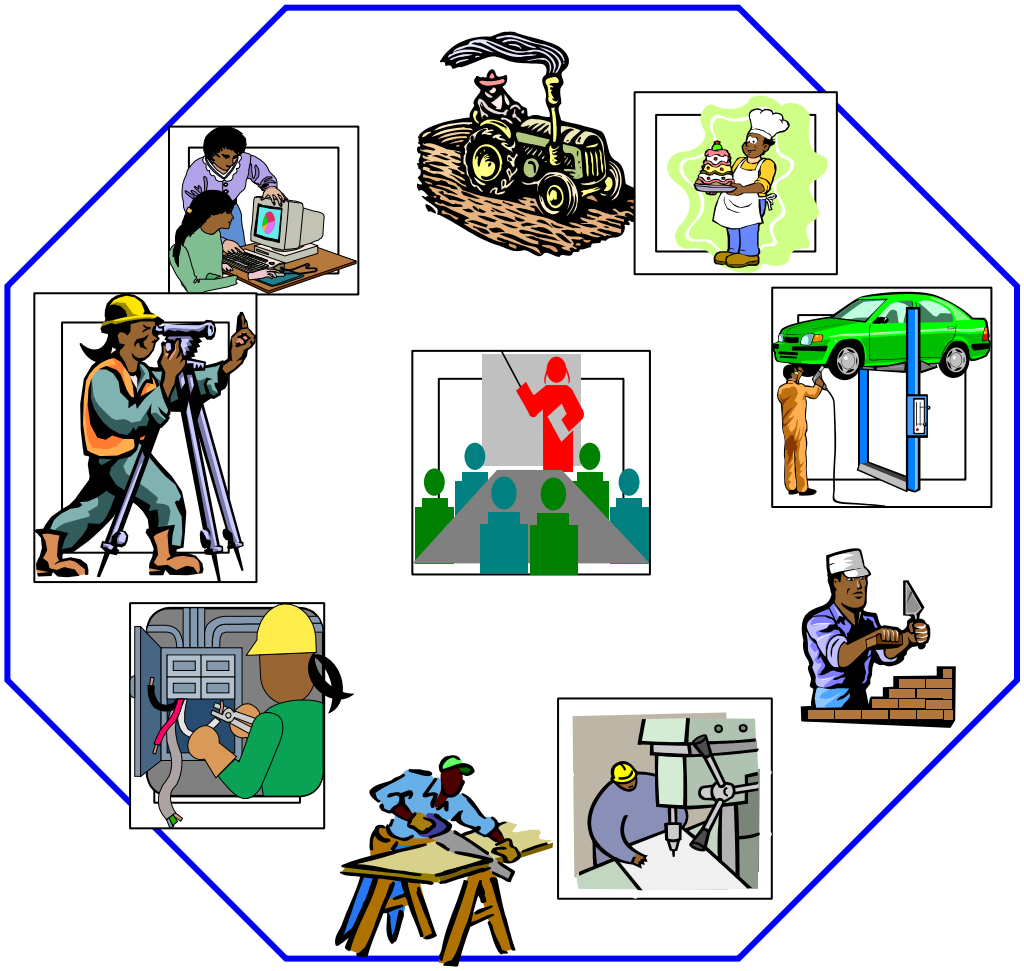
INSTRUMENTATION AND CONTROL SERVICING-III

Based on May 2011 V2 OS and Dec. 2020 V1 Curriculum



Module Title: **Installing Instrumentation and Control Devices**

LG Code: EEL ICS3 **M04 LO (1-4) LG (12-15)**

TTLM Code: EEL ICS3 **TTLM 1220 V1**

December 2020

Bishoftu, Ethiopia

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L #12	LO #1- Planning and Preparing Installation work

Instruction sheet

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

- Planning and preparing installation of OH&S policies and procedures
- Responding to Unplanned events or conditions
- Reading and interpreting work instructions
- Selecting tools, equipment and testing devices
- Obtaining materials necessary to complete the work

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:

- Planand prepare installation of OH&S policies and procedures
- Respond to Unplanned events or conditions
- Read and interpreting work instructions
- Select tools, equipment and testing devices
- Obtain materials necessary to complete the work

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,
   If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Planning installation's OH & S policies and procedures

Planning and preparing installation OH&S policies and procedures

Planning is **preparing** a sequence of action steps to achieve some specific goal. If a person does it effectively, they can reduce much the necessary time and effort of achieving the goal.

An organization's occupational health and safety policy is a statement of principles and general rules that serve as guides for action. The health and safety policy should have the same importance as the other policies of the organization.

Occupational safety and health (OSH) is generally defined as the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment.

Occupational Health and Safety or workplace health and safety, is about preventing work injury, illness and disease. It is the responsibility of all workers to identify potential hazards in the workplace and prevent injury.

1.1.1 OH & S guidelines

Regulatory Practices issues OHS Guidelines to help with the application and interpretation of sections of the Occupational Health and Safety Regulation ***("***OHSR***")*** *and with divisions of the* Workers Compensation *Act*s that relate to health and safety. Guideline is a statement by which to determine a course of action. Guidelines may be issued by and used by any organization (governmental or private) to make the actions of its employees or divisions more predictable, and presumably of higher quality. A guideline is similar to a rule. Occupational Health and Safety (OH&S) policy is a statement of principles and general rules that serve as guides for action. Senior management must be committed to ensuring that the policy is carried out with no exceptions. The health and safety policy should have the same importance as the other policies of the organization.

The policy statement can be brief, but it should mention:

- Management's commitment to protect the safety and health of employees.
- The objectives of the program.

- The organization's basic health and safety philosophy.
- Who is accountable for occupational health and safety programs?
- The general responsibilities of all employees.
- That health and safety shall not be sacrificed for expediency.
- That unacceptable performance of health and safety duties will not be tolerated.

The objective of this issuance is to protect every workingman against the dangers of injury, sickness or death through safe and healthful working conditions, thereby assuring the conservation of valuable manpower resources and the prevention of loss or damage to lives and properties, consistent with national development goals and with the State's commitment for the total development of every worker as a complete human being. Occupational safety and health, including compliance with the OSH requirements pursuant to national laws and regulations, are the responsibility and duty of the employer. The employer should show strong leadership and commitment to OSH activities in the organization, and make appropriate arrangements for the establishment of an OSH management system. The system should contain the main elements of policy, organizing, planning and implementation, evaluation and action for improvement, as shown in figure bellow

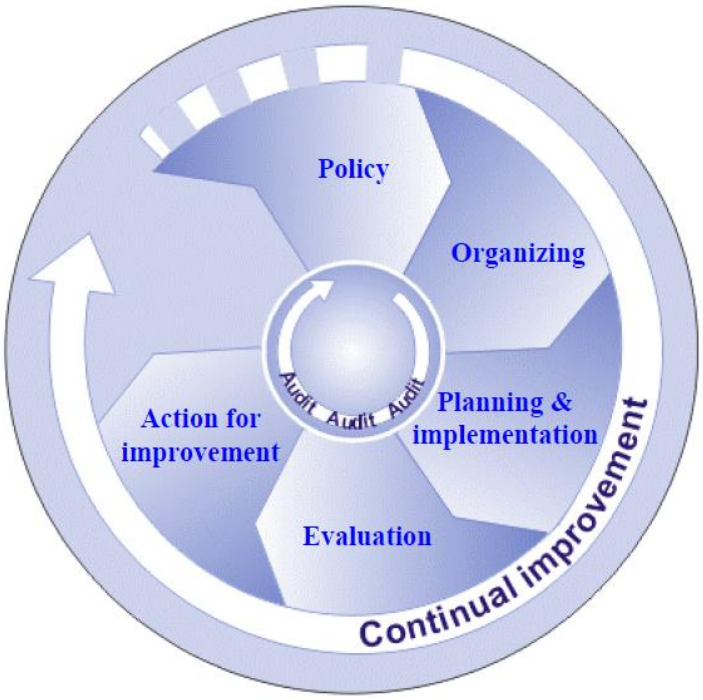


Figure1.1. Planning and implementing policies

The Occupational Health and Safety Regulations (OHS Regulations) build on the OHS Act. They set out how to fulfill duties and obligations, and particular processes that support the OHS Act. For example, they include requirements for:

- safe operation of major hazard facilities and mines
- training for high risk work

- managing and removing asbestos
- licenses for specific activities

Your responsibilities
You must also comply with the legislation. You have responsibilities to:

- protect your own Health and Safety and that of your co-workers;
- not initiate or participate in the harassment of another worker; and
- Co-operate with your supervisor and anyone else with duties under the legislation.

Your rights
The legislation gives your three rights:

- The right to know the hazards at work and how to control them;
- The right to participate in Occupational Health and Safety; and the right to refuse work which you believe to be unusually dangerous.

You may not be punished for using these rights. An employer can be required to legally justify any action taken against a worker who is active in Health and Safety.
If you are inexperienced, you must receive an orientation which includes;

- What to do in a fire or other emergency;
- First aid facilities;
- Prohibited or restricted areas;
- Workplace hazards; and
- Any other information you should know.

You must also be supervised closely by a competent supervisor.

Committees Have Duties To:

- Regularly inspect the workplace;
- Conduct accident investigations;
- Deal with the Health and Safety concerns of employees;
- Investigate refusals to work;

Your right to refuse
You have the right to refuse to do work which you believe is unusually dangerous. The unusual danger may be to you or to anyone else. An unusual danger could include such things as:

- a danger which is not normal for your occupation or the job;
- a danger under which you would not normally carry out your job; and/or
- a situation for which you are not properly trained, equipped or experienced.

1.1.2 Ethiopia environmental standards

Environmental Standard

Environmental standards are administrative regulations or civil law rules implemented for the treatment and maintenance of the environment. Environmental standards are set by a government and can include prohibition of specific activities, mandating the frequency and methods of monitoring, and requiring permits for the use of land or water.Standards differ depending on the type of environmental activity.

Environmental standards produce quantifiable and enforceable laws that promote environmental protection. The basis for the standards is determined by scientific opinions from varying disciplines, the views of the general population, and social context. As a result, the process of determining and implementing the standards is complex and is usually set within legal, administrative or private contexts.

The human environment is distinct from the natural environment. The concept of the human environment considers that humans are permanently interlinked with their surroundings, which are not just the natural elements (air, water, and soil), but also culture, communication, co-operation, and institutions. Environmental standards should preserve nature and the environment, protect against damages, and repair past damage caused by human activity.

Note

- **Statutory** laws and regulations are written in a legal framework; some don't actually tell us how to comply with the laws at an everyday level.
- **Non-statutory regulations** and codes of practice interpret the statutory regulations, telling us how we can comply with the law.

Ethiopian environmental policies

WHEREAS, environmental impact assessment is used to predict and manage the environmental effects which a proposed development activity as a result of its design sitting, construction, operation, or an ongoing one as a result of its modification or termination, entails and thus helps to bring about intended development;

WHEREAS, assessment of possible impacts on the environment prior to the approval of a public instrument provides an effective means of harmonizing and integrating environmental, economic, cultural and social considerations into a decision making process in a manner that promotes sustainable development,

WHEREAS, the implementation of the environmental rights and objectives enshrined in the Constitution would be fostered by the prediction and management of likely adverse environmental impacts, and the maximization of their socioeconomic benefits.

WHEREAS, environmental impact assessment serves to bring about administrative transparency and accountability, as well as to involve the public and, in particular, communities in the planning of and decision taking on developments which may affect them and its environment;

Definitions

In this Proclamation:

1) "Authority" means the Environmental Protection Authority;
2) "Environment" means the totality of all materials whether in their natural state or modified or changed by human; their external spaces and the interactions which affect their quality or quantity and the welfare of human or other living beings, including but not restricted to, land atmosphere, whether and climate, water, living things, sound, odor, taste, social factors, and aesthetics;
3) "Environmental Impact Assessment" means the methodology of identifying and evaluating in advance any effect, be it positive or negative, which results from the implementation of a proposed project or public instrument;
4) "Impact" means any change to the environment orto its component that may affect human health of safety, flora, fauna, soil, air: water, climate, natural or cultural heritage, other physical structure, or in general, subsequently alter environmental, social, economic or cultural conditions;
5) "Licensing Agency" means any organ of government empowered by law to issue an investment permit or a trade or operating license or a work permit or to register a business organization, as the case may be;
6) "Person" means any natural or juridical person;
7) "Pollutant" means any substance whether liquid, solid or gas which directly or indirectly:
   a) Alters the quality of any part of the receiving environment so as to affect its beneficial use adversely, or
   b) Produces toxic substances, diseases, objectionable dour, radioactivity, noise, vibration, heat, or any other phenomenon that is hazardous or potentially hazardous to human health or to other living things.
8) "Project" mans any new development activity under any category listed in any directive issued pursuant to this Proclamation, major expansion or alteration or any existing undertaking, or any resumption of work that had been discontinued;

5.*Projects Requiring Environmental Impact Assessment*

1) Every project which falls in any category listed in any directive issued pursuant to this Proclamation shall be subject to environmental impact assessment.
2) Any directive provided under Sub Article 1 of this Article shall, among other things, determine Categories of:

(a) Projects not likely to have negative impacts, and so do not require environmental impact assessment;

(b) Projects likely to have negative impacts and thus require environmental impact assessment.

Self-check-1

Directions: Answer the following questions depending on the context of information that you read. Submit the Answer sheet to your trainer and take correction if any.

1. What is OH&S planning? (**2** points)
2. What is the merit of OH&S planning? Write at least 5 things (**10** points)
3. What are health and safety policies means? (**2** points)
4. Occupational safety and health (OSH) regulation is _____ (**2** points)
5. _____is a statement (boundary) by which to determine a course of action. (**2** points)
6. _____assessment serves to bring about administrative transparency and accountability. (**2** points)
7. _____is the laws and regulations are written in a legal framework; some don't actually tell us how to comply with the laws at an everyday level. (**2** points)
8. What is the responsibility of workers during activity? (**1** points)
   a) Protecting himself from hazard
   b) Protecting coworkers from hazard
   c) During protecting properties work from hazard
   d) Asking and understanding cause of hazard
   e) All of them are correct
9. _____is administrative regulations or civil law rules implemented for the treatment and maintenance of the environment**.** (**1** points)
   a) Occupational health & Safety
   b) Environmental standard
   c) air, water, and soil
   d) all
10. Someone who has the necessary technical skills training and experience to safely carry out a particular activity is said to be a_____. (**1** points)
    a) legal contract
    b) risk
    c) hazard
    d) competent person

Answer the following question!	
Note: Satisfactory rating – 13 and 25 points	Unsatisfactory - below 13 and 25points

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

1._____

2.

- ✍ _____
- ✍ _____
- ✍ _____
- ✍ _____
- ✍ _____
- ✍ _____
- ✍ _____

3.

- ✍ _____

4.

- ✍ _____

5.

- ✍ _____

6. _____

7. _____

8.

- ✍ _____

Answer Sheet

Name: _____ Date: _____

Information Sheet-2:- Responding to Unplanned events or conditions

1.2 Responding to Unplanned events or conditions

Unplanned events are accidents or upset events or conditions that are not planned as a part of routine Project activities during any Project phase. Even with the planning and application of mitigation, accidents, malfunctions, and unplanned events could occur during any phase of the Project. These could occur as a result of abnormal operating conditions, wear and tear, human error, equipment failure, and other possible causes.

Many accidents, malfunctions, and unplanned events are preventable and can be readily addressed or prevented by good planning, design, equipment selection, hazards analysis and corrective action, emergency response planning, and mitigation.

The focus is on credible accidents that have a reasonable probability of occurrence, and for which the resulting residual environmental effects could be major without careful management.

It is noted that accidents, malfunctions, and unplanned events are evaluated individually, in isolation of each other, as the probability of a series of accidental events occurring in combination with each other is very minimal. These possible events, on their own, generally have a very low probability of occurrence and thus their environmental effects are of low likelihood. They have an even lower probability or likelihood of occurring together – thus their combination is not considered credible, nor of any measurable likelihood of occurrence.

Accidents, malfunctions, and unplanned event scenarios have been conservatively selected that represent higher consequence events that would also address the consequences of less likely or lower consequence scenarios.

The accidents, malfunctions, and unplanned events that have been selected based on experience and professional judgment are as follows:

- Worker accident: worker accidents may occur during either construction or operation, and may result in harm, injury, or death to one or more Project workers;
- Fire: consists of a fire in a Project component. The focus is on the consequence, and not the mechanism by which it occurs;

- Hazardous materials spill: spills of fuel, petroleum products, and/or other chemicals used on site or in Project components; and
- Vehicle accident: Project-related vehicle accidents that could occur on the road transportation network.

A **fault**s not a natural occurrence; it is an unplanned event which occurs unexpectedly. The fault in an electrical installation or piece of equipment may because by:

- Negligence – that is, lack of proper care and attention;
- Misuse – that is, not using the equipment properly or correctly;
- Abuse – that is, deliberate ill-treatment of the equipment.

Unplanned events can be reduced or answered through the following action plan:-

The main goal of safety and health programs is to prevent workplace injuries, illnesses, and deaths, as well as the suffering and financial hardship these events can cause for workers, their families, and employers. The recommended practices in managing workplace safety and health will be:-

a) Safety and Health program

What does *Safety Program* mean? -Safety programs provide guidelines that direct procedures and include checklists that can make work environments safer by preventing mishaps. Workers are required to know safety procedures that need to be followed in their specific department or area.

Safety programs can cover a range of procedures from repairs and maintenance to office space safety and even tips on identity fraud and the safe use of chemicals. OSHA has put forth requirements as a guide to aid in the developing and implementing of a safety program for each workplace. A safety program can only be effective if there has been prior analysis of the work environment and an employee orientation.

Hazard Control

Hazard control refers to workplace procedures adopted to minimize injury, reduce adverse health effects and control damage to plant or equipment. Hazard control practices are often standardized and taught to managers and safety personnel in a given industry.

Hazard control procedures vary from organization to organization and also from job to job. But even then some of the procedures can be adopted generally in every job to protect the health of workers. A worker is exposed to a number of hazards at work. For example, a

worker working in extreme hot temperatures is more likely to get dehydrated, while a worker working high above the ground is at risk of falls. Hazards are often controlled via what's called the hierarchy of hazard control.

This consists of a list of measures in decreasing order of effectiveness:

1. **Elimination**: This involves elimination of the hazard. It is the most effective measure, but may not always be possible. For example, working at heights may be a required part of some jobs.
2. **Engineering Controls:** This involves modifying the plant or equipment so that the associated hazards are reduced. For example, a plant might add a ventilation system.
3. **Administrative Control:** This involves changing the way in which a particular type of work is carried out. This is achieved by changing the timing of the work and/or changing policies and procedures.

b) Personal protective equipment

Personal protective equipment (PPE)is defined as all equipment designed to be worn, or held, to protect against a risk to health and safety. This includes most types of protective clothing, and equipment such as **eye**, **foot** and **head**, ears, lungs, torso, hands and **feet**, protection, safety harnesses, life jackets and high visibility clothing. Additionally, protection from falls may need to be considered. Objects falling from a height present the major hazard against which head protection is provided. Other hazards include striking the head against projections and hair becoming entangled in machinery. Typical methods of protection include helmets, light duty scalp protectors called ‘bump caps’ and hairnets.

c) Flammable and combustible materials

A combustible material is a solid or liquid than can be easily ignited and burned. Flammable and combustible liquids vaporize and form flammable mixtures with air when in open containers, when leaks occur, or when heated. To control these potential hazards, several properties of these materials, such as volatility, flashpoint, and flammable range and auto ignition temperatures must be understood. Information on the properties of a specific liquid can be found in that liquid’s safety data sheet (SDS), or other reference material.

