BASIC INFRASTRUCTURE OPERATIONS

NTQF Level I

Learning Guide-24

Unit of Competence: Operate Small Plants and Equipment

Module Title: Operating Small Plants and Equipment

LG Code: CON BIO1M07-LO1-GL-24

TTLM Code: CON BIO1TTL 0919v1

LO 1: Plan and prepare

Instruction Sheet	Learning Guide #24

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

- Understand work instructions and relevant document
- apply work instruction
- Safety and OHS application
- selecting plant tools and equipment
- Application of environmental protection

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**:

- Access, interpret and apply compliance documentation relevant to operate small plant and equipment
- Obtain, confirm and apply work instructions for the allotted task.
- Obtain, confirm and apply to the allotted task safety requirements from the site safety plan and organizational policies and procedures
- Select plant, tools and equipment to carry out tasks are consistent with the requirements of the job.
- Identify, confirm and apply to the allotted task environmental protection requirements from the project environmental management plan

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” Self-check 5” **in page -4, 6, 8 , 15 and 18** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -19-20.**
6. Do the “LAP test” **in page – 21** (if you are ready).

Information Sheet-1	Understand work instructions and relevant document

Work instructions are key documents to reference when internal or external non conformances are identified. Make the review of the work instructions part of the corrective action process. Ask if the supporting instruction properly defines the process, then and it the instruction to confirm proper definition.

The operator/employee cannot be held fully accountable if the records of training are written to an inadequately defined work instruction. If the task is properly defined, the manner by which training is conducted might need to be revisited.

Work instructions should not be stagnant documents accessed only when auditors ask for them. Reviewing work instructions when improvement opportunities are identified demonstrates that they are "living documents."

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Self-Check -1

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. _____ are key documents to reference when internal or external non conformances are identified .(3 points)

A. Legislative

C. Work instructions

B. Documentation

D. Services

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1. ----------

Information Sheet- 2	Applying Work instruction

1.1. Work Instructions

Are documents that clearly and precisely describe the correct way to perform certain tasks that may cause inconvenience or damage if not done in the established manner? That is, describe, dictate or stipulate the steps that must be followed to correctly perform any specific activity or work.

A document describing specific activities and tasks within the organization. It contains the greatest amount of detail.

As a component of a process, “defines how one or more activities in a procedure should be executed in detail, using technology or other resources.

Here are some examples of documented work instructions which may be found on a typical construction site:

- ✓ Working Drawings issued for construction such as Plans, elevations, sections etc.
- ✓ Specifications/Contract specifications
- ✓ Construction method statements
- ✓ Quality requirements
- ✓ Operational details
- ✓ Maintenance manuals

1.1.1 Diagrams or sketches

A diagram is a symbolic representation of information using visualization techniques. Diagrams have been used since ancient times, but became more prevalent during the Enlightenment. Sometimes, the technique uses a three-dimensional visualization which is then projected onto a two-dimensional surface. The word graph is sometimes used as a synonym for diagram.

The term "diagram" in its commonly used sense can have a general or specific meaning:

- Visual information device: Like the term "illustration", "diagram" is used as a collective term standing for the whole class of technical genres, including graphs, technical drawings and tables.

Specific kind *of* visual display: This is the genre that shows qualitative data with shapes that are connected by lines, arrows, or other visual links

Self-Check -2

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. ---------- are documents that clearly and precisely describe the correct way to perform certain tasks that may cause inconvenience or damage if not done in the established manner.(4point)

   A) Working Drawings C. Safety shoes

   B) Work Instructions D.information

2. ----------is a symbolic representation of information using visualization techniques. (3point)

   A. Construction C. Specifications

   B. Diagram D. Sketches

3. ---------- is sometimes used as a synonym for diagram. (3point)

   A. Quality requirements C. Safety shoes

   B. diagram D. word graph

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1. ----------
2. ----------
3. ----------

Information Sheet-3	Safety and OHS application

1.1. Occupational Health and safety (OHS).

Safety (OHS) is to be in accordance with legislation, regulations, codes of practice, organizational safety policies and procedures, and project safety plan and may include:

- emergency procedures, including extinguishing fires, organizational first aid requirements and evacuation
- handling of materials
- hazard control
- hazardous materials and substances
- safe operating procedures, including the conduct of operational risk assessment and treatments associated with:

    - ✓ earth leakage boxes
    - ✓ lighting
    - ✓ personnel
    - ✓ power cables, including overhead service trays, cables and conduits
    - ✓ restricted access barriers
    - ✓ surrounding structures
    - ✓ traffic control
    - ✓ trip hazards
    - ✓ work site visitors and the public
    - ✓ working at heights
    - ✓ working in confined spaces
    - ✓ working with dangerous materials

- organizational first aid
- personal protective clothing and equipment prescribed under legislation, regulations and workplace policies and practices
- use of firefighting equipment
- use of tools and equipment
- Workplace environment and safety.

