ELECTRICAL/ELECTRONICS EQUIPMENT SERVICING

Level – III

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Table of Contents

Acknowledgement 4
Acronyms 5
Introduction to the Module 6
Unit one: preparation of commission electronics and communication systems. 7
1.3. Identifying system operating parameters. 17
1.4. Obtaining tools, equipment, applications, and testing devices. 19
1.4.1. Obtaining and checking Tools: 19
1.5. Checking preparatory work to ensure no unnecessary damage. 24
1.6. Checking circuits as being isolated 26
Self check 1.1. 28
Unit Two: commission electronics and communication systems. 29
2.1. Connecting and set up testing/measuring devices. 30
2.2. Making measurements and adjustments 31
2.2.1. Measurement Equipment 31
2.2.2. Adjustable guards restricting access 34
2.3. Making decisions for dealing with sudden situations 34

2.4. Perform systems' commissioning procedures 36
2.4.1. General system testing requirements 36
2.4.2. System Commissioning Testing 37
2.5. Carrying out commissioning. 38
Self check 2.1. 39
Unit Three: Complete and report commissioning activities 40
3.2. Clean and making safe work site. 42
3.3. Notify commissioning results and work completion 44
Self check 3.1. 45
REFERENCES 46

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Acronyms

AGC	Automatic Degaussing Circuit
TV	Television
HDTV	High Definition Television
VCR	Video Cassette Recorders
DVD	Digital Versatile Disc
ICs	Integrated Circuits
AC	Alternating current
DC	Direct current
KV	Kilo Volt
MSDS	Material safety data sheets
JSA	job safety analysis
FTP	Functional test procedure)

Introduction to the Module

In Electrical/electronic equipment servicing filed; the: Commissioning Electrical/Electronic Equipment Systems project helps to require Commissioning Electrical/Electronic Equipment Systems includes. It encompasses safe working practices, system parameter testing, analysis and adjusting to assure optimum performance, following procedures, and documenting final operating parameters and settings. This module is designed to meet the industry requirement under the Electrical/electronic equipment servicing occupational standard, particularly for the unit of competency: Commissioning Electrical/Electronic Equipment Systems

Module units

- Prepare to commission electronics and communication systems.
- Commission electronics and communication systems.
- Complete and report commissioning activities.

Learning objectives of the Module

At the end of this session, the students will able to:

- Prepare to commission electronics and communication systems.
- Commission electronics and communication systems.
- Complete and report commissioning activities

Module 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
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP tes

Unit one: preparation of commission electronics and communication systems.

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

- Following established OHS procedures and risk control measures and safety hazards.
- Coordinating appropriate personnel are consulted.
- Identifying system operating parameters.
- Obtaining tools, equipment, applications, and testing devices.
- Checking preparatory work to ensure no unnecessary damage.
- Checking circuits as being isolated

This unit 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:

- Following established OHS procedures and risk control measures and safety hazards.
- Coordinating appropriate personnel are consulted.
- Identifying system operating parameters.
- Obtaining tools, equipment, applications, and testing devices.
- Checking preparatory work to ensure no unnecessary damage.
- Checking circuits as being isolated

1.1. **2.1: Following OH & S policies and procedures are in line with job requirements.**

Machinery guarding and protection against mechanical hazards;

1. Risk of loss of stability
2. Machinery and its components and fittings should be stable enough to avoid overturning, falling or uncontrolled movements during use, transportation, assembly and dismantling.
3. If the shape of the machinery itself or its intended installation does not offer sufficient stability, appropriate means of anchorage should be incorporated and indicated in the instructions.
4. Risk of break-up during operation
5. The various parts of machinery and their linkages should be able to withstand the stresses to which they are subject when used.
6. The durability of the materials used should be adequate for the nature of the working environment foreseen by the manufacturer, in particular as regards the phenomena of fatigue, ageing, corrosion and abrasion, and the maintenance schedule of the owner.
7. The instructions should indicate the type and frequency of inspections and maintenance required for safety reasons. They should, where appropriate, indicate the parts subject to wear and the criteria for replacement.
8. Where a risk of rupture or disintegration remains despite the measures taken, the parts concerned should be mounted, positioned and guarded in such a way that any fragments will be contained, preventing hazardous situations.
9. Rigid or flexible pipes carrying fluids, particularly those under high pressure, should be able to withstand foreseeable internal and external stresses and should be firmly attached and protected to ensure that no risk is posed by a rupture.
10. Where the material to be processed is fed to the tool automatically, the following conditions should be met so as to prevent risks to persons:

11. when the work piece comes into contact with the tool, the latter should have attained its normal working condition; and
12. When the tool starts and stops (intentionally or accidentally), the feed movement and the tool movement should be coordinated.
13. Risks due to falling or ejected objects
14. Measures should be taken to prevent risks arising from falling or ejected objects.
15. Risks due to surfaces, edges or angles
16. In so far as their purpose allows parts that are accessible during use and maintenance of the machinery should have no sharp edges, sharp angles or rough surfaces likely to cause injury.
17. Risks related to combined machinery
18. Where the machinery is intended to carry out several different operations with manual removal of the piece between each operation (combined machinery), it should be designed and constructed in such a way as to enable each element to be used separately, without the other elements constituting a risk to exposed persons.
19. Risks related to variations in operating conditions
20. Where the machinery performs operations under different conditions of use, it should be designed and constructed in such a way that selection and adjustment of these conditions can be carried out safely and reliably.
21. Risks related to moving parts
22. Prevention of hazards due to moving parts of machinery should take into account:
23. the movement of machinery parts consisting basically of rotary, sliding or reciprocating motion, or a combination of these, such as the movements of spindles, chucks, fan blades, counter-rotating gear wheels or rollers, and stroking blades; and
24. the movement of machinery parts which may have the potential to cause injury, for example by entanglement, friction or abrasion, cutting, shearing, stabbing or puncture, impact, crushing, or drawing a person into a position where injury can occur.