Flammable liquids in pressurized containers may rupture and aerosolize when exposed to heat, creating a highly flammable vapor cloud. As with flammable liquids, these should be stored in a flammable storage cabinet.

Flammable solids often encountered in the laboratory include alkali metals, magnesium metal, metallic hydrides, some organometallic compounds, and sulfur. Many flammable solids react with water and cannot be extinguished with conventional dry chemical or carbon dioxide extinguishers. Removing these flammable materials we can respond to nplaned events that we want to avoid.

d) Portable (power operated) tools and equipment

Hand and power tools are a common part of our everyday lives and are present in nearly every industry. These tools help us to easily perform tasks that otherwise would be difficult or impossible. However, these simple tools can be hazardous and have the potential for causing severe injuries when used or maintained improperly. Special attention toward hand and power tool safety is necessary in order to reduce or eliminate these hazards.

Hand tools are tools that are powered manually. Hand tools include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance.

Some examples include the following:

- If a chisel is used as a screwdriver, the tip of the chisel may break and fly off, hitting the user or other employees.
- If a wooden handle on a tool, such as a hammer or an axe, is loose, splintered, or cracked, the head of the tool may fly off and strike the user or other employees.
- If the jaws of a wrench are sprung, the wrench might slip.
- If impact tools such as chisels, wedges, or drift pins have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying toward the user or other employees.

The employer is responsible for the safe condition of tools and equipment used by employees. Employers shall not issue or permit the use of unsafe hand tools. Employees should be trained in the proper use and handling of tools and equipment.

When using saw blades, knives, or other tools, should direct the tools away from aisle areas and away from other employees working in close proximity. Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones. Cracked saw blades must be removed from service.

Wrenches must not be used when jaws are sprung to the point that slippage occurs. Impact tools such as drift pins, wedges, and chisels must be kept free of mushroomed heads. The wooden handles of tools must not be splintered.

Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials should be used where flammable gases, highly volatile liquids, and other explosive substances are stored or used.

e) Powder-Actuated Tools

Many hazards are involved in using these tools. These include the following:

- Flying particles of dirt or scale, or particles discharged from the work surface the stud enters.
- Using too heavy a charge for the material. This can result in the stud being shot completely through the work.
- Studs ricocheting if the tool is not held properly or is being used on too hard a material.
- Fire hazards from using the tool when flammable or explosive dust or fumes are present.
- Using the tool powder charges in fire arms or using firearm blanks in powder-actuated tools.

Before Using:- Test the tool each day before loading to see that the safety devices are working. Follow the manufacturer's test methods. If the tool does not work properly, do not use it until it has been properly repaired. Inspect the tool before using to ensure that it is clean, all moving parts operate freely, and the barrel is free from obstructions. Make a thorough study of each job. Know the types of materials you'll be driving into, so that you can select the proper stud and cartridge. Also know what is on the other side of a wall as well as what is inside it, such as electric wires and pipes or wire chases.

Tool Handling:-

- Never point the tool at anyone. Don't let bystanders stand too close to the operator.
- Clear people from the area on the other side of partitions being worked on
- Don't fire studs into cast iron, high carbon or tempered steel, armor plate, rock, glazed brick, tile, or glass.
- Load immediately before firing only. Never carry a loaded tool from one job to another.
- Always wear adequate eye protection when using these tools. This applies to both you and your helpers.
- Hold the tool perpendicular to the work surface.
- Don't try to start too close to the edge of the work surface. There is a chance of material cracking or spalling. Unless the tool manufacturer recommends otherwise, minimum edge distances of one inch for steel and six inches for concrete are suggested.
- Never place your hand over the muzzle of a loaded tool. Don't rest the tool against your body when loading or making adjustments.
- Don't drop or throw powder-actuated tools. The chance of accidental discharge is great.
- Never fire close to or through pre-drilled holes. This can cause the fastener to ricochet.
- Always keep powder-actuated tools, studs, and cartridges in a safe place when not in use, preferably under lock and key. Don't leave tools or accessories unattended, even for a short period of time.

The charges are much more powerful than firearm loads and should be used only in powder-actuated tools.

f) Lockout/Tag out procedures

Lockout/tag out" refers to specific practices and procedures to safeguard that anyone who work in electrical and instrumentation must do during his activity to avoid hazard that can occur from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

A lockout/tag out program will help prevent: Contact with a hazard while performing tasks that require the removal, by-passing, or deactivation of safe guarding devices. The

unintended release of hazardous energy (stored energy). The unintended start-**up** or motion of machinery, equipment, or processes

g) Electrical

An electrical hazard is a dangerous condition where a worker can or does make electrical contact with energized equipment or a conductor. From that contact, the person may sustain an injury from shock, and there is a potential for the worker to receive an arc flash (electrical explosion) burn, thermal burn or blast injury.

Electricity can either be "static" or "dynamic". Dynamic electricity is the uniform motion of electrons through condition (electric current). Static electricity is the accumulation of charge on surfaces as a result of contact and friction with another surface.

The aim of this program is to provide comprehensive on-site training to high-risk workers (i.e. skilled trades and maintenance workers) and management on the requirements of Sub Part S, and the prevention of serious injuries from electrical hazards at their worksites. Participants will develop understanding of the requirements of OSHA to identify and reduce or eliminate electrical safety hazards in their workplace. Electrical Safe Work Practices including electrical safety principles, guidelines for qualification of personnel, job planning requirements and Management and Personal Responsibility will be covered.

h) Walking – working surfaces

A walking-working surface is any horizontal or vertical surface on or through which a worker walks, works, or gains access to a work area. The rules apply to walking-working surfaces in all general industry workplaces. Walking and working surfaces, such as floors, stairs and ladders, are associated with slip, trip and fall accidents.

- the study shows that in USA 80 workers are injured every day because of a falls(1 every 20 minutes)
- 17,000 lost-time injuries are due to falls in the workplace each year
- Same-level slips and falls account for 65% of all fall injuries (WSIB, 2013). If you need to work at heights specific training is required.

Accident Causes

The following are some walking and working surface conditions that contribute to slip, trip and fall incidents:

- Movement of underfoot surfaces (e.g., mats or ladders).
- Collapse or breakage of support structures (e.g., floorboards, duckboards, ladder rungs, scaffolding or climbing/cradle ropes).
- **Floor surfaces** – holes or depressions in floors, slopes, loose flooring, protruding objects, uncovered drains or pits, curbs, bent floor boards or plates, loose or poorly fitted grating, sagging floor supports, poor drainage.
- Slippery floor surfaces because of composition, age, finish, or lack of maintenance.
- Sudden change in traction brought about by walking from one floor surface (e.g., carpeted floor) to another (e.g., tiled floor).
- **Stairs** – steep, irregular treads, missing or worn treads, clutter, no handrails, poor or uneven lighting, glare from windows, distraction (e.g., signs or posters) in the area of the stairwell, doors that block the stairs when open.

i) Walkways

Sidewalks and walkways are “pedestrian lanes” that provide people with space to travel within the public right-of-way that is separated from roadway vehicles. They provide places for children to walk, run, skate, ride bikes, and play. The aisles and passageways must be kept clear enough to allow the equipment to maneuver. This standard, similar to the housekeeping standard, also requires that aisles and passageways be kept clear and in good repair to prevent accumulation of anything that might cause a hazard. It also requires permanent aisles to be marked.

Aisles and passageways

- Where mechanical handling equipment is used, sufficient safe clearances shall be allowed for aisles, at loading docks, through doorways and wherever turns or passage must be made. Aisles and passageways shall be kept clear and in good repairs, with no obstruction across or in aisles that could create a hazard.
- Permanent aisles and passageways shall be appropriately marked.

Housekeeping is a way to eliminate many the many hazards often cited as violations of the General Duty Clause (blocked entrances and exits; sticking doors; slip, trip and fall hazards; lack of or improperly stocked first aid kit; cuts & lacerations from bent/protruding objects on walls/floors;). Good housekeeping reduces injuries and accidents, improves morale, reduces fire potential, and can even make operations more efficient.

j) Floor and Wall Openings

Floor opening: an opening measuring 12 inches or more in its least dimension, in any floor, platform, pavement, or yard through which persons may fall; such as a hatchway, stair or ladder opening, pit or large manhole. Floor openings occupied by elevators, dumb waiters, conveyors, machinery, or containers are excluded from this subpart.

- **Handrail:** a single bar or pipe supported on brackets from a wall or partition, as on a stairway or ramp, to furnish persons with a handhold in case of tripping.
- **Platform:** a working space for persons, elevated above the surrounding floor or ground; such as a balcony or platform for the operation of machinery and equipment.
- **Runway:** a passageway for persons, elevated above the surrounding floor or ground level, such as a footwalk along shafting or a walkway between buildings.
- **Standard railing:** a vertical barrier erected along exposed edges of a floor opening, wall opening, ramp, platform or runway to prevent falls of persons.

k) Stairs and Stairways

Stairs of all types have been used since ancient times, and because they are inherently **hazardous**, people have been falling on them, getting hurt or even killed in the process. Because stairway accidents can cause severe injury and even death, building codes for stairs and ramps are justifiably very rigorous. Good design can substantially reduce the potential for miss-stepping by providing us with the means to retrieve our balance, but even the best design cannot eliminate falling hazards entirely. The need for proper design also applies to ramps. The fact is that some incidents can be caused by inattention, unsafe behavior, and inappropriate footwear.

The best approach to minimize the hazard of falling down stairs is to encourage the building of well-designed stairways, combined with training focused on raising our awareness of the potential for disaster.

l) Elevated Surfaces

Do you work on or near elevated surfaces such as excavations, pits, unprotected edges, roofs, ramps, etc., or work at a height above dangerous equipment? If so, you may be at

risk of injury or death from a fall. In fact, falls from elevated surfaces are one of the leading causes of occupational injury and death in the world.

A fall hazard is anything in the workplace that could cause an unintended loss of balance or bodily support and result in a fall. Fall hazards cause accidents such as the following:

- A worker walking on top of an elevator to return to the inside of the elevator falls off unguarded side into the elevator shaft.
- A makeshift scaffold with no rails or fall protection results in a 5 foot fall leaving one dead.
- A worker falls through a 60” open pipe 30’ to his death.

m) Hazard communication

Hazard communication, also known as HazCom, is a set of processes and procedures that workers and importers must implement in the workplace to effectively communicate hazards associated with chemicals during handling, shipping, and any form of exposure. Here’s what you need to know about hazard communication, including regulations, Safety Data Sheets (SDS), and label requirements.

Safety data sheets must provide comprehensive information about substances and mixtures used in workplaces. It’s worth noting that OSHA’s HazCom Standard refers to the GHS safety data sheets as material safety data sheets, or MSDS. They are an informational source about hazards and include safety precautions. They also assist employers in developing active programs for worker protection measures and training that are specific to the workplace and in considering the necessary measures for protecting the environment.

One of the major changes to the Hazard Communication Standard is the 16-section format of safety data sheets. The information in a safety data sheet must appear in this order:

- Identification
- Hazard(s) identification
- Composition/information on ingredients
- First-aid measures
- Fire-fighting measures
- Accidental release measures
- Handling and storage

- Exposure controls/personal protection
- Physical and chemical properties
- Stability and reactivity
- Toxicological information
- Ecological information
- Disposal considerations
- Transport information
- Regulatory information
- Other information

All the above list show that the hazard communication.

Self-check-2

Directions: Answer the following questions depending on the information that you read.

1. _____is accidents or upset events or conditions that are not planned as a part of routine Project activities during any Project phase.
    a. Occupational Safety
    b. Unplanned event
    c. Work environment
    d. Policy and strategy
    e. Planned event
    f. All are correct
2. Safety and health pro is to prevent workplace_____.
    a) disturbance
    b) cost
    c) waste
    d) injuries
    e) none of the above
3. The chances of harm actually being done is one definition of:
    a) electricity
    b) risk
    c) health and safety
    d) hazard.
4. Which of the following plan can serve to responded to unplanned events?
    a) using PPE
    b) safety and health program
    c) disposing waste materials
    d) lockout and tag out
    e) all are correct
5. Which of the following can be a sudden response of unplanned events?
    a) Use of fire extinguisher
    b) Budgeting to avoid hazard
    c) Wearing PPE
    d) Attending Training

e) all are answers

6._____ refers to workplace procedures adopted to minimize injury, reduce adverse health effects and control damage to plant or equipment.

a) work procedure

b) Hazard control

c) hand tools

d) manual

e) all are correct

7. _____is a solid or liquid that can be easily ignited and burned.

a) combustible materials

b) negligence

c) rushing up

d) metallic substance

Answer the following question!	
Note: **Satisfactory rating - 8 and 14 points**	**Unsatisfactory - below 8 and 14 points**

Answer Sheet

Name: _____ Date: _____

Information Sheet - 3: Reading and interpreting work instructions

1.3 Reading and interpreting work instructions

Instruction can be detailed directions about how to do something or it may any type of sequence of steps to be followed, as in doing, using, or operating something. Instruction is vital for education, as it is the transfer of learning from one person to another. Any time you are given directions or told how to do something you are receiving *instruction*.

Instruction was defined previously as the purposeful direction of the learning process" and is one of the major teacher class activities (along with planning and management).

Instruction can be developed in a variety of models. Each designed to produce classroom learning. Each model differs in the specific type or measure of learning that is targeted. Therefore, as we make decisions about "best educational practices" we must be certain that we connect recommended practices with specific desired outcomes.

Another important point is that the different models and methods of instruction have been developed based on specific interpretations of concepts and principles of teaching and learning. While it is important to learn and practice the approaches developed by others, it is even more important to understand the concepts and principles upon which they are based.

What Is the Importance of Following Instructions?

Following instructions is important to make tasks simpler, to ensure things are done effectively, to eliminate confusion and to save time. When instructions are properly followed, things work well. People who follow instructions show that they are cooperative, intelligent and dependable, while not following instructions can lead to life and death situations that may end tragically.

When people do not follow instructions properly, it can cause chaos and great frustration in any type of environment. In order to follow instructions, a person must listen well, read carefully and ask questions if necessary. When a person does not follow instructions, he finds that finishing tasks is much more difficult. If a single person on a team does not adhere to instructions, then the entire team suffers on some level. Tasks that are done

properly the first time do not have to be redone, so one saves time and effort by following instructions each time a task is tackled.

Following instructions can preserve one's health and well being, and it is a necessary skill for a quality life. Rules are necessary for every well-functioning society. Professionals that do not follow instructions place themselves and other people at a greater risk for injury and death. Opportunities for advancement are limited, and clashing with others becomes inevitable when a person does not care to heed instructions.

Instructional Strategies

There are a variety of instructional strategies teachers can choose to accomplish learning objectives. Whichever instructional method used by the teacher to create the desired learning environment, it should be associated with a specific activity in which the teacher uses to enhance learning outcomes.

a) **Direct instruction**: -The Direct instruction strategy is highly teacher-directed and is among the most commonly used. This strategy is effective for providing information or developing step-by-step skills.
b) **Indirect instruction: -**In indirect instruction, the role of the teacher shifts from lecturer/director to that of facilitator, supporter, and resource person.
c) **Independent study: -**Independent study refers to the range of instructional methods which are purposefully provided to foster the development of individual student initiative, self-reliance, and self-improvement.
d) **Interactive instruction: -**Interactive instruction requires discussion and sharing among participants. Students can learn from peers and teachers in order to develop social skills and abilities, to organize their thoughts, and to develop rational arguments.

Dear trainees! Following instructions are an important ability to practice in everyday life. Within an academic setting, following instructions can influence grades, learning subject matter, and correctly executing skills so please follow instruction before doing anything during your trainings.

Self-check – 3

Choose the correct answer from the given alternative. And submit the answer to our trainer.

1. What is instruction?
   a) The job that we are going to do
   b) The activity we Lear from
   c) The reference of job
   d) detailed directions to be followed
   e) all
2. What is importance of following instructions?
   a) it make tasks simpler
   b) it shows the direction
   c) it save time of work
   d) it make decisions easy
   e) all
3. Which of the following is a type of instruction?
   a) Direct instruction
   b) indirect instruction
   c) Independent study
   d) Interactive instruction
   e) All
4. _____is instruction methods which foster individual initiative.
   a) communication instruction
   b) direct instruction
   c) independent instruction
   d) interactive instruction
   e) all

Answer the following question!	
Note: **Satisfactory rating - 4 and 8 points**	**Unsatisfactory – below 4 and 8 points**

Answer Sheet

Name: _____ Date: _____

Information sheet -4: Selecting tools, equipment and testing devices

1.4 Selecting tools, equipment and testing devices

Dear Trainees! Do you know the equipment, tools, and testing devices that you use in your occupation?

Equipments are physical resources serving to equip a person or thing they are used to implements an operation or activity. Sometimes testing device are called testing instrument or equipment they in electrical electronics they may include multimeter, oscilloscope, meggere/insulation tester, clamp on ammeter……etc. Generally different types of electrician tools are provided this in context it includes electronics testing devices. Please tell to your Trainer with their appropriate application and specific types.

a) Testing and measuring instruments or devices
b) Cutting and Sharpening tools
c) Hammering tools
d) Loosing and tightening tools
e) Soldering tools
f) Drilling tools
g) Measuring tools

Selecting Healthy Hand Tools

Choosing the right hand tool for a job can protect workers from painful injuries and improve productivity at the same time. Everyone has heard the saying; “the right tool for the right job”, and “you are only as good as your tools.” These sayings are very true when it comes to the choice and use of tools in the in electrical/electronic or engineering field. The proper selection of tools, devices, equipment, mechanisms, resources and utilization for proper activity will justify the job quality and completion of your task at proper time.

Ergonomics advantage

Ergonomics often is described as matching human capabilities (physical, psychological, physiological and biomechanical) to the demands of a specific task. The risk-injury relationship often is described as an exponential relationship. Using ergonomics principles to reduce job risk factors not only decreases the injury risk but often increases the efficiency and quality of a job and improves the overall productivity.

Workers should be trained on safe procedures for working with tools. However, safe practices when carrying or storing those tools may not be thoroughly covered. Tools can pose a safety risk when they are misplaced or improperly handled by workers. The National Safety Council offers the following tips for safe handling of tools when they are not in use

When there is a mismatch in some of these requirements, one of the consequences may be the development of musculoskeletal injuries. The common occupational risk factors for the development of an Musculoskeletal disorders (MSD) are the application of excessive force, high repetition, awkward postures, long task durations and static loading of the muscles. The level of injury risk depends on both the frequency and severity of risk factors present in a task.

Importance of using the right tool for the job – 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.

Never adapt if you are missing a tool or piece of equipment. Remember tools are designed for specific needs and purposes. Using any tool inappropriately is wrong and just plain dangerous. To avoid personal injury and tool damage, select the proper tool to do the job well and safely.

