



# **ELECTRO MECHANICAL EQUIPMENT OPERATION AND MAINTENANCE**

**NTQF Level III**

## **Learning Guide #31**

**Unit of Competence: Install Electro Mechanical  
Machine and drives**

**Module Title: Installing Electro Mechanical  
Machine and drives**

**LG Code: EIS EME3 M03 L02- 31**

**TTLM Code: EIS EME3 TTLM 0219v1**

### **LO 2: Install electrical machines and drive**

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

- OHS policies and procedures
- Appropriate personal protective equipment
- Electrical machines and drives devices
- Establishing working procedures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Use appropriate personal protective equipment in line with standard operating procedures.
- Follow OHS policies and procedures for installation in line with the job requirements.
- Install electrical machines and drives devices in accordance with manufacturer's instructions, requirements, and without damage to the surrounding place or environment
- Establish working procedures for Unplanned events or conditions are responded to in accordance with procedures

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 15.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page .
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

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6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.
8. Read the information written in the “Information Sheet 2”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
9. Accomplish the “Self-check 2” in page .
10. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2).
11. Read the information written in the “Information Sheets 3“ . Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
12. Accomplish the “Self-check 3” in page .
13. Read the information written in the “Information Sheets 4”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
14. Accomplish the “Self-check 4” in page .
15. Do the “LAP test” in page \_\_ (if you are ready). Request your teacher to evaluate your performance and outputs. Your teacher will give you feedback and the evaluation will be either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide #32.

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## Introduction

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. This domain is necessarily vast, encompassing a large number of disciplines and numerous workplace and environmental hazards. A wide range of structures, skills, knowledge and analytical capacities are needed to coordinate and implement all of the “machine installation” that make up national OSH systems so that protection is extended to both workers and the environment.

### 1.2 OHS guidelines

Occupational safety and health is an extensive multidisciplinary field, invariably touching on issues related to scientific areas such as medicine – including physiology and toxicology – ergonomics, physics and chemistry, as well as technology, economics, law and other areas specific to various industries and activities. Despite this variety of concerns and interests, certain basic principles can be identified, including the following:

- **All workers have rights:-** Workers, as well as employers and governments, must ensure that these rights are protected and must strive to establish and maintain decent working conditions and a decent working environment. More specifically:
  - ✓ work should take place in a safe and healthy working environment;
  - ✓ conditions of work should be consistent with workers’ well-being and human dignity;
  - ✓ work should offer real possibilities for personal achievement, self fulfillment and service to society.
- **Occupational safety and health policies must be established:-** Such policies must be implemented at both the national (governmental) and enterprise levels. They must be effectively communicated to all parties concerned.

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- **A national system for occupational safety and health must be established:-** Such a system must include all the mechanisms and elements necessary to build and maintain a preventive safety and health culture. The national system must be maintained, progressively developed and periodically reviewed.
- **A national programmes on occupational safety and health must be formulated:-** Once formulated, it must be implemented, monitored, evaluated and periodically reviewed.
- **Social partners (that is, employers and workers) and other stakeholders must be consulted:-** This should be done during formulation, implementation and review of all policies, systems and programmes.
- **Occupational safety and health programmes and policies must aim at both prevention and protection:-** Efforts must be focused above all on primary prevention at the workplace level. Workplaces and working environments should be planned and designed to be safe and healthy.
- **Continuous improvement of occupational safety and health must be promoted:-** This is necessary to ensure that national laws, regulations and technical standards to prevent occupational injuries, diseases and deaths are adapted periodically to social, technical and scientific progress and other changes in the world of work. It is best done by the development and implementation of a national policy, national system and national programme.
- **Information is vital for the development and implementation of effective programmes and policies:-** The collection and dissemination of accurate information on hazards and hazardous materials, surveillance of workplaces, monitoring of compliance with policies and good practice, and other related activities are central to the establishment and enforcement of effective policies.
- **Health promotion is a central element of occupational health practice:-** Efforts Occupational health services covering all workers should be established. Ideally, all workers in all categories of economic activity should have access to such services, which aim to protect and promote workers' health and improve working conditions.

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- **Compensation, rehabilitation and curative services must be made available to workers who suffer occupational injuries, accidents and work related diseases:-** Action must be taken to minimize the consequences of occupational hazards. must be made to enhance workers' physical, mental and social well-being.
- **Education and training are vital components of safe, healthy working environments** Workers and employers must be made aware of the importance of establishing safe working procedures and of how to do so. Trainers must be trained in areas of special relevance to particular industries, so that they can address the specific occupational safety and health concerns.
- **Workers, employers and competent authorities have certain responsibilities, duties and obligations:-** For example, workers must follow established safety procedures; employers must provide safe workplaces and ensure access to first aid; and the competent authorities must devise, communicate and periodically review and update occupational safety and health policies.
- **Policies must be enforced:-** A system of inspection must be in place to secure compliance with occupational safety and health measures and other labor legislation.

Clearly, some overlap exists among these general principles. For example, the gathering and dissemination of information on various facets of occupational safety and health underlies all the activities described. Information is needed for the prevention as well as the treatment of occupational injuries and diseases. It is also needed for the creation of effective policies and to ensure that they are enforced. Education and training demand information.