25. Moving parts of machinery should be designed and constructed in such a way as to prevent risks of contact which could lead to accidents and should, where risks persist, be fitted with guards or protective devices.
26. All necessary steps should be taken to prevent accidental blockage of moving parts involved in the work. If a blockage remains possible despite the precautions taken, the necessary specific protective devices and tools should be provided to enable the equipment to be unblocked safely. The instructions and, where possible, a sign on the machinery should identify these specific protective devices and how they are to be used.
27. Choice of protection against risks arising from moving parts
28. Guards or protective devices designed to protect against risks arising from moving parts should be selected on the basis of the type of risk.
29. Moving transmission parts
30. Guards designed to protect persons against the hazards generated by moving transmission parts should be either:
    - ✓ fixed guards; or
    - ✓ Inter locking movable guards.
31. Interlocking movable guards should be used where frequent access is envisaged.
32. Moving parts involved in the process
33. When a process requires access to a danger zone and a fixed guard is impracticable, an interlocking guard should be considered. Guards or protective devices designed to protect persons against the hazards generated by moving parts involved in the process should be:
    - ✓ fixed guards;
    - ✓ interlocking movable guards;
    - ✓ protective devices; or
    - ✓ A combination of the above.

Apply OHS requirements, policies and procedures in the industry	**I understand**	
Element 1 Identify and assess risks	**Easy**	**With help**
Hazards in the work area are identified, assessed and reported to designated personnel.		
Safety risks in the work area are identified, assessed and reported to designated personnel.		
Safe work practices, duty of care requirements and safe work instructions are followed for controlling risks.		
OHS, hazard, accident or incident reports are contributed to according to workplace procedures and Australian government and state or territory OHS legislation and relevant information.		
Element 2 Identify hazardous materials and other hazards on work sites	**Easy**	**With help**
Hazardous materials on a work site are correctly identified and, if appropriate, handled and used according to company and legislated procedures.		
Measures for controlling risks and construction hazards are applied effectively and immediately.		
Hazardous materials that have safety implications for self and other workers are secured immediately they are identified, using appropriate signs and symbols.		
Asbestos-containing materials are identified on a work site and reported to designated personnel.		
Element 3 Plan and prepare for safe work practices	**Easy**	**With help**

Easily With help		
Correct personal protective equipment and clothing for each area of construction work are identified, worn, correctly fitted, used and stored according to enterprise procedures.		
Selection of tools, equipment and materials, and organisation of tasks are performed in conjunction with other personnel on site and in accordance with enterprise procedures.		
3 Required barricades and signage are determined and erected at the appropriate site location.		
Material safety data sheets (MSDS), and job safety analysis (JSA) and safe work method statements relevant to the work to be carried out are identified and applied.		
Element 4 Apply safe work practices	**Easy**	**With help**
Tasks are performed in a manner that is safe for operators, other personnel and the general community in accordance with legislative requirements, and enterprise policies and procedures.		
2 Plant and equipment guards are used in accordance with manufacturer specifications, work site regulations and Australian standards where applicable.		
Procedures and relevant authorities for reporting hazards, incidents and injuries are used.		
Prohibited tools and equipment in areas with identified asbestos are recognised and not used.		

Work site safety signs and symbols are identified and followed.		
Work site area is cleared and maintained to prevent and protect self and others from incidents and accidents and to meet environmental requirements.		
Element 5 Follow emergency procedures	**Easy**	**With help**
Designated personnel are identified in the event of an emergency for communication purposes.		
Safe workplace procedures for dealing with accidents, various types of fire and other emergencies are followed, including identification or use, if appropriate, of fire equipment within scope of responsibilities.		
Emergency response and evacuation procedures are known, practiced and carried out effectively when required.		
Emergency first aid treatment of minor injuries is carried out correctly and details of any treatment administered are reported accurately to designated personnel as soon as possible.		

Table 1.1: Apply OHS requirements, policies and procedures in the industry

Commissioning processes and procedures

An electrical system is made up of individual electronic components. Both the components and the systems made up of these components must be inspected and tested prior to being placed into service. The components must be tested prior to testing the system.

Step 1: Design Review

A qualified engineering firm designs each project. During the design process, the mechanical and electrical consultants are constantly changing their designs. Some of these mechanical changes affect the electrical system. Sometimes, these changes do not get passed onto the electrical designer.

The result can be as simple as differing equipment nomenclature Many times, bigger problems occur such as the mechanical equipment schedule not matching the electrical panel board and motor control center schedules. These mistakes can be disastrous and expensive to correct once the equipment is installed.

The electrical commissioning agent usually works directly for the owner. The agent has a fresh set of eyes and can look at the design documents from an owner's point of view. A design review by the electrical commissioning agent will not only provide a quality control check of the design, but will provide a review of issues such as maintainability, installation problems, and "things to avoid from experience". This review must be completed as early as possible, as but no later than at 90% CD (construction documents).

Step 2: Create Electrical Commissioning Specifications

Good communication is the key to success full commissioning. For a construction project, this means the creation of simple, easy to understand, well written, and organized commissioning specifications. A summary table is important to include at the beginning of the specifications to summarize:

- ✓ What equipment is to be tested
- ✓ Who will test the equipment
- ✓ When the equipment will be tested
- ✓ Who will witness the tests

In addition to providing this summary table, our experience has shown that dividing the electrical commissioning specifications into two sections is most effective. The first specification section should describe:

- ✓ Terminology (i.e. CA- commissioning agent , FTP – Functional test procedure)
- ✓ Test contractor qualification requirements
- ✓ Responsibilities and roles of all parties involved

- ✓ Test instrumentation to be used
- ✓ Equipment calibration requirements
- ✓ Equipment and systems to be tested
- ✓ When to test the equipment and systems
- ✓ Who shall witness the tests
- ✓ Inspections and tests to be performed
- ✓ Acceptable test result values
- ✓ Procedures for failed tests and re-tests

The second specification section should contain the Component Test Data Forms, which are blank forms for the Electrical Testing Company to fill in. It is important to create easy to understand and well organized specifications. The more complex the specifications, the greater the chance that they will be misinterpreted, misapplied or even ignored.

The next part of writing good testing specifications is to create component and system functional test procedures (FTPs). These procedures go into detail as to what must be inspected and tested. Each FTP has four different sections.

They are;

- ✓ Scope,
- ✓ Visual and Mechanical Inspections,
- ✓ Electrical Tests, and
- ✓ Test Parameters.

1.2. **Coordinating appropriate personnel are consulted.**

When it comes to coordinating appropriate personnel, consultation is a crucial step in ensuring that the right individuals are involved in decision-making processes and tasks. Consultation allows for the gathering of different perspectives, expertise, and insights, leading to more informed and effective outcomes. In the

context of a PDF document, coordinating appropriate personnel through consultation can be achieved by following a systematic approach.