The **Tools can be classified into two types**

1. The **first type of tool** is the physical device that employees directly use to complete a task correctly. This can include carpentry equipment, scientific instruments, paintbrushes, etc. They are so important, that oftentimes a job can't be done correctly without them. Having the right tool is imperative to successful completion of the task at hand.
2. The **second type of tool** expedites processes at work. These might not be necessary to complete a task but are just as important to the project. There are many applications and services that you can implement into your workplace that do things like facilitate communication between employees, assist them in keeping their tasks organized, and store their shared documents and resources. Tools like this help you take care of internal things that don't directly affect your productivity so that

you can spend more time and brainpower focusing in the things that matter most to the project.

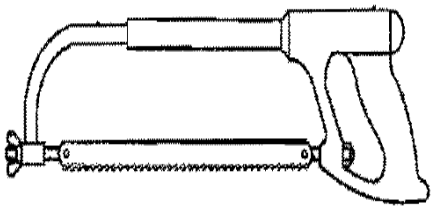
3. **Time saving & Efficiency –** With the right tools and equipment, maximum efficiency can be achieved. Tools are designed to help us accomplish specific tasks easier and safely. Using the incorrect tool for a task not only can take longer to accomplish, but it could also result in injuries, mistakes, and shoddy workmanship. All of these will end up costing you more time and money than if the right tool had been used the right way from the start.
4. **Quality of Work –** When employees are using the wrong equipment, mistakes are bound to happen. Incorrect installation techniques can lead to leaks, damage to the equipment or to the surface being worked on. As a result of these issues, your reputation with your customer and your employees' sense of pride in their work can be damaged. To be successful, you need your customers to trust you to complete the work at a high-quality standard. In addition, your employees will feel proud of the work they do if they know it's important to do it the right way, with the right tools.
5. **Safety** – On job sites, it's crucial to have the proper PPE to protect employees from injury. It's equally as important to equip workers with the right tools to complete jobs safely. You don't want your employees to have to get creative with what ladders or power tools to use. Project managers should work with foremen to understand what their crews need to do their jobs successfully and safely. Equipment that's not in proper working order can also quickly become dangerous so it's important to inspect equipment in the shop and on site prior to construction.
6. To **conclude,** tools are the backbone of business processes. The tools and equipment should be well maintained and serviced to make certain that it stays in good working order and lasts as long as possible. Whether you are attempting to save time or are just negligent, using the wrong tool for the job is a mistake. The best workmen always equip themselves always with the right tools for their work. Foremen and their crews appreciate having the tools they need to do their jobs. Provided with the right tools and equipment, they will not only be happier, more engaged employees, they will also be motivated to do their best work.

Important electrician hand tools

- **Cutter**

Cutter is general name that stands for different types of cutting devices, which include, scissors, diagonal cutting pliers, axle…etc. However it is better idea to consider only hand tools that are used in this competency/ learning module as cutting tools.

1. **Hack saw: -** Hack saw can be manufactured in different size and types**.** It is used to cut PVC or metal pipes and metal frames. Tube frame of hack saw is made up of Iron and the handle is made up of metal or wood. A clip is fixed in its other end to adjust the length.



a) Figure. 1.4.1 Hack saw

b) Figure. 1.4.2 Bolt cutter

c) Figure. 1.4.3 tube cutter

Shaper

- **File**:- Sharper is different type of device or tools that are used to make sharpen tip of object sharpen blade. So, File is a sharper device used to correct the size and smooths the upper part of metals. It is named according to the size and the rough surface for smoothing other surface.

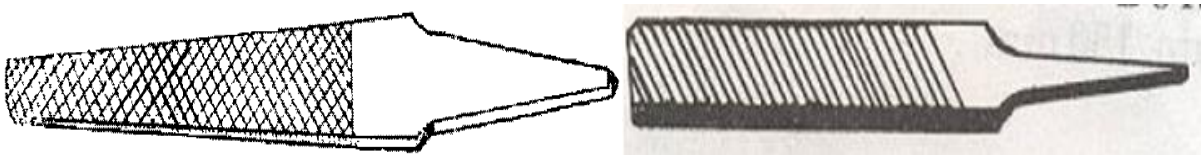


Figure. 1.4.4. file different cutting shape of file

- **Grinder**: - grinders are different types and they are also used for different purposes. So it is one of the sharpening tools that are use for cutting, grinding and sharpening purpose.

Drill

Portable electrical hand drill is used (some of new products has two-mode selection switch) for hammer-drilling in concrete or drill-only mode for wood, steel and plastic. It operates or energized with electrical power supply 220V, 50Hz. The following hammer drills have synchronized gear shift for high speed or torque and self-stop brush system. Compact ergonomic design has a soft-grip handle and two-finger trigger switch. Set concrete screw fasteners and drill small holes for anchors.

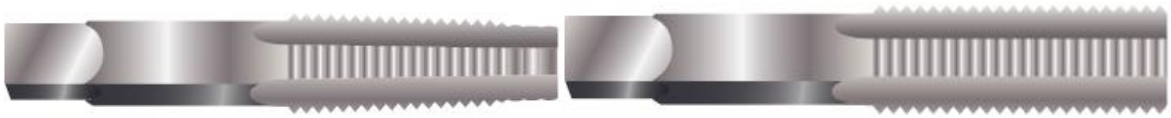
Figure. 1.4.5. electrical powered drill

Figure. 1.4.6. battery powered drill

Threading tool and tappers

A tap is used to cut threads on the inside of a hole, while a die is for cutting external threads on round stock. They are made of hard tempered steel and ground to an exact size. There are four types of threads that can be cut with standard taps and dies. They are: National Coarse, National Fine, National Extra Fine, and National Pipe.

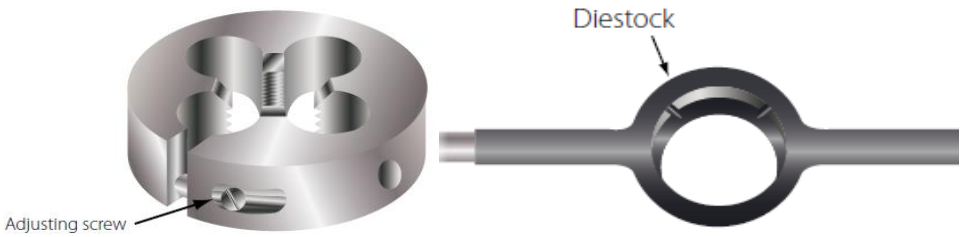
Hand taps are usually provided in sets of three taps for each diameter and thread series. Each set contains a taper tap, a plug tap, and a bottoming tap. The taps in a set are identical in diameter and cross section; the only difference is the amount of taper.



a) Figure. 1.4.7 Taper

b) Figure. 1.4.8 Bottoming

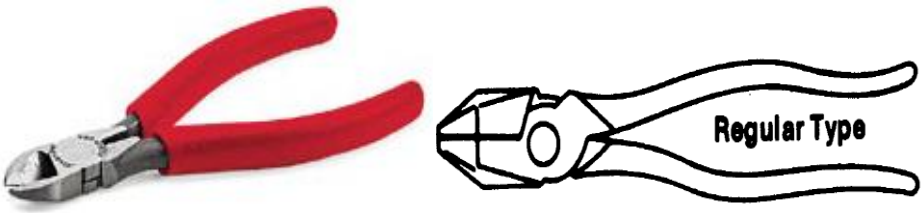
Dies may be classified as adjustable round split die and plain round split die. The adjustable split die has an adjusting screw that can be tightened so that the die is spread slightly. By adjusting the die, the diameter and fit of the thread can be controlled.



(A) Figure. 1.4.9 Adjustable round split die b) Figure. 1.4.10 Diestock

Plier sorted

PLIER: -In electrical works the most useful hand tools are different types of pliers these are combination pliers and cutting plier. Combination pliers are used for holding, griping, twisting and bending, while cutting pliers are used to cut the cables and to tightenthem. The handles of the plier is, wrapped by rubber even to be used in current supply. Even if it is unadvisable at emergency situation it can be also usedto fix or remove screws.



a) Figure. 1.4.11 Side cutting Plier b) Figure. 1.4.12 combination plier

Screw Drivers (Assorted)

The screwdriver can be classified by its shape, type of blade, and blade length. It is made for only one purpose, i.e., for loosening or tightening screws or screw head bolts. There are several different types of screwdrivers. When using the common screwdriver, select the largest screwdriver whose blade will make a good fit in the screw that is to be turned.

The two types of recessed head screws in common use are the Phillips and the Reed & Prince. Both the Phillips and Reed & Prince recessed heads are optional on several types of screws.

Figure. 1.4.14

Figure. 1.4.15

Soldering iron/gun

Soldering Irons: - soldering irons are device that convert electrical energy to heat energy through systematical designed high resistive wire as heating elements. They are used to solder electronic circuits or connecting wires and other materials using soldering leads as well as using other catalysts that aids either to increase strength of connection or to clean contacts.

Figure. 1.4.17 adjustable electronics soldering iron

Figure. 1.4.18 no adjustable soldering iron

Soldering Gun:- It is especially well adapted to maintenance and troubleshooting work where only a small part of the technician's time is spent actually soldering.

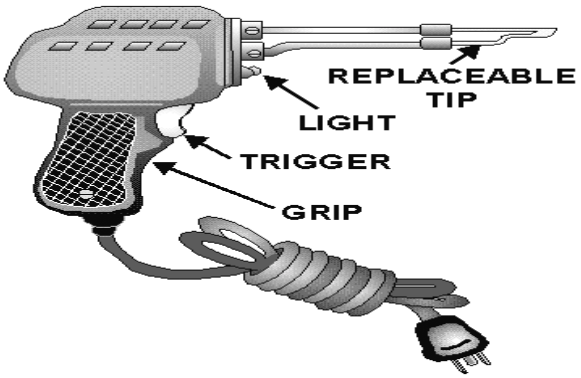


Figure. 1.4.19 soldering gunn

A transformer in the soldering gun supplies approximately 1 volt at high current to a loop of copper, which acts as the soldering tip. It heats to soldering temperature in 3 to 5 seconds. However, it may high heat to the point of solder if left on over 30 seconds. This should be avoided; because excess heat will burn the insulation off the wiring of makes to fail electronic components. The gun is operated by a finger switch; it heats up only while the switch is pressed.

Wrenches, hexagonal wrenches or allen keys

The wrenches most often used in maintenance are classified as open-end, box-end, socket, adjustable, ratcheting and special wrenches. The Allen wrench, although seldom used, is required on one special type of recessed screw. Solid, nonadjustable wrenches with open parallel jaws on one or both ends are known as open-end wrenches. Box-end wrenches are popular tools because of their usefulness in close quarters. They are called box wrenches since they box, or completely surround the nut or bolt head.

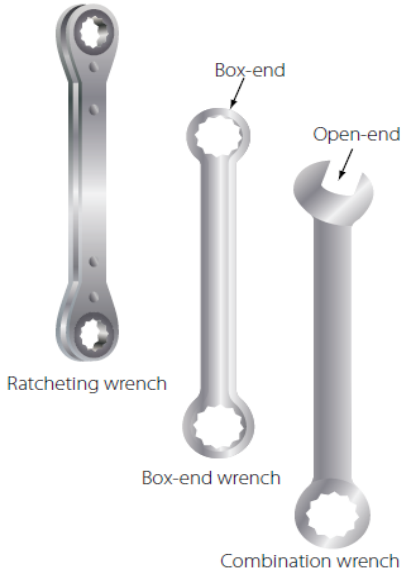
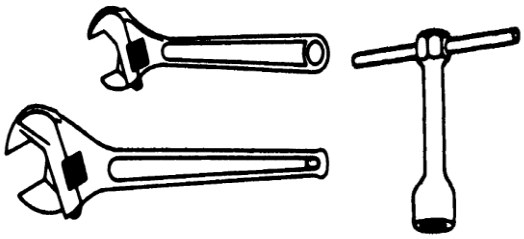


Figure. 1.4.20 open and closed end spanner

Figure. 1.4.21 changeover tightening and loosing tool



Adjustable wrench

Figure. 1.4.22 adjustable wrench

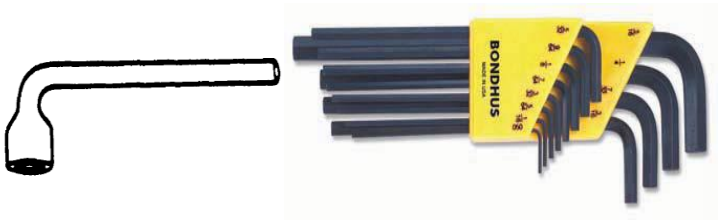


Figure. 1.4.23 Allen-key

Water level, tri-square

Water sprit level: - is a device used for measuring or machining surface elevation of locations is too far apart for a sprit level to span. Alcohol such as ethanol is often used rather than water because alcohols have low viscosity and surface tension.

Figure. 1.4.24 sprit level

Tri-Square: - MEASURING ANGLES frequently you will have to determine angles between parts or units of aircraft. In layout work, it is also sometimes necessary to measure angles. The tools most frequently used for measuring angles are Tri-squares, the combination set, angle gages, and levels. It is used for measuring angles of90: (Right angle) Measurements in mile meter are marked in its scale. it is used to measure 90 right angle accurately.

Figure. 1.4.25 try square

Measuring tapes

They are extended easily or coiled in their cases for stowage, and you can conveniently carry one of these in your pocket. Another thing, they are not as bulky to handle as the large steel tapes. You have to pull the FLEXIBLE STEEL TAPE, shown in figure 85, from its case by hand. When you want it back in the case, wind it with a crank. Tapes of this type are long, flexible steel rules, usually furnished in 3m, 8m, and 15m- lengths.

Figure. 1.4.26 folding/ steel tape

Calipers and gauges

Layout and measuring devices are precision tools. They are carefully machined, accurately marked and, in many cases, are made up of very delicate parts. When using these tools, be careful not to drop, bend, or scratch them. The finished product will be no more accurate than the measurements or the layout; therefore, it is very important to understand how to read, use, and care for these tools.

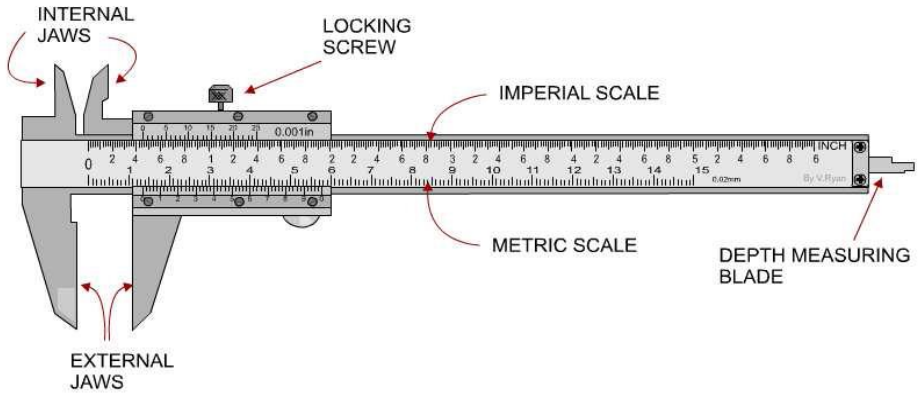


Figure. 1.4.27 venire caliper

Micrometer

A micrometer can be used to measure small and large sizes of wires, it is also used to remove the diameter of circular wires. A micrometer can measure the diameter of thin wire accurately or thickness of sheet metal.

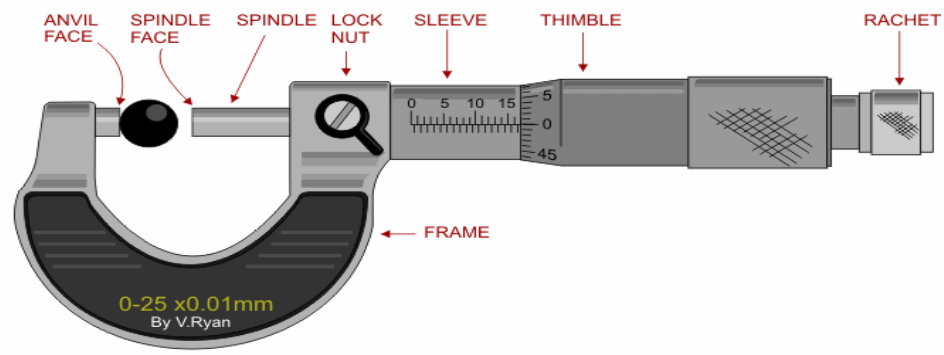


Figure. 1.4.28 micrometer

Measuring/testing instruments

The classification of an electrical measuring instrument is based on the nature of the operation, function, purpose, uses and many other terms.

Generally, it is classified into two categories.

1. Direct Measuring Instrument
2. Comparison Measuring Instrument

A direct measuring instrument measures the electrical unit by reading and deflection.

Ammeter, voltmeter, wattmeter are types of direct measuring instruments.

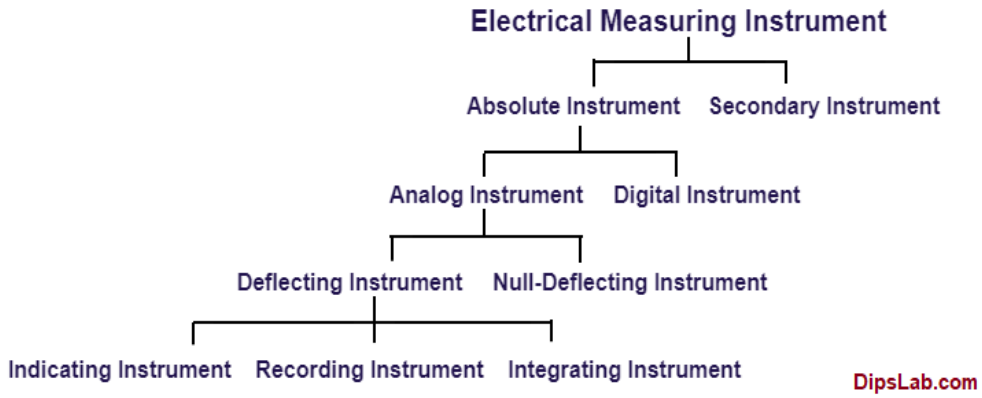
It is mostly used in engineering practical study especially electrical and electronics stream.

It is simple and inexpensive as compared to the comparison instrument.

It is also classified into two different parts like,

1. Absolute Instrument
2. Secondary Instrument

You can easily understand the classification of an instrument through the block chart.



For further classification details, I have explained each type of electrical measuring instruments in another article.

Multimeters are a popular type of electrical measuring instrument. Like its name, it works like an ammeter, voltmeter, and ohmmeter to measure current, voltage, and resistance, respectively.

The multimeter is available into two different forms, like-

1. Analog type Multimeter
2. Digital type Multimeter

In this advanced technology, both types of meter are needed as per requirement.

A signal multimeter performs all standard analog and digital meters measurement units or functions for AC and DC.