## 1.2 Occupational safety, health and working environment

**Article 92** clearly spells out the fundamental obligations of an employer with regard to putting in place of all the necessary measures in order to ensure, work places are safe, healthy and free of any danger to the well being of workers. In the same article the employer is obliged to take, in particular the following measures to safeguard the health and safety of the workers; o To comply with the occupational safety and health requirements provided for is the proclamation; take appropriate steps to ensure that

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workers are 14 properly instructed is notified concerning the hazards of their respective occupations and the precautions necessary to avoid accident & injury to health. Ensure that directives are given and also assign safety officer, establishes an occupational, safety and health committee, provides workers with protective equipment, clothing and other materials and instruct them of its use, obliged to register and notify to the nearest labour inspection services occupational accident and diseases) arrange according to the nature of the work at his/her own expense, for the medical examination of newly employed workers and for those workers engaged in hazardous work as may be deemed necessary, take appropriate precautions to ensure that all processes of work shall not be a source or cause of physical, chemical, biological, ergonomical and psychological hazards to the health and safety of the workers.

**Article 93.** In this article the law provides the obligations of workers pertaining to the required co-operation and putting in to practice of the regulation and instruction given by the employer in order to ensure safety health and working conditions at work places. The following are the major obligations set by the law for workers to abide with.

- o To co-operate in the formulation of work rules to safe-guard the workers health and safety and implement these are
- o To inform the employer of any defects related to the appliances used and injury to the health and safety of workers, he/she discovers within the company.
- o Report to the employer any situation, which he/she may have reason, to believe could present a hazard and which he/she cannot avoid on his/her own or any accident or injury to health which arises in the course or in connection with work
- o To make proper use of all safeguards, safety devices and other appliances furnished for the protection of the health and safety of others.
- o To obey all the health and safety instructions issued by the employer or by competent authorities. 15 In the same law it is clearly stipulated that no worker may interfere with remove, displace, damage or destroy any safety devices or other appliances furnished for his/her protection or the protection of others and may not obstruct any method or process adopted with a view to minimizing occupational hazard. Occupational Injuries.

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The law has clearly stipulated about occupational injuries in its Articles 95-112 as follows;

o The provisions are started by defining occupational injury, accident and occupational diseases. The law also stipulates that an employer shall be liable for, all occupational injuries on workers except those that are caused intentionally by workers in case of non-obedience to safety instructions, non observance of accident prevention regulation and injuries caused being intoxicated. For the sake of handling the benefit of an injured worker and compensation of occupational accident and diseases, the law has clearly defined type of disablement as follow: effects;

- a. Temporary disablement
- b. Permanent partial disablement
- c. Permanent total disablement
- d. Death or fatal injury (Article 97-100)

The law in its Article 102 clearly states that the assessment for degree of permanent disablement and partial temporary disablement will be fixed in accordance with assessment table prescribed by directives issued by the Minister. In addition, the provision states that, a competent medical board shall use the assessment table, to determine the extent of the degree of disablement as far as possible with in twelve months from the date of injury. Per the provision of Articles 104-105 details of special obligations, types of benefits and duration of benefits liability are put on the employer. It is also stated that these medical benefits of the injured worker shall be withdrawn in accordance with the decision of the Medical Board. Articles 107-110 has also clearly puts that the cash benefit that the worker ought to be provided i.e. periodic payment during temporarily disablement; disablement person (gratuity) compensation in case of permanent disablement and survivors' pension gratify 16 or compensation to dependant where the worker dies. The law has also clearly indicated that the maximum compensation up on the death of the worker due to fatal accident is to be five time his annual wages. The employers' liability could be handled by pension scheme for state owned enterprises or insurance scheme arranged by enterprises for private owned enterprises. An employer shall pay a lump sum of disablement compensation to workers

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who are neither covered by pension law or insurance scheme. In Articles 110-112 clearly included who are entitled to the survivors benefit for easing the implementation of the law. Articles 112-169 states that both workers and employers can form their associations which could help them as an instrument to guarantee their rights and interest collectively. Both parties can also enter in to collective agreement which could help them design conditions which could be respected by the parties. The law states also how such associations could be established at lower and higher levels. Collective bargaining is also one of the tools through which the two parties can set conditions that could help them provide occupational safety, health and working environment matters. Labour disputes and the mechanism how to settle have also been clearly spelt out by the law with in the context of the fundamental principles underlined by the international principles of standards. The issue of strike and lock out exercise procedures is well stipulated by the law. The law has also clearly provided that what kind of labour administration system functions should be established for the proper implementation of the law. It is also clearly spelt-out powers vested to the minister to issue various subsidiary directives that could help the law to be properly implanted. It has also provided that a tripartite labour advisory Board shall be established to serve as forum for tripartite partners including advising of the minister on labour matters. Articles 170-171 has clearly indicated the duties of the Tripartite Labour Advisory Board including among other to make consultation and undertake various activities meant to promote and develop polices of labour administration system by integrating occupational safety, health and working environment services in particular, at a macro level . Article 177 has clearly spelt out that Labour Inspection Services as an organ of implementation of all the ideals of the law is established and this organ have been empowered to discharge the following major duties.