Firstly, it is important to identify the specific goals and objectives of the project or task at hand. This will help determine the types of personnel that need to be consulted. For example, if the project involves implementing a new software system, it would be essential to involve IT specialists who have expertise in that particular area.

Once the goals and objectives are established, the next step is to identify the key stakeholders who should be consulted. Stakeholders can include individuals or groups who have a vested interest in the project or task, such as managers, team members, subject matter experts, customers, or external partners. It is important to consider both internal and external stakeholders to ensure a comprehensive perspective.

After identifying the stakeholders, it is necessary to plan and schedule consultation sessions. This may involve setting up meetings, workshops, or interviews where stakeholders can provide their input and insights. It is crucial to create an inclusive environment where all stakeholders feel comfortable expressing their opinions and ideas.

During the consultation sessions, it is important to actively listen to the stakeholders' perspectives and concerns. This includes asking open-ended questions, seeking clarification when needed, and encouraging participants to share their thoughts freely. By actively engaging with stakeholders, coordinators can gain valuable insights that can inform decision-making processes.

Once the consultation sessions are completed, coordinators need to analyze and synthesize the information gathered. This involves reviewing the input provided by stakeholders and identifying common themes or

patterns. By analyzing this data, coordinators can gain a comprehensive understanding of different viewpoints and make informed decisions based on this collective knowledge.

In addition to consultation, effective coordination of appropriate personnel also involves clear communication and delegation of responsibilities. After decisions have been made, it is important to communicate the outcomes to all relevant stakeholders. This ensures that everyone is aware of the decisions made and their respective roles in implementing them.

To summarize, coordinating appropriate personnel through consultation in a PDF document involves several steps. These include identifying goals and objectives, identifying key stakeholders, planning and scheduling consultation sessions, actively listening to stakeholders' perspectives, analyzing and synthesizing the information gathered, making informed decisions, communicating outcomes, and delegating responsibilities.

1.3. Identifying system operating parameters.

When commissioning electrical/electronics servicing, it is crucial to identify and understand the system operating parameters. These parameters provide essential information about the system's performance, limitations, and requirements, enabling technicians to effectively service and maintain the equipment. In this comprehensive response, we will discuss the key steps involved in identifying system operating parameters for commissioning electrical/electronic servicing.

1. **Review System Documentation:** The first step in identifying system operating parameters is to review the relevant documentation provided by the manufacturer or system designer. This documentation typically includes user manuals, technical specifications, schematics, and wiring diagrams. By thoroughly studying these documents, technicians can gain insights into the system's design, functionality, and performance characteristics.

2. **Analyze Electrical/Electronic Components**: Next, technicians need to analyze the electrical and electronic components of the system. This involves examining each component's specifications, such as voltage ratings, current ratings, frequency range, temperature limits, and power requirements. Understanding these parameters helps technicians determine the compatibility of replacement parts and ensure that they are operating within safe limits.

3. **Measure Electrical Parameters:** To accurately identify system operating parameters, technicians may need to measure various electrical parameters using specialized instruments. These measurements can include voltage levels, current flow, resistance values, capacitance values, inductance values, and frequency response. By measuring these parameters at different points within the system, technicians can assess its overall performance and identify any deviations from expected values.

4. **Consider Environmental Factors:** System operating parameters can also be influenced by environmental factors such as temperature, humidity, altitude, and electromagnetic interference (EMI). Technicians should take these factors into account when identifying operating parameters as they can significantly impact the system's reliability and performance. For example, certain electronic components may have temperature limitations or require additional shielding to mitigate EMI.

5. **Consult Manufacturer or Design Engineer:** If there are uncertainties or complexities in identifying system operating parameters, it is advisable to consult the manufacturer or design engineer. They possess in-depth knowledge of the system and can provide valuable insights and clarifications. Additionally, they may have specific guidelines or recommendations for commissioning and servicing the equipment.

6. **Perform Functional Testing:** To further validate the identified operating parameters, technicians should conduct functional testing of the system. This involves simulating various operational scenarios and monitoring key parameters to ensure that the system performs as expected. Functional testing helps identify

any discrepancies between the documented parameters and the actual performance of the system.

7. Document Identified Parameters: Once all the relevant operating parameters have been identified, it is crucial to document them accurately. This documentation should include detailed information about each parameter, such as its name, value, unit of measurement, and any associated limitations or tolerances. Having a comprehensive record of operating parameters facilitates future servicing, troubleshooting, and maintenance activities. In conclusion, identifying system operating parameters for commissioning electrical/electronic servicing requires a systematic approach that involves reviewing documentation, analyzing components, measuring electrical parameters, considering environmental factors, consulting experts, performing functional testing, and documenting the identified parameters. By following these steps, technicians can ensure that they have a thorough understanding of the system's performance characteristics and requirements.

1.4. Obtaining tools, equipment, applications, and testing devices.

A. Correct operation and safety.

Self-checklist as you work through this guide you should return to this checklist and record your progress. Where you understand something and think that you can perform it ‘easily’, congratulations. Where your response is ‘with help’ revise the material in that section and/or discuss with your lecturer or other learners in your group.

Test equipment. It is important that in any test program the proper equipment is used. The equipment should be calibrated, in good condition, and used by qualified operators. Any test equipment used for calibration shall have twice the accuracy of the equipment to be tested. Care should be taken to use a quality or regulated power source for the equipment as voltage, frequency, and waveform variation can produce invalid results.

All equipment should be operated in accordance with its instruction manual. Tools, equipment s and OH &S should be obtained as listed below;

1.4.1. Obtaining and checking Tools:

There are a lot of Tools needed for any activity performed in Mechatronics devices, such as;

- **Pliers**

Sometimes you need appliers / tool that will do the tougher work, like twisting and reshaping wire. Here are the types of pliers that will help you get the job done safely and accurately. In fact people with various industry backgrounds use this tool on a daily basis. From cutting to holding to clipping to severing, pliers are a multi-use instrument.