Digital Multi-meters

Multi-meters are Electronic measuring instruments that help to measure different quantities, they have advantages over instruments such as the moving-iron or moving-coil meters, in that they have a much higher input resistance (some as high as 1000M) and can handle a much wider range of frequency (from D.C. up to MHz).they can be categorized as digital and analog multi-meter their difference is how they display measured quantities. Even digital multi-meters have different quality, different size, testing methods. Look the following figures.

Figure. 1.4.30 . different types of multimeters

Analog multimeters

Analog multimeters are instruments that are used to measure electrical quantities such as voltage, current, resistance, frequency and signal power. Basic functionality includes measurement of potential in volts, resistance in ohms, and current in amps. Analog multimeters are used to find electronic and electrical problems. Advanced units come with more features such as capacitor, diode and IC testing modes.

Figures 1.4.31 analog multi-meters

Insulation resistance

However insulation resistance is different from the above mentioned tests. It conducted using an Insulation Resistance Tester, not a multi-meter, which is incapable of delivering the test voltages. Test between live conductors, individually or collectively, to earth and between each live conductor.

The minimum values and the test voltages for insulation resistance test are:

Table 1 Minimum value of insulation resistance – normal circuits.

Circuit nominal voltage (V)	Test voltage d.c. (V)	Minimum insulation resistance (MW)
Normal LV circuits up to 500 V	500V	≥ 1.0
Normal LV circuits up to 500 V where it is difficult to disconnect sensitive equipment	250V	≥ 1.0

Table -2 Minimum value of insulation resistance SELV, PELV and circuits above 500 V.

Circuit nominal voltage (V)	Test voltage d.c. (V)	Minimum insulation resistance (MW)
SELV and PELV	250	0.5
Above 500 V	1000	1.0

Figure. 1.4.31digital and insulation tester/megger

Oscilloscope

An oscilloscope is a laboratory instrument commonly used to test and display and analyze the waveform of electronic signals. In effect, the device draws a graph of the instantaneous signal voltage as a function of time.

An oscilloscope's primary function is to provide a graph of a signal's voltage over time. Usually the Y axis represents the voltage and the X axis time. This is useful for measuring such things as clock frequencies, duty cycles of pulse-width-modulated signals, propagation delay, or signal rise and fall times based on the input to its probes.

Figure. 1.4.32. analog oscilloscope

Self-check - 4

Answer the following questions depending on the information sheet readings. And submit the answer to your trainer and ask the correction if any.

Fill the dash space with appropriate words or phrases.

___1. _____ they can be categorized as Philips head and flat head

___2._____ used for holding, twisting or cutting wires.

___3._____ For holding, twisting or joining the wires at narrow places.

___4._____ used for removing insulation of the wire.

___5. _____ is power tool use to join wires using melting conductors

___6._____ is used for cutting conductor wire, but does not used for griping, holding and twisting.

___7. _____ Used for fixing clip and hitting nails.

___8. _____ we do not use in place of firmer chisel, but used to tight or loose screws

___9._____is used for drawing vertical lines while doing wiring.

___10. _____ used to check the corner/ right angle

Choose the best answer from the following alternatives

___1. Which of the following is an insulation tester?

A) Clamp on Ammeter B) Vernier Caliper C) Multimeter D) Megger E) all

___2. Which of the following is testing tool made of transparent material?

A) Multimeter B) Clamp on Ammeter C) test Light D) micrometer E) None

___3. Which of the following is used for removing pulley from the shaft of the motor?

A) Combination plier B) Long nose Plier C) Bearing puller D) Spanner

___4. Which of the following is not measuring instrument?

A) Megger B) multi-meter C) oscilloscope D) Voltmeter E) none F) all

___5. One of the following is not used for measuring purpose.

A) Hacksaw B) ohmmeter C) Voltmeter D) Tape meter E) Ruler

___6. One of the following is not cutting tool.

A) Bow saw B) Tennon saw C) Jigsaws D) Drill bit E) none

___7. Which of the following tool is used to lose and tight bolts and nuts?

A) Spanner B) vice C) combination pliers D) side cutter E) all

___8. Which of the following is not heating power tool?

A) Pipe wrench B) blowlamp C) soldering Iron D) soldering Gun E) A and D

___9. Which of the following is used to hit/hammer soft materials when we work on installation?

A) Fill B) combination plier C) mallet D) wrench E) all

___10. Which of the following is used to rough wooden or metal things?

A) Side cutter B) fill C) long nose plier D) combination plier E) all F) A and D

___11. One of the following is used to drill wood by rotating in one side only

A) Center punch B) screw driver C) jigsaw D) hand Drill E) C and D

Match the following column "A" with column "B"

___1. Used for making guide holes for drilling in metals	A) Vice
___2. Used as a Hammer for soft metals	B) Tenon saw
___3. Used for tightening or opening conduit pipes	C) Long nose pliers
___4. Used for holding any substance for cutting or filling	D) Centre Punch
___5. Used for chipping, boring and channeling in walls	E) Grinder
___6. Used to cut only the wood	F) Mallet
___7. Used for cutting, pulling and pushing wire at narrow places or ordinary places	G) **Pipe wrench**
___8. Is used to ease works but need electric power to operate	H) Cold chisel

Answer the following question!	
Note: **Satisfactory rating - 8 and 16 points**	**Unsatisfactory – below 8 and 16 points**

Answer Sheet

Name: _____ Date: _____

Information sheet - 5: Obtaining materials necessary to complete the work

1.5 Obtaining materials necessary to complete the work

Dear Trainees! In the above activity you have selected necessary materials that you use for installation activity in accordance the instructionyou provided by your trainer. But have you obtained necessary tools, equipments, material and testing devices?

Obtaining is the process of gaining exactly required needs which related to the activity you are going to do. Dear Trainees! Have you obtained an exact materials, tools and equipments according to your specifications?

Good project management in construction must vigorously pursue the efficient utilization of labor, material and equipment. Productivity is a major and continual concern of those who are responsible for cost, time and facilities management.

Material handling, which includes procurement, inventory, shop fabrication and field servicing, requires special attention for cost reduction. The use of new equipment and innovative methods has made possible wholesale changes in construction technologies in recent decades. Organizations which do not recognize the impact of various innovations and have not adapted to changing environments have justifiably been forced out of the mainstream of construction activities.

Materials

A material is something that is used for a process but gets changed either temporarily or permanently and is what the process is being carried out on by a tool. But like most else, there are some grey areas. For example, when you hammer a nail into a wall, you could say that both the hammer and nail are tools and the wall is the material since only the wall gets permanently changed (deformed) in the process. You could call the nail both a tool and a material because no *visible* property of it gets changed permanently (if you hammer straight enough) and it is used to bring about a change in the wall but by my definition it is also a material because there are microscopic changes that occur when it is being hammered. In the field of electrical electronics materials are consumable things that we use in our operations.

- Wires and cables
- Pipes/tubes & fittings
- Sealing materials

- Fasteners
- Flux/paste
- Soldering lead
- Adhesive Tape
- Connector Clip & Single Wire Connector Accessories
- Connector Clips & Single Wire Connectors
- Junction Boxes
- Mains Power & Power Cable Connectors
- Screw Terminals

Materials Required

Dear Trainees! To perform configuration to interconnect different machines and accessories the following materials are very important. Thus why we need to study about them now let us list some of them.

a) Connectors

An electrical connector is an electro-mechanical device used to join electrical terminations and create an electrical circuit. Connectors may join two lengths of flexible copper wire or cable, or connect a wire or cable to an electrical terminal. An electrical connector can also be known as a physical interface.

Figure 1.5. 1 Power Cable Connectors

Figure 1.5. 2 Connector Clips & Single Wire Connectors

Electrical connectors consist of plugs (male-ended) and jacks (female-ended). The connection may be temporary, as for portable equipment, require a tool for assembly and removal, or serve as a permanent electrical joint between two wires or devices. An adapter can be used to effectively bring together dissimilar connectors.

Types of electrical connectors and ports

A *terminal* is a simple type of electrical connector that connects two or more wires to a single connection point. Wire nuts are another type of single point connector.

b) Terminal blocks

Terminal blocks (also called terminal *boards* or *strips*) provide a convenient means of connecting individual electrical wires without a splice or physically joining the ends. They are usually used to connect wiring among various items of equipment within an enclosure or to make connections among individually enclosed items.

Figure 1.5.3different types of Terminal blocks

c) Keying

Many connectors are keyed, with some mechanical component which prevents mating except with a correctly oriented matching connector. This can be used to prevent incorrect or damaging interconnections, either preventing pins from being damaged by being jammed in at the wrong angle.

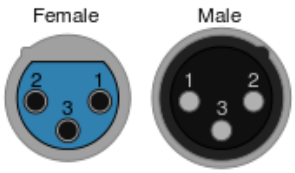


Figure 1.5.4 *XLR connector, showing the notch for alignment.*

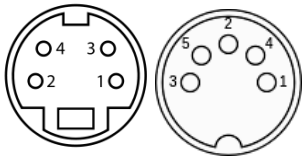


Figure 1.5.5 *4-pin Mini-DIN S-Video cable: the notches are keyed*

d) Posts

A general type of connector that simply screws or clamps bare wire to a post; such connectors are frequently used in electronic test equipment and audio. Many, but not all binding posts will also accept a banana connector plug.

Figure 1.5. 6 Posts screw type connector

e) Crimp-on connectors

Are used for Power conductors which carrying more than a few amperes are more reliably terminated with other means, though "hot tap" press-on connectors find some use in automotive applications for additions to existing wiring.

f) Plug and socket connectors

Plug and socket connectors are usually made up of a male plug (typically pin contacts) and a female receptacle (typically socket contacts)

Plugs generally have one or more pins or prongs that are inserted into openings in the mating socket. The connection between the mating metal parts must be sufficiently tight to make a good electrical connection and complete the circuit.

Figure 1.5. 7a)*A male plug made by Amphenol* 1.5. 8 *b) A female VGA connector* *1.5.9.c) A male serial port connector*

g) Component and device connectors

Electrical and electronic components and devices sometimes have plug and socket connectors or terminal blocks, but individual screw terminals and fast-on or quick disconnect terminals are more common. Small components have bare lead wires for soldering. They are manufactured using casting.

Figure 1.5.10 component connector

h) Blade connector

A blade connector is a type of single wire connection using a flat conductive blade which is inserted into a blade receptacle. Usually both blade connector and blade receptacle have wires attached to them either through of the wire to the blade or crimping of the blade to the wire.

Figure 1.5.11 blade connector and crimp

i) Ring and spade terminal

The connectors in the top row of the image are known as ring terminals and spade terminals (sometimes called fork or split ring terminals). Electrical contact is made by the flat surface of the ring or spade, while mechanically they are attached by passing a screw or bolt through them.

Figure1.5. 12 ring blade connector

Commonly used connectors

j) Ethernet connector

Ethernet connectors are used to connect computer with internet receiver and transmitter. There are several types of Ethernet connector cables depending on the number of conductor lines and the manner in which the configured.

- 8P8C (Eight positions, eight conductors)
- CAT5 cables.
- RJ45 (Registered jack)
- T568A and T568B (Ethernet crossover cable)

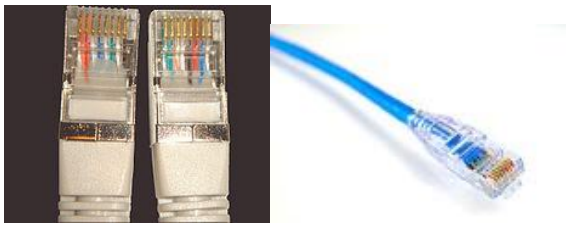


Figure 1.5.14 Ethernet connector

k) USB connectors

The Universal Serial Bus is a serial bus standard to interface devices. It is currently widely used among PCs. There are several types of USB connectors, and some have been added as the specification has progressed. The most commonly used is the (male) series "A" plug on peripherals, when the cable is fixed to the peripheral.

Figure 1.5.14 USB connector

l) Radio frequency connectors

A radio-frequency connector must not allow external signals into the circuit, and must prevent leakage of energy out of the circuit. At lower radio frequencies simple connectors can be used with success, but as the radio frequency increases, transmission line effects become more important, with small impedance variations from connectors causing the

signal to reflect from the connector, rather than to pass through. Common types of RF connectors are used for

- Television receivers
- Two-way radio
- Certain Wi-Fi devices with removable antennas, and
- Industrial or scientific measuring instruments using radio frequencies.

Figure 1.5.15 radio-frequency connector

m) Adaptors

Adaptor is a DC power supply that used to minimize and if it needed convert power from AC to DC to energize PLC or LOGO to get power a power for controlling purpose. But the level and type of power it need is different from what we get from socket out let, thus adaptor is necessarily used to energize the LOGO. Basically an adaptor is a device that converts attributes of one electrical device or system to those of an otherwise incompatible device or system. Some modify power or signal attributes, while others merely adapt the physical form of one electrical connector to another.

An electric power adapter may enable connection of a power plug, sometimes called a travel plug, used in one region to a AC power socket used in another, by offering connections for the disparate contact arrangements, while not changing the voltage.

An AC adapter, also called a "recharger", is a small power supply that changes household electric current from distribution voltage (in the range 100 to 240 volts AC) to low voltage DC suitable for consumer electronics.

For computers and related items, one kind of serial port adapter enables connections between 25-contact and nine contact connectors, but does not affect electrical power- and signaling related attributes.

n) connecting wires and cables

To perform control activity or to interconnect different parts and components we must use wires and cables to connect with each other or to connect PLC with motor, for that these purpose we use connecting wires and cables. Wires are the electrically conductive connections between the elements in electronic circuitry. Designing your project are wires interconnecting different parts. Theoretically, these are zero resistance, perfect connections. On the breadboard, they are nice colored jumper wires. In practice, the designer has a many possible choices of how to connect electronic parts together. Connections may be broken down into three categories:

1. Wires
2. Cables
3. Connectors on the ends of wires

o) Materials

Wire may be drawn from different conductive materials, most often metal. Gold and silver are excellent conductors of electricity. But exotic metals are often soft and expensive. Most practical wires you may use are made mostly of copper and tin.

Figure 1.5.16a)Pre-Wired Connection Cables and Modules... Makes Wiring Neat, Quick and Easy

Figure 1.5.17b) Device Connection Cables

Figure 1.5.18 c) Multi-conductor Cable for Industrial Applications Flexible Power Cable, Data Cable and Control Cable)

p) Adhesive tapes

Adhesive tapes are useful aids in electrical installation. They create order and can also be used for attachment. In addition to conductive and insulating adhesive tapes with one-sided or double-sided adhesive strength, anti-slip tapes, sealing tapes, masking films and marking tapes can also be found in this sub-category.

Figure 1.5.19 adhesive tape

q) Cable channels/ducts

The mounting material for the power cable laying includes different versions of cable support systems as well as guide and cover channels for electrical cables. These include baseboard systems as well as cable channels, cable ducts, installation pipes, mounting rails and other passive cable control systems that have nothing to do with the actual electronics.

Figure 1.5.19 cable duct/ channel

r) Installation boxes

Installation boxes are switch boxes. They serve as additional housings for the contact protection of electrical components. There are junction boxes as well as junction boxes. For high demands there are installation boxes for damp rooms and those with high fire protection classes.

Figure 1.5.20 junction box

Self- check 5

Answer the following questions

1. What is the difference between obtaining and selecting?

a) Selecting and obtaining are similar

b) Selecting is similar to finding exact what we want

c) Obtaining is picking out exact what we want

d) All are correct

2. _____includes procurement, inventory, shop fabrication and field servicing, requires special attention for construction.

A) Business operations

B) Material handling

C) Bidder form

D) material specifications

E) all are correct

3._____isanelectro-mechanicaldeviceusedtojoinelectricalterminations.

A) extension cord

B) cable mark

C) electrical connector

D) conductor color

4. Which of the following is a simple type of electrical connector that connects two or more wires to a single connection point?

A) cable track

B) *terminal*

C) screw driver

D) junction box

5. Whichofthefollowingconnectormoreusedfordifferentconnectionpurpose?

A) RF connector

b)USB connector

C) RJ45connectot

D) Terminal block

Answer the following question!	
Note: **Satisfactory rating - 5 and 10 points**	**Unsatisfactory – below 5 and 10 points**

Answer Sheet

Name: _____ Date: _____

Operation title: - Plan and Prepare Installation work

1. **Operation title2:-** Read and interpret work instructions to determine which are necessary for installation work
   a) The trainer will proved the trainees different types of instruction that they use during assessment
   b) Let they differentiate them, what type of instruction is it.
   c) Let they tell to their trainer some examples where we use it.
2. **Operation title2:-** Selecting Tools, equipment and testing devices needed to carry out the installation work
   a. The trainees must provided with lean paper and let they write name of equipment they need to perform installation work
   b. The trainer will provide them tools and equipments in mixed
   c. The trainees must pick measuring and cutting tools in electro pneumatic installation hardware
   d. The trainees must describe for what specific purpose we use them
   e. The trainee must show how to use the picked/obtained hand tools
   f. The trainer must order the trainees let they write tools types and specifications
   g. The must give the correction if they missed or their work need correction

LAP Test Plan and Prepare Installation work

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

1. You are required to perform any of the following:
   1.1. Select wire cutting and measuring tools that we use during installation
   1.2. Read specification and write full list of equipment that we use to perform one simple task.
   1.3 Rewrite the specification and explain the use of obtained equipments
   1.4. Coming in front of student the trainees and trainer attend and evaluate, while one shows how to use oscilloscope in testing circuit.
2. Request your teacher for evaluation and feedback

L #13	**LO #2- Installing instrumentation and control devices**

Instruction sheet

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

- Wearing/using Personal protective equipment
- Following OH & S policies and procedures for installation.
- Following instrumentation and control devices standard
- Principles of instrumentation
- Installing instrumentation and control devices
- Responding unplanned events or conditions

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:

- Wear/use Personal protective equipment
- Follow OH & S policies and procedures for installation.
- Follow instrumentation and control devices standard
- Understand principles of instrumentation
- Install instrumentation and control devices
- Respond unplanned events or conditions

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:- Wearing/using Personal protective equipment

2.1 Wearing/using Personal protective equipment

Personal protective equipment (PPE) is defined as all equipment designed to be worn, or held, to protect against a risk to health and safety. This includes most types of protective clothing, and equipment such as eye, foot and head, ears, lungs, torso, hands and feet, protection, safety harnesses, life jackets and high visibility clothing. Additionally, protection from falls may need to be considered. Objects falling from a height present the major hazard against which head protection is provided. Other hazards include striking the head against projections and hair becoming entangled in machinery. Typical methods of protection include helmets, light duty scalp protectors called ‘bump caps’ and hairnets.

Ear muffs/plugs

Noise may be defined as any disagreeable or undesirable sound or sounds, generally of a random nature, which do not have clearly defined frequencies. The usual basis for measuring noise or sound level is the decibel scale. Whether noise of a particular level is harmful or not also depends on the length of exposure to it. This is the basis of the widely accepted limit of 85 dB of continuous exposure to noise for 8 hours per day.

A peak sound pressure of above 200 pascals or about 120 dB is considered unacceptable and 130 dB is the threshold of pain for humans. If a person has to shout to be understood at 2 m, the background noise is about 85 dB. If the distance is only 1 m, the noise level is about 90 dB. Continuous noise at work causes deafness, makes people irritable, affects concentration, causes fatigue and accident proneness and may mask sounds which need to be heard in order to work efficiently and safely.