- o To ensure the implementation of the provision of the proclamation and other regulations and directives issued in accordance with the proclamation.
- o Supervise, execute, educate, make research and prepare a standard of work to ensure the implement of the provisions issued with this proclamation.
- o Conduct studies and compile statistical data's relating to working conditions.
- o Supervise and ensure that where undertaking are constructed, expanded, renovated or their

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appliances installed, are not dangerous to the safety and health of workers. o Take administrative measures to implement all the provisions of the proclamation regulations and directives issued in accordance with this proclamation; o Prepare training on occupational safety, health and working environment. o To seek in the court or in the authorities responsible for determining labour disputes appropriate measures for the enforcement of the provisions of this Proclamation and of such sanctions as may be required by its decision rendered in the course of its lawful activities. Under the provision that state the enforcing machinery the law has put Labour Inspectors who are authorized to carry out the responsibilities of Inspections, supervising of the working conditions and places services will be discharged. The law has also provide that the inspectors recruited for this purpose will have a credential to exercise the power to enter during working hours or otherwise without prior notice any work place that they may think necessary to inspect in order to examine, test or enquire to ascertain observation of the provisions of the law that is meant to establish the labor inspection service. Articles 178-182 has also clearly put the measures that should be taken by the inspector and set of restriction on their functions in due course of their services that could serve as “code of conduct” during exercising of their powers and authoritative functions. It has been clearly provided that certain set of acts have been deemed to constitute obstruction of the labour inspector in the performance of his/her duties, the acts include such as, preventing 18 the labour inspector from entering a workplace or from staying in the premises, refusing to let the inspector examine records or documents necessary for his/her functions, conceding data relating to employment accidents and the circumstances in which they occur, any other act or omission that delays or interferes with the exercise of the labour inspector function, are to mention a few.

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<b>Self-Check 1</b>	<b>Written Test</b>
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Name: \_\_\_\_\_

Date: \_\_\_\_\_

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

1. What is OHS? (2 point)
2. what are the basic principles of OHS? write some of it. (2 point)
3. what is the importance of OHS? (2 point)
4. what are the Ethiopian working environment guidelines?(2 point)
5. what are the occupational accident and diseases, the law has clearly defined type of disablement? (2 point)

**Note: Satisfactory rating - 10 points**

**Unsatisfactory - below 10 points**

**Answer Sheet**

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Short Answer Questions**

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_

### Introduction

Personal protective equipment can be categorized by the area of the body protected, by the types of hazard, and by the type of garment or accessory. A single item, for example boots, may provide multiple forms of protection: a steel toe cap and steel insoles for protection of the feet from crushing or puncture injuries, impervious rubber and lining for protection from water and chemicals, high reflectivity and heat resistance for protection from radiant heat, and high electrical resistivity for protection from electric shock. The protective attributes of each piece of equipment must be compared with the hazards expected to be found in the workplace.

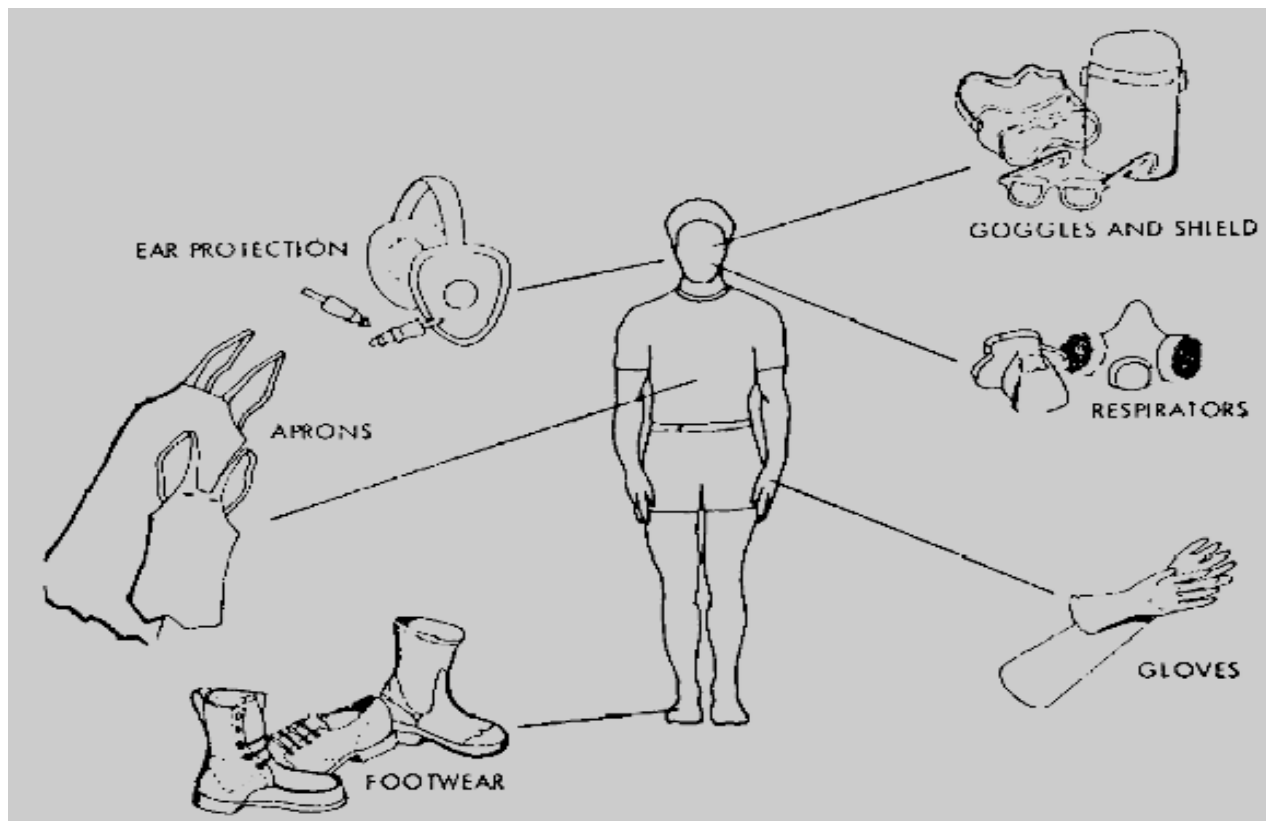


figure 2.1 examples of PPE

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## 2.1 Head and eye protection

