Instead of cutting through the cable, insert the tip of the blade into the head of the cable tie between the tape and the tab, known as the pawl. With the tip in place and the tab disengaged, pull the cable tie to loosen it and eventually undo the cable tie completely

A cable tie (also known as a hose tie, zip tie, or by the brand name Ty-Rap) is a type of fastener, for holding items together, primarily electrical cables or wires. Because of their low cost and ease of use, cable ties are ubiquitous, finding use in a wide range of other applications

https://www.youtube.com/watch?v=YfpooQoxNvo

fig 31. Trimmed flush cable ties

Self-Check -9	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction I:-give short answer for the following questions not more than one page (5pts)

____ 1. What does it mean Trimmed flush cable ties?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 10- Installing cables as catenaries

10.1 Installing cables as catenaries

In our world, a catenary is a system of overhead wires used to supply electricity to a locomotive, streetcar, or light rail vehicle which is equipped with a pantograph. The pantagraph presses against the underside of the lowest overhead wire, the **contact wire.**

Current collectors are electrically conductive and allow current to flow through to the train and back to the feeder station through the steel wheels on one or both running rails. Unlike simple overhead wires, in which the uninsulated wire is attached by clamps to closely spaced crosswires supported by poles, catenary systems use at least two wires. The catenary or messenger wire is hung at a specific tension between line structures, and a second wire is held in tension by the messenger wire, attached to it at frequent intervals by clamps and connecting wires known as *droppers*. The second wire is straight and level, parallel to the rail track, suspended over it as the roadway of a suspension bridge is over water.

Simple wire installations are common in light rail, especially on city streets, while more expensive catenary systems are suited to high-speed operations.

The Northeast Corridor in the United States has catenary over the 600 miles (1000 km) between Boston, Massachusetts and Washington, D.C. for Amtrak's high-speed Acela Express and other trains. Commuter rail agencies including MARC, SEPTA, NJ Transit, and Metro-North Railroad utilize the catenary to provide local service.

Overhead line equipment can be adversely affected by strong winds causing swinging wires. Power storms can knock the power out with lightning strikes on systems with overhead wires, stopping trains if there is a power surge. During cold or frosty weather, there is a risk of ice build-up on overhead lines. This can result in poor electrical contact between the collector and the overhead line, resulting in electrical arcing and power surges

fig 32. **cables as catenaries**

Self-Check – 10	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction I:-give short answer for the following questions not more than one page (5pts)

1. Define Installing cables as catenaries

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 11- Fitting over-voltage protection devices to all cable pairs

11.1 Fitting over-voltage protection devices to all cable pairs

A traditional and rugged technique for cable routing is conduit, either metal or plastic (PVC). Conduit resembles piping used to convey fluids, except that it is much thinner-walled than fluid pipe and is not rated to withstand internal pressure as pipe is. In fact, threaded conduit uses the same thread pitch and diameter standards as NPT (National Pipe Taper) fluid pipe connections Metal conduit naturally forms a continuously-grounded enclosure for conductors which not only provide a measure of protection against electrical shock (all enclosures and devices attached to the conduit become safely grounded through the conduit) but also shields against electrostatic interference. This is especially important for power wiring to and from devices such as rectifiers and variable-frequency motor drive (VFD) units, which have a tendency to broadcast large amounts of electromagnetic noise.

Plastic conduit, of course, provides no electrical grounding or shielding because plastic is a non-conductor of electricity. However, it is superior to metal conduit with regard to chemical corrosion resistance, which is why it is used to route wires in areas containing water, acids, caustics, and other wet chemicals

Thin-wall conduit is made with metal so thin that threads cannot be cut into it. Instead, special connectors are used to join “sticks” of thin-wall conduit together, and to join thin-wall conduit to electrical enclosures. Several runs of thin-wall conduit appear in this next photograph. Two of those conduit runs have been severed following a wiring change, exposing the conductors inside

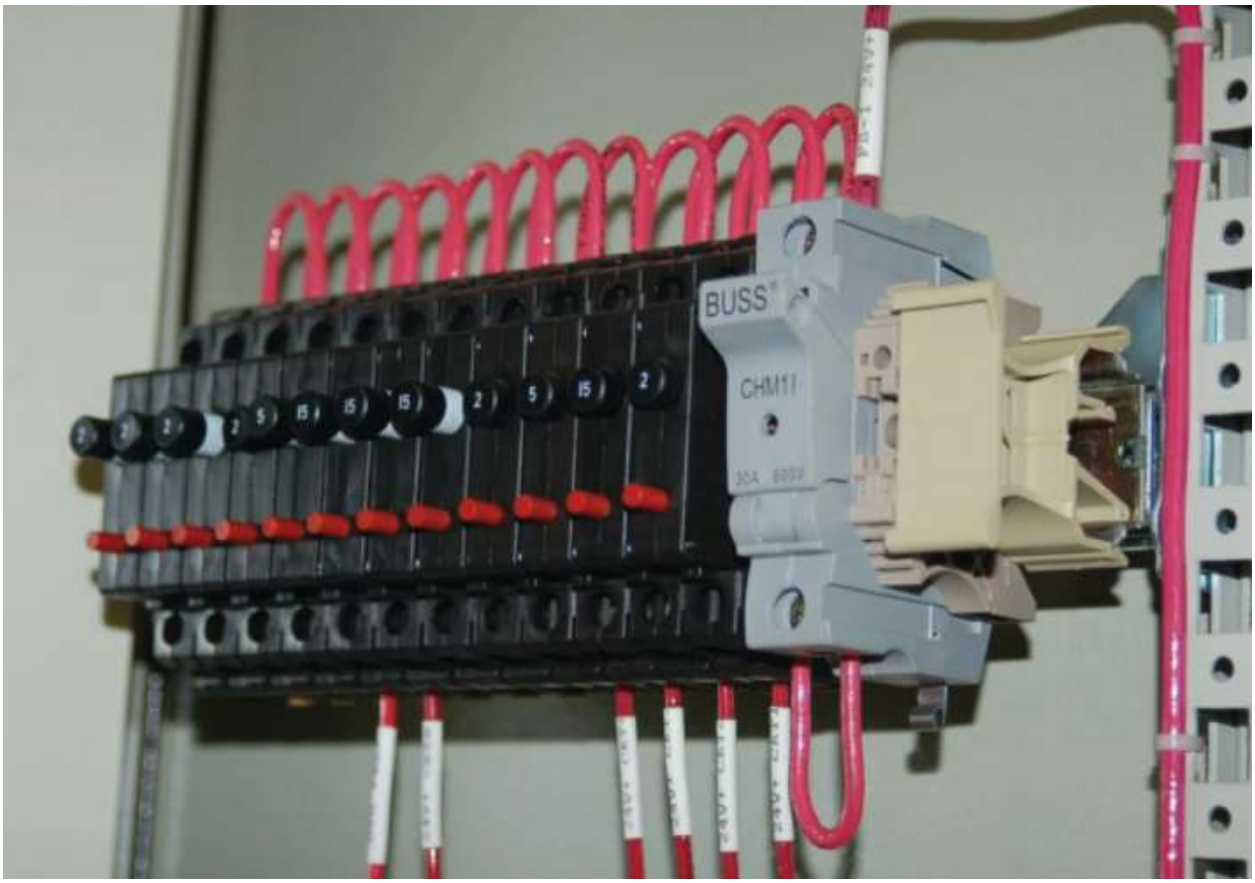


fig 33 Fitting over-voltage protection devices to all cable pairs

Installing cable into an electrical conduit is a task referred to as cable pulling, and it is something of an art. Cable “pulls” may be especially challenging if the conduit run contains many bends, and/or is close to capacity in terms of the number and size of conductors it already holds. A good practice is to always leave a length of nylon pull string inside each length of conduit, ready to use for pulling a new wire or cable through. When performing a wire “pull,” a new length of nylon pull string is pulled into the conduit along with the new wires, to replace the old pull string as it is pulled out of the conduit. Special lubricating “grease” formulated for electrical wiring may be applied to conductors pulled into a conduit, to reduce friction between those new conductors and the conductors already inside the conduit

Self-Check – 11	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided

_____1. Traditional and rugged technique for cable routing is conduit, either metal or plastic (PVC)

_____2. Installing cable into an electrical conduit is a task referred to as cable pulling

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 12- Fitting Over-voltage protection device to all cable pairs eart with standard

12.1 Fitting Over-voltage protection device to all cable pairs earthed in accordance with standard

Neutral is a circuit conductor that normally carries current, and is connected to ground (earth) at the main electrical panel. The connection between neutral and earth allows any phase-to-earth fault to develop enough current flow to "trip" the circuit overcurrent protection device

The bottom line is that while (steel) trucking need to be adequately earthed, there's no requirement in BS 7671 to do it in any particular way. Adding copper wire(s) as you suggest is certainly one option, but there are many other possible methods allowed

The reason that one of the power wires is named “neutral” is because it is connected directly to the building ground connection at the circuit breaker panel. Therefore it is connected directly to the grounding (third) wire. Every electrical circuit is protected by a circuit breaker

If the grounded (neutral) service conductor is opened or not provided at all, objectionable neutral current will flow on metal parts of the electrical system and dangerous voltage will be present on the metal parts providing the potential for electric shock.

A second problem with connecting the ground to the neutral happens if your neutral wire breaks between the outlet and your service entrance.Given a ground to neutral connection, this will cause the chassis of your device to be at the "hot" voltage, which is very dangerous

In an electrical systems, surge protection devices (SPDs) are usually installed in tap-off configuration (in parallel) between the live conductors and the earth. The operating principle of SPD can be similar to that of a circuit breaker.

fig 34. Over-voltage protection device

Self-Check – 12	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided

_____1. Circuit breaker is one of Fitting Over-voltage protection device

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 13- Protecting TRC/CES/Earth wire insulation against damage

13.1 Protecting TRC/CES/Earth wire insulation against damage

Electrical wiring is an electrical installation of cabling and associated devices such as switches, distribution boards, sockets, and light fittings in a structure.

Wiring is subject to safety standards for design and installation. Allowable wire and cable types and sizes are specified according to the circuit operating voltage and electric current capability, with further restrictions on the environmental conditions, such as ambient temperature range, moisture levels, and exposure to sunlight and chemicals.

Associated circuit protection, control and distribution devices within a building's wiring system are subject to voltage, current and functional specification. Wiring safety codes vary by locality, country or region. The International Electro technical Commission (IEC) is attempting to harmonies wiring standards amongst member countries, but significant variations in design and installation requirements still exits.

Self-Check – 13	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided

_____1. Wiring is subject to safety standards for design and installation?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

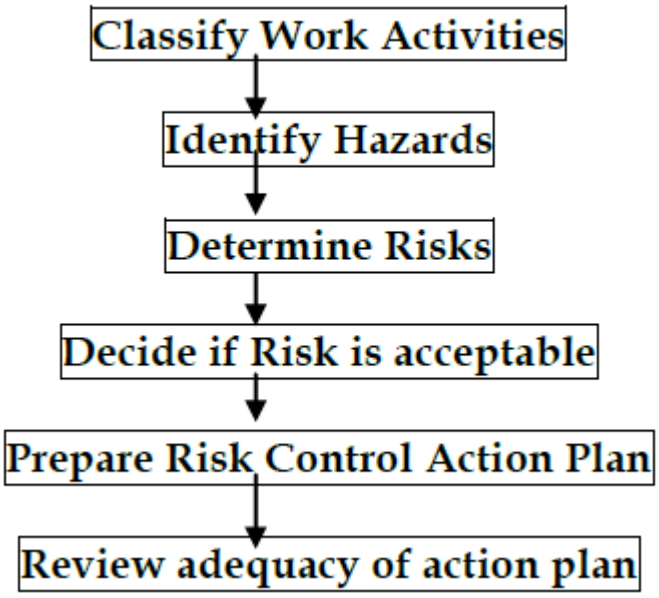
Rating: _____

Information Sheet 14- Following procedures for referring non-routine events

14.1 Following procedures for referring non-routine events

While routine problem solving concerns solving problems that are useful for daily living (in the present or in the future), non-routine problem solving concerns that only indirectly.A non-routine problem is any complex problem that requires some degree of creativity or originality to solve. Non-routine problems typically do not have an immediately apparent strategy for solving them. Often times, these problems can be solved in multiple ways.not routine : not of a commonplace or repetitious character a no routine situation an extended shutdown necessary for no routine repairs.

Non-routine Maintenance is any maintenance that isn't performed at pre-determined intervals. ... Aside from Shutdown Maintenance, Non-routine is the worst kind of inspection and repair.



Self-Check – 14	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided

_____1. A non-routine problem is any complex problem that requires some degree of creativity or originality to solve

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 15- Installing cabling without waste of materials and energy

15.1 - Installing cabling without waste of materials and energy

Cable installers work in homes and businesses to install and repair telecommunications cables, This could be phone lines, internet cables or cable television. If it comes into your home or office through a cable, then a cable installer put it there Simple as that! We are very knowledgeable and have the expertise in running wires through walls of any type of building home. Installing a cable outlet is the equivalent skill of installing your general-use electrical outlets

Conductive plastic materials have not been used in the telecommunication cable industry for 20 years; therefore, there is no longer any need to Classification of outside plant waste ... Installation of optical fiber cables in the access network

Also production of primary materials is included in order to account for that material recycling avoids primary material production.

Portable Equipment

All portable electric equipment will be handled in such a manner that will not damage or reduce service life. Flexible cords connected to equipment may not be used for raising or lowering equipment and will not be used if damage to the outer insulation is present. Additionally, visual inspections are required and unauthorized alterations of the grounding protection are not allowed to ensure the safety of employees. Prior to each shift, a visual inspection will be performed for external defects and for possible internal damage. Attachment plugs and receptacles may not be connected or altered in a manner that would prevent proper continuity of the equipment grounding conductor. In addition, these devices may not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current-carrying conductors.

Portable electric equipment and flexible cords used in highly conductive work locations or in job locations where employees are likely to contact water or conductive liquids shall be approved by the manufacturer for those locations. The hazardous locations that employees should be aware of include, wet locations and locations where combustible or flammable atmospheres are present.

For wet locations, employees' hands will not be wet when plugging and unplugging energized equipment. Energized plug and receptacle connections will be handled only with protective

equipment if the condition could provide a conductive path to the employee's hand (if, for example, a cord connector is wet from being immersed in water). In addition, ground-fault circuit interrupter (GFCI) protection is required for some equipment/locations and is also recommended for use in all wet or highly conductive locations.

For combustible/flammable atmospheres, all electric equipment and wiring systems in classified locations must meet The National Electric Code requirements for that particular classification.