Where individuals must be subjected to some noise at work, it may be reduced by ear protectors. These may be disposable ear plugs, reusable ear plugs or ear muffs. The chosen ear protector must be suited to the user and suitable for the type of noise and individual personnel should be trained in its correct use.

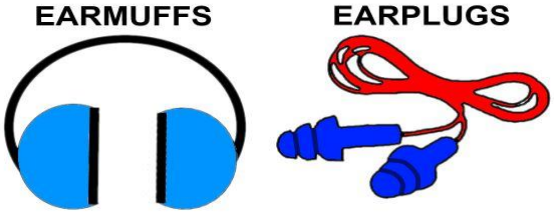


Figure 2.1 ear plug

Goggles/glasses

The eyes are very vulnerable to liquid splashes, flying particles and light emissions such as ultraviolet light, electric arcs and lasers. Types of eye protectors include safety spectacles, safety goggles and face shields.

Figure 2.2 different types of Goggle

Face shield

Such as ultraviolet light, electric arcs and lasers requires wear of face shield. Screen-based workstations are being used increasingly in industrial and commercial locations by all types of personnel. Working with VDUs (visual display units) can cause eye strain and fatigue.

Figure 2.3 face shield

Safety hat

Objects falling from a height present the major hazard against which head protection is provided. Other hazards include striking the head against projections and hair becoming entangled in machinery. Typical methods of protection include helmets, light duty scalp protectors called ‘ bump caps ’ and hairnets.

Figure 2.4 helmet / safety hat

Safety apparel/suit

A worker's body may need protection against heat or cold, bad weather, chemical or metal splash, impact or penetration and contaminated dust. Alternatively, there may be a risk of the worker's own clothes causing contamination of the product, as in the food industry. Appropriate clothing will be recommended in the company's health and safety policy. Ordinary working clothes and clothing provided for food hygiene purposes are not included in the Personal Protective Equipment at Work Regulations.

Safety belt/harness

Safety belt or harness is a body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning. Is a device consists of straps that are secured about a body in a manner that distributes the arresting forces over at least the thighs, waist, chest, shoulders, and pelvis, with provision for attaching a lanyard, lifeline, or deceleration device.

Safety shoes

Boots or shoes with in-built toe caps can give protection against impact or falling objects and, when fitted with a mild steel sole plate, can also provide protection from sharp objects penetrating through the sole. Special slip resistant soles can also be provided for employees working in wet areas.

Figure 2.5 different types of safety shoes

Mask

Breathing reasonably clean air is the right of every individual, particularly at work. Some industrial processes produce dust which may present a potentially serious hazard. The lung disease asbestosis is caused by the inhalation of asbestos dust or particles and the coal dust disease pneumoconiosis, suffered by many coal miners, has made people aware of the dangers of breathing in contaminated air.

Some people may prove to be allergic to quite innocent products such as fl our dust in the food industry or wood dust in the construction industry. The main effect of inhaling dust is a measurable impairment of lung function. This can be avoided by wearing an appropriate mask, respirator or breathing apparatus as recommended by the company's health and safety policy and indicated by local safety signs.

Figure 2.6 breathing apparatus

Gloves

Hands and feet may need protection from abrasion, temperature extremes, cuts and punctures, impact or skin infection. Gloves or gauntlets provide protection from most industrial processes, but should not be worn when operating machinery because they may become entangled in it. Care in selecting the appropriate protective device is required; for example, barrier creams provide only a limited protection against infection.

Figure 2.7 different types of gloves

Use PPE like best professional

Self-check-1:

Answer the following question choosing from given alternatives

What is PPE?

1._____is defined as all equipment designed to be worn, or held, to protect against a risk to health and safety.

A) Reading b) PPE c) handling D) cleaning E) all

2._____isanequipmentusedtoprotectdisagrablesound?

a) Earmuffs b) helmet C) harness D) safety shoes

3. WhichofthefollowingPPEisusedtoprotecthazaroccuredduetoobjectfallingfromheigh?

a) safety shoes B) hand glove C) safety belt D) helmet E) all are correct

4. Which of the following PPE is used to protect ultraviolet light, electric arcs and lasers hazards from face?

A) Goggle B) Helmet C) Over Coat D) face shield E) All

5. Which of the equipment is used to support when working one elevated/vertical surface?

A) face shield B) harness C) hands D) ladder

6._____is breathing equipment used to get reasonably clean air is the right, particularly at some industrial processes.

A) goggle B) Musk C) helmet D) gloves

7. Which of the following PPE used to protect skin from temperature and dirt?

a) goggles b)helmet c)belt D) gloves

8. Which of the following is not installation tool?

A) Cutting tools

B) Drilling tools

C) Sharpening tools

D) Paints

9. What is the purpose of Calibrators?

A) Precision instruments that inject simulated output signals

B) Inject simulated output signals into the transmitter

C) Checks the integrity of a complete measurement system.

D) Used as an standard for measuring tools

E) All

F) None

Answer the following question!	
Note: **Satisfactory rating - 9 and 18 points**	**Unsatisfactory – below 9 and 18 points**

Answer Sheet

Name: _____ Date: _____ **Score** _____

Information sheet -2: Following OH & S policies and procedures for installation

2.2 Following OH & S policies and procedures for installation

An organization's safety OH&S policy is a recognized, written statement of its commitment to protect the health and safety of the workers/employees, as well as the surrounding community. OH&S policy recommends the following rules and regulations

- Using personal protection and safety equipment as required by the employer.
- Following safe work procedures.
- Knowing and complying with all regulations.
- Reporting any injury or illness immediately.
- Reporting unsafe acts and unsafe conditions.

Personal Safety rules must be observed in the electric workshop

a) Never turn on power line without permission of the instructor.
b) No horseplay in the electric workshop.
c) All tools must be used for the purpose that they are designed for.
d) Sharp edge or pointed tip tools should be handled with care.
e) Safety procedure stated in all laboratory activities must be strictly observed.
f) Keep your work area hazard free.
g) Keep tools and cords away from heat, oil and sharp edges that can damage electrical insulation.
h) Disconnect tools and extension cords by holding safely the plug, not by pulling on the cord. Be sure that the control switch on electrical equipment is in the off position before putting in plug or pulling it out.
i) Do not use electrical equipment in damp or wet areas.
j) Do not use electrical equipment on or near metal ladders, which may conduct electricity.
k) If tools or cords run very hot, report the condition to the instructor. The insulation could be deteriorating. Never wrap a cloth around a tool too hot to hold. Sparks can ignite the cloth.
l) Report immediately any damage tool or equipment or one that gives off minor shock. Report any exposed live parts immediately. Do not attempt to make repairs yourself.
m) Make sure that the cord does not create a tripping hazard.

n) Use a Ground Fault Circuit Interrupter (GFCI) when using portable tools.

o) Do not overload circuits.

Safety Precaution in Handling of Tools

a) Handle sharp edge tools with special care.

- Never carry them unshielded in pockets.
- Never had such a tool to a friend with the cutting edge first.
- Avoid placing your fingers or hands in the path of motion of the cutting tools.

b) Never leave tools on top of a stepladder or any other place above your head.

c) Never abuse tools and Never use them for the purpose other than, for which they are designed.

d) Tools maybe stored horizontally or vertically depending on the construction and safety requirements.

e) Tools must not be exposed to an environment, which shortens their service span (e.g. damp areas).

f) Tools must be stored so that they may be easily accessible and easily noticed when missing.

g) Heavy objects should not be stored overheated where they can easily cause accidents.

h) Chemicals and inflammable *must* be stored in restricted areas.

For more information please refer to the information sheet 1.1 Planning and preparing OH&S policies and procedures

Self check – 2

Answer the following questions,

1. Which of the following is an indication of following safety rule?
   a) using personal protective equipment
   b) eating breakfast every morning before any work
   c) reading manual
   d) getting information from news
   e) working fast to complete work on time
   f) all are correct
2. which of the following is recommended by OH&S policy, rules and regulations
   a) Reporting unsafe acts and unsafe conditions.
   b) Reporting any injury or illness immediately
   c) Knowing and complying with all regulations.
   d) Following safe work procedures.
   e) All are answer
3. Which of the following is safety rule of electric work shop?
   a) Unreasonably using tools and equipments
   b) Keep your work area hazard free.
   c) Showing tools and equipments store to friend
   d) No horseplay in the electric workshop.
   e) B & D
   f) All
4. Do not use electrical equipment in damp or wet areas; this rule is used to reduce electrical energy waste?
   a) True b) false
5. Which of the following can damage electrical conductor insulation if not properly kept?
   a) spilled oil
   b) adverse heat
   c) sharpen edged tools
   d) all of the above
   f) A & C

Answer the following question!	
Note: **Satisfactory rating - 5 and 10 points**	**Unsatisfactory – below, 5 and 10 points**

Answer Sheet

Name: _____ Date: _____ score _____

Information sheet- 3:- Following instrumentation and control devices standard

2.3 Following instrumentation and control devices standard

3.1. Ethiopian building code standard EBCS -10 and EBCS-11, various Ethiopian ES on electrical materials and standards

Generally Ethiopian building codes and standards recommend that any electrical installation should comply with the standards and must include such as installation, testing and commissioning

1. Every installation shall, during erection and/or on completion but before being put into service, be inspected and tested to verify, so far as is reasonably practicable, that the requirements of this Electrical Installation Code have been met.
2. The method of test shall be such that no danger to persons, livestock or property or damage to equipment can occur even if the circuit tested is defective.

Inspection

(1) Detailed inspection shall precede testing and shall normally be carried out with that· portion of the installation under inspection being disconnected from the supply.

(2) The detailed inspection shall be made to verify that the installed electrical equipment is:

a) in compliance with this Electrical installation Code;
b) correctly selected and erected in accordance with this Electrical Installation Code; and
c) Not visibly damaged or defective so as to impair safety.

3. The detailed inspection shall include at least the checking of the following items, where relevant to the installation. and, where necessary, during erection:

a) connection of conductors;
b) identification of conductors;
c) routing of cables in safe zones or mechanical protection;
d) selection of conductors for current carrying capacity and voltage drop in accordance with the design;
e) connection of single pole devices for protection or switching in phase conductors only;
f) correct connection socket-outlets and lamp holders;
g) presence of fire barriers and protection against thermal effects;

h) methods of protection against direct contact (including measurement of distances, where appropriate); i.e.,

i) protection by insulation of live parts,

ii) protection by barrier or enclosure,

iii) protection by obstacles,

iv) protection by placing out of reach;

i) **Methods of protection against indirect contact; i.e,**

i) Presence of protective conductors,

ii) Presence of earthling conductors,

iii) Presence of main equipotential bonding conductors,

iv) Earthling arrangements for combined protective and functional purposes,

v) Use of Class H equipment or equivalent insulation,

vi) Non-conducting location (including measurement of distances, where appropriate),

vii) earth-free local equipotential bonding,

viii) Electrical separation;

j) Prevention of mutual detrimental influence;

k) presence of appropriate devices for isolation and switching;

l) presence of under-voltage protective devices;

m) choice and setting of protective and monitoring devices (for protection against indirect contact and/or protection against overcurrent);

n) labeling of circuits, fuses, switches and terminals;

o) selection of equipment and protective measures appropriate to external influences;

p) adequacy of access to switchgear and equipment;

q) presence of danger notices and other warning notices;

r) presence of diagrams, instructions and similar information;

s) Erection methods.

Testing

1. The following tests, where relevant, shall be carried out in that sequence.

a) Continuity of protective conductors

i) Every protective conductor shall be tested to verify that it is electrically sound and correctly connected.

d) continuity of ring final circuit conductors

i) A test shall be made to verify the continuity of each conductor, including the protective conductor, of every ring final circuit.

e) Insulation resistance

i) The insulation resistance between live conductors shall be measured before the installation is connected to the supply.

ii) Particular attention shall be given to the presence of electronic devices connected in the installation and, where necessary, such devices shall be isolated so that they are not damaged by the test voltage and thereafter tested in accordance with (vi) below.

iii) The insulation resistance shall also be measured between each live conductor and earth, the PEN conductor in TN-C systems being considered as part of the earth. Where appropriate during this measurement, phase and neutral conductors may be connected together.

iv) The insulation resistance measured with the d.c. test voltages indicated in Table 1 shall be considered satisfactory if the main switchboard, and each distribution circuit tested separately with all its final circuits connected but with current-using equipment disconnected, has an insulation resistance not less than the value given in Table 1.

v) The testing equipment shall be capable of supplying the test voltage indicated in Table A.1 when loaded with l.0mA.

vi) Where equipment such as electronic devices are disconnected for the tests prescribed in a(i) through c (v) above and the equipment has exposed conductive parts to be connected to protective conductors, the insulation, resistance between the exposed conductive parts and live parts of the disconnected equipment shall be measured separately and shall be not less than 0.5mega Ohm.

Table 1: Minimum values of insulation- resistance

Circuit nominal voltage VJ	**Test voltage D.C,**	**Minimum insulation resistance (mega Ohms)**
Extra-low voltage circuits when the circuit is supplied from a safety isolating transformer	250	0.5
Up to and including 500.0V with the exception of the above cases	500	0.5
Above 500.0V up to 1000.0V	1000	1.0
Between SELV circuits and associated LV circuits	500	5.0

Note*:*

i) In the event of any test indicating failure to comply with the requirements of clause (le) above, that test and those preceding it (the results of which may have been influenced by the indicated fault) shall be repeated after the fault has been rectified.

ii) Reference methods of test are described in Guidance Notes on the Wiring Regulations published by the Institution of Electrical Engineers (IEE); but the use of other methods giving no Jess effective results is not precluded.

Site surveys are performed to evaluate concerns for power quality and equipment performance throughout a facility. The survey will include inspection of wiring and grounding concerns, equipment connections, and the voltage and current characteristics throughout the facility. Power quality monitoring, along with infrared scans and visual inspections, is an important part of the overall survey.

The initial site survey should be designed to obtain as much information as possible about the customer facility. This information is especially important when the monitoring objective is intended to address specific power quality problems. This information is summarized here.

1. Nature of the problems (data loss, nuisance trips, component failures, control system malfunctions, etc.)
2. Characteristics of the sensitive equipment experiencing problems (equipment design information or at least application guide information)
3. The times at which problems occur

4. Coincident problems or known operations (e.g., capacitor switching) that occur at the same time
5. Possible sources of power quality variations within the facility (motor starting, capacitor switching, power electronic equipment operation, arcing equipment, etc.)
6. Existing power conditioning equipment being used
7. Electrical system data (one-line diagrams, transformer sizes and impedances, load information, capacitor information, cable data, etc.)

Control standards

2.3.2 OIML (International Organization for Legal Metrology) Standards) or ES

OIML is the international organization for developing documentary standards related to regulated and legally mandated measurements. OIML is an inter-governmental treaty organization established in 1955 by the "Convention" (the treaty), which has an objective of harmonization of national regulations and metrological controls

Example

- Type approval,
- Verification……etc

Applied by legal metrology authorities. There are 60 Member States (voting) and 68 Corresponding Members (nonvoting).

The oversight body of OIML is the International Committee of Legal Metrology (CIML), which meets annually. A meeting of the OIML Conference is held every four years to establish general policy, vote on the budget and confirm the decisions of the CIML.

Example of OIML rules

T. 4.1 Electronic device

Device employing electronic sub-assemblies and performing a specific function. Electronic devices are usually manufactured as separate units and are capable of being tested independently.

***Notes**:*

1. The electronic parts of CVDDs are not tested separately.
2. A measuring system including at least one electronic device subject to legal control is called an electronic measuring system.

T.4.2 checking facility

Facility that is incorporated in a measuring system and which enables significant faults to be detected and acted upon.

Note:

The checking of a transmission device aims at verifying that all the information which is transmitted (and only that information) is fully received by the receiving equipment.

2.3.3. ISA (Instrumentation, Systems and Automation) Society (formerly Instrument Society of America)

The International Society of Automation (isa.org) is a non-profit professional association founded in 1945 to create a better world through automation. ISA advances technical competence by connecting the automation community to achieve operational excellence. The organization develops widely-used global standards; certifies industry professionals; provides education and training; publishes books and technical articles; hosts conferences and exhibits; and provides networking and career development programs for its 40,000 members and 400,000 customers around the world.

The International Society of Automation (ISA) writes standards for automation professionals for streamlining processes and improving industry safety, efficiency and profitability. These standards govern symbols and nomenclature, safety and communication. One of the most used forms is the ISA "TR20.00.01 with Forms" collection, containing the industry-recognized ISA-TR20.00.01 instrumentation specification forms. ISA standards ensure you can:

- Improve safety
- Simplify component integration
- Provide consistent instrumentation

2.3.4. ANSI (American National Standards Institute)

- The American National Standards Institute (ANSI) is a non-profit organization that coordinates standards and technical regulations that relate to how U.S. businesses, consumer groups, and government agencies function.
- ANSI doesn't develop the standards itself but helps facilitate the development through promoting standards, accrediting procedures for developing standards undertaken by its member organizations, and approving documentation.

- ANSI does not develop standards itself. Rather, it oversees the creation of voluntary standards for a variety of manufacturing processes, products, systems, services, and personnel in nearly every U.S. business sector. It also works to ensure that U.S. standards are consistent with international standards enabling U.S. products to be sold and used abroad.
- ANSI oversees the standards that pertain to terminology and definitions, rules about quality and construction of goods and products, and product testing, among others.

2.3.5. ASME (American Society of Mechanical Engineers)

ASME stands for American Society of Mechanical Engineers, ASME is a nonprofit professional organization that enables collaboration, knowledge sharing and skill development across all engineering disciplines, while promoting the vital role of the engineer in society.

ASME recently formed the International Society of Interdisciplinary Engineers (ISIE), a new for-profit subsidiary to house business ventures that will bring new and innovative products, services, and technologies to the engineering community

ASME promotes art, science and multidisciplinary engineering while encouraging collaboration across all engineering disciplines. ASME also serves as the leading international developer of standards and codes used to regulate the mechanical engineering industry.

ASME code – also known as ASME Boiler & Pressure Vessel Code or BPVC – is the standard that regulates the design, development and construction of boilers and pressure vessels utilized in a variety of industries.

ASME Code

Finding a heating system that adheres to ASME's BPVC is important for a number of reasons, including:

Safety

ASME's Boiler & Pressure Vessel Code was established in the early 1900s following two devastating boiler explosions that took place at factories in Massachusetts. Since then, the

BPVC has provided guidelines that have helped to prevent accidents by making steam boilers and other mechanical engineering equipment safer.

Quality

ASME industrial heaters and boiler systems that are ASME stamped have been thoroughly inspected and have met the quality and safety standards established by the Boiler & Pressure Vessel Code. By purchasing a system that adheres to BPVC code, you can feel confident that you are investing in a high quality piece of equipment for your plant or facility.