Self-Check -3

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. _____ is to be in accordance with legislation, regulations, codes of practice, organizational. (**3 points**)

A. Safety

C. Traffic safety

B. Interpreting information

D. Gathering information

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1. ----------

Information Sheet-4	selecting plant tools and equipment

4.1 Selection of construction equipment

The effective selection of construction equipment for use on any construction project relies on the proper analysis of three principal considerations

- Technical efficiency i.e. the requirement that the particular task be completed to the correct specification with in project time table by using the correct machines
- Commercial and financial viability i.e that the cost of the equipment fall within the estimates for the specific project.
- In addition where purchase of equipment is involved the selection must meet the overall financial criteria by the construction company as whole
- Availability equipment can be supplied from a number of sources i.e existing internal holding the hire market or by addition purchase

4.1.1 The principle of selection

The need for selection of construction equipment can airs from number of situation which vary according to nature and size of the organization

During any construction work .there will be requirements for items of plant and equipment in order to carry out the work in a more cost-effective manner. This involves site staff initially in making a technical selection using the following criteria

- Comparing mechanization with other more lab our intensive methods of working.
  The nature of modern construction methods material and component means that even oversees contracts are new a days substantially mechanized
- Comparing alternative plant methods for a particular operation bulk earth moving may be carried out either with tractors and scrapers or with lorries and loading shovel/excavators depending on the output required.
  From the foregoing paragraphs it will be seen that the selection process can be summarized under the following stages

  - ✓ Selection of the best types of machine to do a particular size task
  - ✓ selection the source of supply
  - ✓ Selection the right mark and model should Purchas be necessary as new or replacement.

4.1.2 Selection methods and procedures

This Selection process can be broken down in to six separate stages

- Task identification
- Preliminary Selection
- Machine out estimation
- Machine matching
- Output costing
- Final Selection

4.1.3 Plant and equipment in road construction project involves different types of equipment for Earth Excavation, Earth moving, and Earth cutting, grading, and hauling of excavated earth, aggregate spreader, roller, binder sprayer and paver finisher etc.,.

- **Excavation Equipment:**
  - ✓ Dipper or Power shovel
  - ✓ Dragline
  - ✓ Clamshell
  - ✓ Hoe
- **Compaction Equipment**
  - ✓ Smooth wheel roller
  - ✓ Pneumatic type roller
  - ✓ Sheep's foot roller
  - ✓ Vibratory roller
  - ✓ Hand operated vibratory roller
- **Earth Moving Equipment**
  - ✓ Dozer
  - ✓ Grading
  - ✓ Wheel Loader
  - ✓ Hydraulic Excavator
  - ✓ Scrapper

- **Special Equipment For Cement Concrete And Bitumen Pavement:**
  - ✓ Batching plant
  - ✓ Paver finisher
  - ✓ Mixers

- ✓ Hot mix plan
- ✓ Bitumen mixer
- ✓ Concrete Pumps
- ✓ Bitumen sprayer
- ✓ Mini Mixers
- ✓ Bitumen storage equipment

Equipment

Name	Type	Use
Twin drum pedestrian vibrating roller		Compacting sand and cohesion less soil Compacting in restricted space.
Vibrating Plate Compactor		Compacting sand and cohesion less soil Compacting all type of soils for obtaining high densities
Mixer For Cement, Concrete And Emulsion Mix Applications		Concrete mixers are available in from of different capacities. Mixers are driven with diesel, benzene engine or electrical power.

Tampers		Tampers belong to the smallest compaction machines used on construction sites.
		
Pneumatic		Pneumatic tired rollers are designed with a steering/oscillating axle at the front and a rigid drive axle at the rear

Plant

Name	Type	Use
Mobile Stone Crusher (Parker)		
		
Mix paver		The travel plant mixer or mix paver is a single unit that mixes both the aggregate and asphalt and places it on the roadway.
Graders		used for leveling or finishing earth work, making and maintaining project roads construction

Bulldozer		Machinery for leveling, earth moving & clearing.