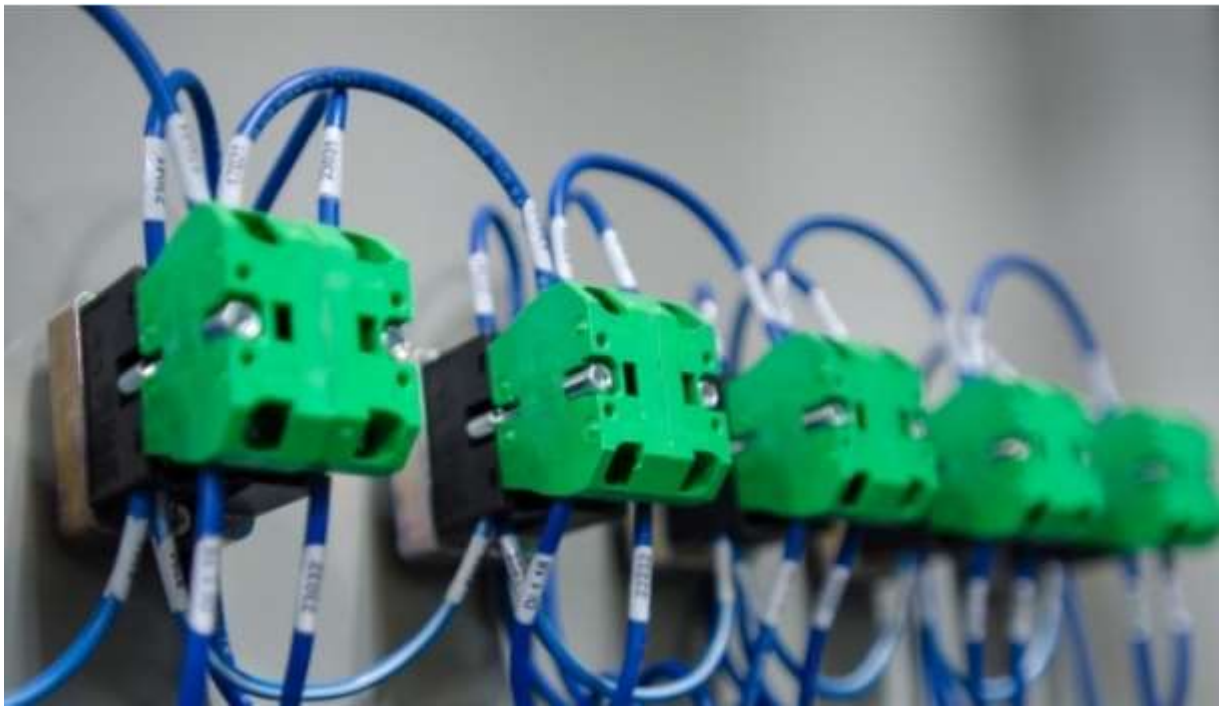


fig 35. Installing cabling without waste

Self-Check – 15	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1. A non-routine problem is any complex problem that requires some degree of creativity or originality to solve

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 16- Carrying out routine quality checks

16.1 Carrying out routine quality checks

Quality is an important factor when it comes to any product or service. Quality control is essential to building a successful business that delivers products that meet or exceed customers' expectations. It also forms the basis of an efficient business that minimizes waste and operates at high levels of productivity

Quality is critical to satisfying your customers and retaining their loyalty so they continue to buy from you in the future products make an important contribution to long-term revenue and profitability. They also enable you to charge and. Quality maintain higher prices

By undertaking effective inspection and control over production processes and operations, production costs are considerably reduced. Quality control further checks the production of inferior products and wastages thereby bringing down the cost of production considerably

Quality can be defined as “fitness for use,” “customer satisfaction,” “doing things rights the first time,” or “zero defects.” These definitions are acceptable because quality can refer to degrees of excellence

Self-Check – 16	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

____1. Quality is critical to satisfying your customers and retaining their loyalty so they continue to buy from you in the future.

____ 2. **Quality** is an **important** factor when it comes to any product or service.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

LG #34	LO #3- Terminate and test cables and earth wires

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Following established OHS risk control measures and procedures
- Removing cable sheath
- Installing terminating modules
- Terminating conductors
- Earthling cable shield
- Undertaking visual inspection to confirm termination color code.
- Testing and clearly labeling cable pairs to provide an accurate identification
- Terminating TRC/CES/Earth wires with connectors.
- Maintaining TRC/CES /Earth wire continuity
- Testing TRC/CES /Earthling installation for continuity, insulation
- resistance and conductive resistance
- Labeling earthling system
- Confirming compatibility of alterations with existing systems and testing new work
- Following procedures for referring non-routine events
- Terminating cabling efficiently without waste of materials and energy
- Carrying out routine quality checks

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Follow established OHS risk control measures and procedures
- Remove cable sheath
- Install terminating modules
- Terminate conductors
- Earth cable shield
- Undertake visual inspection to confirm termination color code.
- Test and clearly label cable pairs to provide an accurate identification
- Terminate TRC/CES/Earth wires with connectors.
- Maintain TRC/CES /Earth wire continuity
- Test TRC/CES /Earthling installation for continuity, insulation
- Resistance and conductive resistance
- Label earthling system
- Confirm compatibility of alterations with existing systems and testing new work
- Following procedures for referring non-routine events
- Terminate cabling efficiently without waste of materials and energy
- Carry out routine quality checks

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Follow established OHS risk control measures and procedures

1.1 Follow established OHS risk control measures and procedures

What is Risk?

When we refer to risk in relation to occupational safety and health the most commonly used definition is 'risk is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard.'

Categorising Risk

The level of risk is often categorised upon the potential harm or adverse health effect that the hazard may cause, the number of times persons are exposed and the number of persons exposed. For example exposure to airborne asbestos fibres will always be classified as high because a single exposure may cause potentially fatal lung disease, whereas the risk associated with using a display screen for a short period could be considered to be very low as the potential harm or adverse health effects are minimal.

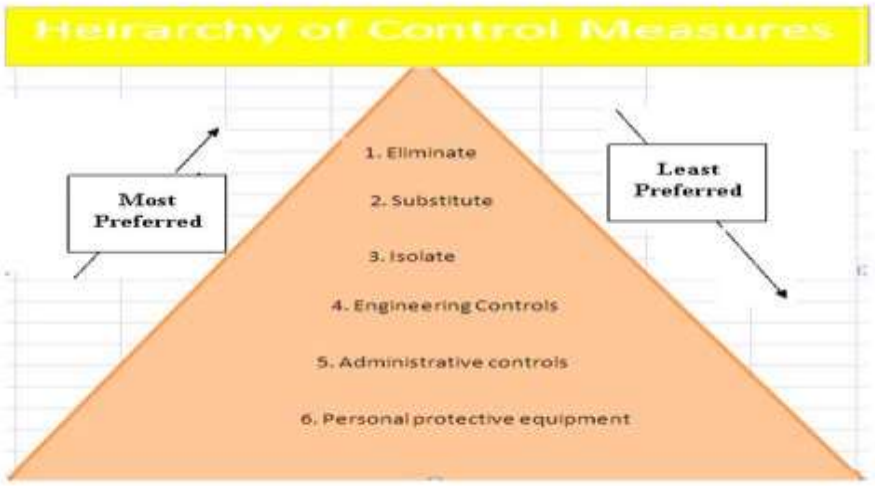


Fig 36 hierarchy of control measures.

What are Control Measures?

Control measures include actions that can be taken to reduce the potential of exposure to the hazard, or the control measure could be to remove the hazard or to reduce the likelihood of the risk of the exposure to that hazard being realised. A simple control measure would be the secure guarding of moving parts of machinery eliminating the potential for contact. When we look at control measures we often refer to the hierarchy of control measures.

(Source: http://www.commerce.state.wi.us/SB/SB-DivCodesListing.html)

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1. Quality is critical to satisfying your customers and retaining their loyalty so they continue to buy from you in the future.

_____2. Quality is an important factor when it comes to any product or service.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 2- Removing cable sheath

2.1 Removing cable sheath

Ssteps-by-step: twisted-pair cable preparation and connector termination

The following steps will guide you through the preparation and termination process for UTP cable. Following these guidelines will help give you the optimum performance from the twisted pair cabling.

1.1. The following procedure elaborate the Cross over connection system

Step 1: The tools you will need:

• Jacket stripper

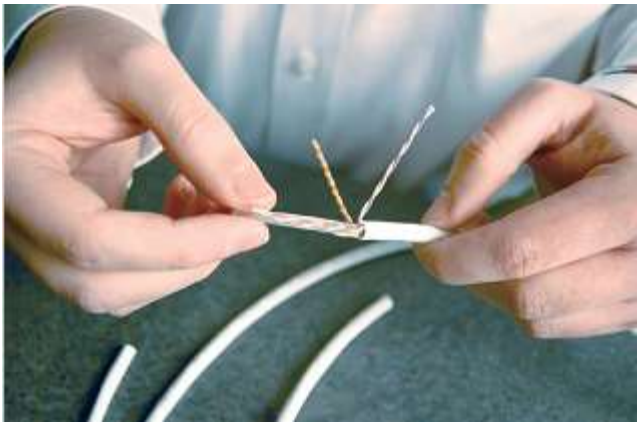
•Punch-down tool

• Wire cutters

Step 2: Insert cable into stripping tool to the desired strip length. Strip off only as much cable jacket needed to properly terminate the pairs (1 to 1½ inches should be sufficient to terminate pairs).

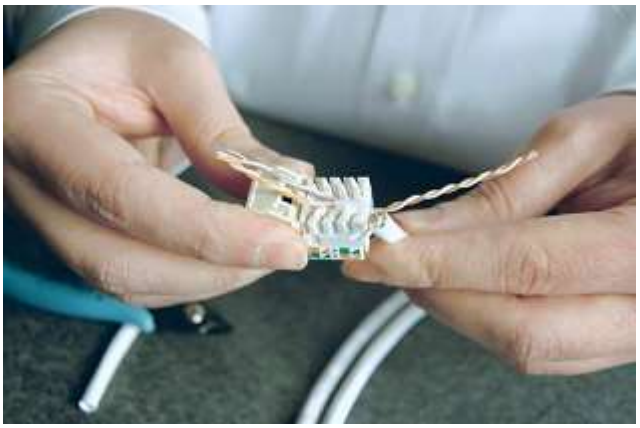
Step 3: Holding the cable near the tool, rotate the tool around the cable several times.

Step 4: Slightly bend the outer jacket and manually remove the cut piece or slide the cut outer jacket with the stripper.

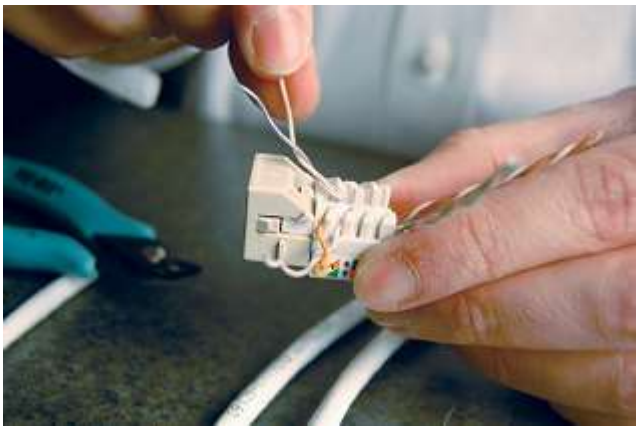


Step 5: Bend each pair in one direction to expose the rip cord, binder or cross-web filler on the cable.

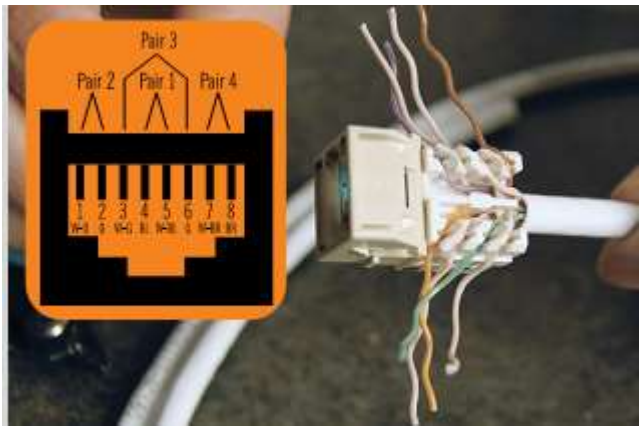
Step 6: Remove the rip cord, binder or cross web filler if they are present on the cable, leaving only the twisted pairs of wire. The cross-web filler should be cut as flush as possible to the jacket.



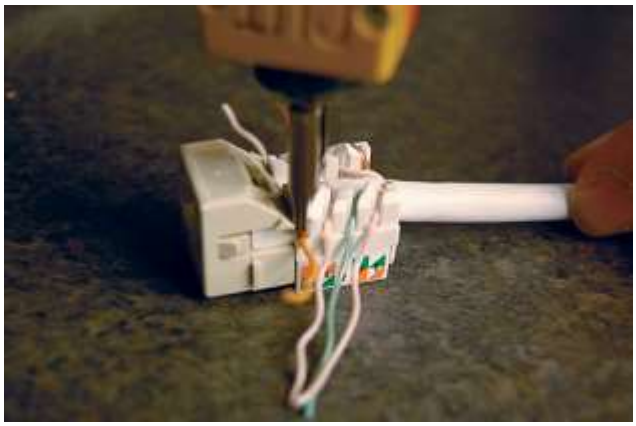
Step 7: Determine the wiring scheme and properly align all four cables accordingly on the jack. Keep the cable jacket as close to the connector as possible. Always use connectors, wall plates and patch panels that are compatible (same rating or higher) with the grade of the cable used.



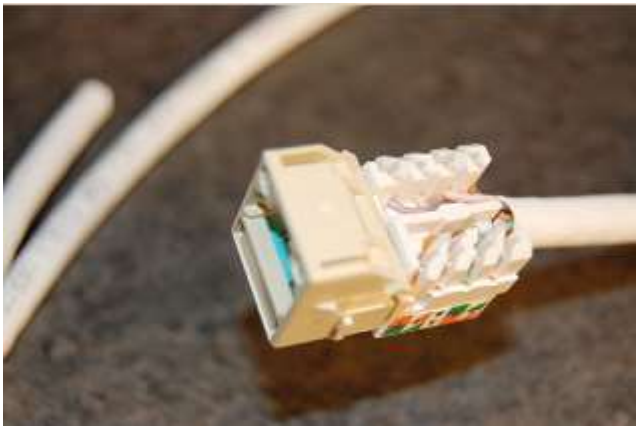
Step 8: Preserve the wire pair twists as close as possible to the point of termination. When connecting jacks and plugs,do not untwist the cable more than 0.5 inches for Category 5e, 6 and 6A cable.



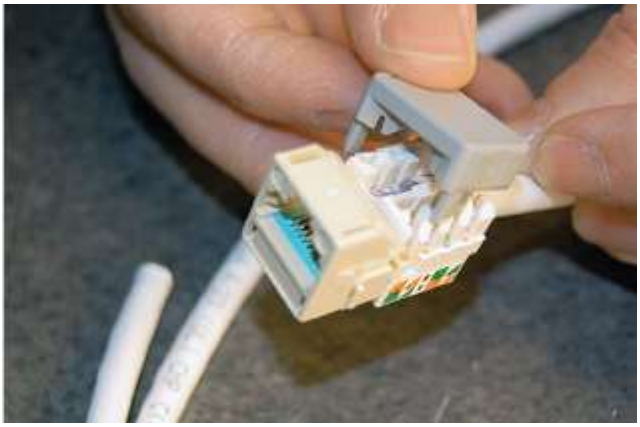
Step 9: Insert wires down into IDC terminal slots to position them before punching down. Maintain the twist. To “future-proof” an installation, terminate all four pairs. The Picture above shows an outlet being wired to the T568B wiring scheme.



Step 10: When using a punch-down tool, make sure the tool is straight before punching down on the connector. Make sure the cut-side of the tool is facing outward.



Step 11: Inspect the connector to verify that the wires are fully engaged in the IDC terminals and they are cut properly.



Step 12: Place a dust cover on the jack for protection.

Step 13: This is how your assembled jack should look.