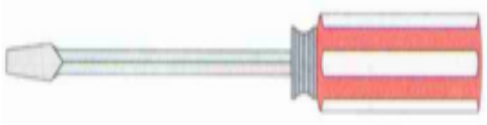


Figure 1.1: Checking of plier's sharpness

- **Screwdrivers(Flat and Philips)**

✓ **Flat screw driver**

The standard slot screwdriver is a very simple yet useful tool. It is most commonly used to remove and replace slotted screws and a countless number of other useful applications that are only limited by the user's imagination.



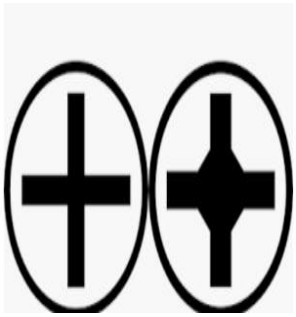


Figure 1.2: Standard screw driver

- ✓ **Philips screw drivers**

Is a driver that is designed to be used with a type of screw (called a Phillips-head screw) that has a slot in its top that seems a cross;



Figure 1.3: Philips screw drivers

- **Soldering iron**

The solder should also be resistant to oxidative and corrosive effects that would degrade the joint over time. Solder used in making electrical connections also needs to have favorable electrical characteristics



Figure 1.4: solder Iron

- **Test equipment/instruments**

It used in commissions of large numbers and samples are taken as;

- ✓ **Multi-tester**

A multimeter or a multitester, also known as a volt/ohm meter or VOM, is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter may include features such as the ability to measure voltage, current and resistance. Multimeters may use analog or digital circuits—analog multimeters and digital multimeters (often abbreviated DMM or DVOM.) Analog instruments are usually based on micrometer whose pointer moves over a scale calibration for all the different measurements that can be made; digital instruments usually display digits, but may display a bar of a length proportional to the quantity measured.

A multimeter can be a hand-held device useful for basic fault finding and field service work or a bench instrument which can measure to a very high degree of accuracy. They can be used to troubleshoot electrical problems in a wide array of industrial and household devices such as electronic equipment, motor controls, domestic appliances, power supplies, and wiring systems.

Multimeters are available in a wide ranges of features and prices. Cheap multimeters can cost less than US$10, while the top of the line multimeters.

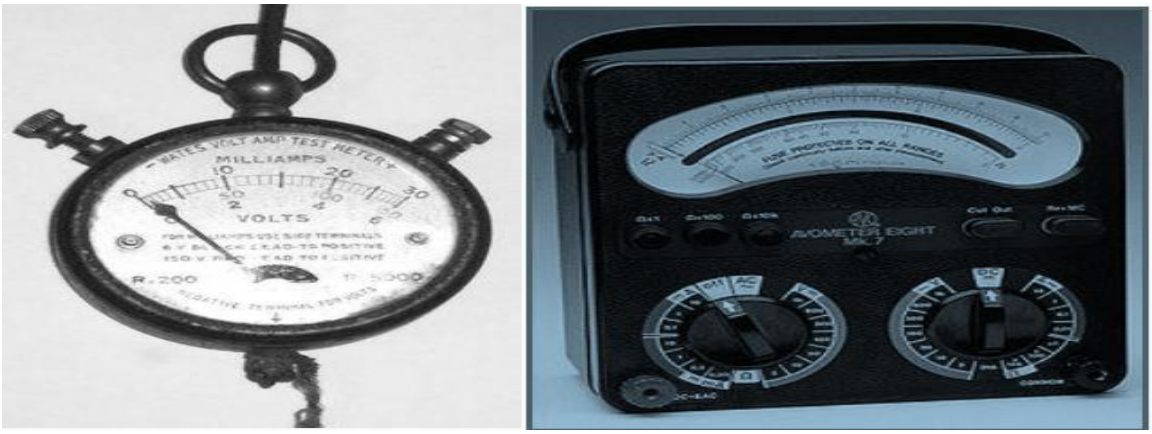


Figure 1.5: Analog multimeter

Contemporary multimeters can measure many quantities;

The common ones are:

- Voltage, alternating and direct, in volts;
- Current, alternating and direct, in amperes; The frequency range for which AC measurements are accurate must be specified;
- Resistance in ohms;

Additionally, some multimeters measure:

- Capacitance in farads.
- Conductance in Siemens.
- Decibels.
- Duty cycle as a percentage.
- Frequency in hertz.
- Inductance in henrys.
- Temperature in degrees Celsius or Fahrenheit, with an appropriate temperature test probe, often a thermocouple

Digital multimeters may also include circuits for:

- Continuity; beeps when a circuit conducts.
- Diodes (measuring forward drop of diode junctions, i.e., diodes and transistor junctions) and transistors (measuring current gain and other parameters).
- Battery checking for simple 1.5 volt and 9 volt batteries. This is a current loaded voltage scale. Battery checking (ignoring internal resistance, which increases as the battery is depleted), is less accurate when using a DC voltage scale.

Various sensors can be attached to multi-meters to take measurements such as:

- Light level
- Acidity/Alkalinity(pH)
- Wind speed
- Relative humidity edit Resolution



Figure 1.6: Digital multimeter

✓ **Signal generator**

Signal sources have a variety of applications including checking stage gain, frequency response, and alignment in receivers and in a wide range of other electronics equipment. Signal source provide a variety of waveforms for testing electronic circuits, usually low power. The various waveforms are generated by several different kinds of instruments. Sinusoidal Oscillator is used for an instrument that provides only a sinusoidal output signal.

Generator is applied to an instrument that provides several output waveforms, including sine wave, triangular wave, and pulse trains as well as amplitude modulation of the output signal.

1.5. Checking preparatory work to ensure no unnecessary damage.

1.5.1. Preparatory Work to Ensure No Unnecessary Damage Before Demolition

Before commencing with demolition, it is crucial to perform preparatory work to minimize potential damage

to the surrounding structures, environment, and workers. This process involves several steps that are essential to ensure a safe and successful demolition project.

1. **Assess the Site and Structures**

a. Conduct a thorough site assessment to identify any potential hazards, such as asbestos, lead, or other toxic materials that may be present in the building.

b. Evaluate the structural integrity of the building to determine if any sections need to be shored up or reinforced before demolition.

c. Identify any underground utilities, such as electrical, gas, or water lines, and make arrangements to have them safely disconnected or rerouted.

d. Check for any environmental hazards, such as the presence of hazardous materials or contaminated soil, and develop a plan to address them.