ASME performs

- Codes and standards
- Develops Publications
- Performs Conferences on codes
- Continuing education, and
- Professional development training programs

Figure 2.3.5.1. Industrial heating in thermal fluid heating systems

2.3.6. NEC (National Electrical Code)

The National Electrical Code (NEC), or NFPA 70, is a regionally adoptable standard for the safe installation of electrical wiring and equipment in the United States. It is part of the National Fire Code series published by the National Fire Protection Association (NFPA), a private trade association.

The National Electrical Code (NEC) codifies the minimum requirements for safe electrical installations in a single, standardized source. While the NEC is not itself a U.S. law, the NEC is commonly mandated by state or local law. Where the NEC is adopted, anything

less is illegal. The NEC is revised by the National Fire Protection Association's Committee on the National Electrical Code, which consists of 19 code-making panels and a technical correlating committee. Revision occurs every three years to ensure that the code takes into account the latest in technology and safety.

The **NEC** as stated in article 90.1(A) “The purpose of this Code is the practical safeguarding of persons and property from hazards arising from the use of electricity. This Code is not intended as a design specification or an instructional manual for untrained persons.”

NEC use is commonly mandated by state or local law, as well as in many jurisdictions outside of the United States. The NEC codifies the requirements for safe electrical installations into a single, standardized source. The "authority having jurisdiction" inspects for compliance with these minimum standards.

Figure 2.3.6 NEC

The NEC is developed by National Fire Protection Association (NFPA). First published in 1897, the NEC is updated and published every three years. The 2020 Code is the most recent edition. Although the code is updated every three years, some jurisdictions do not immediately adopt the new edition.

The NEC covers the installation of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables and raceways for the following:

1. Public and private premises, including buildings, structures, mobile homes, recreational vehicles, and floating buildings
2. Yards, lots, parking lots, carnivals, and industrial substations
3. Installations of conductors and equipment that connect to the supply of electricity
4. Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings, that are not an integral part of a generating plant, substation, or control center.

2.3.7. IEC (International Electro technical Commission)

The International Electro technical Commission (IEC; is an international organization that prepares and publishes international standards for all

electrical, electronic and related technologies collectively known as "electro-technology". IEC standards cover a vast range of technologies from power generation, transmission and distribution to home appliances and office equipment, semiconductors, fiber optics, batteries, solar energy, nanotechnology and marine energy as well as many others. The IEC also manages four global conformity assessment systems that certify whether equipment, system or components conform to its international standards..All electro-technologies are covered by IEC Standards, including energy production and distribution, electronics, magnetic andelectromagnetics,electroacoustics,multimedia,telecommunication and medical technology, as well as associated general disciplines such as terminology and symbols, electromagnetic compatibility, measurement and performance, dependability, design and development, safety and the environment.

IEC International Standards and Conformity Assessment systems to ensure the safety, efficiency, reliability and interoperability of electrical, electronic and information technologies, to enhance international trade, facilitate broad electricity access and enable a more sustainable world.

Self check 3

Answer the following questions

1. Which of the following is OHS policies and procedures?
   A) Safety and health program
   B) B) Long time work
   C) C) High level education
   D) D) Effective Saving
2. Which of the following is an environmental policies and procedures?
   A) Housekeeping program
   B) Clean work sites
   C) Remove hazardous materials
   D) Removed and stored waste safely
   E) All
3. Which of the following is direct benefit of Personal protective equipment?
   A) Reducing hazards
   B) Improving working efficiencies
   C) Reducing waste
   D) Decreasing cost
4. What is the benefit of Control Standards?
   A) To increase personal safety
   B) To decrease qualities of work
   C) To decrease number of workers
   D) All
5. Which of the following is standard of Ethiopian?
   A) NEMA
   B) ANSI
   C) EBCS
   D) ASME
   E) All

Answer the following question!	
Note: **Satisfactory rating - 5 and 10points**	**Unsatisfactory – below 5 and 10 points**

Answer Sheet

Name: _____ Date: _____ score _____

Information sheet 1:- Principles of instrumentation

2.4 Principles of instrumentation

Instrumentation is the art of measuring the value of some plant parameter, pressure, flow, level or temperature to name a few and supplying a signal that is proportional to the measured parameter. The output signals are standard signal and can then be processed by other equipment to provide indication, alarms or automatic control.

Trained personnel are required to operate most heavy machinery, to say nothing of the people who need to be trained to repair it. When working with such heavy and dangerous equipment, getting accurate measurements can be a very difficult process. This is why instrumentation is so important.

Because of the number of processes involved in modern machines, accurate instrumentation is needed to ensure that everything is operating properly. Most cars have a few gauges on the dashboard so that you know if your gas or oil level is running low. That saves you the trouble of having to physically measure them. Most of the other gauges are automated. You, the driver, are only notified when something is wrong. Heavy equipment isn't like that. Operators must be aware of dozens of factors at a moment's notice. The temperature, pressure, fluid level, position, and flow may all be important to keep track of. Failing to have accurate readings could result in critical injuries to personnel.

2.4.1. sensors/transmitters/transducers

Sensors

There are numerous definitions as to what a sensor is but I would like to define a Sensor as an input device which provides an output (signal) with respect to a specific physical quantity (input).

The term "input device" in the definition of a Sensor means that it is part of a bigger system which provides input to a main control system (like a Processor or a Microcontroller).

Another unique definition of a Sensor is as follows: It is a device that converts signals from one energy domain to electrical domain. The definition of the Sensor can be understood if we take an example in to consideration.

The concept of integrating Sensors, Actuators, Electrical (and Electronic) and Mechanical devices into a single chip is considered one of the breakthrough technologies. MEMS technology will enable development of smart devices with the perception of Micro-sensors, control or Micro-actuators and computational ability of Microelectronics.

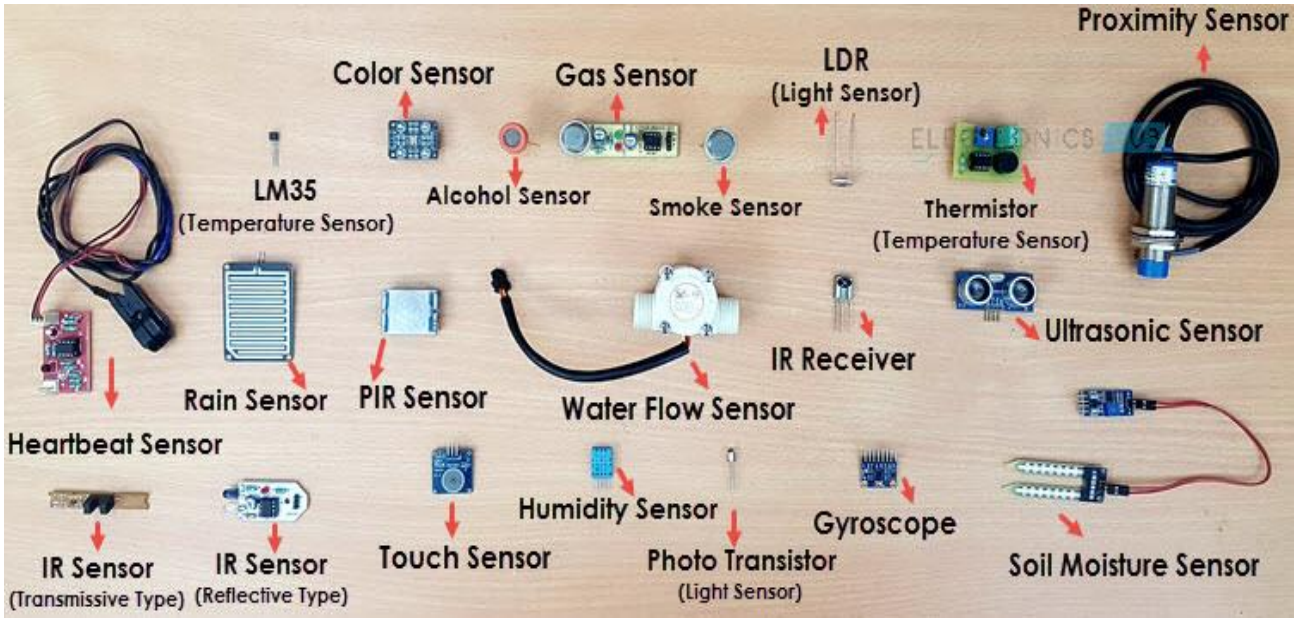


Figure 2.3.9.1 different types of sensors

Different Types of Sensors

The following is a list of different types of sensors that are commonly used in various applications. All these sensors are used for measuring one of the physical properties like Temperature, Resistance, Capacitance, Conduction, Heat Transfer etc.

- Temperature Sensor
- Proximity Sensor
- Accelerometer
- IR Sensor (Infrared Sensor)
- Pressure Sensor
- Light Sensor
- Ultrasonic Sensor
- Smoke, Gas and Alcohol Sensor

- Touch Sensor
- Color Sensor
- Humidity Sensor
- Tilt Sensor
- Flow and Level Sensor

MEMS Sensors

MEMS are short for Micro Electro Mechanical Systems. It is a technology associated with manufacturing of microscale devices like Sensors, Transducers, Actuators, Gears, Pumps, and Switches etc.

Since all the computation and processing is done on digital signals, there should be a medium between the analog world and the digital electronics. Sensors bridge this gap as they are used to observe the temporal effects of analog physical parameters and produce meaningful information (to the computer).

Modern definition of a Sensor is confusing at times but in simple words a Sensor is a device that contains basic sensing elements which sense the physical quantity like temperature or humidity and convert it into an electrical signal. A sensor also consists of a signal processing unit like an amplifier, filter or ADC or a combination of these elements.

Applications

MEMS Sensors are already being used in a variety of applications like controlling and handling equipment, managing robots, cars, grippers, etc. You can find these sensors in modern ink jet printers, Colour Projectors, Display Systems, Clocks and Scanning equipment.

- Accelerometers – For Electronic Stability Control and Airbag deployment.
- Inertial Measurement Units or IMU (they are combination of MEMS Accelerometer and MEMS Gyroscope) – For measuring yaw, pitch and roll for autonomous driving.
- Magnetometer – For direction used in navigation.
- Pressure and Inertial Sensor – For braking control.
- Pressure Sensor – Tire Pressure Monitoring System.
- Airflow Sensor – Air intake monitoring.

- Fuel Sensor – Fuel Level Indicator.
- Impact and Crash Sensor – Impact detection and Airbag deployment.
- MEMS Microphone – For communication and Noise Cancellation.
- Temperature Sensor – For Automatic Climate Control and Engine Temperature Monitoring.
- There are many other MEMS based devices for various applications.

What is a Transmitter?

A Transmitter is a device that converts the signal produced by a sensor into a standardized instrumentation signal such as 3-15 PSI air pressure, 4-20 mA DC electric current, Field bus digital signal etc., which may then be conveyed to an indicating device, a controlling device, or both. The indicating or controlling device is often located in a centralized control room. The transmitter often combines a sensor and the transmitter in a single piece. The sensor measures the process variable and generate a proportional signal. The transmitter then amplifies and conditions the sensor signal for onward transmission to the receiving or controlling device.

Transmitters Used in Process Instrumentation:

Transmitters can be broadly divided into two broad groups:

(a) Electronic Transmitters

(b) Pneumatic Transmitters

Electronic transmitters can either be analog or digital/smart as the case may be. We can further group transmitters according to the types of signals they produce namely:

- Pneumatic Transmitters
- Analog Transmitters
- Digital Transmitters

✓ Pneumatic Transmitters:- Pneumatic differential pressure transmitters are used in process industries for measuring various variables such as level or differential pressure of fluids such as gas, air, and liquids, or pressure.

✓ Pneumatic differential pressure transmitters are used in process industries for measuring various variables such as level or differential pressure of fluids such

as gas, air, and liquids, or pressure. The value of the measured variable is transmitted as a 3 to 15 PSI pneumatic signal to equipment that is remotely mounted. This remotely mounted equipment may include various types of indicators, recorders, controllers, or the combination of these devices. Looking for a transmitter that brings you accurate results when put to flow, liquid level, density, and low pressure measurement applications?

Digital transmitters

- ✓ An “intelligent” transmitter too has a microprocessor, but it also has digital communication capability, which permits.
- ✓ Other digital sensors operate on frequency phase-shift. Timers in the microprocessor easily measure frequency and duration using precise crystal clocks. In such direct digital measurements there is no need for an A/D converter, which also eliminates the conversion error and lowers inaccuracy by eliminating quantization error.
- ✓ An analog transmitter is a field-mounted device that senses a physical parameter such as pressure or temperature and generates a current proportional to the measured variable in the standard range, 4 to 20 mA.

An analog transmitter measures in real time, has a measurement accuracy approximately 1 percent and is very responsive. A digital transmitter is microprocessor-based and measures in sampled time. Its measurement is digitized, it is generally not as responsive as analog transmitter, it can communicate digitally with other devices and can be easily re-ranged. A digital transmitter has a measurement accuracy of approximately 0.1 percent.

The difference between a digital transmitter and an analog transmitter

- ✓ a digital transmitter is a microprocessor digital device that can communicate
- ✓ digital transmitters are an enhanced version of an analog transmitter
- ✓ analog transmitters measure more accurately than a digital transmitter
- ✓ there is no difference
- ✓ all of the above

2.4.2. Indicators analogue and digital

The indicator are used to provide a human readable indication of an instrument signal..

In some cases we may need extra local display for showing the process value to the operators, examples like an level transmitter installed on a big tank & level value will be shown to operator at the bottom of the tank using indicators or loop powered devices.

An indicator gives a human operator a convenient way of seeing what the output of the transmitter is without having to connect test equipment. Moreover, indicators may be located far from their respective transmitters, providing readouts in locations more convenient than the location of the transmitter itself.

Figure 2.4.1 digital indicators

Digital indicators are flexible devices which can be used in many different fields such as industry and research, as well as for a wide variety of measurement works. Digital indicators allow the user to view diverse parameters such as temperature, humidity, vibration, normalized signals, etc. Digital indicators with frame insertion are usually mounted on a panel together with other digital indicators or control systems. Digital indicators have a case so they can be used as mobile devices. Digital indicators with IP 65 protection can be used in harsh conditions. In addition to standard signal measurements and indications, digital indicators can also measure other physical quantities, for instance temperature or force by means of sensors which are directly connected to the indicator. Digital indicators are normally programmed in situ by means of the keypad, however, some can be set using a PC. The advantage is that programmed settings are stored, so other digital displays can use the same setting to save time, especially when different digital indicators should do the same work. Additionally, this function protects digital indicators against a misuse. Digital indicators programmed via a computer can be delivered with a previous setting.
Analogue Indicator are used to gain a quick overview of measurement parameters. Analogue indicator often measure electric currents, voltages and electric capacities.

The measured values are simply displayed on an analogue scale. The analogue indicator is especially convenient wherever a simplified and not too elaborate display mechanism is required. Often the analogue indicator is installed for larger facilities consisting of many units. For example to monitor generators in power stations or standby sets. PCE instruments offers analogue indicator for electric currents, voltages and electric capacities.

Figure 2.4.2 analog indicators

These analogue indicators measure the alternating current in accordance to the three-phase-method and can be switched via a rotary switch. All analogue indicator have the same size of 96 x 96 mm and by that they are suitable for installation into control panels. Furthermore the analogue indicator can be mounted at various angles. Due to different scale ranges the analogue indicator can be applied in almost any area. These analogue indicator have an advantage over digital indicators, and that is that they do not require any separate power source. All kinds of fluctuation are immediately shown on the analogue indicator. Furthermore the course of measured signals can be viewed directly by means of this analogue indicator, e.g. during the start of machines.

Transducer

An electrical transducer is a device which is capable of converting physical quantities into a proportional electrical quantity such as voltage or electric current. Hence it converts any quantity to be measured into a usable electrical signal. This physical quantity which is to be measured can be pressure, level, temperature, displacement etc. The output which is obtained from the transducer is in the electrical form and is equivalent to the measured quantity.

For example, a temperature transducer will convert temperature to an equivalent electrical potential. This output signal can be used to control the physical quantity or display it.

Instrumentation is the heart of industrial applications. Instrumentation is the art and science of measuring and controlling different variables such as flow, level,

temperature, angle, displacement etc. A basic instrumentation system consists of various devices. One of these various devices is a transducer**. A** transducer plays a very important role in any instrumentation system.

Note that any device which is able convert one form of energy into another form is called as a transducer. For example, even a speaker can be called as a transducer as it converts electrical signal to pressure waves (sound). But an electrical transducer will convert a physical quantity to an electrical one.

Types of Transducer

Transducer based on Quantity to be Measured

- Temperature transducers (e.g. a thermocouple)
- Pressure transducers (e.g. a diaphragm)
- Displacement transducers (e.g. LVDT)
- Oscillator transducer
- Flow transducers
- Inductive Transducer

Transducer based on the Principle of Operation

- Photovoltaic (e.g. a solar cell)
- Piezoelectric transducer
- Chemical
- Mutual induction
- Electromagnetic
- Hall effect
- Photoconductors

Transducer based on the External Power Source

Active Transducer

Active transducers are those which do not require any power source for their operation. They work on the energy conversion principle. They produce an electrical signal proportional to the input (physical quantity). For example, a thermocouple is an active transducer.

Passive Transducers

Transducers which require an external power source for their operation is called as a passive transducer. They produce an output signal in the form of some variation in resistance, capacitance or any other electrical parameter, which than has to be converted to an equivalent current or voltage signal. For example, a photocell (LDR) is a passive transducer which will vary the resistance of the cell when light falls on it. This change in resistance is converted to proportional signal with the help of a bridge circuit. Hence a photocell can be used to measure the intensity of light.

A transducer is an electrical device that is used to convert one form of energy into another form. The best examples of the transducer are mic, fluorescent bulb, and the speaker can be considered as a transducer. Likewise, there are different kinds of transducers used in electrical and electronic projects.

2.4.3. Controllers and PLC controlled devices

Generally when we say controller we mean that it is a device or other responsible body that control another controllable object or system. Controller is a part which acts as an overseer of another device or system to be controlled. But in industrial and automation system controllers are devices that control another system depending on the interest of programmer/ commander. Depending on the company's needs, a controller may also be responsible for hiring and training staff who will work in the financial department.
A Programmable Logic Controller (PLC) is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices.

Almost any production line, machine function, or process can be greatly enhanced using this type of control system. However, the biggest benefit in using a PLC is the ability to change and replicate the operation or process while collecting and communicating vital information.

Another advantage of a PLC system is that it is modular. That is, you can mix and match the types of Input and Output devices to best suit your application.

PC-based instrumentation and control systems is amazingly simplifying control methods of different machines simultaneously and making a system very integrated while reducing or interconnecting control device and reducing labor force.

The purpose of a PLC was to directly replace electromechanical relays as logic elements, substituting instead a solid-state digital computer with a stored program, able to emulate the interconnection of many relays to perform certain logical tasks.

Basically, in this sub-title there is a great deal more to programming than simply about instrumentation and control system. Programming benefits from a disciplined approach and this is absolutely essential when someone able to convert hardware program to software (PLC) program.

Example looks the advantage of simple control system:

A control system is a system of integrated elements whose function is to maintain a process variable at a desired value or within a desired range of values. The control system monitors a process variable or variables, and then causes some action to occur to maintain the desired system parameter. In the example of the central heating unit, the system monitors the temperature of the house using a thermostat. When the temperature of the house drops to a preset value, the furnace turns on, providing a heat source. The temperature of the house increases until a switch in the thermostat causes the furnace to turn off.