When working on site, or in a heavy engineering erection shop involving the use of overhead cranes, all persons should wear a safety helmet. Even small objects such as nuts and bolts can cause serious head injuries when dropped from a height. Safety helmets (hard hats) are made from high impact resistant plastics or from fiber-glass reinforced polyester mouldings. Figure 2.2(a) shows such a helmet. Such helmets can be colour-coded for personnel identification and are light and comfortable to wear. Despite their lightweight construction, they have a high resistance to impact and penetration. To eliminate the possibility of electric shock, safety helmets have no metal parts. The harness inside a safety helmet should be adjusted so as to provide ventilation and a fixed safety clearance between the outer shell of the helmet and the wearer's skull. This clearance must be maintained at 32 millimeters. The entire harness is removable for regular cleaning and sterilizing. It is fully adjustable for size, fit and angle to suit the individual wearer's head. Whilst it is possible to walk about on an artificial leg, nobody has ever seen out of a glass eye. Therefore, eye protection is possibly the most important precaution you can take in a workshop. Where eye safety is concerned, prevention is better than cure.

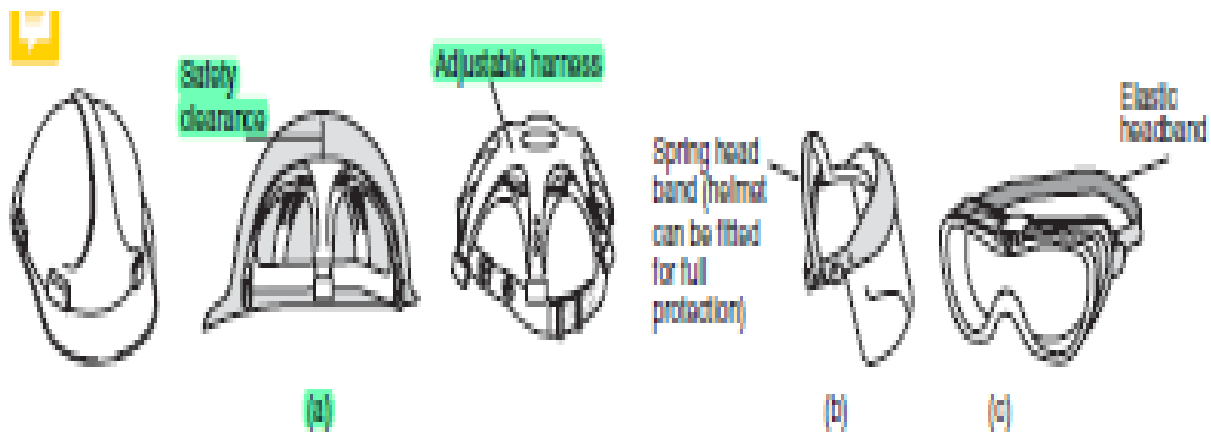


Figure 2.2 Head protection: (a) a typical fiber-glass safety helmet (b) plastic face safety visor for complete protection against chemical and salt-bath splashes; (c) transparent plastic goggles suitable for machining operations

## 2.2 Hand protection

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The edges of thin sheet metal can be razor sharp and can cause deep and serious cuts. Gloves and ‘ palms ’ of a variety of styles and types of materials are available to protect your hands whatever the nature of the work. In general terms, plastic gloves are impervious to liquids and should be worn when handling oils, greases and chemicals. However, they are unsuitable and even dangerous for handling hot materials. Leather gloves should be used when handling sharp, rough and hot materials. NEVER handle hot metal with plastic gloves. These could melt onto and into your flesh causing serious burns that would be difficult to treat.