2. **Develop a Demolition Plan**

a. Create a detailed demolition plan that outlines the sequence of events, the methods and equipment to be used, and the safety protocols to be followed.

b. Identify any potential risks or challenges and develop strategies to mitigate them.

c. Coordinate with local authorities, such as the building department, fire department, and police department, to ensure that all necessary permits and approvals have been obtained.

3. **Protect the Environment**

a. Implement measures to minimize dust and noise pollution during the demolition process, such as using water sprays or specialized equipment.

b. Develop a plan for disposing of the demolition waste, including recycling and proper disposal of hazardous materials.

c. Protect any adjacent structures, such as neighboring buildings or roads, by installing temporary barriers or shielding.

4. **Secure the Site**

a. Install fencing around the demolition site to prevent unauthorized access and protect the public.
b. Implement security measures, such as surveillance cameras and guards, to deter theft and vandalism.
c. Ensure that all equipment and materials are properly secured and protected from theft.

5. **Train Workers and Emergency Responders**

a. Provide thorough training to all workers involved in the demolition process, including proper use of equipment and safety protocols.
b. Develop an emergency response plan that outlines the procedures to be followed in the event of an accident or injury.
c. Ensure that all workers are aware of the location of emergency exits, fire extinguishers, and first aid kits.

6. **Conduct Pre-Demolition Inspections**

a. Conduct thorough inspections of the building and equipment to ensure that they are in good working condition and meet safety standards.
b. Check for any signs of structural weakness or deterioration that may affect the safety of the demolition process.
c. Ensure that all equipment is properly calibrated and tested before use.

7. **Establish Communication Protocols**

a. Establish clear communication protocols between all parties involved in the demolition project, including workers, contractors, and local authorities.
b. Develop a system for reporting accidents, incidents, and near misses to ensure that lessons can be learned and safety improvements made.
c. Ensure that all workers are aware of the communication protocols and emergency response plan.

By following these steps, you can ensure that your demolition project is carried out safely and with minimal damage to the surrounding environment and structures

1.6. Checking circuits as being isolated

Checking Circuits as Being Isolated for Electrical Commission

Checking circuits for isolation is a crucial step in ensuring electrical safety during commissioning. This

process involves verifying that the circuit is completely disconnected from the power source and poses no risk of electric shock or short-circuiting. In this explanation, we will delve into the details of checking circuits for isolation during electrical commissioning, using only credible print sources.

Self check 1.1.

Directions: **Answer all the questions listed below.**

TEST I : <u>Say True or False</u>

1. Checking circuits for isolation is a crucial step in ensuring electrical safety during commissioning.
2. Generator is applied to an instrument that provides several output waveforms.
3. Digital multi-meters may also include circuits for Continuity.
4. Various sensors can be attached to multi-meters to take measurements such as: Light level and Wind speed

TEST II : Writes short answer.

5. **Write necessary steps for Commissioning processes and procedures of the components must be tested prior to testing the system**
6. **Write the four different sections of functional test procedures**

Unit Two: commission electronics and communication systems.

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

- Connecting and set up testing/measuring devices.
- Making measurements and adjustments.
- Making decisions for dealing with unexpected situations.
- Performing systems' commission procedures.
- Carrying out commissioning.

This unit 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:

- Connect and set up testing/measuring devices.
- Make measurements and adjustments.
- Make decisions for dealing with unexpected situations.
- Perform systems' commissioning procedures.
- Carry out commissioning.

2.1. Connecting and set up testing/measuring devices.

Connecting and setting up testing/measuring devices commissioning involves the process of establishing the necessary connections and configurations for these devices to function properly. This process typically includes the installation, calibration, and verification of the devices to ensure accurate measurements and reliable performance.

To begin, the first step in connecting and setting up testing/measuring devices commissioning is to identify the specific devices that need to be installed. This may include instruments such as multimeters, oscilloscopes, data loggers, or any other equipment used for measuring various parameters.

Once the devices have been identified, the next step is to determine the appropriate connections required for each device. This involves understanding the input/output requirements of the device and ensuring that the necessary cables, connectors, and adapters are available.

After the connections have been established, the devices need to be properly installed in their designated locations. This may involve mounting the devices on racks or panels, securing them in place, and ensuring that they are positioned correctly for optimal performance.

Once the physical installation is complete, the devices need to be calibrated. Calibration involves adjusting the settings of the device to ensure accurate measurements. This may include adjusting voltage levels, frequency ranges, or any other parameters specific to each device.

After calibration, it is essential to verify that the devices are functioning correctly. This can be done by performing various tests and measurements using known standards or reference sources. These tests may

include checking for accuracy, precision, linearity, or any other performance criteria relevant to the specific device.

Finally, once all the devices have been connected, installed, calibrated, and verified, they are ready for commissioning. Commissioning involves a comprehensive evaluation of all connected devices as a system to ensure that they are functioning together seamlessly and meeting all required specifications.

In summary, connecting and setting up testing/measuring devices commissioning is a detailed process that involves identifying the devices needed, establishing proper connections, installing them correctly, calibrating their settings, verifying their performance, and commissioning them as a system

2.2. Making measurements and adjustments

2.2.1. Measurement Equipment

A. Acceptance tests and commissioning can performed only if adequate measurement equipment is at disposal:

- **Radiation survey equipment:**
  - ✓ Geiger counter.
  - ✓ Large volume ionization chamber survey meter.
  - ✓ Neutron survey meter (if the unit operates above 10 MeV).
- **Ionometric dosimetry equipment**
- **Other dosimetric detectors (film, diodes)**
- **Phantoms**
  - ✓ Radiation field analyzer and water phantom.
  - ✓ Plastic phantoms.



B. A Geiger-Mueller (GM) counter and a large volume ionization chamber survey meter are required for radiation survey for all treatment rooms

For facilities with a treatment unit operated above 10 MeV, neutron survey equipment are necessary.

- *Example* of neutron survey meters:
  - ✓ Bonner spheres
  - ✓ Long counters
  - ✓ BF_3 counters
- **Radiation survey equipment**

However, for neutron measurements specialized skills and knowledge are required.