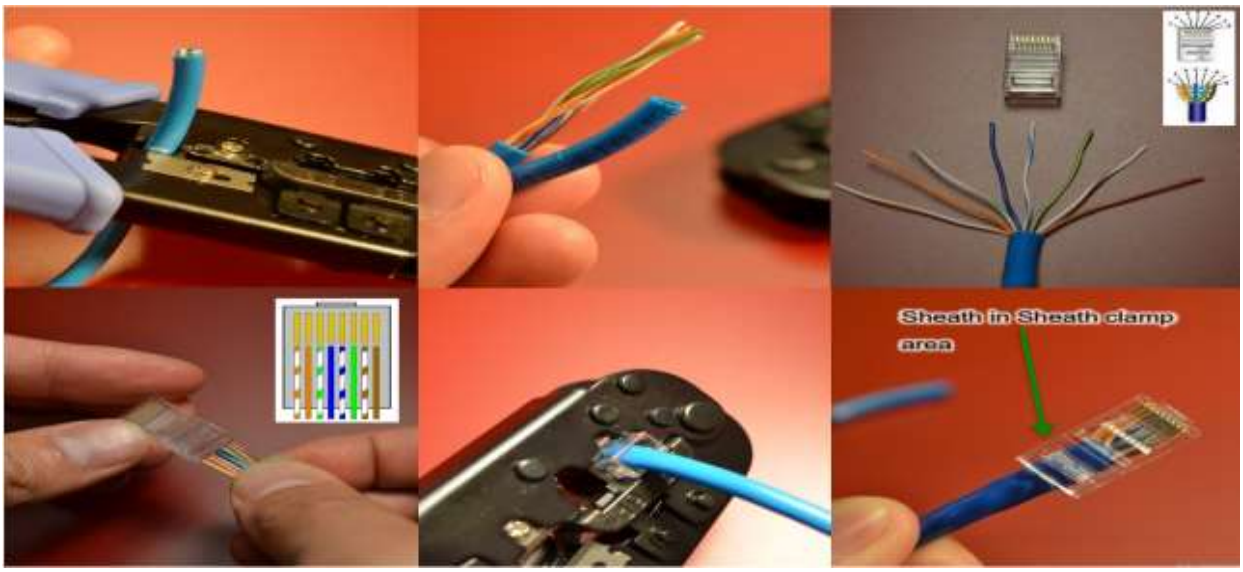


fig 36. Steps how to remove the wire and connects

Self-Check –2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____ 1. The same crimper can crimp 8p8c of crossover and straight through **(3 points)**

_____ 2. No problem to close proximity of cabling to water pipe work **(2 points)**

_____ 3. No big difference b/n crossover and straight through in application **(2 points)**

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information Sheet 3- Installing terminating modules

3.1 Cable installation

Data cables must be installed with care to ensure maximum performance. Stretching, sharp bending, kinking, crushing or jointing of the cable must be avoided to ensure that the pair twist and conductor spacing are maintained for the full length of the cable.

When installing data cables:

- Keep at least 50 mm (preferably more) away from power cables and appliances whether or not there is an interposing barrier. When it is necessary to cross power cables, cross at right angles.
- Avoid excessive tension when pulling cables in and don't allow any kinks or knots to form in the cable.
- Ensure that a bend radius of at least 8 times the cable diameter (for UTP cable) or 10 times the cable diameter (for STP cable) is maintained while pulling in cables (e.g. through conduits or around corners) and a bend radius of at least 4 times the cable diameter (for UTP cable) or 5 times the cable diameter (for STP cable) is maintained in the installed cable.
- Ensure that the cable is evenly supported, protected from crushing or trampling during and after installation, and that the cable sheath is not appreciably distorted by mechanical protrusions, cable ties, clips or other securing devices.
- Do not staple the cable using conventional staples. If the cable needs to be supported or restrained within a building cavity (e.g. to keep it out of harm's way or to maintain separation from other services), use loose fitting devices such as conduit or conduit saddles. For surface runs on walls, use plastic trucking, conduit, plastic clips or insulated staples to support the cable.
- Make each run of cable as short and direct as possible while ensuring that the above requirements are met. Allow for 200 mm to 500 mm of slack cable to be left at each end after termination of the cable.

- Don’t joint/splice the cables. If any cable is damaged or too short, replace the full length of cable rather than repairing/extending with a joint/splice.
- Doesn’t tee or tap off any cable. Only connect one socket to each end of the cable. Use conduit to protect cables in accessible roof space or for pulling additional or replacement cables through inaccessible areas

3.2. Conduit installation

3.2.1. Conduit material and size

for an individual home, the lead-in conduit must be rigid UPVC with an inside diameter (ID) of 23 mm. Flexible or corrugated conduit must not be used for underground lead-in cabling. The cross-sectional dimensions of the conduit are illustrated in Figure below.

Notes:

1. This conduit size is referred to by Telstra as “20 mm” conduit (its nominal inside diameter) or “P20” (“Plastic 20 mm”).

2. Any conduit manufactured to Australian Standard AS/NZS 2053 (e.g. marked as “20 mm”, “25 mm” or “32 mm” and including “2053” in the markings) is physically incompatible with Telstra and NBN Co networks and is not suitable for lead-in cabling. Polyethylene conduit or pipe is also not suitable for lead-in cabling

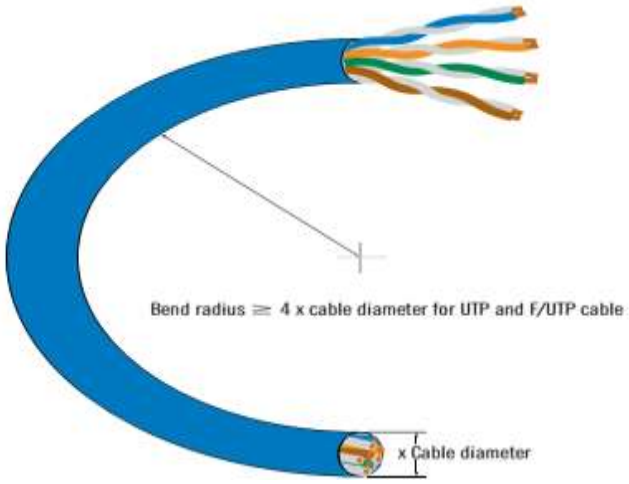


fig 37. Cable installation

3.2.2. Conduit color and markings

Lead-in conduit and bends must be color white. Conduit of any other color is not acceptable. For Telstra lead-in cabling, the conduit and bends may be marked “Telstra”, “NBN” or “Communications”. Any of these markings are acceptable to Telstra as long as the conduit ID is 23 mm.

Note: Alternative conduit markings may not be acceptable to NBN Co for NBN lead-in cabling.

3.2.3. Bends and curves

No more than two underground 90° bends with a minimum inner bend radius of 300 mm are permitted between access points. A third 90° bend with a minimum inner bend radius of 100 mm is permitted above ground at the cable access point at the building (e.g. in the wall cavity). Only prefabricated bends may be used. Conduits must not be bent on site (e.g. by application of heat). Curvature of glued lengths of conduit is allowable without affecting the number of bends that may be used as long as the curvature radius is no less than 130 times the nominal inside diameter of the conduit(in practical terms, this means curving the conduit without distorting the cross-sectional roundness of the conduit).

3.2.4. **Conduit installation**

Conduit and bend joints must be glued with solvent cement.

The conduit markings should face upwards when the conduit is laid in the trench so as to be visible if the conduit is exposed by digging after its initial installation. A pull-cord or cable must be threaded through the lengths of conduit during assembly for later installation of the lead-in cable by the carrier. Each end of the conduit must be plugged to prevent the ingress of silt or debris into the conduit.

3.2.5. Conduit integrity: - the lead-in conduit and bends must be capable of passing an optical fiber cable that has a pre-terminated connector protected by stiff plastic tubing and covered by a polypropylene hauling sock. This assembly has a total diameter of up to 18 mm for a length of about 800 mm and is semi-rigid. The protective tubing and hauling sock protect the optical fibre and optical connector while the cable is being pulled through the lead-in conduit and ensure that no pulling force is exerted on the connector. The sock will not pull through small-radius conduit bends due to its large diameter and relative stiffness.

Pre-terminated optical fiber lead-in cable threaded through 23 mm ID conduit bends

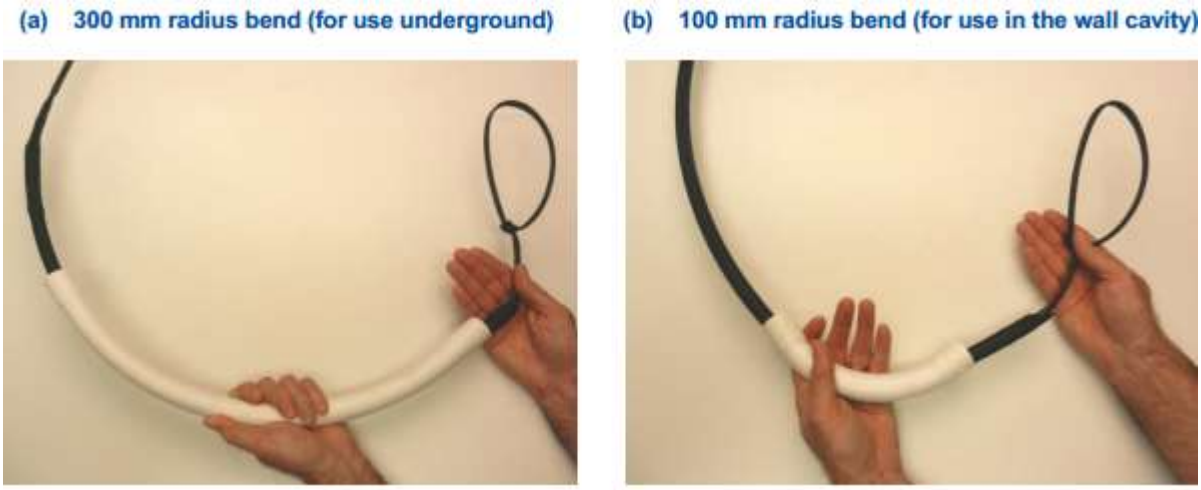


fig 38. A and B conduit bends

Notes:

1. 300 mm radius bends are used at pits and vertically at the building footings.
2. A 100 mm radius bend is only permissible in the wall cavity of the building.
3. It can be seen from the above pictures that the cable hauling sock is a tight fit in the conduit, so clear, undamaged conduit and large radius bends are essential

3.2.6. Saddles: -Saddles are metallic or non-metallic clips used to support a single run of conduit. In the metallic version saddles are also available as half saddles – that is they have only one fixing hole. The half saddle is used for convenience (it is quicker to install) where the strain on the fixing is not excessive or where a conduit needs to be run in a corner. A full saddle is used for a more secure fixing. In timber or cladded timber saddles can be nailed or screwed. Conduits where permitted can be saddled directly to the surface of a building.

Figure below shows conduit saddles

fig 39. Shows conduit saddles

Figure: Right and wrong use of intermediate pits

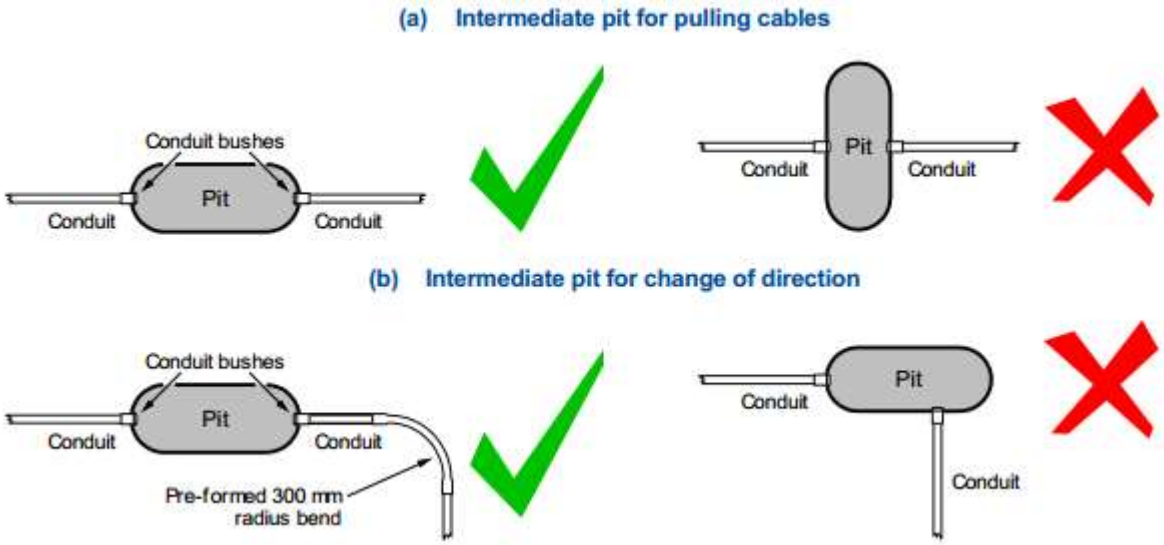


fig 40 Right and wrong use of intermediate pits

Notes:

1. A size 2 (“P2”) pit may be used as an intermediate pit for lead-in conduit to a single dwelling. The minimum internal dimensions (in mm) of a size 2 pit are 490 L x 125 W x 500 D. These pits are usually round-ended as shown above.
2. The conduit should be glued to a bush that is installed flush with the inside wall of the pit except in highly reactive soils where the conduit may be extended no more than 50 mm inside the pit. The bush or conduit must be a tight fit through the pit wall to minimize the entry of silt into the pit.
3. The bottom edge of the conduit must enter the pit no less than 50 mm above the inside surface of the bottom of the pit (this is to reduce the risk of silt or debris entering and clogging the conduit over time).
4. Where more than one conduit enters the same end of the pit (e.g. for branching of conduits as shown in Figure below the conduits must be separated at the pit by at least 25 mm.

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____ 1. Doesn't tee or tap off any UTP cable? (3 points)

_____2. Installation of underground electrical cable in customer premises without a Protective covering is not allowable under the electrical wiring rules (AS/NZS 3000).(2 points)

_____3. Conduit used for telephone wiring or communication can be: (2 points)

A) Only pre-formed bends may be used. B. Conduit must not be bent on site C. All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 4- Terminating conductors

4.1. Terminate the Cable

Now that you've learned about installing the cable; you need to know what to do with both ends of the cable. Terminating the cables involves installing some kind of connector on each end (either a connector or a termination block) so that the cabling system can be accessed by the devices that are going to use it. This is the part of cabling-system installation that requires the most painstaking attention to detail, because the quality of the termination greatly affects the quality of the signal being transmitted. Sloppy termination will yield an installation that won't support higher-speed technologies.

Though many termination methods are used, they can be classified one of two ways: connect or patch-panel termination. There are many different types of patch panels, some for copper, some for fiber. Copper cable patch panels for UTP all have a few similar characteristics, for the most part. First off, most UTP LAN patch panels (as shown in Figure 12.16) have UTP ports on the front and punch-down blades (see Figure 12.17) in the back. During termination, the individual conductors in the UTP cable are pressed between the metal blades to make both the mechanical and electrical connection between the cable and the connector on the front of the patch panel. This type of patch panel is a 110-punch-down block (or 110-block, for short).