Self-Check -4

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Matching

A	B
----1. Bitumen pavement	A. Dragline
----2.Earth moving equipment	B. Final Selection
-----3.Compaction equipment	C. Hydraulic Excavator
----- 4. Excavation equipment	D. Paver finisher
	E. Pneumatic type roller

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1. ---------
2. ---------
3. --------
4. ---------

Information Sheet-5	Application of environmental protection

5.1 Environmental protection

- ✓ Erosion
- ✓ Siltation
- ✓ Tree removal
- ✓ Gravel reserves
- ✓ Dust
- ✓ Quarry Reinstatement

5.1.1 Protection of Environmental Resources

The following are guidelines for fulfilling the responsibility for protecting and preserving various environmental resources during construction as required by law:

- ✓ Archeological and Historical Resources
- ✓ Endangered Species
- ✓ Migratory Bird Act

5.1.2 Environmental protection requirements

- Safety precautions have to be followed
- Economical aspects has to be taken into account
- Environmental protection has to be considered
- Should ensure that adequate support personnel are available
  Asphalt spray
- Should be checked adequate tools, equipments and other auxiliary tools are on site.

This Environmental Protection Plan (EPP) describes conceptual environmental protection measures that will limit the environmental disturbances associated with the project's design and construction.

- Anchor fields, including well sites, production facilities and flow lines
- Gathering pipelines and the gas pipeline
- Access roads
- facility sites

5.1.3 Construction environmental management plans (CEMP)

Construction activities include demolition work, site preparation, road maintenance or repair work, the operation of vehicles entering or leaving the construction site, and activities, at or within the immediate vicinity of a construction site, of persons who perform work at the site, or work connected with work at the site. Air emissions, noise, site contamination, waste, and water quality need to be managed to prevent impacts on the land subject to development, and on nearby land uses and the natural

environment. Construction activities can affect the amenity value of an area, interfering with the enjoyment of that area by people who may live in or use it. Causing an 'environmental nuisance' is an offence under the Environment Protection for which a person could be prosecuted.

5.1.4 Water quality protection

Water Quality During construction phase, the bridges, side drains, miter drains and culverts will require cleaning, de-silting, reshaping and repair. Some of the drains and culverts might be prone to soil erosion, which will result in siltation of nearby water courses. Also impacts on water quality may be caused by contaminated run-off of petroleum product spillages, leakages from storage areas and heavy vehicles, improper disposal of used oils and from hydraulic fluids which enters the nearby surface water sources. Similarly, easily eroded destabilized soils may be washed into surface water sources and cause siltation and sedimentation which will reduce the water quality. Activities that will give rise to this impact include construction of detours, access roads, drainage channels, excavation and grading works. During construction phase water will be needed for various purposes such as for watering down the dust. Abstraction of water in large quantities from local sources may lead to water shortage to the local community. This impact is considered significant. In some section of the road, labour force will put up temporary camps and will require sanitation facility such as pit latrines. Construction of sub-standard pit latrines for campsite labour force will contaminate groundwater through seepage to groundwater.

5.1.5 Noise ,vibration and dust management

Noise management will be limited to standard sound retarding devices on all operational vehicles as recommended by the manufacturer.

Noise generated from operations at the project site is not expected to impact on local communities due to the distances between the operations area and areas of habitation. However, the Environmental Management unit from Roads Department will investigate any noise complaints received.

Self-Check -5

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Matching

A	B
1. Migratory Bird Act	A. Water Quality
2. Environmental Protection Plan	B. Environmental protection
3. Tree removal	C. Protection of Environmental Resources
4. Environmental protection requirements	D.PPE
	E. Economical aspects has to be taken into account

Note: **Satisfactory rating – 4 points Unsatisfactory - below 3 and points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1. --------
2. --------
3. --------
4. --------

Operation Sheet 1	1. Techniques of select plant tools and equipment:

1.1. Techniques of select plant tools and equipment:

Step 1-select proper methods and procedures construction tools and equipment
Step 2- indentify road construction plant and equipment
Step 3- indentify excavation equipment
Step 4- indentify compaction equipment

Operation Sheet 2	Techniques of Applying Environmental protection

2.1 Techniques of Applying Environmental protection;

Steps 1- identify environmental protection

Step 2- responsibility of Protection of environmental resources

Step 3-List out orderly environmental protection requirements

Step 4-Apply Construction environmental management plans

Step 5-Water quality protection

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2-4 hours.