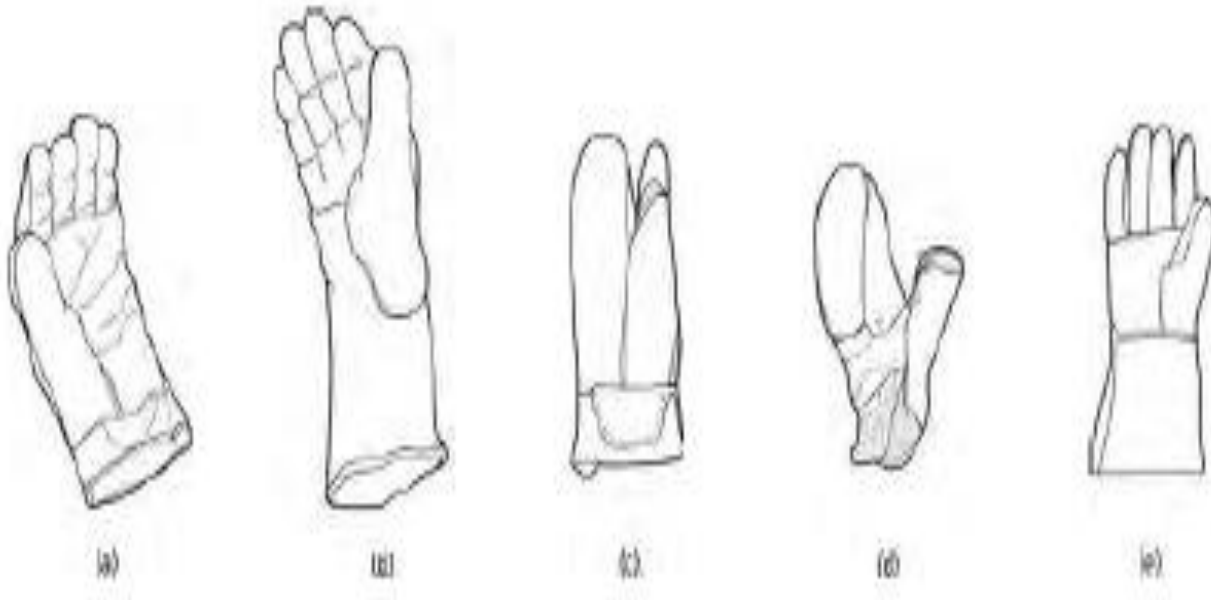


Figure 2.3 Gloves suitable for industrial purposes: (a) leather glove with reinforced palm – ideal for handling sheet steel and sections; (b) gauntlet – available in rubber, neoprene or PVC for handling chemical, corrosive or oily materials; (c) heat resistant leather glove – can be used for handling objects heated up to 300°C; (d) chrome leather hand pad or ‘palm’ – very useful for handling sheet steel, sheet glass, etc.; (e) industrial gauntlets – usually made of leather because of its heat resistance:

### 2.3 Foot protection

The injuries that you can suffer when wearing lightweight, casual shoes in a workshop environment are shown in Fig. This figure also shows some examples of safety

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footwear. Such safety footwear is available in a variety of styles and prices. It looks as smart as normal footwear and is equally as comfortable.

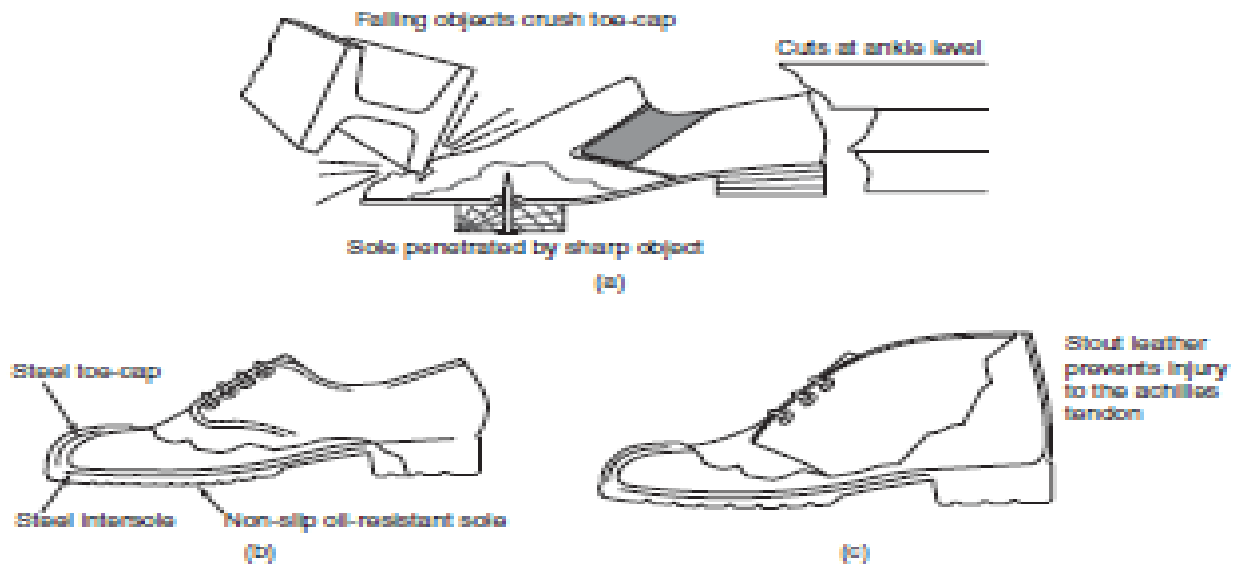


Figure 2.4 Safety foot ware: (a) lightweight shoes offer no protection: (b) industrial safety shoes; (c) industrial safety boot





<b>Self-Check 2</b>	<b>Written Test</b>
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Name: \_\_\_\_\_

Date: \_\_\_\_\_

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

1. Personal protective equipment is categorized into what? (2 point)
2. What are the most important personal protective equipments? (2 point)
3. What are the hazardous conditions in the workplace? (2 point)
4. How can we minimize or eliminate accidents and hazards around the workplace? (2 point)

**Note: Satisfactory rating - 10 points**

**Unsatisfactory - below 10 points**

**Answer Sheet**

Score = \_\_\_\_\_

Rating: \_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Short Answer Questions**

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_

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## Introduction

The Electrical machines device is an electromechanical energy conversion gadget that provides and processes power to the load. The exact same electric device can run as a motor to convert electrical power to mechanical power or operate as a generator to transform mechanical power to electrical power. The electrical device in conjunction with the power electronic converter and the connected controller makes the motor drive. The power electronic converter is made from solid state devices and handles the circulation of bulk power from the source to the motor input terminals. The advances in the power semiconductor innovation over the past several decades allowed the advancement of compact, trustworthy and efficient DC and AC Electrical machines motor drives.

### 3.1 Generator

A generator is a device that converts motive power (mechanical energy) into electrical power for use in an external circuit. Sources of mechanical energy include steam turbines, gas turbines, water turbines, internal combustion engines and even hand cranks.