4.2. The procedure for connecting an individual cable is as follows:

1. Route the cable to the back of the punch-down block.
2. Strip off about 1/4–1/2 inch of the cabling jacket. (Be careful not to strip off too much, as that can cause interference problems.)
3. Untwist each pair of UTP conductors and push each conductor onto its slot between the color-coded "fingers,"

The main wiring standard for Ethernet cable connectors is actually EIA-568A – the EIA-568B layout was made available as an acceptable alternative. However, the B version has been implemented within the industry as the main standard. The EIA-568A standard has a slightly different layout:

- Pin 1: Green stripe
- Pin 2: Green solid
- Pin 3: Orange stripe
- Pin 4: Blue solid
- Pin 5: Blue stripe
- Pin 6: Orange solid
- Pin 7: Brown stripe
- Pin 8: Brown solid

There is a standard sequence for those colored wires in an 8P8C connector. It is not entirely logical. The order is as follows:

- Pin 1: Orange stripe
- Pin 2: Orange solid
- Pin 3: Green stripe
- Pin 4: Blue solid
- Pin 5: Blue stripe
- Pin 6: Green solid
- Pin 7: Brown stripe
- Pin 8: Brown solid

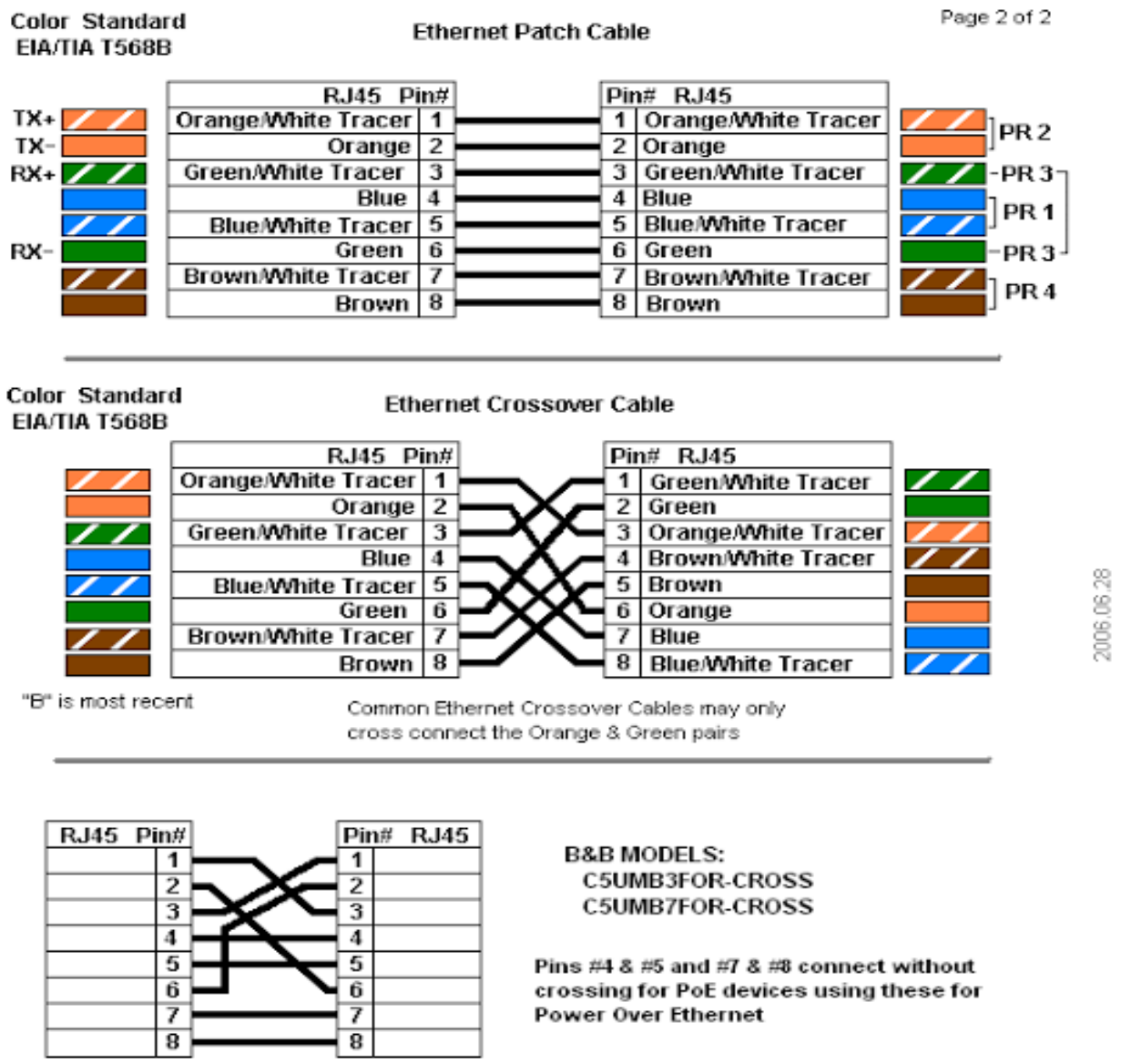
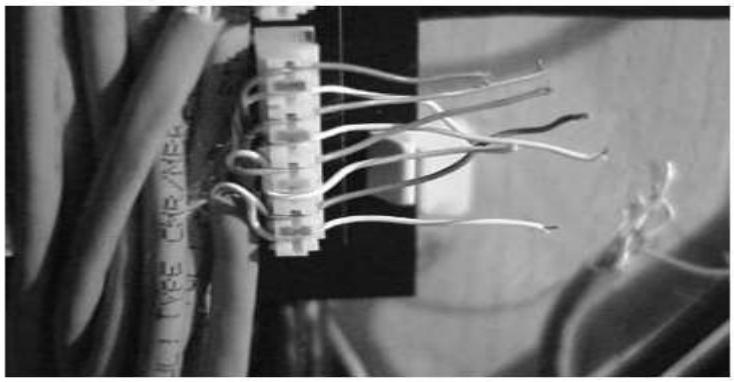


fig 41. Colored wires

NOTE

Each Category rating has standards for termination. For example, each Category rating has a standard for how much length can be untwisted at the termination point. Make sure you follow these standards when terminating cable.



WARNING Make sure that no more than 1/2 an inch or less of each twisted-conductor pair is untwisted when terminated.

4. Using a 110-punch-down tool, push the conductor into the 110-block so that the metal fingers of the 110-block cut into the center of each conductor, thus making the connection, as shown here.

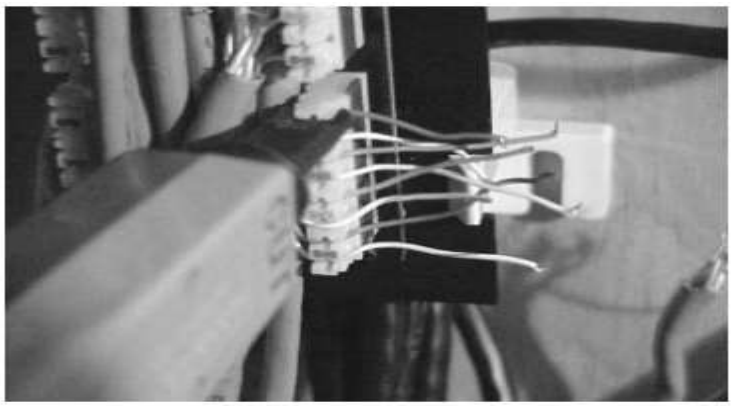


fig 42. Terminating cable

5. Repeat steps 3 and 4 for each conductor.

4.3. Cable installation

Coaxial cables must be installed with care, to ensure maximum performance. Stretching, sharp bending, kinking or crushing of the cable will permanently change the cable geometry and thus its impedance at the point where it is damaged, causing additional loss and signal reflections.

Coaxial cables should not be bent to a radius less than:

- 5 times the cable diameter when installed; or
- 10 times the cable diameter when pulling around corners or through conduit.

4.4. Terminating connectorsterminate a compression type F-connector on quad shield RG6 coaxial cable as described below Coaxial Cable

Coaxial Cable Wiring Descriptions—CCTV and CATV CCTV operate in a lower frequency range than CATV and require different cable constructions. Be sure that the cable used is chosen accordingly. The primary differences are based on the frequency range differences as shown below

Self-Check -4	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____ 1. BNC-Connect 75-ohm, 4 GHz are available to meet the demands of 75-ohm coax cables.

_____ 2. Coaxial cables should be bent to a radius more than5 times the cable diameter when installed. (2 points)

_____ 3. Coaxial cables must be installed with care, to ensure maximum performance (2 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 5- Earthling cable shield

5.1 Earthing of Cable Shields and Drain Wires.

Cable shields are for signal protection from external influences. Conductor or electrode. The cable shield may be connected to any point on the CES.

1) Where shielded cable is installed between separate buildings or structures where the shield is earthed, either intentionally or unintentionally

5.2. EARTHING SYSTEMS

Most of us are familiar with the idea of earthing an electrical circuit. Earthing plays a very important role in protecting both the electrical installation's and the users of electrical equipment from the risk of fire and shock injury.

Earthing To look at earthing more closely we need to understand two terms:

- General mass of earth - a term used to describe the conductive surface of our planet
- Earth Electrode – An electrode is a device used to make an electrical connection with the earth's surface, such as a buried conductor or a driven pipe or rod. Hence Earthing is the connection of an electrical circuit to the general mass of earth via an earth electrode.

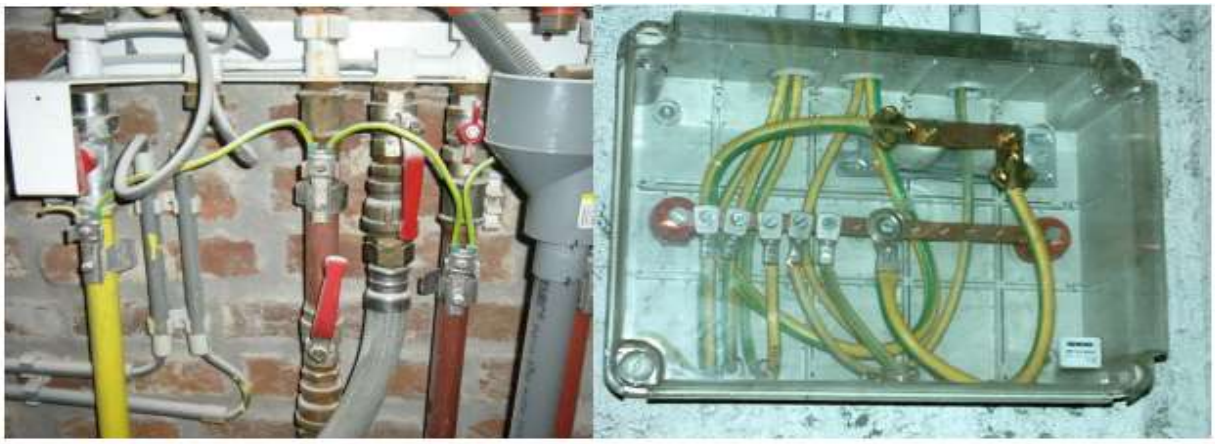


fig 43. Earth electrode

In buildings containing a telecommunications system, certain parts of the telecommunications system must also be equipotential bonded to earth. Equipotential bonding can be used during installation of telecommunications equipment where there are multiple services at the point of installation. A bond is being formed between the service being worked on and adjacent services to avoid accidents involving potential differences between services.

5.3. Earth Potential Rise EPR

The neutral conductor is joined to the earth at numerous points in the power system. This allows any fault currents to flow back to the supply via the earth. Consider the earth to have a small amount of resistance, then it can be seen that a current flowing through the earth will cause a voltage drop to occur. The point at which the active conductor touches the ground will rise in potential to be equal to the supply voltage. The further you move away from this point, the lower the rise in earth potential. At the supply, the earth's potential remains at zero volts. This rise in potential of the ground is known as Earth Potential Rise only occurs in areas where fault currents may flow through the earth.

5.4. Step potential and Touch Potential

If you are standing in the area around an EPR you are at risk in several ways.
Step potential occurs when your feet are in two areas of different potential. Imagine taking a stride towards the source of the EPR. One foot will be in contact with a potential of, say, 200V while the other might be in an area with a potential of 1000V. The difference between the two is 800V. if your resistance is low – perhaps 100 ohms – you will experience a current of 800 milliamp. This is more than enough to stop your heart – at the very least.

5.5. Earthing Telecommunication Systems

- Customer Network and Earthing Definitions ,Building Distributor (BD) or main distribution frame (MDF) – a distributor in which the building backbone cables terminate
- Floor Distributor (FD) – the distributor used to connect between the horizontal cables and other cabling subsystem or equipment. In most large buildings, large cables are run from the BD to the FD where smaller cables then run out to other points

- Local Distributor (LD) is the distributor in which horizontal cables emanating from the floor distributor may connect prior to connecting to telecommunications outlets. Small cables may run from the LD to each individual phone outlet
- Customer Switching System (CSS) - A switching system in an installation that can switch voice, digital data, images, video or any other information. One example is a PABX. The figure below shows where these components fit into a distributed cabling system.

5.6. CES Definition

The Communications Earth System (CES) is a dual-purpose telecommunications earthing system used for both functional and protective purposes. Earthing conductors used for this system have green/yellow insulation. The CES is available for any communications system that requires and earth, fire, security, data, video or voice equipment/cabling etc. CES wires are Green/Yellow earthing colors. The Shield or drain wire of cables is connected to this earth and the punch down module used for earthing is colored green.

fig 44. Earthing colors

TRC Definition

The Telecommunications Reference Conductor (TRC) is a conductor used exclusively for signaling and other functional telecommunications purposes. It is separate and distinct from the protective earth and other building earth systems. It is not used for providing protection of personnel. A TRC is an earthing system available for use where a functional earth is required

5.7. Installing Ear thing

Planning the installation the first step in any task is the most important. It has been said that failing to plan is really planning to fail. Correct planning results in an efficient job that is done right first time.

Self-Check -5	Written Test

Directions: Answer all the questions listed below.

Instruction: - choose and write the letter of the correct answer on the space provided.

_____1. The total earthing conductor length between the device and the main earthing bar in the electrical switchboard should not exceed.

A.10m B. 5m C.2m

_____2. All TRC link bars and terminations are to be enclosed or located to prevent customer access (2 points)

_____3. The Communications Earth System (CES) is used for. (2 points)

A. Functional B. protective purposes C. All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 6- Undertaking visual inspection to confirm termination color code

6.1 Undertaking visual inspection to confirm termination color code

Visual Inspection, used in maintenance of facilities, mean inspection of equipment and structures using either or all of raw human senses such as vision, hearing, touch and smell and/or any non-specialized inspection equipment.

Visual inspection is commonly used in both manufacturing tasks and non- production environments. In manufacturing tasks, the purpose is to verify that a product is free of defects before installation in the next level of assembly or final distribution to the customer.

Here are 5 simple steps to effectively perform visual inspections:

1. Step #1 clearly defines defect criteria.
2. Step #2 Standardize inspection performances. ...
3. Step #3 Analyze visual defects. ...
4. Step #4 Communicate improvement measures. ...
5. Step #5 Use mobile-ready checklists

There are no mandatory requirements for cable sheath colors. However, cables with red sheath should not be used, as red is normally associated with fire detection/alarm systems. Also, cables with orange, white, pink or violet sheath should be avoided as they may be mistaken for power cabling or cabling associated with power control (“home automation”).

It may be beneficial to the installer to use cables with different sheath colors (e.g. blue, grey, yellow, green) to cable different sockets on the same TO. Alternatively, the cable sheaths may be marked at each end with the TO socket colors, e.g. “Blue” and “White”, for the corresponding socket colors, if different colored sockets are to be used at each TO. In addition, mark the TO cables at each end by room designation (e.g. “Kitchen”, “Family”, Bed 1”, etc.) or in numerical sequence (i.e. “1”, “2”, “3”, and so on). The TO wall plates and the corresponding patch panel sockets at the CCP should be colored and designated in the same manner so that the end-user will be able to readily identify them.

Advantages and disadvantages in inspection visual

- It is the lowest cost non-destructive test;

Self-Check -6	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

__1. There are no mandatory requirements for cable sheath colors.

__2**.**Cables with red sheath should not be used, as red is normally associated with fire detection /alarm Systems (2 points)

Instruction I: - choose and write the letter of the correct answer on the space provided.

__3. Alternatively, the cable sheaths may be marked at each end with the TO ____colors,.(2 points)

A. Socket B. RJ-45 C. All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 7- Testing and clearly labeling cable pairs to provide an accurate

7.1 Testing and labeling Cable pairs

Ensure that your inside wire is connected properly at the demarcation point. You can determine a lot about the trouble by listening to sounds on your telephone line:

Static:Wires could be wet or pierced. Wires could be loose at a connecting point. Carefully check all wires and connections.

Buzzing or Humming: A wire may have come into contact with metal, other than the connection terminals. Is any exposed copper wire touching the box or other metal around the jack? Check that colors have been matched correctly. Also, if you are using a cordless phone, you should try plugging in a wired telephone to ensure that the problem is not with your equipment. Given the nature of a cordless phone, it is possible that buzzing or humming is coming from the phone itself and not your wiring.

Dead Air:Wires may be crossed. Is there a contact between any exposed copper from wires of different colors (red crossed with green if 2-pair wire is being used; or blue crossed with white if 3-pair wire is being used)?

Cross Talk: Be sure you are not using a cordless phone, since cross talk is likely from the wireless nature of the phone. If you have multiple phone lines in the home or are in a multi-unit dwelling, cross talk could be the result of damages or faulty wiring.

Check that all connections have been made properly. Are all the colored wires connected to the right terminals? Is the exposed copper wiring making a solid contact with the right terminals?

Check the wire. Is it broken or split? Is it pierced by a staple, nail, screw or other object? If it is, replace the entire section of wire from end to end.

Check that the pins or connecting terminals inside the jacks are not touching each other and that a jack itself is not damaged.

How many phones do you have? It may be possible that your phones are drawing too much energy and compromising the system as a whole. Unplug a few phones a see if the problems persist.

Modem problems? If you are having problems connecting to the Internet, the problem may be

with the modem. Try disconnecting the computer and use a standard telephone and see if there are problems on the line. If the line does not show a problem, the issue is likely with your computer equipment. This is also true
if you are using a Digital Subscriber Line (DSL) (or other high speed internet service) which may involve separate filters that could cause problems on the line, even though the line is working properly.