Therefore, it may be appropriate to contract neutron measurements to a medical physics consulting service. This may be a less expensive option than developing the skills and knowledge and acquiring the expensive neutron detection equipment that is typically required only during the acceptance tests

C. Ionometric dosimetry equipment's

- During acceptance testing and commissioning of a radiation treatment unit, a variety of radiation beam properties must be measured.
- Good quality **ionometric dosimetry equipment** is essential for this purpose

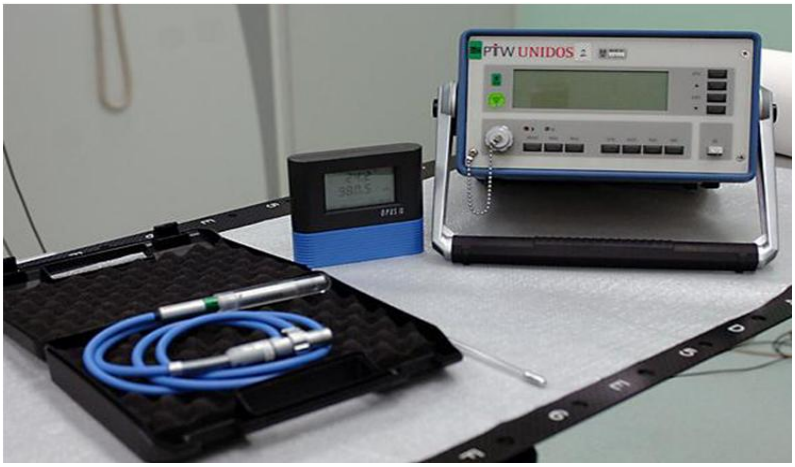


Figure: **Ionometric dosimetry equipment's**

- **Main components of ionometric dosimetry equipment are:**
  - ✓ Several ionization chambers (of thimble or plane-parallel type)
  - ✓ Versatile electrometer
  - ✓ Cable and connectors fitting to the electrometer and all chambers
  - ✓ Thermometer, barometer (for absolute dose measurements!)

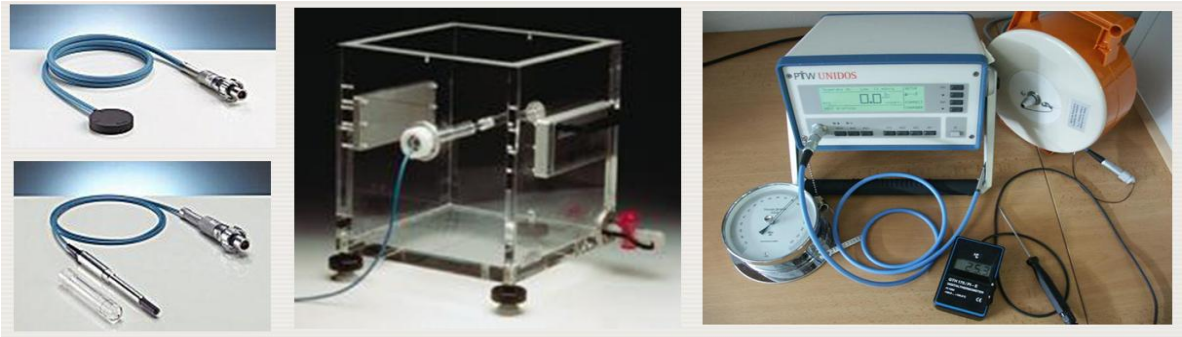
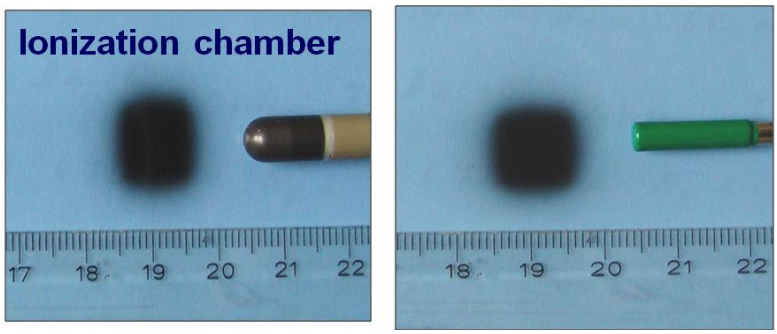


Figure: components of ionometric dosimetry equipment

- **Diodes**

Because of their small size silicon diodes are convenient for measurements in small photon radiation fields. Example: Measurements in a 1×1 cm^2 field

Ionization chamber



Note: Response of diodes must always be checked against ionometric measurements before use

2.2.2. Adjustable guards restricting access

Adjustable guards restricting access to those areas of the moving parts strictly necessary for the work should be:

- ✓ Adjustable manually or automatically, depending on the type of work involved; and
- ✓ Readily adjustable without the use of tools.

- **Special requirements for protective devices**

Protective devices should be designed and incorporated into the control system in such a way that:

- ✓ Moving parts cannot start up while they are within the operator's reach;
- ✓ Persons cannot reach moving parts while those parts are moving; and
- ✓ The absence or failure of one of their components prevents starting or stops the moving parts.
- ✓ Protective devices should be adjustable only by means of an intentional action.

2.3. Making decisions for dealing with sudden situations

Dealing with unplanned events by drawing an essential knowledge and skills to provide appropriate solutions. Decisions for dealing with unexpected situations are made from discussions with appropriate person and job specifications and requirements. if any performance deficiencies revealed during the functional performance tests must be evaluated to determine the cause.

After completion of the necessary corrective measures, the contractor shall repeat the test. During this stage you need to know and understand:

The procedure for obtaining replacement parts, materials and other consumables necessary for the commissioning.

The methods and techniques used to dismantle equipment in order to replace defective components (such as isolation procedures, removal of components by de-soldering).

Accidents, malfunctions, and 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.

In this section, the potential accidents, malfunctions, and unplanned events that could occur during any phase of the Project and potentially result in significant adverse environmental effects are described, discussed, and assessed. 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 assembly 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.

2.4. Perform systems' commissioning procedures

2.4.1. General system testing requirements

The purpose of electric systems commissioning is to increase the reliability of electrical power systems after installation by identifying problems and providing a set of baseline values for comparison with subsequent routine tests. A procedure should be developed to include a planned approach or road map of what should be done in order to verify the proper system installation.

- This procedure re is the commissioning plan. Specific areas addressed in a commissioning plan include
  - ✓ The verification of the installation of all equipment/components,
  - ✓ Iinterface connections between equipment and individual systems, and
  - ✓ Iinterconnection drawings.