#### Steps for Generator Installation

step 1: choose a location

The location should meet these guidelines:

- Stable, well-drained area that will not flood
- Room around the generator for the technician and maintenance personnel.
- keep in mind homeowners association and community restrictions when choosing a site.

Approximate clearances to keep in mind:

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- 18 inches (1.5 feet) from the house
- 60 inches (5 feet) from doors, windows, and fresh air intakes
- 36 inches (3 feet) in front of the generator for servicing room

The closer the site is to a natural gas line and the electric meter, the more you will save on installation costs.

#### step 2: installation

- prepare the site with a concrete slab or pea gravel
- place generator on the concrete slab/ gravel

#### step 3: connecting fuel and electrical

- fuel line is connected
- transfer switch installed next to the main breaker box
- the transfer switch senses where the power is coming from and when to switch over to generator power.

#### step 4: outage simulation

- technician checks that everything works as it should
- set up weekly self-test to ensure everything continues to function as normal

### 3.2 pump

Pump a device that expends energy in order to raise, transport, or compress fluids. Many kinds of **pumps** are used in distribution systems. Pumps that lift surface water and move it to a nearby treatment plant are called **low-lift pumps**. These move large volumes of water at relatively low discharge pressures. Pumps that discharge treated water into arterial mains are called high-lift pumps. These operate under higher pressures.

#### 3.2.1 Classification Of Pumps.

##### Positive displacement pumps

Positive displacement pumps, which lift a given volume for each cycle of operation, can be divided into two main classes, reciprocating and rotary. Reciprocating pumps include

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piston, plunger, and diaphragm types; rotary pumps include gear, lobe, screw, vane, and cam pumps.

## Kinetic Pumps

Kinetic pumps can be divided into two classes, centrifugal and regenerative. In kinetic pumps a velocity is imparted to the fluid. Most of this velocity head is then converted to pressure head.

## Electromagnetic Pumps

These can be used only to pump fluids that are good electrical conductors. The pipe carrying the fluid is placed in a magnetic field and a current passed crosswise through the fluid, so that it is subjected to an electromagnetic force in the direction of the flow.

### 3.2.2 pump installation

#### Pump Location

Your submersible pump should be installed no less than 5 feet (1.5 meters) from the bottom of your well. CAUTION: To avoid accidental loss of the pump in the well, it is recommended that a ¼" polypropylene rope be permanently attached to the eye provided on the discharge head of the pump. The other end of the polypropylene rope should be secured to an anchor at the well head.

#### Drilled Well Installation

- 1) Check your submersible pump and accessories for physical damage.
- 2) Check the electric supply for proper voltage, fusing, wire size, grounding, and transformer size.
- 3) Check the well casing. The upper edge of the casing should be perfectly smooth. Jagged edges could cut or scrape the cable and cause a short circuit.
- 4) Select your pipe. Use only CSA approved polyethylene pipe, semi-rigid plastic pipe or schedule 40 steel pipe for setting high pressure pumps. The pipe must have sufficient strength to withstand the system's maximum pressure. The pump discharge is 1¼". 1" pipe may be used on the 5, 7 & 10 gpm units. On 10 gpm units when depth to water

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level exceeds 300 feet (91 m) deep use only 1¼" pipe sizes. On 15 and 20 GPM units use only 1¼" pipe sizes. Ensure that you have the correct length of pipe required. The pump should be installed no less than 5 feet (1.5 meters) from the bottom of the well.

### Installing The Control Center

Note: Teflon tape must be used on all thread joints.

- Wrap the outside thread of the tank control centre with teflon tape at position (A) and thread into tank opening (see fig. 4). Control center will thread directly into 1" opening in the side of the pre-charged tank.
- Install the pressure gauge with a ¾" x ¼" bushing at the opening marked position (B) on the control centre.
- Install A pressure switch or "loss of pressure" switch using ¼" x 3" nipple at the opening position (C) in the control centre.
- Connect pipe coming from well and pump to position (E) in the control center using the appropriate male plastic pipe adapter and clamp, if polyethylene is used, or thread directly into control center if ABS or steel pipe is used.
- Proceed from position (D) on the control centre to house service lines.