Two terms which help define a control system are input and output. Control system input is the stimulus or program applied to a control system from an external source to produce a specified response from the control system. In the case of the central heating unit, the control system input is the temperature of the house as monitored by the thermostat.

Control system output is the actual response obtained from a control system. In the example above, the temperature dropping to a preset value on the thermostat causes the furnace to turn on, providing heat to raise the temperature of the house.

In the case of nuclear facilities, the input and output are defined by the purpose of the control system. Knowledge of the input and output of the control system enables the components of the system to be identified. A control system may have more than one input or output.

Control systems are classified by the control action, which is the quantity responsible for activating the control system to produce the output. The two general classifications are open-loop and closed-loop control systems.

Advantages of Controller

A controller is a mechanism that seeks to minimize the difference between the actual value of a system (i.e. the process variable) and the desired value of the system (i.e. the set point). Controllers are a fundamental part of control engineering and used in all complex control systems.

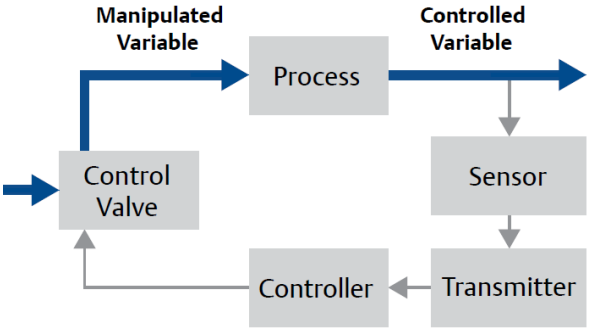


Figure-*3.1 Feedback Control Loop*

Before we introduce you to various controllers in detail, it is very essential to know the uses of controllers in the theory of control systems. The important uses of the controllers include:

1. Controllers improve the steady-state accuracy by decreasing the steady state error.
2. As the steady-state accuracy improves, the stability also improves.
3. Controllers also help in reducing the unwanted offsets produced by the system.
4. Controllers can control the maximum overshoot of the system.
5. Controllers can help in reducing the noise signals produced by the system.
6. Controllers can help to speed up the slow response of an over damped system.

Different varieties of these controllers are codified within industrial automotive devices such as programmable logic controllers and SCADA systems. The various types of controllers are discussed in detail below.

Types of Controllers

There are two main types of controllers: continuous controllers, and discontinuous controllers.

In discontinuous controllers, the manipulated variable changes between discrete values. Depending on how many different states the manipulated variable can assume, a distinction is made between two position, three position, and multi-position controllers. Compared to continuous controllers, discontinuous controllers operate on very simple, switching final controlling elements.

The main feature of continuous controllers is that the controlled variable (also known as the manipulated variable) can have any value within the controller's output range. Now in the continuous controller theory, there are three basic modes on which the whole control action takes place, which are:

A) Proportional controllers**.**

B) Integral controllers**.**

C) Derivative controllers**.**

We use the combination of these modes to control our system such that the process variable is equal to the set point (or as close as we can get it). These three types of controllers can be combined into new controllers:

1. Proportional and integral controllers (PI Controller)
2. Proportional and derivative controllers (PD Controller)
3. Proportional integral derivative control (PID Controller)

2.4.4. Control valves

Control valves are device that used in many processes to control flow, pressure, temperature or other variables. Control valve is used to control fluid flow by varying the size of the flow passage as directed by a signal from a controller. This enables the direct control of flow rate and the consequential control of process quantities such as pressure, temperature, and liquid level.

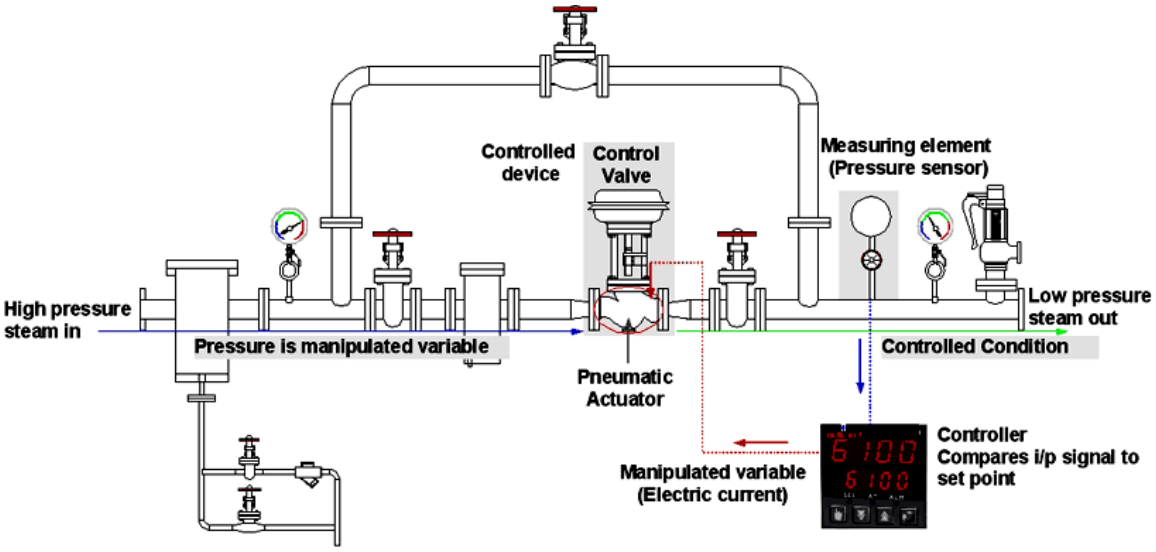


Figure 3.2.process control with feeadback loop

The type of valve used will depend on the size of the pipe, the overall pressure that the system operates the flowing media, process conditions, and other factors. There is also a balance between the cost of the valve and the cost benefits associated with tighter control.

Types of valves include:

- ***Butterfly valves*** – These valves are typically lower cost and use less space than other valves. These valves are good for control but other valves can provide more precise control. They are available in large diameters.
- ***Globe valves*** – These valves provide very precise control and are available with a wide variety of flow characteristics. The downside is that these valves tend to be more expensive that other types. These are also not well suited for anything but clean fluids
- ***Ball valves*** – There are 2 main styles of ball valves, full and segmented. Typically the full ball is used for on/off service but these can also be used for modulating service. The segmented ball valve was originally designed for control of slurry flows. These offer high flow capacity and wide range ability. The cost of these valves falls between that of the butterfly and globe valves.
- ***Gate valves*** – These are typically used for shutoff and isolation. Occasionally they are used for throttling service but they are not well suited to this type of service.
- ***Pinch valves*** – These are low cost valves usually used with abrasive or corrosive fluids. They are typically used for open/close service but can be used for modulation. These are typically operated using air pressure to collapse the sleeve.
- ***Plug valves*** -These are similar to ball valves but are less expensive due to their design. They are used where there are high flow rates at low pressure drops. Control valves are not limited to this only there are numerous types of valves depending on their purpose, shape and control mechanisms.

Use of Control Valves

Process plants consist of hundreds, or even thousands, of control loops all networked together to produce a product to be offered for sale. Each of these control loops is designed to keep some important process variable such as

pressure, flow, level, temperature, etc. within a required operating range to ensure the quality of the end product. Each of these loops receives and internally creates disturbances that detrimentally affect the process variable, and interaction from other loops in the network provides disturbances that influence the process variable.

To reduce the effect of these load disturbances, sensors and transmitters collect information about the process variable and its relationship to some desired set point. A controller then processes this information and decides what must be done to get the process variable back to where it should be after a load disturbance occurs. When all the measuring, comparing, and calculating are done, some type of final control element must implement the strategy selected by the controller.

Self-check 4

Answer the following questions depending on the information sheet reading

1. A device that reacts to certain physical conditions is known as?
   A) Hand tools
   B) Safety Equipments
   C) Sensors
   D) Control standards
   E) All
2. A device that converts a parameter of interest to a form that is more convenient to use.
   A) Sensors
   B) Accelerators
   C) Standards
   D) Indicators
   E) All
3. What are transducers?
   A) A device that convert input to mechanical
   B) A device that converts input to electrical
   C) A device that converts input to physical
   D) A device that converts input chemical
   E) All
4. A piece of equipment that is used for sending signal is
   A) Transmitter
   B) Architect
   C) Matter
   D) Counter
   E) Transfer
5. A devices used to transform one kind of energy to another form of energy can be.
   A) Inspector
   B) Accumulator
   C) Transducer
   D) Informer

6. A device that converts an electrical signal into a non-electrical quantity is
   A) Sensor
   B) Sonar
   C) Shocker
   D) Shower
   E) actuators

Answer the following question!	
Note: **Satisfactory rating - 6 and 12points**	**Unsatisfactory – below 6 and 12 points**

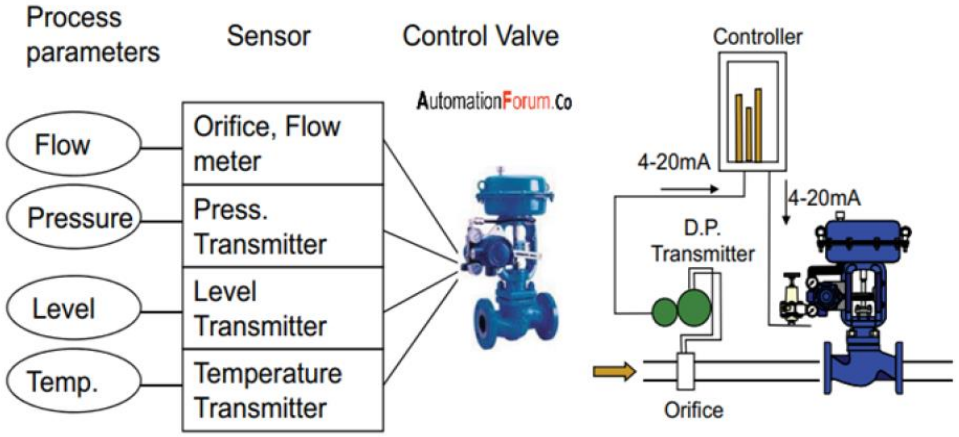
Answer Sheet

Name: _____ Date: _____ score _____

Information sheet-5:- Installing instrumentation and control devices

2.5 Installing instrumentation and control devices

Control valves are used to control the low and direction of fluid such as gas, water, steam or chemical compounds. They are controlled so that the load disturbance can be compensated. Control valves are used in gas centrifugal compressors to avoid damages in the compression machine. Control valves are used in the fluid power system. Automatic control of the modern plants is done with the help of control valves they can do an exchange of energy and reduction of pressure. The control valve is the final control element; it is the major part of the automatic control. Control valves will provide the required energy to the controllers.



There are numerous valve types, styles, sizes, and shapes available for use in industry. Even though there are dozens of valve varieties to choose from, the primary purpose of valves remains the same; that is to stop or start flow, or to regulate flow. Regulation of flow includes: throttling, prevention of flow reversal, and relieving or regulating pressure within a system. Selection of valves for a system is based on the valve's intended service and design function. There are eight basic valve designs available:

- Gate
- Globe
- Check
- Diaphragm
- Ball

- Butterfly
- Plug
- Relief

Installation of control valves

In case of installing a valve we must know it's functions, we must know if it is able to prevent back flow, start the flow, stop the flow, regulate flow, or regulate pressure. Most of the details will be stamped on the valve body by the manufacturer, like the type of system, operating pressure direction of flow….etc.

The operating characteristics of the valve must be known. We must aware of metal it is made of and the type of end connection it has. Operating characteristics and the material of the valve could affect the service a valve can provide. By checking the end connection we could know if the valve is suited or not for the installation in the system.

The installation of the valve should be done at accessible places and with proper headroom for better operation. The stem position must be kept upwards whenever it is possible. It is ok if the stem position is horizontal or straight up but the inverted position or the stem pointing downward must be avoided. Before installation, the system should be checked so that we could know if the pressure is on the wrong side of the disk if so it could damage the valve.

The valve installation

The valve configuration and material of construction have been selected to meet specific pressure, temperature, pressure drop and fluid conditions. Since the body and trim material combinations are limited in their pressure, temperature and pressure drop ranges, please contact the factory prior to applying additional conditions not stated as approved.

1. Inspect control valve for any shipment damage and for any foreign material that may have collected during packaging and shipment.
2. Blow out all pipe lines to remove pipe scale, chips, welding slag and other foreign material.
3. Verify the flow direction marked on the body. Note: a. Flow under the plug for parabolic trim.
4. Install the control valve, preferably in a straight run of pipe, away from bends or sections of abnormal velocity.

5. Control valves can be installed in any orientation. However the preferred installation is in horizontal pipeline with the actuator in a vertical position. However we can install control valve in other position.
6. If continuous operation is required during maintenance and inspection, a by-pass should be installed.
7. Install the valve using accepted piping practices. For flanged bodies use a suitable gasket between the body and pipe line flanges and tighten the bolts evenly to avoid any strain on the body or cracking of the flange.
8. An Armstrong drain separator (equivalent to line size) draining to a TVS trap is recommended to assure clean dry steam.
9. An Armstrong 100 mesh Y strainer should be installed before the control valve to reduce the chance of dirt fouling.
10. It is recommended to install pressure gauges before and after the control valve.
11. Piping immediately downstream of the control valve should be expanded to accommodate low pressure expansion. The pipe size should be chosen so a maximum velocity of 8,000 ft/min is achieved.
12. Install upstream and downstream gate valves to isolate control valve for maintenance and upgrades.
13. Install drains in-between control valve and isolation valves for depressurizing the line during maintenance.
14. Install a filter regulator on the air line to the actuator or positioned. The maximum air pressure to the actuator is 60 psig.
15. Tighten gland packing enough to prevent leakage, if packing is graph oil.

Self- check 5

Answers the following self-check questions

1. PLC is an acronym of _____ Logic Controller
    A. Programmable
    B. Peripheral
    C. Periodic
    D. Pneumatic
2. Ladder Logic Programming consists primarily of
    A. logic gate symbol and connecting lines
    B. virtual relay contacts and coils
    C. function blocks and connecting lines
    D. text-based codes
3. In a PLC, scan time refers to the amount of time in which
    A. timer and counters are indexed by
    B. One rung of ladder logic takes to get complete
    C. the entire program takes to excecute
    D. the technician enters the program
4. Main difference between online and offline PLC programming is
    A. where the edited program resides
    B. whether the programming PC has internet connectivity
    C. whether the PLC is running or stopped
    D. the type of program used
5. _____ language can be programmed interactively with the PLC
    A. Online
    B. Offline
    C. Basic
    D. C

Answer the following question!	
Note: **Satisfactory rating - 5 and 10points**	**Unsatisfactory – below 5 and 10 points**

Answer Sheet

Name: _____ Date: _____ score _____

Information shee-1:- Responding unplanned events or conditions

2.6 Responding unplanned events or conditions

Unplanned events are accidents or upset events or conditions that are not planned as a part of routine Project activities during any Project phase. Even with the planning and application of mitigation, accidents, malfunctions, and unplanned events could occur during any phase of the Project. These could occur as a result of abnormal operating conditions, wear and tear, human error, equipment failure, and other possible causes.

Many accidents, malfunctions, and unplanned events are preventable and can be readily addressed or prevented by good planning, design, equipment selection, hazards analysis and corrective action, emergency response planning, and mitigation.

The focus is on credible accidents that have a reasonable probability of occurrence, and for which the resulting residual environmental effects could be major without careful management.

It is noted that accidents, malfunctions, and unplanned events are evaluated individually, in isolation of each other, as the probability of a series of accidental events occurring in combination with each other is very minimal. These possible events, on their own, generally have a very low probability of occurrence and thus their environmental effects are of low likelihood. They have an even lower probability or likelihood of occurring together – thus their combination is not considered credible, nor of any measurable likelihood of occurrence.

Accidents, malfunctions, and unplanned event scenarios have been conservatively selected that represent higher consequence events that would also address the consequences of less likely or lower consequence scenarios.

The accidents, malfunctions, and unplanned events that have been selected based on experience and professional judgment are as follows:

- Worker accident: worker accidents may occur during either construction or operation, and may result in harm, injury, or death to one or more Project workers;
- Fire: consists of a fire in a Project component. The focus is on the consequence, and not the mechanism by which it occurs;
- Hazardous materials spill: spills of fuel, petroleum products, and/or other chemicals used on site or in Project components; and

- Vehicle accident: Project-related vehicle accidents that could occur on the road transportation network.

Refer to information sheet- 1.1 Planning and preparing installation

Self- check 6

Answer the following questions

1. What is the cause of unplanned events?

   _____

   _____

   _____

2. How can we protect or reduce occasion of unplanned events?

   _____

   _____

3. Who can be affected by unplanned events?

   _____

   _____

   _____

   _____

Answer the following question!	
Note: **Satisfactory rating - 5 and 9points**	**Unsatisfactory – below 5 and 9 points**

Answer Sheet

Name: _____ Date: _____ score _____

L #14	**LO #3- Test installed instrumentation and control devices**

Instruction sheet

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

- Inspecting installed devices for formal functional tests
- Testing device functionality according to the standard procedures
- Undertaking final inspections to conform technical requirements
- Preparing report on installation and testing of equipment

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:

- Inspect installed devices for formal functional tests
- Test device functionality according to the standard procedures
- Undertake final inspections to conform technical requirements
- Prepare report on installation and testing of equipment

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:- Inspecting installed devices for formal functional tests

3.1. Inspecting installed devices for formal functional tests

This will depend on type of work equipment, its use and the conditions to which it is exposed. This should be determined through risk assessment and take full account of any manufacturer's recommendations. The advice of others, such as trade associations and consultants, as well as other sources like published advice on health and safety, may also be helpful.
An inspection should concentrate on those safety-related parts which are necessary for the safe operation of work equipment and, in some cases; this may require testing or dismantling. However, not all safety-critical features on a particular item of work equipment may require inspection at the same intervals.

An inspection can vary in its extent, as the following demonstrate:

- quick checks before use (eg electric cable condition on hand-held power tools, functional testing of brakes, lights on mobile machinery)
- weekly checks (eg presence of guarding, function of safety devices, tire pressures, and the condition of windows, mirrors and CCTV on mobile plant)
- more extensive examinations, undertaken every few months or longer (eg general condition of a ladder, close examination of a safety harness, portable appliance testing)

Records are not normally required to be made for the simplest pre-use checks.
The use of checklists can assist but these, and the records made, should be tailored to the particular type of work equipment to minimize the burden to what is strictly necessary for safety. Requiring too much detail too often can lead to inspection activity becoming burdensome with the risk of a superficial 'tick box' approach or even, in some cases, the inspection activity ceasing altogether. You only need to inspect what is necessary for safety.

When should work equipment that needs inspection be re-inspected?
Work equipment which is exposed to conditions causing deterioration that could result in a dangerous situation should be inspected at suitable intervals, and after every event liable to

jeopardise its safety. The frequency of inspection may vary; depending on environmental conditions (e.g. equipment subject to harsh outdoor conditions is likely to need more frequent inspections than if used in an indoor environment).