7.2. Undertaking Visual inspection to confirm termination color code sequence for Data line (Data cable)

The specific procedures for testing a cable vary depending on the cable tester. Usually you select the type of cable you are testing, hook up the cable, and then press a button labeled something like Begin Test. If the cable does not work or meet the testing requirements, reconnect the cable.

7.2.1. Wire Mapping

Wire mapping is the most basic and obvious test for any twisted-pair cable installation. For twisted-pair cables, you must test each cable run to make sure that the individual wires within the cable are connected properly; you can select either the T568-A or T568-B pin out configurations for a twisted-pair installation. Because all of the pairs are wired straight through and the difference between the two configurations is minimal, there is no functional difference between them. However, you should select one pin out and stick to it throughout your entire installation.

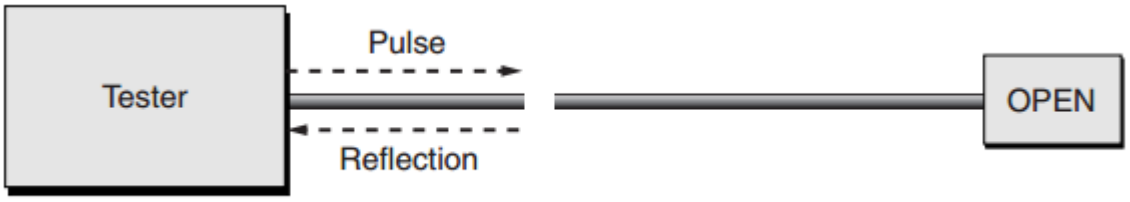
7.2.2. Locating Cable Faults

Cable testers use TDR to locate breaks and faults in cable by distinguishing between these various types of reflections. For example, an open located at 25 feet in a cable run that should be at least 100 feet long indicates that a fault in the cable exists and gives an indication of its approximate location (see Figure 14.4). The problem may be caused by a cable that has been entirely severed or by faulty or damaged wires inside the cable sheath. Sometimes you can't tell that a cable is faulty by examining it from the outside. This is why a test of each cable run during the installation process is so important

7.2.3. Resistance measuring

The second method for determining the length of a cable is to measure its resistance using a digital multimeter (DMM). All conductors have a resistance specification, expressed in ohms per

meter (or sometimes ohms per 100 meters or ohms per



foot

fig 45. Resistance measuring

7.2.4. Performance Testing

The tests we've discussed so far all relate to physical properties of the cable and ascertain if the cable has been terminated properly and is an acceptable length. They can be performed quickly and with relatively unsophisticated and inexpensive test devices. They are the basic, minimum levels of testing that should be performed to ensure your network will work.

fig 46. Performance Testing

7.2.5. Impedance

The statistic that measures the uniformity of the cable's impedance is called its structural return loss (SRL), which is measured in decibels (dB), with higher values indicating a better cable7.2.6. Attenuation

Attenuation is one of the most important specifications for high-speed networks; if it is too high, the signals can degrade prematurely and data can be lost..

7.2.8.Cable-Testing Tools

The best method for addressing a faulty cable installation is to avoid the problems in the first place by purchasing high-quality components and installing them carefully. But no matter how careful you are, problems are bound to arise.

7.2.9. Wire-Map Testers

Aware-map tester transmits signals through each wire in a copper twisted-pair cable to determine if it is connected to the correct pin at each end. Wire mapping is the most basic test for twisted-pair cables because the eight separate wire connections involved in each cable run are a common source of installation errors.

7.2.11. Continuity Testers

A continuity tester is an even simpler and less expensive device than a wire-map tester. It is designed to check a copper-cable connection for basic installation problems, such as opens, shorts, and crossed pairs. These devices usually cannot detect more complicated twisted-pair wiring faults such as split pairs, but they are sufficient for basic cable testing, especially for coaxial cables, which have only two conductors that are not easily confused by the installer. Like a wire-map tester, a continuity tester consists of two separate units that you connect to each end of the cable to be tested. In many cases, the two units can snap together for storage and easy testing of patch cables.

7.2.12. Tone Generators

The simplest type of copper-cable tester is also a two-piece unit, a tone generator and probe, also sometimes called a fox and hound wire tracer. With a standard jack, you connect to the cable the unit that transmits a signal; or, with an alligator clip, you connect the unit to an individual wire.

7.2.13. Excessive Crosstalk

Cross talk is a major problem that can have many different causes, including the following: Inferior cable Cables not of the grade required for a protocol can produce excessive crosstalk levels. The only solution is to replace the cable with the appropriate grade

Self-Check -7	Written Test

Directions: Answer all the questions listed below.

Instruction: - choose and write the letter of the correct answer on the space provided

____1.Which of the following is Cable testing tool? (3 points)

A. Continuity Testers B .Wire map testing C. All

_____2. Using Category ___connectors on a Category 5e network can introduce excessive crosstalk and other Problems (2 points)

A. 3 B.5 C.6 D. All

_____ 3. During a twisted-pair installation, you fail to maintain the twist of the wire pairs up to a

Pointno more than ____ for Category 5 and 5e, and ____ for Category 6,

A. 0.5 inches and 0.375inches B. 0.5.inches & 0.75inches C.A& B D.All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 8- Terminating TRC/CES/Earth wires with connectors

8.1. Terminate*TRC/CES/Earth wires* with connectors

Communications Earth System (CES) a system of ear thing using common elements to provide for ear thing of electrical and communications equipment within premises. A CES may be used for protective and functional ear thing for telecommunications purposes. Communications Earth Terminal (CET) a terminal provided for the purpose of equipotential bonding of the CES or the TRC(telecommunications reference
conductor) to the main ear thing bar, main ear thing conductor or sub-main ear thing conductor of the electrical installation.

The CET provides a demarcation between the electrical ear thing system and the telecommunications ear thing system and was formerly known as a 'bonding terminal'.

8.2. Protective Earth (PE)

This conductor is generally supplied via the third pin of a power cord. However in some systems this must be hard wired to the equipment by a licensed electrician. A hard wired PE connection is specified in those instances where it is required.

Ear thing Options

1.TRC and PE

The TRC and the PE must be connected to the equipment on separate terminals, in accordance with the individual TRC and PE requirements listed above.

2. None. Neither a PE nor a TRC is required to be connected to this equipment.

3. TRC or PE Either a PE or a TRC must be connected to this equipment. However in some uses of the type of equipment, a TRC must be used. (E.g. a CAE mounted behind another CAE may need earth recall to access the first CAE. A TRC is required for this functional use). If this is the case, a note appears under the equipment listing in the installation guide.

Communication Earth System (CES) Communication Earth System as defined in AS/CA may be used for any functional or PE reference. Where either a TRC or a protective earth or both TRC

and PE are specified, the CES can be substituted for these requirements. If a TRC is specified and the CES in not suitable (noisy) a TRC compliant to AS/CA will need to be installed. Reinstalling Recovered CAE, if a system is recovered from an installation, which originally required a Telecommunications Service Earth (TSE) – then that system, when reinstalled must use the TRC in place of the TSE.

Self-Check -8	Written Test

Directions: Answer all the questions listed below.

Instruction: - choose and write the letter of the correct answer on the space provided

--------1. The_____ provides a demarcation between the electrical ear thing system and the

Telecommunications ear thing System **(3 points)**

A. CET B .TRC C. All

------2. The____ must be connected to the equipment on separate terminals (2 points)

A. TRC B. PE C.All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 9- Maintaining TRC/CES /Earth wire continuity

9.1. Pair Continuity Testers

Continuity testers can be used to check that pairs are not open circuit. They work on a similar principle to an ohmmeter but usually use light emitting diode or audible tone indicators. Many modern digital multimeters have built in continuity testers

9.2. Other devices

There are several instruments that can be used to identify low resistance faults such as the Riser Bond, PET or C2300.Multimeters Two main types of multimeters are in common use, analogue or digital. Both types share many common features and are equally good for general purpose testing. The digital multimeter is a battery operated instrument that uses a digital display. The analogue type is a simpler in design and has an analogue meter display. All multimeters combine the operations of voltmeters, ammeters and ohmmeters and usually offer the following:

- AC and DC voltage ranges from less than one to many hundreds of volts
- AC and DC current ranges from a few milliamps to several amps
- Resistance ranges from ohms to me ohms

9.3. Inspection of Work

Inspection of work by a carrier the carriers are responsible for their networks. They also have the right to inspect cabling work. They may inspect work to ensure it satisfies current AS/CA technical standards in relation to network integrity, personal safety and proper network functioning. If a carrier inspection reveals a threat to safety or integrity of their network then they may disconnect or refuse to connect some or all services.

Maintenance of cabling advice It is the responsibility of the registered cable to maintain all necessary installation records. The registered cable (maintenance licensed person) must maintain these ‘cabling advices’ in a clear and legible fashion.

Self-Check **-9**	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

1. Analog and Digital multimeter, both types share many common features andare equally good for general purpose testing. (3 points)

2. If a carrier inspection reveals a threat to safety or integrity of their network then hey may disconnect or refuse to connect some or all services.(2 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 10- Testing TRC/CES /Earthling installation for continuity, insulation Resistance and conductive resistance

10.1. Testing a CES Test the installation

A cable can determine the approximate resistance of the CES by cable length. If the value is close to the limit then a measurement will have to be taken which will account for any resistance included at termination points.

Step 1 – Resistance measurement

(a) Select a pair (or extend one) to run from the:

(i) Protective earth bonding point (or CET if it is adjacent to the point of bonding) to,

(ii) The termination point of the CES at the CSS or LD To use in your measurements

(b) Connect each wire of the reference pair using an appropriate test lead, to the CES cable at the CSS or LD after removing it from its termination point.

(c) Using a multi meter at the protective earth end, measure and record the loop resistance of the reference pair. Record this value in the space below.

(i) R1 = _____Ω

(d) Now measure the resistance of each leg of the reference pair to the CES cable. Record this value below

(i) R2 = _____Ω R3 = _____Ω

(e) Before calculating the CES resistance remove all test conductors and reconnect the CES cable to the earth terminal.

(f) Substitute your values of R1, R2 and R3 into the following formula to calculate the CES resistance

$$CES\ resistance = \frac{R_2 + R_3 - R_1}{2}\Omega$$

$$CES\ resistance = \_\_\_\_\_\Omega$$

You should remember that the resistance from the point of connection to the protective earth and furthermost end of the CES cable should be no more than 1 ohm.

Terminate at CET's Remove the insulation from the ends of all conductors and terminate them in the CET's. Be sure to consolidate all bared conductors by twisting or folding them in two. Make sure both screws clamp on the conductor in the CET. Alternatively, if you are terminating using cable lugs, use a sustainable crimp too to fit the lug to the TRC cable.

4. Connecting to the Protective earth electrode To connect a bonding conductor to an electrode, use an appropriate clamp and fit this below the protective earth connection.

5. Extend the CES to CSS To extend the CES to the CSS, run the minimum sized CES cable to the earth terminal of the CSS (or a LD if a CSS is not available).

ACTIVITY – TESTING A CES Test the installation using Section 20 of AS/CA S009:2013 as a guide. By using table 6 of AS/CA S009:2013 a cable can determine the approximate resistance of the CES by cable length. If the value is close to the limit then a measurement will have to be taken which will account for any resistance included at termination points.

10.2. Testing A TRC Test your TRC installation using the testing procedure in AS/CA S009:2013.

The cable tray should still be earthed to the protective earth from the previous CES activity.

1) Resistance Measurement

(a) Select a cable pair from the BD-FD riser to use in your measurements.

(b) Connect each wire of the reference pair to the TRC connection at the FD using an appropriate test lead

(c) Disconnect the TRC riser from the earth bar at the BD

(d) Using a digital multimeter measure and record the loop resistance of the reference pair from the

BD. Record this value in the space below.

(i) R1 = _____Ω

(e) Now at the BD measure the resistance of each leg of the reference pair to the TRC cable. Record this value below.

(i) R2 = _____Ω R3 = _____Ω

(f) Before calculating the TRC resistance remove all test short circuits and reconnect the TRC to the BD earth bar

(g) Substitute your values of R1, R2 and R3 into the following formula to calculate the TRC resistance

$$Main\ TRC\ resistance = \frac{R_2 + R_3 - R_1}{2}\Omega$$

$$Main\ TRC\ resistance = \_\_\_\_\_\Omega$$

You should remember that the resistance from the BD link bar to the FD should be no more than 2 ohms. If it was required to test the resistance from the BD link bar to a LD the reference pair would have to be extended to the LD and the testing process repeated. In this case 5 ohms is the maximum permissible reading.

10.3. Accidental bonding

Once you have measured the resistance of the TRC and found it to be within the limits, it is necessary to check for accidental equipment bonding.

(a) Remove the main TRC cable from the BD earth bar

(b) Make sure the BD earth bar is connected to the protective earth at the CET

(c) Set the voltage on the insulation resistance tester to 500Vdc and connect the test leads tothe TRC cable and the BD earth bar

(d) Measure the resistance and record the result below.

$$Insulation\ Resistance = \_\_\_\_\_M\Omega$$

(e) Reconnect the main TRC cable to the BD earth bar the value you measure should be greater than 1MΩ to comply with the standards.

Self-Check -10	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

----1. A cable can determine the approximate resistance of the CES by cable length **(3 points)**

------2. Using a multi meter at the protective earth end, we can measure and record the loop

Resistance of the reference pair **(2 points)**

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 11- Labeling earthling system

11.Labelling Earthing system in accordance with requirements.

With the increasing demand for computer network installations, telecommunications grounding and bonding has become a growing opportunity for electrical contractors. Although similar grounding principles apply, understanding the telecommunications terminology and special considerations has been a challenge. As with traditional electrical grounding, telecommunications networks and equipment should be grounded to the electrical service. However, simply grounding to structural steel isn't enough when tackling telecommunications systems. The sensitivity of the electronic equipment requires that the telecommunications cabling and power be effectively equalized to prevent loops or transients that can damage the equipment. This means designing a complete grounding and bonding system that goes beyond the basic "green-wire

11.1. Grounding

The NEC article 100 defines ground *as*:

*"*A conducting connection, whether intentional or unintentional, between electrical circuits or equipment and the earth, or some conducting body that serves in place of the earth"."

Electrical systems and communication cabling systems that are required to be grounded must be connected to the earth. The grounding mechanism must provide a reliable means to safely conduct the voltages imposed by lightning, line surges, or unintentional contact with high voltage lines or equipment to ground.

11.2. Bonding

The NEC article 100 and 250-70 defines ***bonding*** as:

"The permanent joining of the metallic conducting parts of equipment and conductor enclosures to assure and electrically conductive path between them that will ensure electrical continuity and have sufficient capacity to safely conduct any foreign current likely to be imposed to ground."

Bonding is required because electrically conductive materials such as structural steel, metal cable trays, and metallic supporting structures may become energized in the event of making contact with: lightning, line surges, or unintentional contact with high voltage lines.

11.3. Electrical exposure

Communication cables have exposure to electrical currents. The NEC Article 800-2 defines a communication cable as “exposed” when

- Outside building exposure
- Inside building exposure

11.3.1outside Building Exposure

All copper communication cables, or any dielectric cables that have a conductive element, are conductors of electrical energy. When these types of cables are run between buildings, they are electrically exposed to lightning. These cables would carry a lightning strike along the cable and into any cables that are connected to these cables.

11.3.2. Inside Building Exposure

Communication cables are exposed to electrical hazards inside a building. Copper communication cables are installed in the same vicinity as electrical power conductors. These is the possibility of accidental contact with power conductors, which would cause power fault induction.

11.4. Telecommunications grounding and bonding standard – ansi/tia/eia-607

The ANSI/EIA/TIA-607 standard is the commercial building grounding and bonding requirements for telecommunications. The primary objective of this standard is to provide guidance around the issue of bonding and grounding as it relates to building telecommunications infrastructure.

11.5. Telecommunication grounding system components

The telecommunications grounding and bonding system starts with a physical connection to the building grounding electrode system and extends to every telecommunications room (TR) in the building (see the following figure).