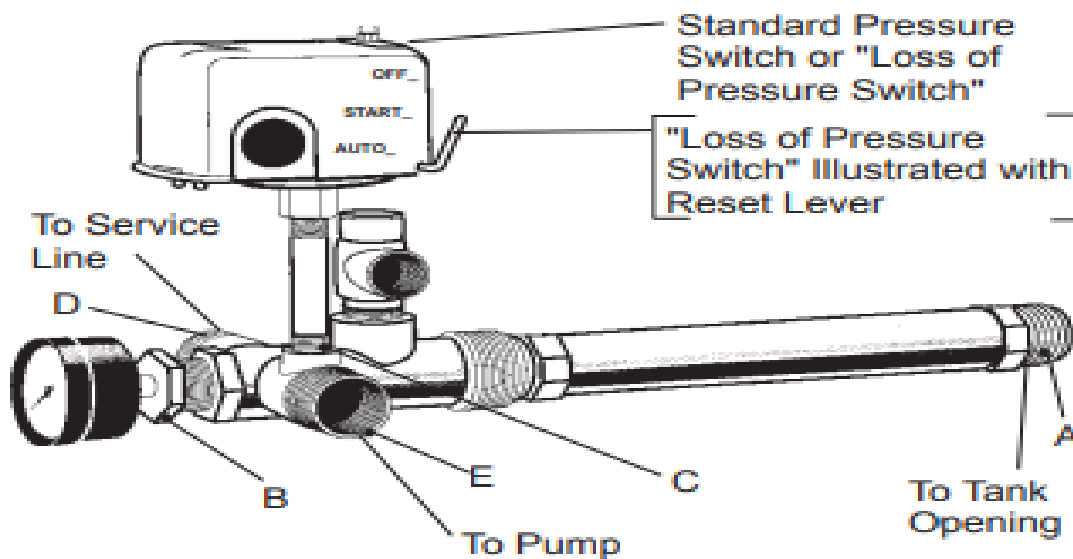


figure control centor

### 3.3 Motor

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An electric motor is a machine that uses the concept of conversion of energy and consequently converts electric to mechanical energy. The main parts that help propel the process are the rotor, stator, windings, air gap and commutator. The approximate efficiency of an electric motor is 70%-85% (extra energy is taken by the sound and heat emitted by it).

### 3.3.1 Uses of Electric Motors

Electric motors, both large and small, can be used in a number of ways in residential and industrial applications.

- At home, they can be used as water pumps for a number of different reasons such as central heating, fish tanks, etc. Moreover, there are a lot of electrical appliances at home that use electric motor, like food processors, DVD drives, garage door openers, power windows, etc.
- On the field, some examples of electric motors include mills, lathes, fork-lift trucks, extruders, etc. A lot of work is dependent on these machines.

### 3.3.2. Electric Motor Installation

Here are the general and specific requirements that need to be followed in order to install an electric motor:

#### 3.3.2.1 General Requirements

- The environment impacts the kind of motor that needs to be installed.
- All Variable Frequency Drive controlled motors must be rated by IEC or NEMA inverter duty.
- Article 430 of NEC must be complied with.
- If the nameplate of the motor is hidden or unclear after installation, a new one must be put up someplace where it can easily be seen.

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- Special consideration has to be given to the insulation limits and if the motor is installed on a height.
- If the surface temperature exceeds 60 C, the motor needs to be provided with guarding.
- Clear signs and arrows should be propped up so that no reverse-rotation scenarios occur, causing health hazard or equipment damage.
- RTDs and a temperature relay system are necessary for motors using above 55 kW, so they shut down if very high temperatures are reached.
- There are certain performance characteristics that need to be adhered to with an S1 duty rating.
- A wire made of stranded copper must be ground insulated in the motor, with one end in the control panel that has the motor starter.
- In case of any special usage warrants or motors that require a different duty fee from those stipulated above, a P&G certified electric engineer must be notified.
- Connection of the motor through wire nuts is prohibited except for certain exceptions.
- Boxes that contain the motor junction are supposed to be made of metal.
- Continuous motor leads are expected with a ground wire running along.
- A motor must have a service factor of at least 1.15 if it is to work continuously or in an environment where the temperature exceeds 40C.

### 3.3.2.2 Specific Requirements

There are 3 kinds of specific requirements that you need to keep in mind:

1. **Global:** All AC motors are to be made for 50/60 Hz and 400 VAC, and a Variable Frequency Drive is imperative for AC motors.
2. **U.S. Only Tools:** The design of such motors must adhere to 60 Hz and 460 VAC. Moreover, those that are not controlled by VFD and with 0.75 HP or higher

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power rating need necessary protection for thermal overload. Those below 0.75 HP are encouraged to get overload protection.

3. **E.U. Only Tools:** The motor designs must correspond to 50 Hz and 400 VAC. The rest of the requirements coincide with those of U.S. Only Tools.

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<b>Self-Check 3</b>	<b>Written Test</b>
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Name: \_\_\_\_\_

Date: \_\_\_\_\_

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

1. What are the main electrical machines for your department ? (2 point)
2. Which machine convert mechanical energy to electrical energy? (2 point)
3. what is main function of pump? (2 point)
4. Which machine is convert electrical energy to mechanical energy?(2 point)
5. what are the main parts of motor? (2 point)

**Note: Satisfactory rating - 10 points**

**Unsatisfactory - below 10 points**

**Answer Sheet**

Score = \_\_\_\_\_

Rating: \_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Short Answer Questions**

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_

## Introduction

Information in these sample safe work procedures comes from various workplaces and professionals within. These procedures are intended to assist sites by sharing information for similar tasks, provide sample layouts, as well as to provide examples for content expectations. The sample safety principles are intended to highlight basic safety rules for a designated department or area, much like a safety orientation. This may reduce the need to create Safe Work Procedures for relatively simple tasks, or for tasks that carry lower risks for injury, or they can serve as a reminder of safety considerations for that area. Tasks in the area that are assessed as having a higher risk for injury should have a Safe Work Procedure created.

The sample procedures have been written with different layouts. Choose the template that you prefer to work with or create your own. You can change, add or delete text in any of these documents to suit the needs of your facility.

Safe work procedures for your facility do not have to follow a particular format, however, your safe work procedures should include:

- name or description of the work task
- date the Safe Work Procedure was created and date it was last reviewed or revised
- hazards that may cause harm to a worker
- common signs and symptoms of a musculoskeletal injury if the hazards of the job task could lead to this type of injury
- equipment / devices, personal protective equipment (PPE), or other safety considerations necessary to perform the task safely
- required training and / or relevant documentation needed to perform the task safely
- steps to perform the task safely including safe body positions and / or movements as appropriate
- indication that workers are to be trained on the Safe Work Procedure and employers must ensure workers follow them



Safe work procedures must be based on a risk assessment. They must also be developed in consultation with your workplace safety and health committee or representative and be approved by management. Workers must be trained in the safe work procedures for your facility so they understand the steps and equipment they must use to work safely. Supervisors must ensure that safe work procedures are followed. Safe work procedures should be readily available to workers for reference. Remember to review your safe work procedures regularly to ensure they are accurate and effective. If a task or equipment changes, the safe work procedure(s) that relate to this change must also be updated.