The frequency of inspection should be determined through risk assessment, taking account of the manufacturer's recommendations, industry advice and your own experience. It may be appropriate to review the frequency of inspection in the light of your experience. Intervals between inspections can be increased if the inspection history shows negligible deterioration, or shortened where experience shows this is necessary to prevent danger.

Who should carry out the inspection of work equipment?

Equipment can be inspected by anyone who has sufficient knowledge and experience of it to enable them to know:

- what to look at
- what to look for
- what to do if they find a problem

The necessary level of competence will vary for inspections, according to the type of equipment and how / where it is used. The nature of these inspections does not have to be determined by the same person who undertakes them, provided the person determining them is competent. This can often be done in-house by experienced staff, taking account of:

- the manufacturer's recommendations
- industry advice
- their own experience

Self-check-1	Written test

Choose the best answer from given alternatives

1._____ can be performed either visually or instrumentally

a) inspection

b) functionality test

c) disassembling

d) reassembling

e) all are correct

2. Which of the following is performed before and after installation to assure safety related issue?

a) Inspection

b) communication

c) calibration

d) installation

1. Which of the following need checklist during the activity?

a) reading

b) instruction

c) inspection

d) service

2. When does inspection performed?

a) Before and after job completion

b) During and after purchase

c) every day before activity

d) all are correct

e) none of the above

3. What can we inspect/look in control valve installed?

a) leakage

b) damage

c) installation

d) job quality

e) all are correct

f) none

4. _____ is the process of taking assessment about completed installation.
   a) Inspecting
   b) Checking
   c) Specifying
   d) Diagnosing
   e) All
5. _____ can be carried out either visually or instrumentally
   a) Observation
   b) Testing
   c) Inspection
   d) all
6. Which of the following is varying the value of set point if not inspected?
   a) Operation time
   b) Environmental situation
   c) Faults
   d) All

Answer the following question!	
Note: **Satisfactory rating - 4 and 8points**	**Unsatisfactory – below 4 and 8 points**

Answer Sheet

Name: _____ Date: _____ score _____

Information sheet – 2:- Testing device functionality according to the standard procedures

3.2. Testing device functionality according to the standard procedures

An inspection is, most generally, an organized examination or formal evaluation exercise. In engineering activities inspection involves the measurements, tests, and gauges applied to certain characteristics in regard to an object or activity. The results are usually compared to specified requirements and standards for determining whether the item or activity is in line with these targets, often with a Standard Inspection Procedure in place to ensure consistent checking. Inspections are usually non-destructive.

The following are elements of complete testing program based on the assumption that the device being offered is a new design or custom product, and hence the device should be subjected to all aspects of requirements verification. After this initial case testing program, the steps can probably be eliminated or minimized for standard products and modified.

The testing for a device or product can be broken down into the following general categories:

- Design verification.
- Functionality.
- Mechanical and construction.
- Standards compliance.
- Environmental.
- Serviceability.

Inspection of control valves

How to do the inspection of the control valve

- Check whether the flow direction of the control valve is equal to the process fluid flow direction
- Diaphragms bolts and nuts must be checked
- Check the bonnet clamp bolts and yoke clamp bolts
- Check for any air leakage in the valve
- Actuator spring and the gland packing must be checked

What are the testing methods of the control valve

- Shell test
- Backseat test
- Low-pressure closure test
- High-pressure closure test
- Visual examination of casting

How to do the periodical inspection and maintenance of the control valve

- Air leak from the diaphragm must be checked
- Check for any leak from flanges and bonnet
- Yoke clamp must be tight and there should not be any air leak from the air piping of the actuator
- The stem connectors should be checked for a loose connection
- The actuator stem and valve stem must be checked
- Check for any vibrations from the control valve
- Gland packing must be checked, and confirm there is no leak

Self-check-2	Written test

Choose the best answer from given alternatives

1. Why personal training & qualification is necessary/needed?
   A. To produce quality product
   B. To provide quality service
   C. To reduce waste of product
   D. All of the above
   E. None of the above
2. Why ISO award is given to some companies?
   A. To motivate quality system
   B. To create un-required system
   C. to create International fund
   D. To motivate pre- work license
   E. To create un-required competition
   F. None of the above
3. Which of the following type of test is purposely performed
   a) Functionality.
   b) Mechanical and construction.
   c) Standards compliance.
   d) Environmental.
   e) All are correct
4. Why specification is necessary?
   A. To create set of identification
   B. To create set of Distribution
   C. To create Confusion
   D. To create vibration
   E. All of the above
   F. none of the above
5. Which of the following is not a part of specification?

A. title
B. Identifier
C. Drawing
D. photograph
E. all of the above
F. None of the above

6. Which of the following is not included in specification?
   A. Material requirement
   B. Total cost required
   C. Occupation of worker
   D. all
   E. None

Answer the following question!	
Note: **Satisfactory rating - 6 and 12points**	**Unsatisfactory – below 6 and 12 points**

Answer Sheet

Name: _____ Date: _____ score _____

Information sheet -3:- Undertaking final inspections to conform technical requirements

3.3. Undertaking final inspections to conform technical requirements

Final inspection refers to the inspection performed in the final stage of job/activity. In this inspection, whether the complete job meets the requirements or specified to be sure we make it again visually.

In electrical/instrumentation work after the activity is done by a licensed technician/qualified person, the proper procedure generally includes two reviews the completed job. Electrical inspections may also take place for other reasons, such as when you are considering buying or sale. In control valves the final inspection can be to insure that no leakage or other purposes and it are inspection usually to answer the following questions.

Steps of Visual Inspection	Yes	No	N/A
• Is the valve properly identified, including the valve number and area served?	☐	☐	☐
• Is the valve locked or wired in the open position?	☐	☐	☐
• Is the locking device for the valve, such as padlock and chain or wire, in good condition?	☐	☐	☐
• Does an electrical tamper device supervise the valve?	☐	☐	
• Is the valve in the open position? If not, has the impairment procedures been followed?		☐	☐
• Are there any signs of damage or leakage?	☐	☐	☐
• Is the valve accessible (e.g., does snow, ice, dirt, or debris need to be removed)?			

Self-check -3

1. _____is type of test that can be done after the job completion
   a) final inspection
   b) general comment
   c) correction
   d) activity
2. Final inspection is required to _____that if there is something missed job?
   a) to remove
   b) correct
   c) to communicate
   d) to negotiate
   e) disassemble
3. Which of the following job is performed by qualified person or the technician who completed the job?
   2. specification
   (b) qualification
   (c) initiation
   (d) communication
   (e) final inspection
4. Final inspection is required _____ to carry out the job
   a) visually
   b) verbally
   c) primarily
   d) all
5. _____ is performed at the end of all activity.
   a) consultation
   b) correlation
   c) final inspection
   d) justification

Answer the following question!	
Note: **Satisfactory rating - 5 and 10points**	**Unsatisfactory – below 5 and 10 points**

Answer Sheet

Name: _____ Date: _____ score _____

Information sheet – 4:- Preparing report on installation and testing of equipment

3.4. Preparing report on installation and testing of equipment

Reports are well researched, planned and organized documents that are written for specific purpose and reported for a specific audience; it must always be accurate and objective. It is a concise document based on research that typically analyses a situation and sometimes makes recommendations.

- A report is a structured document, usually prepared for more than one reader, presenting factual information in a concise format. Reports are usually used for decision making but may be for presenting information.
- A report is a document that presents information in an organized format for a specific audience and purpose. Although summaries of reports may be delivered orally, complete reports are almost always in the form of written documents.

Types of reports include memos, meeting minutes, expense reports, audit reports, closure reports, progress reports, justification reports, compliance reports, annual reports, project report, business report, scientific and research reports, and feasibility reports.

Short steps to prepare project report

- Step 1: Plan
- Step 2: Analyze the question
- Step 3: Draft an outline
- Step 4: Find information
- Step 5: Write
- Step 6: Edit and proofread

What makes an effective report?

- Clear, concise and accurate
- Easy for the audience to understand
- Appropriate for the audience
- Well organized with clear section headings

Report structure:

Reports follow a standardized format. This allows the reader to find the information easily and focus on specific areas. Most reports follow the following structure best report includes section.

A report must have:

7. Title Page
8. Table of Contents
9. Abstract or Executive Summary
10. Introduction (or Terms of Reference and Procedure)
11. Findings and/or Discussion
12. Conclusions
13. Recommendations
14. References

Report may include the following

15. Cover letter
16. Bibliography
17. Glossary
18. Appendices

Dear Trainees till now we have discussed the purpose, types and contents of report. Do not forget that since there are different formats of lab report exists don't expect the format. The report format depends on the purpose, content, aim …..etc.

Self – check: – 4

Answer the following question depending on the reading of information sheet

1. _____ is written and presented for specific audience

   a) paper b) analysis C) specification d) report e) all

2. _____must be presented for more than one or more reader

   a)voucher

   b) magazine

   c) receipt

   d) research

   e)all

3. Which of the following is not a type of written document that reported to your trainer/teacher?

   a) news paper

   b) broacher

   c) lab report

   d) answer sheet

4. Which of the following is written after the activity is completed for, more improvement ?

   a) report title

   b) report body

   c) recommendation

   d) conclusion

   e) all

5. Which of the following is an indicator of the date report conducted?

   a) title

   b) procedure

   c) date

   d) conclusion

   e) none

Answer the following question!	
Note: **Satisfactory rating - 5 and 10points**	**Unsatisfactory – below 5 and 10 points**

Answer Sheet

Name: _____ Date: _____ score _____

L #15	LO #4- Clean-up

Instruction sheet

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

- Cleaning and clearing work site

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:

- Clean and clear work site

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 – 4:- Cleaning and clearing work site

A cleaned, work area helps/plays extremely important roleon occupant's psychology creating a welcoming atmosphere, often subconsciously encouraging hard work and collective effort. The appearance is one of the major elements that separates one building from another and brings added value.

Simple example

- To create safe work area
- To create attractive work area
- To reduce hazards

In the manor we must use the 5s and housekeeping principles:

PURPOS

- Establishing a normal condition makes the abnormal conspicuous
- Standardized work depends up on each tools being in the same place… a place for everything and everything in its place
- clean well-organized, visual workplace is fundamental to standardization
- A factory that has not adopted the 5-S is dirty with oil, dirt, and chips. Parts and boxes are lying around in non-designated areas; high precision equipment is bought, but not maintained. When a jig or fixture is needed, it cannot be found. The morale of associates is poor and the plant is doomed for trouble.

What is 5s?

- It is fundamental clean up of work environment.
- 5s makes a place for everything and puts everything in its place
- Clean up leads to improve efficiencies, emproved qualities and reduces coasts.
- Makes west appear immediately so that it can be acted up on

The 5's's

The origins of 5's is in japans that translated loosely to English

- Sorting
- Set in order
- Shining

- Standardizing
- Sustaining

All 5's are important for lasting change and success. None on their own can have lasting results.

OK, what happens when the 5-S are used?

5-S is the Top Salesperson

- A Neat and Clean Facility impresses customers
- A Neat and Clean Facility wins more contracts
- A Neat and Clean Facility is more productive
- A Neat and Clean Facility produces fewer defects

5-S is Thrifty

- A Neat and Clean Facility is thrifty and economizes on everything

5-S is the Engine of Safety

- A Neat and Clean Facility is spacious, bright, visibly appealing
- A Neat and Clean Facility is a much safer place to work
  - ✓ Work areas and traffic areas are clearly marked
  - ✓ Hoses and electrical cords are not on the floor

5-S is a Timekeeper

- A Neat and Clean Facility meets deadlines better

5-S Promotes Standardization

- Better communication results in better understanding of plans and decisions
- Visual presentation of instructions is widespread
- Associates can easily perform most operations
- Quality and cost are stabilized with clearly communicated goals

5-S creates an enjoyable workplace

- Fewer troubles in a bright, clean workplace.
- More involvement of
- associates and more ideas for improvement
- New ideas are quickly adopted
- There is a spirit of improvement in the plant.

- A Get-It-Done attitude is the rule.

Cleaning and storing tools and equipment

Set-In-Order:

- Neatly place and identify needed work items. Designate a place for every needed item so that anyone can find it
- Always put things back in their designated spots
- Make it so that new employees, people from other companies, or people who seldom come to the plant can find things easily
- Design a storage place that is well marked so that necessary items can be taken out quickly and used easily
- Create storage space that makes it easy to return things to their places and see if they're missing
- If things are in order, time wasted due to searching is eliminated.

Step 1 - Straighten up thoroughly

- Never straighten up anything you do not need; just get rid of it
- Within the work area, store only the necessary minimum
- Decide whether each item is a personal possession or a group possession

Step 2 - Decide on where to place things

- Decide on a convenient place in the work area to place things
- The more it's used, the closer to the process you place it

Step 3 - Decide on how to place things

- There are many different ways of storing things such as: shelves, boxes, lockers, and hanging. Storage should display items clearly for easy identification and access. We welcome any ideas from each work area.

According to function: storage places for objects with the same function

According to product: organizing a set of objects necessary for a certain product and placing them in one container or location

☞ For more information read M01:-Eliminate and Prevent MUDA

Self-check -4 :- cleaning and clearing

1. _____ is a good habit if we apply after work completion.
   A) cleaning work area
   B) Drinking water
   C) Going home
   D) working for money
2. Which of the following is the advantages of 5S?
   A) To create safe work area
   B) To create attractive work area
   C) To reduce hazards
   D) All
3. Which of the following is not the purpose of cleaning?
   a) Establish normal condition
   b) Create safe work area
   c) Change the image of organization
   d) Increase cost
   e) C & D
   f) A &B
4. One of the following is not 5S
   A) Sort
   B) set in order
   C) sustain
   D) suit order
   E) none
5. Which of the following is not applicable after the work completion?
   A) storing tools
   B) storing waste
   C) Cleaning tools
   D) washing hand

Answer the following question!	
Note: **Satisfactory rating - 5 and 10points**	**Unsatisfactory – below 5 and 10 points**

Answer Sheet

Name: _____ Date: _____ score _____

Operation sheet

Operation title: -cleaning and storing tools and machine

Purpose	To motivate the trainees to clean their work area.
Equipment ,tools and materials	Supplies and tools needed to perform this operation include these: • Buckets • Brooms • Cleaning foam/sponge • Soap/detergent • Cleaning alcohol
Conditions or situations for the operations	• All tools, equipment's and materials should be available on time when required. • Appropriate table, working area/ workshop to assemble cream separator practice.
Procedures	1. Fulfil necessary PPE 2. Be sure thatall necessary tools are presented 3. Open the windows to get clean air 4. Put on light 5. Remove tables and chairs from area to be cleaned 6. Select and identify wastes before cleaning 7. Put recyclable material according to 5S procedure and segregatethem 8. Clean the area properly 9. Clean chairs and table with proper cleaning material 10. Restore the to their proper positions 11. Check that all activities are made without missing 12. Inform your Trainers your completion let he/she approve
Precautions	• Care should be taken while connecting with electric power. • Use materials, tools and equipment are according their purpose
Quality criteria	• Did personal protective equipment worn while fitting and adjusting cream separator machine • Did trainees fitting and adjusting the component of the machine proper without leakage • The machine functional for cream separation

The Trainers who developed the TTLM

No	Name	Qual.	Educational background	Region	E-mail
1	Bayu Assefa Wakijera	A	Automation And Controlling Techinolgy	Oromia	bayuassefa2006@gmail.com
2	Tamira Ayele Birru	A	Electronic Communication Technology	Oromia	Tamiratayu@gmail.com
3	Roman Ayalew Meskele	A	Automation and controlling techinolgy	Oromia	nimonaroman@gmail.com

LO1:- Plan and Prepare Installation work

Self-check-1 Key Answer
1. It is sequence of action steps to achieve some specific goal 2. Improved health and safety performance. • Reduced cost associated with accidents and incidents. • Improved staff relations and morale. • Improve business efficiency. • Improved public image and PR. • Lower insurance premiums. • Easier access to finance. 3. Occupational Health and Safety (OH&S) policy is a statement of principles and general rules that serve as guides for action 4 . General rules that serve as a guides for action 5. Guide lines 7. To protect every workingman against the dangers of injury, sickness or death through safe and healthful working conditions 8. environmental impact 9. Statutory law 10. E) All of them are correct 11. D) All

Self-check-2 Key Answer
1. c) Unplanned event 2. d) injuries 3. c) risk 4. e) all are correct 5. a)Use of fire extinguisher 6. b)Hazard control 7. d) combustible materials

Self check 3- **Key Answer**
1. d detailed directions to be followed **2.** e) all **3.** e) all **4.** d) interactive instruction

Self –check 4- Answer key	**Part II**	**Part III**
1. Screw derivers	1.D	1. D
2. Combination pliers	2. C	2. F
3. Longnose pliers	3. C	3. G
4. Wire strippers	4. E	4. A
5. Soldering iron	5. A	5. H
6. Side cutter	6. D	6. B
7. Claw hammer	7. A	7. C
8. Flat screw driver	8. E	**8.** E
9. Rulers	9. C	
10. Try squares	10. B and 11.D	

Self check -5 Key Answer
1. d) Obtaining is picking out exact what we want 2. B) Material handling 3. b)USB connector 4. B) terminal 5. C) electrical connector

LO2:- Install instrumentation and control devices

Self-check-1 **Key Answer**
1. b) PPE 2. a) Earmuffs 3. D) helmet 4. D) face shield 5. D) ladder 6. B) Musk 7. D)gloves 8. D) Paints 9. E) All

Self check-2 **Key Answer**
1. a) using personal protective equipment 2. f) All are answer 3. e) B & D 4. d) all of the above 5. b) false

Self- check-3 **Key Answer**
1. A) Safety and health program 2. E) all 3. A) Reducing hazards 4. A) To increase personal safety 5. C) EBCS

Self-check-4 Key Answer

1. C) Sensors
2. A) Sensors
3. B) A device that converts input to electrical
4. A) Transmitter
5. C) Transducer
6. E) actuators

Self check-5 Key Answer

1) A. Programmable

2) A. logic gate symbol and connecting lines

3) B. One rung of ladder logic takes to get complete

4) B. whether the programming PC has internet connectivity

5) C. Basic

Self- check 6 Key Answer

1. Sudden occasion

   Improper design of materials

   Misuse of equipments or materials

2. `Proper plan

   Daily follow-up reasons of causes....etc

3.

   - Works
   - Any person who faced
   - Property
   - Environments...etc

LO3:- Test installed instrumentation and control

Self-check-1: Key Answer

1. a) inspection
2. a) Inspection
3. c) inspection
4. d) all are correct
5. e) all are correct
6. a) Inspecting
7. a) Inspection
8. d) All

Self-check -2:- Key Answer

1. D) All of the above
2. A) To motivate quality system
3. A) Functionality
4. A) To create set of identification
5. F) None of the above
6. C) Occupation of worker

Self-check-3 Key Answer

1. a) Final inspection
2. b) Correct
3. a) Final inspection
4. a) Visually
5. c) Final inspection

Self-check -4 Key Answer

1. D) report
2. C) research
3. C) lab report
4. C) recommendation
5. C) date

Self - check -1:- Key Answer

A) cleaning work area

D) all

E) C & D

D) suit order

B) storing waste

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