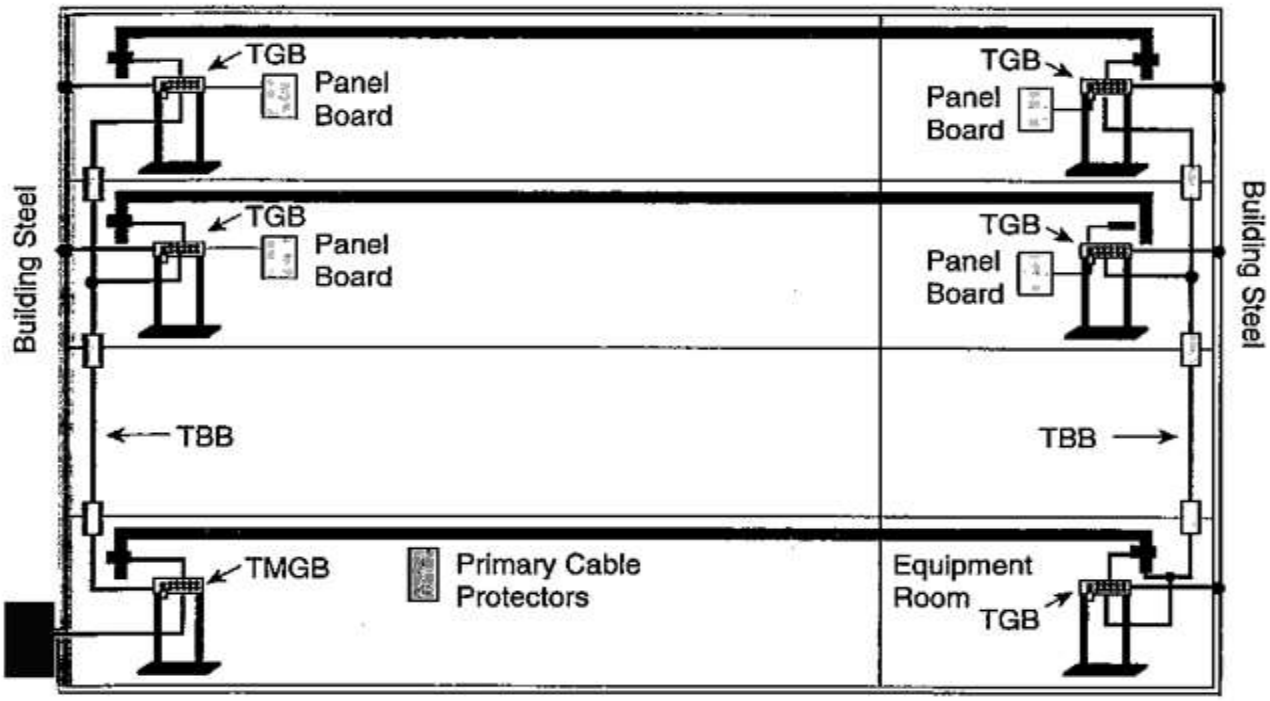


fig 47. Grounding system

In general, a telecommunications grounding system defined by the ANSI/TIA/TIA-607 standards contains the following components:

- Telecom bonding conductor
- Telecom main grounding busbar (**TMGB**)
- Telecom bonding backbone (**TBB**)
- Telecom grounding busbar (**TGB**)
- Telecom bonding backbone interconnecting bonding conductor (**TBBIBC**)
-

11.6. Telecom Entrance Facility (TEF)

The telecommunications entrance facility (TEF) includes the entrance point at the telecommunications service and also the space where the inter- and intra-building backbone facilities join. Telecommunication-related antenna entrances and electronic equipment may be located in the TEF.

Self-Check -11	Written Test

Directions: Answer all the questions listed below.

Instruction: - choose and write the letter of the correct answer on the space provided

1. Ground electrode conductor is a conductor used to connect the grounding electrode (5 point)

A.The equipment grounding conductor B.The source of a separate system

C.The grounded conductor of the circuit at the service equipment D. All

2. The practice of creating effective bonding is to create a reliable path for such to the------

Electrical system ground(5 point)

A. fault currents B. fault voltage . C. All

3. Water pipes or metallic cable shield should not be used as telecommunicationsbonding backbone

A. False B. True

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 12- Confirming and Testing compatibility of alterations with existing Systems

12.1confirming and Testing Compatibility of alterations with existing systems

Compatibility Testing is a type of Software testing to check whether your software is capable of running on different hardware, operating systems, applications, network environments or Mobile devices. Compatibility Testing is a type of Non-functional testing

12.2. Before testing a cable pair the following procedure should be followed:

- Remove any telecommunications equipment from both ends.
- Avoid actual contact with the conductors of the pairs where possible.
- With a voltmeter, check that no stray DC or AC voltages are present on the pair.
- Test between legs and each leg to earth. If a hazardous voltage is detected, the pair should be isolated and expert assistance obtained.
- Discharge any stray capacitive charges by briefly short circuiting the legs of the pair together and to earth with an insulated wire, avoiding actual contact with the conductors of the pair where possible.
- Test telephones – Buttinski's Test telephones are similar in operation to normal telephones. They are portable and used to check the operation of telephone circuits. Test telephones are robust and conveniently shaped and usually have additional features to normal telephones. These features of test telephones include monitoring facilities, polarity testing and earth recall. Test telephones are often called "Buttinski's" or "Butts" for short. This name derives from their ability to "butt in" on telephone lines.

12.3. The following best practices are recommended during the installation of cables:

- Install higher cable categories to meet the application requirements that may arise in the future.
- Use thin and high-density cables as necessary to enable more cable runs in tight spaces.

- Use modular cabling systems to map the ports from equipment with high density port counts.
- Avoid leaving loose cables on the floor, as this could constitute as a major safety hazard. Instead, use the vertical, horizontal, or overhead cable managers.
- Store a few spare patch cables. The type and quantity of the patch cables can be determined from the installation and projected growth. Ensure to store all the unused cables in a bagged and capped condition when not in use.
- Use the patch cable of exact length, and leave some slack at each end for end device movements.
- Use vertical and horizontal cable guides for routing cables within and between the racks.
- Use cable spool devices in the cable managers to prevent kinks and sharp bends in the cable.
- Bundle the related cables together in groups (for example, bundle the ISL cables and uplinks to their core devices), as this eases management and troubleshooting.
- Use the Velcro-based ties every 1 to 2 meters for bundling or securing the cables, and avoid using the zip ties as they apply pressure on the cables.
- Regularly maintain the cabling documentation, labeling, and physical or logical cabling diagrams.

12.4. Testing of the completed installationthe generic cabling system should be inspected and tested after completion to ensure that:

- there are no open circuits
- there are no short circuits
- all sockets are correctly terminated
- the CCP is correctly labeled
- TO sockets are correctly color-coded or labeled in relation to the CCP color-coding or labeling
- end-user information is clear, concise and corresponds to the actual installation
- the “as-built” cabling plan is neat and accurate.

Self-Check -12	Written Test

Directions: Answer all the questions listed below.

Instruction: - choose and write the letter of the correct answer on the space provided.

1. When Testing of the completed data/telephone cable installation check **(3 points)**

A. there is no open circuits B. there are no short circuits

C. all sockets are correctly terminated D. All

2. The following best practices are recommended during the installation of cables. **(2points)**

A. Install higher cable B. use thin and high-density C. Use modular cabling D .All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 13- Following procedures for referring non-routine events

13.1 Follow supervisor direction for non-routine events

The Structured Cabling System shall be installed only by accredited firms of the cabling system components and by suitable qualified personnel(s)

Cabling system installation shall be performed in a safe manner.

b) Personnel undertaking installation works shall be equipped with appropriate personal protection equipment, tools and mechanical aids.

c) Appropriate barriers and warning signs shall be used to restrict access and draw attention to potential hazards such as open trenches and the like.

The following best practices are recommended during the installation of cables

- Install higher cable categories to meet the application requirements that may arise in the future.
- Use thin and high-density cables as necessary to enable more cable runs in tight spaces.
- Use modular cabling systems to map the ports from equipment with high density port counts.
- Avoid leaving loose cables on the floor, as this could constitute as a major safety hazard. Instead, use the vertical, horizontal, or overhead cable managers.
- Store a few spare patch cables. The type and quantity of the patch cables can be determined from the installation and projected growth. Ensure to store all the unused cables in a bagged and capped condition when not in use.
- Use the patch cable of exact length, and leave some slack at each end for end device movements.
- Use vertical and horizontal cable guides for routing cables within and between the racks.
- Use cable spool devices in the cable managers to prevent kinks and sharp bends in the cable.

- Bundle the related cables together in groups (for example, bundle the ISL cables and uplinks to their
  core devices), as this eases management and troubleshooting.
- Use the Velcro-based ties every 1 to 2 meters for bundling or securing the cables, and avoid using
  the zip ties as they apply pressure on the cables.
- Regularly maintain the cabling documentation, labeling, and physical or logical cabling diagrams.
  • Document and regularly update all the cabling components and their mapping.
- For new installations or re-cabling of the existing equipment, install the cable guides to reduce mechanical stress and bending of the data cables, and to enhance the maintainability. Figure below shows an example of the recommended cable guides for the Cisco Catalyst 6500 chassis.

The installation and usage of cable guides should be independent of the number of cables that are installed. However, there are products that do use cable guides, or where the cable guides cannot be installed.

Self-Check -13	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1. Personnel undertaking installation works shall be equipped with appropriate.

_____2. Leaving loose cables on the floor, as this could constitute as a major safety hazard.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 14-Terminating cabling efficiently without waste of materials and energy

14.1 Terminating cabling efficiently without wast of materials and energy

Pre-terminated cable provides a plug-and-play solution for links between switches, servers, patch panels, and zone distribution areas in the data center. These solutions include a variety of trunk cables, array cables, and plug-and-play cassettes that give data center managers options that suit specific needs. When compared to field-terminated cabling, there are many reasons to consider pre-terminated optical fiber and category rated copper cabling

Field termination is the most time-consuming, labor-intensive part of the cable installation process. Once pre-terminated cabling is delivered, it can be unpacked, readied for deployment, and connected quickly. In many cases pre-terminated cabling can cut installation time by up to 80% over field terminations

Using the proper termination method is essential for maintaining the electrical and mechanical integrity of the cable Insulation displacement is a means of making a connection without having to cut the cable. Connection pins are pushed through the sheathing and insulation and onto the conductor.

A wire termination is the work performed to the end of a wire that allows it to connect to a device (connector, switch, terminal, etc.). ... The wire insulation is stripped, and the contact or terminal is attached to the wire using a crimp tool. The tool crimps the contact or terminal onto the wire conductor "joint" is a term usually applied where two (or more) cables are joined together, in a way which is intended to reflect the construction of the cable itself; a "connector" is usually a mechanical device for connecting conductors.

"Joint" is a term usually applied where two (or more) cables are joined together, in a way which is intended to reflect the construction of the cable itself; a "connector" is usually a mechanical device for connecting conductors.

fig 47. Terminating cabling

Self-Check -14	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1. Using the proper termination method is essential for maintaining the electrical cable Insulation.

_____2. Field termination is the most time-consuming, labor-intensive part of the cable installation process.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Information Sheet 15- Carrying out routine quality **checks**

15.1 Carrying out routine quality checks

Quality is critical to satisfying your customers and retaining their loyalty so they continue to buy from you in the future. Quality products make an important contribution to long-term revenue and profitability. They also enable you to charge and maintain higher prices.

By undertaking effective inspection and control over production processes and operations, production costs are considerably reduced. Quality control further checks the production of inferior products and wastages thereby bringing down the cost of production considerably.

Good laboratory practice requires testing normal and abnormal controls for each test at least daily to monitor the analytical process. If the test is stable for less than 24 hours or some change has occurred which could potentially affect the test stability, controls should be assayed more frequently

Advantages of Quality Circles are (1) improved communication; (2) management awareness of employee job-related concerns; (3) personal growth and development; (4) enhanced decision making skills; (5) increased individual power; (5) improved motivation; and (6) opportunities for recognition of individual improvement

Quality control involves testing of units and determining if they are within the specifications for the final product. The purpose of the testing is to determine any needs for corrective actions in the manufacturing process. Good quality control helps companies meet consumer demands for better products

Self-Check -15	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1.Quality is critical to satisfying your customers and retaining their loyalty.

_____2. Quality control involves testing of units and determining if they are within the specifications for the final product

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

LG #35	LO #4- Complete cabling work, records and reporting

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Following OHS work completion risk control measures and procedures
- Cleaning and making safe Work site
- Creating and storing record sheets and plans of cable
- Creating cable pair record books
- Documenting and reporting cabling completion

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Follow OHS work completion risk control measures and procedures
- Clean and make safe Work site
- Create and store record sheets and plans of cable
- Create cable pair record books
- Document and report cabling completion

Learning Instructions:

10. Read the specific objectives of this Learning Guide.
11. Follow the instructions described below.
12. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
13. Accomplish the “Self-checks” which are placed following all information sheets.
14. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
15. If you earned a satisfactory evaluation proceed to “Operation sheets
16. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
17. If your performance is satisfactory proceed to the next learning guide,
18. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Following OHS work completion risk control measures and proced

1.1 Occupational Health and Safety (OHS)

The Installer shall comply with all rules and Regulations, Approved Codes of Practice, all relevant Standards, Work Safe. Guidelines, Occupational Health and Safety requirements, accepted codes of practice, manufacturer's instructions and any temporary rules and restrictions that may be in force at the time.

The installer shall ensure that all its personnel working on collage of vocational Education or working on laboratory safe working on networks have undertaken appropriate training and have a Recognized site safety accreditation for both the site and work to be undertaken at practical training time. No open pits, holes, trenches, or access areas, are to be left unattended at any time. All are to be clearly marked and secured in accordance with OSH regulations and all ground or structural disturbances are to be secured and/or removed at the end of each day's work in accordance with OSH regulations.

Decide to plug a second extension block into the first one, so increasing the risk of overheating; or plug an adaptor into an extension block, especially as blocky-type adaptors are usually un fused. Accepting the danger of a breach in H&S policy, putting each rectangular-style socket extension block inside a D-Line Cable Tidy Unit represents a practical way to reduce such risk; making the socket block less accessible or less inviting to employees, and an adaptor more awkward to fit.

fig 48. Portable divider

Enclosures that when containing pvc insulated cables ‘not more than 45% of space within a conduit or trucking must be occupied by cables’; a principle transferable to Cable Tidy Units). Cable Tidy Units should provide ample space, and require also that the cable from each plug-top must be routed via one of the three rear exit slots… so further minimizing risks from ‘excessive’ heat build-up. These slotted exits are vents also. Entry and exit cables should be concealed in D-Line Spiral Wrap, Cable Tidy Tubes or Trucking. D-Line Cable Tidy Units are produced in the UK using electrically safe material, and have been fully safety tested (when overloaded with cables, and vents blocked!)

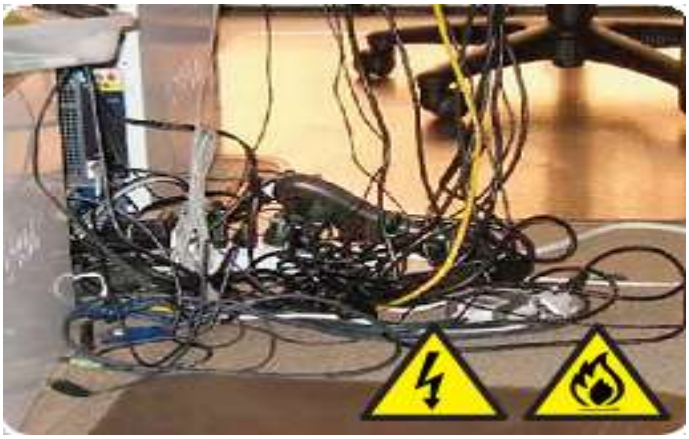


fig 49. Un safe installation

Broken conductor strands disrupt the natural flow of current, creating resistance by forcing high wattages over a smaller conductor area, and, over periods, where perhaps power is on 24/7, excessive heat builds up. Becoming glowingly-hot can ignite common office materials such as paper and waste, to start a fire.