### **Installation Requirements**

- The installer shall read and understand the manufacturer's installation requirements prior to beginning the installation of the equipment.
- Equipment shall only be lifted and handled in accordance with the manufacturer's instructions and at points and locations designated for such handling.
- Before installation, all parts shall be thoroughly cleaned of all rust, grit and foreign matter. Where accessible without disassembly, all holes and grooves for lubrication shall be examined and cleaned where necessary. Bolts and screws shall be tightened uniformly without over-stressing the threads. Anchor bolts shall be adequately tightened, and all other bolts shall be tightened per manufacturer's instructions.
- During installation of equipment, all small access openings shall be covered with temporary covers made of tape, plywood or sheet metal whenever work is not actually in progress.
- Clearance around all equipment shall be checked prior to installing the equipment. Any interference or lack of access for maintenance that may be evident shall be reported to the OWNER Construction Manager.
- All foundation elevations and bolt locations shall be verified prior to the start of installation of equipment. Bending of bolts to fit equipment base plate holes beyond the limit of the bolt sleeves will not be acceptable.

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- Leveling and alignment of all equipment shall be within the tolerance specified in the manufacturer's instructions. Where equipment is received as a shop-assembled unit, alignment shall be checked and adjusted where necessary.
- Leveling plates, dowels, shims, and grout are to be furnished by the Contractor. Grouting material shall be applied in accordance with the printed instruction from the grouting material manufacturer.
- Field alterations to equipment to facilitate installation shall not be made without written approval from OWNER. Subassemblies shall be dismantled only to the extent necessary to verify clearances, equipment condition and lubrication requirements. Total dismantling of the subassemblies, if necessary, shall be carried out only with the written approval from OWNER.
- The Contractor shall maintain alignment and lubrication records on all mechanical equipment and submit them to OWNER for acceptance upon completion of the installation. Such records shall clearly indicate at least the following:
  1. Equipment name and number
  2. Contract number and name
  3. Contractor's name
  4. Contractor's employee name, craft type and employee number.
  5. Date and other pertinent details
- Shaft coupling installation and alignment shall be per manufacturer's instructions. All allowable offsets and angular misalignment shall be per manufacturer's tolerances.
- Safety guards around rotating equipment furnished by the equipment manufacturer, but shipped loose shall be installed by the Contractor in accordance with equipment manufacturer's instructions.
- Cleaning, Lubricating and Hydraulics
  1. All equipment shall be lubricated in accordance with the manufacturer's instructions.
  2. Rotating equipment which has been shipped dismantled for assembly in the field, or shipped without lubricants, shall have the bearings cleaned, inspected and lubricated.

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3. All field-assembled lubrication or hydraulic oil supply and return piping shall be cleaned and pressure tested in accordance with the applicable specification or alternate procedure as approved by OWNER. Factory-assembled lubrication and hydraulic systems do not require flushing unless manufacturer states otherwise or if contamination is suspected.
4. Grease or other protective coating applied for protection of the equipment in shipping and storage shall be removed using suitable solvents or cleaners which will not damage the finish of the machine.
5. Contractor shall be responsible to provide all hydraulic oils, lubricating oils and flushing oils for all mechanical equipment in strict accordance with the manufacturer's.

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<b>Self-Check 1</b>	<b>Written project</b>
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Name: \_\_\_\_\_

Date: \_\_\_\_\_

*Directions:* write the answer for the given questions

1. use the installation requirement and try to establish motor installation work procedure.

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## Operation Sheet 1

## Installation of pump station components

procedure 1

1. read the given drawing and instructions carefully.
2. identify the appropriate tools and testing device.
3. wear the appropriate PPE.

procedure 2

task 1: Test and inspect the components

1. generator pre operational test
  - fuel, water, oil and battery
2. control board pre operational test
  - devices like breaker, contactor, relay, timer and others functionality.
3. pump pre installation test
  - cable, motor, valves and so on

task 2: Install the cable

- power cable u1, v1, w1, to L1, L2, L3 or from power source to control board
- pump cable and to control board
- water level electrode to control

task 3: Use the barrel as borehole and install the pump

- use clamps to hold the pump

task 4: Inspect your installation

task 5: check to discharge output

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LAP Test	Practical Demonstration
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Name: \_\_\_\_\_ Date: \_\_\_\_\_

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

Instructions: install the pump with the appropriate procedure, tools and materials and testing devices that required to perform the following tasks within 4hours.

procedure 1

1. read the given drawing and instructions carefully.
2. identify the appropriate tools and testing device.
3. wear the appropriate PPE.

procedure 2

task 1: Test and inspect the components

1. generator pre operational test
  - fuel, water, oil and battery
2. control board pre operational test
  - devices like breaker, contactor, relay, timer and others functionality.
3. pump pre installation test
  - cable, motor, valves and so on

task 2: Install the cable

- power cable u1, v1, w1, to L1, L2, L3 or from power source to control board
- pump cable and to control board
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task 3: Use the barrel as borehole and install the pump

- use clamps to hold the pump

task 4: Inspect your installation

task 5: check to discharge output

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