The development of this test plan specific to each system and/or component is key to the usefulness of any maintenance program. The plan consists of the schedule of when acceptance and routine tests should be performed, test forms to be used to record the outcome of the tests which are retained for comparison with previous and subsequent tests, and a listing of the required test devices.

- Since the results of the commissioning tests become baseline test values to compare with later tests and the results of the routine maintenance tests are compiled to identify any downward trend in performance, it is vital to the maintenance program to have accurate and complete records. To perform the testing, the plan lists all required tests in order of performance and gives a schedule for each test.
- The work items and schedule depend on many items including
    - ✓ The importance and cost of the equipment,
    - ✓ Cconsequences of failure,
    - ✓ Age of equipment,
    - ✓ Past and future frequency of service,
    - ✓ Hours of operation,
    - ✓ Ffuture maintenance availability,
    - ✓ Eenvironmental conditions and safety requirements.

2.4.2. System Commissioning Testing

Electrical systems commissioning on new projects is critical to ensure that a system is installed properly and that it will operate as designed. The commissioning of a system encompasses the individual testing of the related components, the verification of the component interconnection against the drawings, and the functional testing of the system as a whole. An understanding of the equipment involved and the modes of operation for a system are essential to the development of the system commissioning plan. A survey of the equipment of the system and listing the equipment in order of importance and startup is the first step in developing the commissioning plan.

- **The schedule of the tests and inspections is dependent on many aspects of the equipment such as :-**
    - ✓ Its importance and cost,
    - ✓ The frequency of service,
    - ✓ Hours of operation,
    - ✓ Environmental conditions,
    - ✓ Accessibility and safety requirements.

The inspection, testing, and startup plan is then developed in conjunction with this schedule with instructions and procedures for the test plan. Problems may arise during the testing of the equipment and systems. In order to identify and correct these problems, troubleshooting techniques should be developed. Checking of equipment such as **fuses, lights, and breakers for continuity, equipment calibration and settings**, and investigating for faulty equipment or connections should be the first troubleshooting steps. For all problems, the equipment and component manuals are consulted for troubleshooting directions. Examples of the possible causes to common problems are shown for each system in the chapters that follow.

2.5. Carrying out commissioning.

The equipment to be commissioned, its operating procedures and functions.

The checks to be carried out on the equipment prior to undertaking the commissioning operations such as :-

- ✓ Installation damage,
- ✓ Contamination level and alignment,
- ✓ Security of fastening,
- ✓ Electrical connections are correct,
- ✓ All guards and safety devices are in place. The importance of making ‘off-load’ checks before running the equipment under power. The application and use of a range of electrical components (such as plugs, switches, sockets etc

Self check 2.1.

Directions: **Answer all the questions listed below.**

TEST I : <u>Say True or False</u>

1. worker accidents may occur during either assembly or operation
2. Once all the devices have been connected, installed, calibrated, and verified, they are ready for commissioning.
3. The procedure for obtaining replacement parts, materials and other consumables necessary for the commissioning
4. Once the devices have been identified, the next step is to determine the appropriate connections required for each device

TEST II : <u>Writes short answer.</u>

1. How checks out on the equipment prior to undertaking the commissioning operations for the equipment to be used.

2. Write different types of system commission procedures.

3. How to perform systems' commissioning procedures

Unit Three: Complete and report commissioning activities

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

- Documenting adjustment settings.
- Cleaning and making safe work site.
- Notifying commissioning results and work completion

This unit 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:

- Document adjustment settings.
- Clean and making safe work site.
- Notify commissioning results and work completion

3.1. Documenting adjustment settings.

- Reports, forms, and records. Accurate and complete reports, forms, and records should be developed and kept updated after the testing for the equipment and the system for initial evaluation of the results before energization and on-going evaluation by operations and maintenance.
- Analysis of the data and results should provide a decision to startup and a guide for future maintenance requirements and its cost.
- You should be kept for the **time, cost, and equipment used** for each test for input to the development of the maintenance program.
- Care should be taken to ensure that extraneous information does not become part of the record, because record keeping might hamper future use.
- Test reports giving test description and basic procedure, components, drawing and other document references, test circuit diagrams, test equipment model and age and calibration date, special tools required, test forms with results filled in, time to run the test, acceptance criteria, failure or unusual event information, recommended repair, and when the test should be performed again for equipment maintenance should be developed for the tests.
- Summary logs developed from the information can be used for developing and scheduling an on-going maintenance program. Forms should be used to document the results of testing procedures. They should be detailed and direct, but simple and durable enough to be used in the field.
- **The forms should be used as input to the development of the test reports.**
    - ✓ A well designed form will contain
    - ✓ checklist information for inspections,
    - ✓ test procedures,
    - ✓ safety and special precautions,
    - ✓ required equipment and tools,
    - ✓ reference drawings and manuals,
    - ✓ acceptance criteria,