Cable management products — that can protect insulation; stop cords twisting and knotting; and prevent tugs and pulls — are a small price-to-pay for safeguarding from the worst consequences.

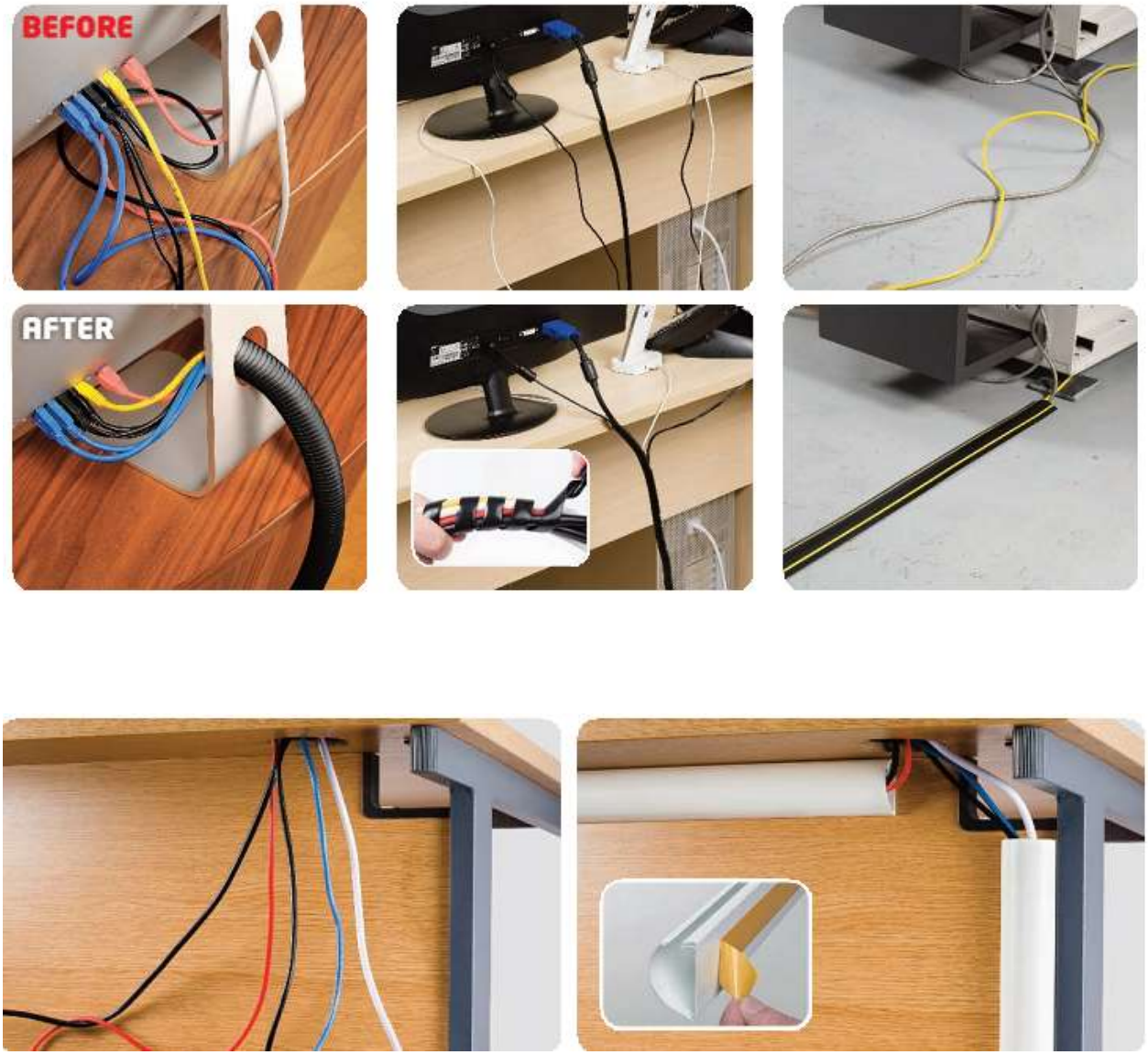


fig 50. Tugs and pulls

1.2. How to choose Floor Cable Protectors

- The Floor Cable Cover should be sufficiently long to cover the full length of cable(s)across the floor.

- Where a longer length is required, any link to a subsequent strip should be mechanically secure to avoid the run breaking in the event of a kick or knock.

Note D-Line's Medium Duty profiles can uniquely be joined by patent-pending push-in pull-out connector rods that fit the continuous grip- holes along the lengths so the runs can be as long as

- The Floor Cable Cover must not itself be a trip hazard!
- This means it should have a tapered design, and not a sharp effect that could be potentially obtrusive
- The strip must be able to lie flat on the floor. Beware versions that are overly stiff, prone to curl or twist and never uncoil to lie flat
- Avoid alternatives that are overly thin and flimsy, too lightweight to lay flat and vulnerable to movement after minor knocks
- Consider the size and volume of cables that need to be covered, then select a Floor Cable Cover with a cavity-size that can accommodate the relevant cables.

Using only a tape will not offer the same protection against the cable becoming frayed, or pinched under the leg of a chair or desk. As previously, beware the electrocution risk of exposed conductors and how broken conductors can lead to power failures, heat build-ups and fires.

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____1. The installer shall familiarize themselves with the site conditions prior to undertaking or Providing quote or estimate prices for any work. (3 points)

_____ 2. Installers are required to undertake all necessary investigations to fully inform themselves of the site conditions. (2 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Answer Sheet

Information Sheet 2- Cleaning and making safe Work site

2.1. Cleaning and making safe work site

Site conditions

The installer shall familiarize themselves with the site conditions prior to undertaking or providing quote or estimate prices for any work. Specific conditions to be observed at collage work station during practical session or on site work of cablings OSH requirements, qualification and identification of personnel and onsite legacy equipment and configurations. Installers are required to undertake all necessary investigations to fully inform themselves of the site conditions and other factors that could impact the cost and execution of works.

This includes but is not restricted to:

a) Hazards that may be present at the collage practical work station or onsite cabling

b) Heritage registration of buildings

c) Environmental conditions including special precautions for the protection of flora and fauna

d) Local site conditions including weather hazards and cultural significance

e) Easements

f) Safety of students and staff with respect to pit covers and location

g) Existing and projected underground services, note that site maps may not be complete or available

Self-Check -2	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

1. The installer shall familiarize themselves with the site conditions prior to undertaking or providing quote or estimate prices for any work. (3 points)

2. Installers are required to undertake all necessary investigations to fullyinform themselves of the site conditions. (2 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 3- Creating and storing record sheets and plans of cable

3. 1 Creating or updating Record sheets

The record sheets are generally established and maintained by the carrier or installer (supervisor) of the cable install ion. Network jumpers, distribution line, mainline, color code mark ,identification at each terminal that is input and output all these and the ext. connection records will be recorded and established on the sheet and provided for owner and set for future extension or remove and add

Table 3-cable record sheets

Cable Details	Pair No	Service Number	Other particulars of Service	Jumpered to vertical pair

Always complete records in pencil to allow for future changes.

Cabling Record Sheets

Table 4-cable record sheets

Termination records

Module 8

M8	1	2	3	4	5	6	7	8	9	10	

Module 7

M7	1	2	3	4	5	6	7	8	9	10	

Module 6

M8	1	2	3	4	5	6	7	8	9	10	

Module 5

Please note that this frame does/ does not leave each 11th module position blank

Termination records----------

Records correct as of_____sheet_____

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

Instruction II: - write true if the statement is correct or write false if the statement is incorrect and write the answer on the space provided**.**

_____**1.** Record sheet controlling is the mandate of electrical **(3 points)**

_____ 2 .The owners the network can manage data power cable using the record sheet **(2 points)**

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Answer Sheet

Information Sheet 4-Creating cable pair record books

4.1 Creating cable pair record books

Creating Cable pair record books to provide an accurate record information In an installation of data cable, Telephone cable, coaxial cable, CCTV- cable, Fiber optics and all other cable for signal transfer whether for high or low speed Planning is the first critical issue that discussed at first of all. By doing this all data survey of the area, environment, length, type of the building and all other information required to for the routing of the cable must be organized each step by step for the next removal, addition, re installation of the existing or for new construction of the system, all this records are recorded to the book form for the next option of constructing to much the coming technology or for better decision of the cost, lobber, management analysis.

Table 5-cable pair record books

Vertical ____ Pair Number	Equipment Number	Extension Number	Direct or Jumper	Connected to	
0					
9					
8					
7					
6					
5					
4					
3					
2					
1					
0					
9					
8					
7					
6					
5					
4					
3					
2					
1					

Note that this frame may use 20 pair modules for the PABX tails.

Table 6- cable distribution record books

Cable Distribution Records

Cable Details	Pair	Service Number or Port	Name or Other particulars of Service	Jumpered /Patched to	
				Vertical	Pair
	0				
	9				
	8				
	7				
	5				
	5				
	4				
	3				
	2				
	1				
	0				
	9				
	8				
	7				
	5				
	5				
	4				
	3				
	2				
	1				

Self-Check -4	Written Test

Directions: Answer all the questions listed below.

Instruction: - choose and write the letter of the correct answer on the space provided.

_____1.In creating data book for information about cable installed (3 points)

A. Planning is the first pinot of view.

B. Information analysis of environment

C. Condition of the area D. All

_____2. The cable record book is used for (2 points)

A. Adding cable to the existing

E. For removal of the installed cable

F. For extension of the existing

G. All

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Answer Sheet

Information Sheet 5- Documenting and reporting cabling completion

5.1. Documentation

A comprehensive strategy for managing power and data cables within IT racks in telecommunication is critical for the uptime, safety, and cooling efficiency of data centers. Advancements in IT rack designs have improved power and data cable management (documentation):

Effective rack power and data cable management leads to a number of IT infrastructure Benefits including: Enhanced availability through reduced downtime. A system operator or employee can be easily confused by a mess of cables, which often results in human error. Human error is widely regarded as the leading cause of data center downtime based on a study by The Uptime Institute

- Effective cable management can help system operators to manage cables and IT devices easily, so as to reduce human error.
- Improved system performance through reduced crosstalk and interference between power and data cables. Power and data cables in close proximity to each other can create electromagnetic interference (EMI), which can result in erratic or error-prone data transfer in network cables. Cable management tends to separate power and data cables within the racks, which can help reduce the risk of interference.
- Improved maintenance and serviceability by allowing easier and safer access to individual components.
- Increased cooling efficiency by allowing hot exhaust air to escape out the back of the rack. Cable management keeps cables organized and out of critical airflow paths.
- Improved scalability by simplifying moves, adds, and changes. Cable management can make it easier to integrate additional racks and components in the future as the data center grows

This documentation or guidance on power and data cable management that will improve Physical appearance, cable traceability, airflow, cooling efficiency, and troubleshooting time while reducing

the risk of human error.Following the steps outlined below can help you achieve a clean and well organized data center (documentation):

- Plan
- Determine the routes for power and data cables
- Identify cables
- Route and retain cables
- Secure cables and connectors
- Avoid thermal issues
- Document and maintain organize

Plan

Planning is the first step for power and data cable management in IT racks, and when done properly, it facilitates all of the steps below. Planning plays a critical role in any successful cable management project. If this is your first structured cabling project, we recommend that you hire a professional cabling contractor like Schneider Electric to complete the entire project. Table below shows an example statement of work (SOW) for cable management in documentation.

A key output of the planning step is to determine the number of cables needed. This is done by calculating the number and type of connections per device and the total number of devices

Table 7- document and reporting cable distribution

Activities	Description
Management	will provide cable management for the servers migrating over to the new racks in existing and for new installation
	will dress cabling into neat and presentable bundles in all locations Install
Installation	will install and manage all patch cords into the rack and organize them with a specific cable management system that allows for proper airflow in the rack

Labels	will professionally label primary and secondary data cables, and primary and secondary power cables.
Logistics	will provide the knowledge and labor required for a well-organized and professionally maintained data center with minimal downtime.
	will utilize a fully tested cable management system.

Activities	Description
Advanced copper testing	will physically test each port from the Data Distribution Cables (DDC) to the switch for compliance to current standards, with customer approval.
	will use a network cabling certification tester, compliant to TIA/EIA TSB67 Level III specifications.
Advanced crossover and strait through(wide-networking)	install and manage all patch cords into the rack and organize them with a specific cable management system that allows for proper airflow in the rack
Basic copper testing	Perform a continuity port test and wire map of each port of the cables (digital mult meter)
Basic coaxial testing	Coaxial cable testing

Source:http://www.schneider-electric.com/ww/en/download/document/APC_TESS-6W9KFF_R1_EN_SRC?showAsIframe=true&xtmc=cable%20management%20statement&xtcr=1

Cabling System Documentation

The most often overlooked item during cable installation is the documentation of the new cabling system. Cabling system documentation includes information about what components make up a cabling system, how it is put together, and where to find individual cables.

This information is compiled in a set of documents that can be referred to by the network administrator or cabling installer any time moves, adds, or changes need to be made to the cabling system.

The most useful piece of cabling system documentation is the cabling map. Just as its name implies, a cabling map indicates where every cable starts and ends. It also indicates approximately where each cable runs. Additionally, a cabling map can indicate the location of workstations, segments, hubs, routers, closets, and other cabling devices. To make an efficient cabling map, you need to have specific numbers for all parts of your cabling system. For example, a single cable run from a cabling closet to wall plate should have the same number on the patch panel port, patch cable, wall cable, and wall plate. This way, you can refer to a specific run of cable at any point in the system, and you can put numbers on the cabling map to refer to each individual cable run.

Self-Check -5	Written Test

Directions: Answer all the questions listed below.

Instruction: - choose and write the letter of the correct answer on the space provided.

_____1. Which of the following statement is true about documentation? (3 points)

A.Improved system performance

B.Effective cable management can help

c. All

_____2. In documentation work_____ is the basic point (2 points)

A. planning

B. cable maintenance

C. Cable grouping

D. all

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Operation sheet 1– step-by-step: twisted-pair cable preparation and connector termination

Steps-by-step: twisted-pair cable preparation and connector termination

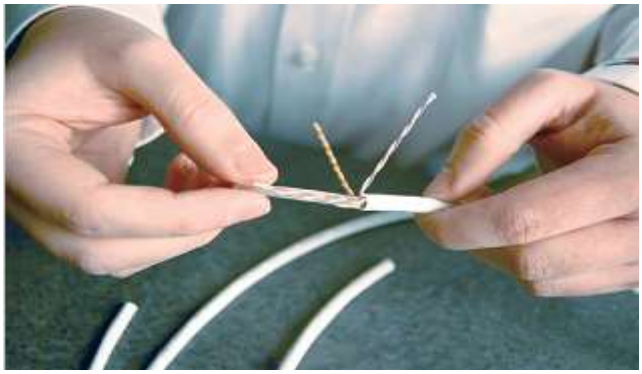
The following steps will guide you through the preparation and termination process for UTP cable. Following these guidelines will help give you the optimum performance from the twisted pair cabling. The following procedure elaborate the Cross over connection system.

Step 1:select appropriatehand tools used to terminate and connecttelecommunication apparatus:

Step 2: Insert data cable to stripper

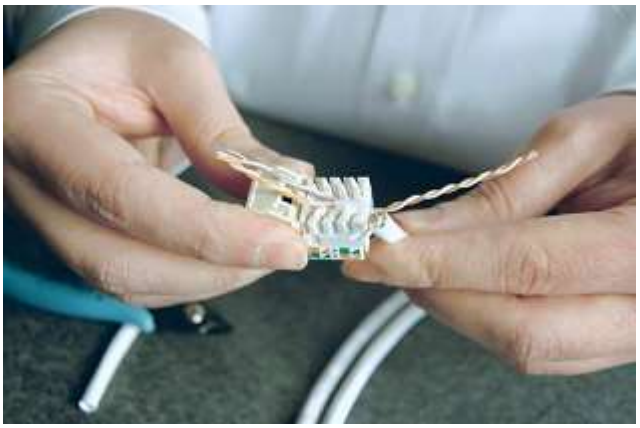
Step 3: Holding the cable near the tool

Step 4: Slightly bend the outer jacket and manually remove the cut piece or slide the cut outerjacket with the stripper.