Task 1: Identify key information about operate plant and equipment

Task 2: List information types of road construction plant and equipment

List of Reference Materials

- Road Work Theory and Practice
- Building Rural Roads, Bjorn Johannessen
- Contractor's Handbook, Roads Training School, Zambia
- Guideline for Quality Assurance Procedures and Specifications for Labor-Based Road Works
- "Overseas Road Note 2: Maintenance Techniques for District Engineers (2nd Edition)",
- Highway Administration, 200
- Rural Road Maintenance Handbook, TRANSPORT PUBLISHING HOUSE Ha Noi - 2003

BASIC INFRASTRUCTUREOPERATIONS

NTQF Level I

Learning Guide-25

Unit of Competence: Operate Small Plants and Equipment

Module Title: Operating Small Plants and Equipment

LG Code: CON BIO M07 LO-02-LG-25

TTLM Code: CON BIO1 TTLM 0919v1

LO 2: Conduct pre-operational checks

Instruction Sheet	Learning Guide # 25

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

- Type & uses of Lubricant, fuel, hydraulic fluid and water
- Select fuel and lubricants
- Check and adjust fuel, oil, hydraulic fluid and water levels
- Uses of bolts, nuts, guards and attachment couplings
- Function of controls and gauges
- Standard start-up and shutdown 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:

- Select fuel and lubricants according to manufacturer's specifications
- Check and adjust fuel, oil, hydraulic fluid and water levels according to manufacturer's manual.
- Secure/tighten and maintain bolts, nuts, guards and attachment couplings in accordance with manufacturer's instructions.
- Check and adjust function of controls and gauges where necessary to comply with manufacturer's manual.
- Conduct standard start-up and shutdown procedures according to requirements of operator's manual.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5".
4. Accomplish the "Self-check 1, Self-check t 2, Self-check 3, Self-check 4 and Self-check 5" **in page -28, 31, 34, 36 and 38** respectively.
5. If you earned a satisfactory evaluation from the "Self-check" proceed to "Operation Sheet 1 and Operation Sheet 2" **in page -39.**
6. Do the "LAP test" **in page – 40** (if you are ready).

Information Sheet-1	Select fuel and lubricants

1.1 Type of Lubricant, fuel, hydraulic fluid and water

Lubricants oil which is enabling to minimize frictions of gears and the parts can be used for a long period of time.

NO 10

NO30

NO 40

NO 180

Grease

Coolant

Fuel Is Formed From Petroleum Product Can Be Used For Operate Heavy and Small Construction Machineries.

Diesel

Benzene

Kerosene

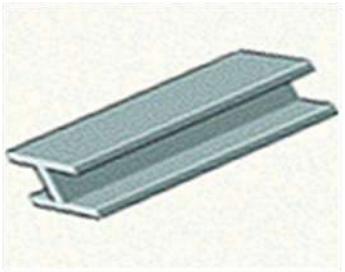
Hydraulic oil it can be used for carrying and move too much amount of load easily.

Water ,

Hydraulic fluid

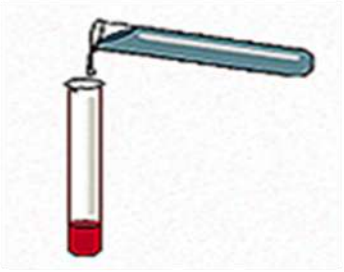
- Hydrolytic Stability
- Viscosity
- Compressibility
- Wear Resistance
- Oxidation Stability
- Thermal Stability
- Filterability

- Rust and Corrosion Protection
- Foam Resistance
- Demulsibility
- Seal compatibility



Solids

Aerosols



Liquids

Vapors

- **Hydrolytic Stability**

When hydraulic fluids come into contact with water, the water can interact with the additive system of the hydraulic oil resulting in the formation of acids. Hydraulic fluids that lack hydrolytic stability hydrolyze in the presence of water to form oil insoluble inorganic salts that can block filters and valves inhibiting oil flow. This can result in hydraulic system failure.

- **Viscosity**

It is a hydraulic fluid's most important characteristic and has a significant impact on the operation of the system Viscosity is a measure of a hydraulic fluid's resistance to flow. When hydraulic oil is too thin (low viscosity), it does not seal sufficiently. This leads to leakage and wear of parts. When a hydraulic oil is too thick (high viscosity), the fluid will be more difficult to pump through the system and may reduce operating efficiency. All hydraulic fluids must be able to retain optimum viscosity during operation in cold or hot temperatures, in order to consistently and effectively transmit power.

- **Compressibility**

Compressibility is a measure of the amount of volume reduction due to pressure. Although hydraulic oils are basically incompressible, slight volume reductions can

occur under certain pressure ranges. Compressibility increases with pressure and temperature and has significant effects on high-pressure fluid systems. It causes servo failure, efficiency loss, and cavitations; therefore, it is important for a hydraulic oil to have low compressibility.

- **Wear Resistance**

Wear resistance is a hydraulic fluid's ability to reduce the wear rate in frictional boundary contacts.