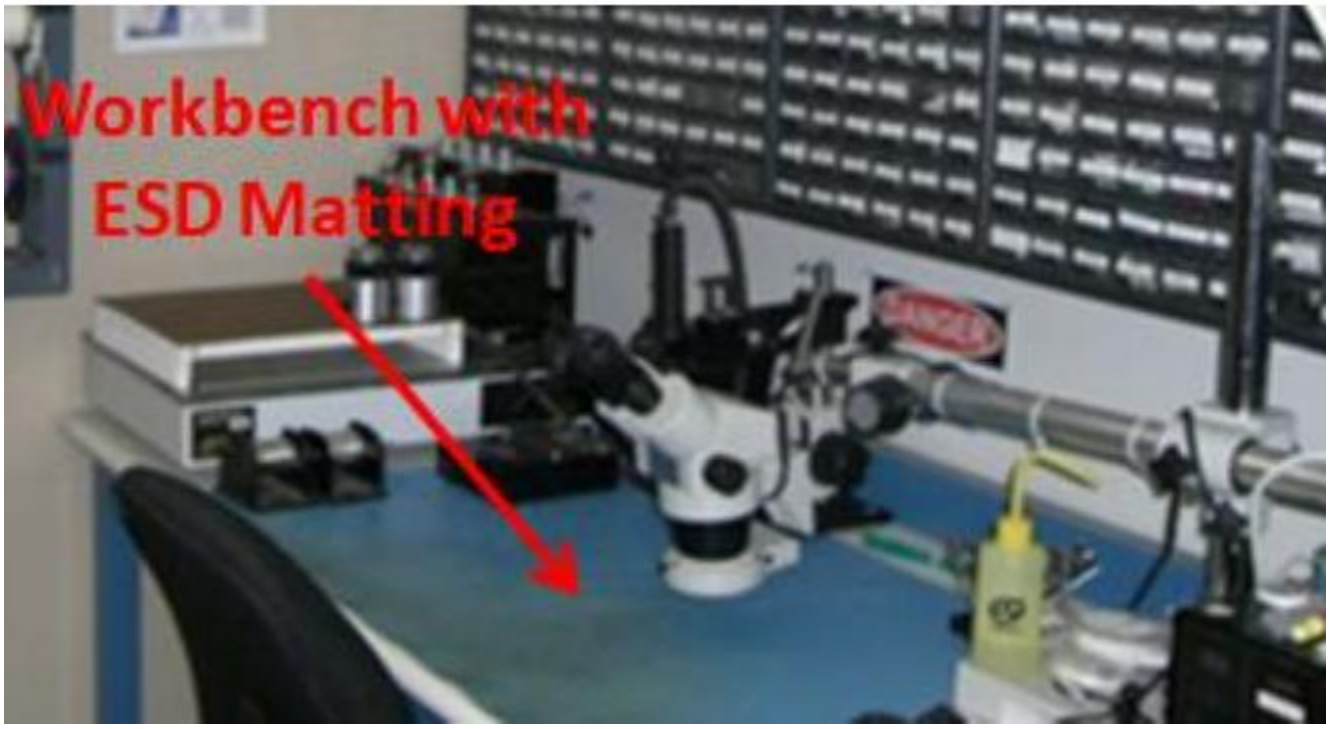
- ✓ Estimated time to perform the test, and remarks/event recording area .
- ✓ Sample forms for basic equipment and tests are attached

3.2. Clean and making safe work site.

A. ESD (Electrostatic Sensitive Devices) Safe Work Areas.

- **The purpose of an ESD safe work area by :-**
  - ✓ To prevent damage to sensitive components from spikes and
  - ✓ To prevent damage to static discharges.

It is required that before commissioning the workplace should be equip with anti-static matting and discharged plate. These areas must be designed and maintained to prevent ESD damage



1. Every circuit boards, components and electronics equipment must always be handled at properly designated work areas.

2. Designated work areas must be checked periodically to ensure their continued safety from ESD.

- **Areas of main concern include**:
  - ✓ Proper grounding methods.
  - ✓ Static dissipation of work surfaces.
  - ✓ Static dissipation of floor surfaces.

3. Designated work areas must be kept free of static generating materials such as Styrofoam, vinyl, plastic, fabrics or any other static generating materials.

4. Work areas must be kept clean and neat. To prevent contamination of circuit board, there must be no eating or smoking in the work area.

5. When not being worked on, sensitive components and circuit boards must be enclosed in shielded bags or boxes in which the material includes to prevent static electricity from passing through the package and an over-package that has enough conductivity to dissipate any static build-up.

6. Whenever handling a circuit board the operator must be properly grounded by one of the following:

A. Wearing a wrist strap connected to earth ground.

B. Wearing 2 heel grounders and have both feet on a static dissipative floor surface

A. To clean a worksite and equipment for Commission of maintenance, follow these steps:

- ✓ **Gather necessary supplies:** You will need cleaning materials such as gloves, safety goggles, a face mask, cleaning cloths, mild detergent, warm water, a bucket, and a vacuum cleaner.
- ✓ **Clear the worksite:** Remove any items around the refrigerator that could obstruct your access or get damaged during the cleaning process. This includes nearby furniture, appliances, or any other objects.
- ✓ **Disconnect the Electronic equipment:** Unplug any Electronic equipment from the power source to ensure your safety during the cleaning process.
- ✓ **Empty the Electronic equipment:** Remove all the items, shelves, and drawers from the **Electronic equipment**. Dispose of any expired items. Place the removable parts in a sink or tub filled with warm, soapy water for cleaning.
- ✓ **Clean the Electronic equipment:** Use a cloth dampened with soapy water to clean the inside and outside of the device.

- ✓ **Reconnect and power on:** Once the cleaning is complete and everything is dry, plug the **Electronic equipment** back into the power source and turn it on. Allow it to preves working standards application to the desired temperature before returning the food items.

3.3. Notify commissioning results and work completion

Commissioning is a well-planned, **documented, and managed engineering** approach to the start-up and turnover of facilities, systems, and equipment to the End-User that results in a safe and functional environment that meets established design requirements and stakeholder expectations. That is, Commissioning verifies what was specified was installed; that it functions properly, and it was successfully turned over to the user and reasonably ensures the next step verification for regulated industries will be successful.

Proper start-up and commissioning of power distribution and control equipment is vital to the long-term health of an electrical system. Improper installation and commissioning are the leading causes of premature failures. Start-up & Commissioning Services, you can be assured that your equipment has been installed properly and meets the factory standards for operation.

In short commissioning is the process for quality delivery or process for achieving, validate and documenting that meet the design and requirements of the owner.

Commission electronics and communications systems shall show that, required skills and knowledge has been acquired of safe working practices and commissioning that includes:

a. Identifying system design performance parameters and requirements as a result testing/measuring devices are connected and setup in accordance with requirements for a particular system.

Before carrying out any test, the contractor shall ensure that the installation complies all relevant requirements and regulations, since system commissioning procedures are performed in accordance with requirements.

During this stage you need to know and understand: How to obtain and interpret drawings, specifications, and manufacturer's manuals, instructions (including ISO schematics, IEEE regulations, symbols and terminology.

Self check 3.1.

Directions: **Answer all the questions listed below.**

TEST I : <u>Say True or False</u>

1. Designated work areas must be kept free of static generating materials
2. Work areas must be kept clean and neat.
3. Every circuit boards, components and electronics equipment must always be handled at properly designated work areas.
4. Care should be taken to ensure that extraneous information does not become part of the record.

TEST II : <u>Writes short answer.</u>

1. Define commissions for electronic maintenance**.**
2. How to write report and documentation, for managed engineering approach of commissioning

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