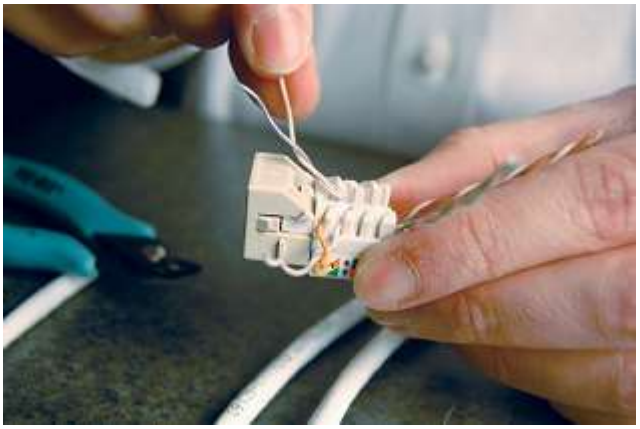


Step 5: Bend each pair in one direction

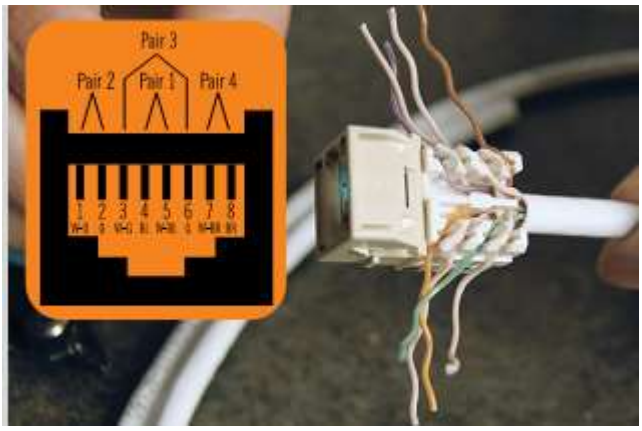
Step 6: Remove the rip cord, binder or cross web



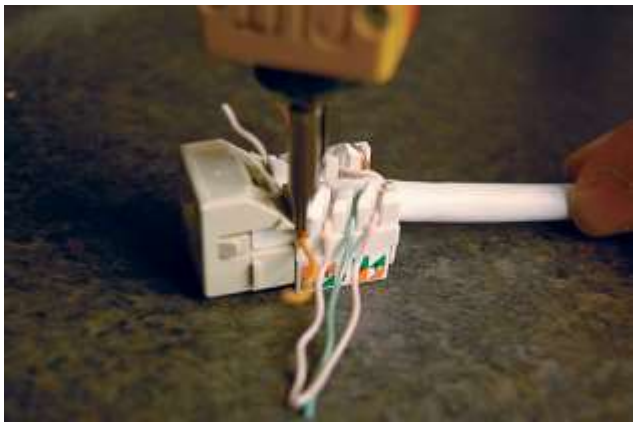
Step 7: Determine the wiring scheme in accordance with the corresponding color



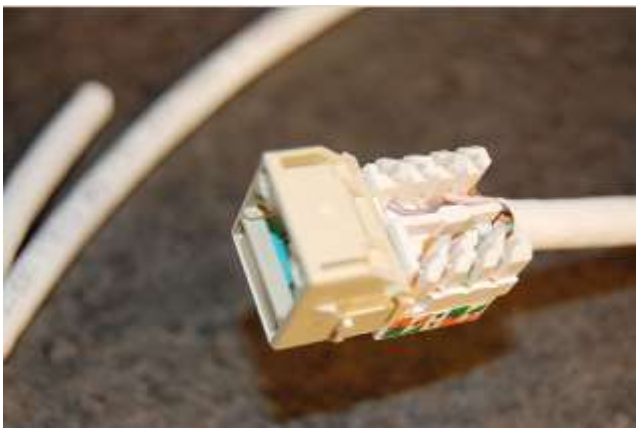
Step 8: Preserve the wire pair twists as close as possible to the point of termination.



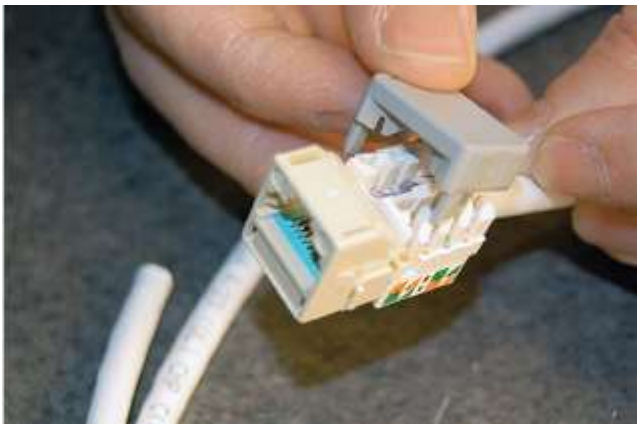
Step 9: Insert wires down into IDC terminal slots to position them before punching down.



Step 10: Make sure the cut-side of the tool is facing outward.

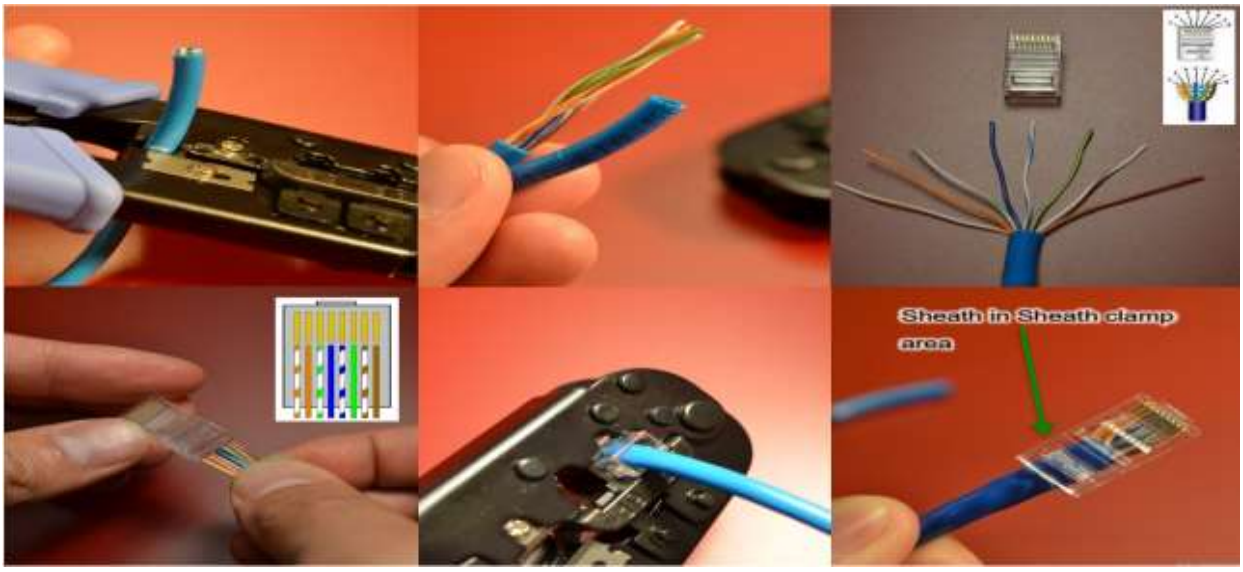


Step 11: Inspect the connector and cut properly.



Step 12: Place a dust cover on the jack for protection.

Step 13: This is how your assembled jack should look.



Lap Test	PracticalDemonstration

Name……ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

Task: 1. Prepare andconnecttwisted-pair cableconnectortermination?

Reference Materials

- Https//:commos.wikimedia.org/w/index
- https//:www.bicsi.org
- http://www/info.org/lan/htm
- http://www/info.org/rj-45.html
- http://www/info.org/twisted-pair.html
- http://www/info.org/crossover-cable.
- http://www.te.com/en/industries/enterprise-networks-north-america/partners/usndis.html.)

- (Source: **http://www.commerce.state.wi.us/SB/SB-DivCodesListing.html**)
- TelecommunicationGrounding Bonding
- ICTCBL2137B Install, maintain and modify customer premises communications cabling: ACMA Open Rules**& Bo**
- David Barnett David Growth Jim McBee Cabling: The Complete Guide to Network Wiring, Third Edition

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- **EIA-568A from Wikimedia Commons. Public Domain.**
- **EIA-568B from Wikimedia Commons. Public Domain.**
- **Network cable colors from PXHere. Public Domain**

AKNOWLEDGEMENT

We wish to extend thanks and appreciation to the many representatives of TVET instructors and respective experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

We would like also to express our appreciation to the TVET experts of Amhara Regional TVET bureau and Federal Technical and Vocational Education and Training Agency (FTVET) experts who made the development of this Teaching, Training and Learning Materials (TTLM) with required standards and quality possible.

This Teaching, Training and Learning Materials (TTLM) are developed on December 2020 at Adama Ethiopia.

The trainers who developed the learning guide

No	Name	Qualification	Educational background	Region	E-mail and contact number
1	ASSEN AHMED	B	Civil Engineering	Amhara	nuredinahmed999.na@gmail.com 0967670522
2	ABEL MOLLA	B	Electrical Communication	Amhara	mollaabel1@gmail.com 0911591900
3	BETELIHEM GIZACHEW	B	Electrical Engineering	Amhara	betelihemgiz@gmail.com 0931604585
4	EYAYA MULIE	B	Building construction Technology	Amhara	Eyaya4040@gmail.com 0918248937

TVET Coordinators

No	Name	Work position	Email and Tel.	Remark
1	TILAHUN TESFAYE	TVET Curriculum TTLM Expert	tilahuntesfayeewnetu@gmail.com 0940651823	
2	MULUKEN KASSAHUN	TVET Curriculum TTLM Expert	Muluk.last@gmal.Com 0910779269	

Installing and Maintaining Cabling for Multiple Access to Telecommunication Services

LO #1-Prepare to install and maintain cabling

Information Sheet 1- Identifying, obtaining and understanding OHS procedures

Self-check 1 Answer

1. C. All
2. F. all

Information Sheet 2- Identifying and establishing health and safety risks

Self-Check -2 Answer

Instruction I

1 C.Fire

Instruction II

1 Risk is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard.

Information Sheet 3- Identifying and establishing remote power feeding risk control Measures

Self-Check – 3 Answer

Instruction I

1. A.Elimination
2. B. Substitution

Instruction II

1. True

Information Sheet 4- Determining the nature and location of the work

Self-Check – 4 Answer

1. True
2. True

Information Sheet 5- Planning cable routes within the constraints

Self-Check -5 Answer

1. False
2. True

Information Sheet 6- Determining earthling requirements

Self-Check – 6 Answer

1. True
2. True
3. True

Information Sheet 7- Require advice from appropriate persons

Self-Check – 7 Answer

1. True
2. True
3. True

Information Sheet 8- Establishing sources of materials

Self-Check –8 Answer

1. True
2. True

Information Sheet 9- Obtaining and checking Tools, equipment and testing devices

Self-Check -9 Answer

Instruction I

1. True

Instruction II

1.D All

LO #2- Install and maintain cabling

Information Sheet 1- Following established OHS risk control measures and procedures

Self-Check – 1 Answer

1. True

2. False

Information Sheet 2- Checking installed support structure to the cable

Self-Check –2 Answer

1. True
2. True
3. True

Information Sheet 3- Securing catenaries supports to building structure

Self-Check -3 Answer

1. C All of them
2. D All

Information Sheet 4- Installing protective earthling of metal work

Self-Check – 4 Answer

1. True
2. False

Information Sheet 5- Handling cables/wires

Self-Check – 5 Answer

1. True
2. True

Information Sheet 6- Allowing sufficient excess at cable ends to facilitate termination

Self-Check -6 Answer

1. True
2. True

Information Sheet 7- Labeling telecommunication outlet ends of cable

Self-Check -7 Answer

- Aluminum Cable Trays. Cable trays manufactured with aluminum by cable tray manufacturers in India are known as aluminum cable trays
- Steel Cable Trays. Cable tray manufacturers also recommended using steel cable trays.

- Stainless Steel Cable Trays
- Ladder Type Cable Trays
- Solid Bottom Cable Trays

Information Sheet 8-Placing and securing cable

Self-Check -8 Answer

- Cut: Cut the base and cord cover to match the length you just measured.
- Mark anchor points: Use a pencil to mark the anchor points on the wall.
- Mount base:
- Lay the cables:
- Paint:

Information Sheet 9- Trimmed flush cable ties

Self-Check -9 Answer

1. A cable tie (also known as a hose tie, zip tie, or by the brand name Ty-Rap) is a type of fastener, for holding items together, primarily electrical cables or wires

Information Sheet 10- Installing cables as catenaries

Self-Check – 10 Answer

1 catenary is a system of overhead wires used to supply electricity to a locomotive, streetcar, or light rail vehicle which is equipped with a pantograph

Information Sheet 11- Fitting over-voltage protection devices to all cable pairs

Self-Check – 11 Answer

1. True

2. True

Information Sheet 12- Fitting Over-voltage protection device to all cable pairs earthed in accordance with standard

Self-Check – 12 Answer

1. True

Information Sheet 13- Protecting TRC/CES/Earth wire insulation against damage

Self-Check – 13 Answer

1. True

Information Sheet 14- Following procedures for referring non-routine events

Self-Check – 14 Answer

1. True

Information Sheet 15- Installing cabling without waste of materials and energy

Self-Check – 15 Answer

1. True

Information Sheet 16- Carrying out routine quality checks

Self-Check – 16 Answer

1. True
2. True

LO #3- Terminate and test cables and earth wires

Information Sheet 1- Follow established OHS risk control measures and procedures

Self-Check – 1 Answer

1. True
2. False

Information Sheet 2- Removing cable sheath

Self-Check – 2 Answer

1. True
2. False
3. False

Information Sheet 3- Installing terminating modules

Self-Check -3 Answer

1. True
2. False

Information Sheet 4- Terminating conductors

Self-Check -4 Answer

1. True
2. True
3. True

Information Sheet 5- Earthling cable shield

Self-Check -5 Answer

1. B. 5m
2. C. All

Information Sheet 6- Undertaking visual inspection to confirm termination color code

Self-Check -6 Answer

Instruction I

1. False
2. True

Instruction II

1, C All

Information Sheet 7- Testing and clearly labeling cable pairs to provide an accurate

Self-Check -7 Answer

1. C All
2. B 5
3. D All

Information Sheet 8- Terminating TRC/CES/Earth wires with connectors

Self-Check -8 Answer

1. A. CET
2. C. All

Information Sheet 9- Maintaining TRC/CES /Earth wire continuity

Self-Check -9 Answer

1. False

2. True

Information Sheet 10- Testing TRC/CES /Earthling installation for continuity, insulation Resistance and conductive resistance

Self-Check -10 Answer

1. True
2. False

Information Sheet 11- Labeling earthling system

Self-Check -11 Answer

1. True
2. False
3. True

Information Sheet 12- Confirming and Testing compatibility of alterations with existing Systems

Self-Check -12 Answer

1. **D All**
2. **D All**

Information Sheet 13- Following procedures for referring non-routine events

Self-Check -13 Answer

1. True
2. True

Information Sheet 14-Terminating cabling efficiently without waste of materials and Energy

Self-Check -14 Answer

1. True
2. False

Information Sheet 15- Carrying out routine quality checks

Self-Check -15 Answer

1. True

2. False

LO #4- Complete cabling work, records and reporting

Information Sheet 1- Following OHS work completion risk control measures and procedures

Self-Check -1 Answer

1. True

2. True

Information Sheet 2- Cleaning and making safe Work site

Self-Check -2 Answer

1. True

2. True

Information Sheet 3- Creating and storing record sheets and plans of cable

Self-Check -3 Answer

1. True

2. True

Information Sheet 4-Creating cable pair record books

Self-Check -4 Answer

1. **D All**
2. **D All**

Information Sheet 5- Documenting and reporting cabling completion

Self-Check -5 Answer

1. **C All**
2. **D All**