- **Oxidation Stability**

Oxidation stability is hydraulic oil's resistance to heat-induced degradation caused by a chemical reaction with oxygen. Hydraulic oils must contain additives that counteract the process of oxidation, improve the stability and extend the life of the fluid. Without these additives, the quality of the hydraulic oil will deteriorate quickly.

- **Thermal Stability**

Thermal stability is the ability to resist breakdown at elevated temperatures. Anti wear additives naturally degrade over time and this process can be accelerated at higher temperatures. The result of poor thermal stability is the formation of sludge and varnish which can clog filters, minimize flow and increase downtime

- **Filterability**

Water can react with additives in hydraulic fluids forming oil insoluble material. These contaminants can precipitate from the lubricant and block filters, valves and other components resulting in decreased oil flow or the system going on bypass.

- **Rust and Corrosion Protection**

In many systems, water can enter as condensation or contamination, and mix with the hydraulic oil. Water can cause rusting of hydraulic components.

- **Foam Resistance**

Foam results from air or other gases becoming entrained in the hydraulic fluid. Air enters a hydraulic system through the reservoir or through air leaks within the system. A hydraulic fluid under high pressure can contain a large volume of dissolved or dispersed air bubbles.

- **Demulsibility**

Water that enters a hydraulic system can mix or emulsify with the hydraulic oil. If this 'wet' fluid is circulated through the system, it can promote rust and corrosion. Highly refined mineral oils permit water to separate or demulsify quickly.

- **Seal Compatibility**

Leaking hydraulic fluids can cause many issues from simple housekeeping problems to more serious safety concerns and lubrication failures

Self-Check -1

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. _____ is a hydraulic fluid's ability to reduce the wear rate in frictional boundary contacts. (**4points**)

   A. Oxidation Stability
   C. Local resources
   B. Local maps
   D. Wear resistance

2 ----------is the ability to resist breakdown at elevated temperatures. (**3 points**)

   A. Thermal stability
   C. Oxidation Stability
   B. maintenance
   D. Wear resistance

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1.----------

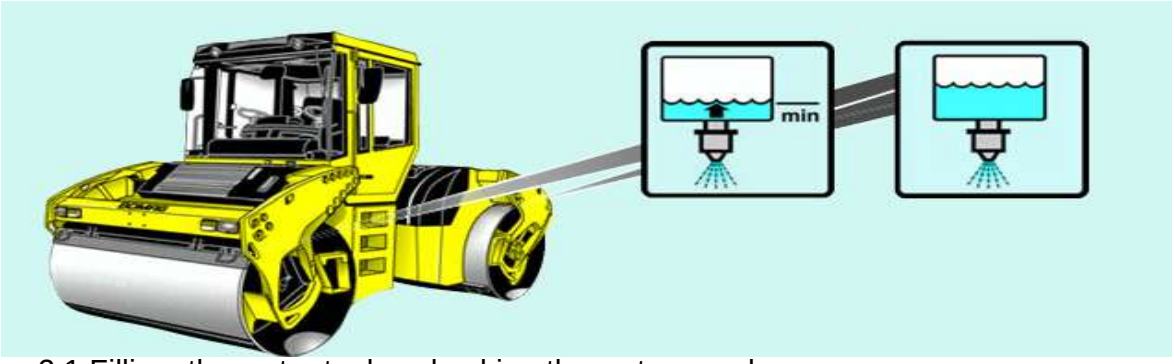
2. ----------

3.----------

Information Sheet-2	Check and adjust fuel, oil, hydraulic fluid and water levels

2.1 Check and adjust fuel, oil, hydraulic fluid and water levels

In order to be able to perform high quality compaction work, the "tools" required for this work must be optimally maintained or checked for functionality. This includes thorough inspection of the machine with respect to engine, hydraulic system and water sprinkling system, before work is started. Possible faults, which could later cause major problems during compaction work, can thereby be detected at an early stage.



Finger 2.1 Filling the water tanks, checking the water nozzles

- **Activities before starting work:**
  - ✓ Fill the water tanks
  - ✓ Check the water filter (in case of frost unscrew the filter to drain the pump)
  - ✓ Check the nozzles, clean or replace if necessary.
  - ✓ In case of frost drain the complete water sprinkling system; unscrew all nozzles.

At the start of each day, plant operator must check oil, fuel and lubricant levels as applicable, and at the end of the day he should clean down the plant and do the required maintenance before the next day's work.

- **Maintenance of plant/equipment**

Maintenance is a combination of actions carried out to return an item to, or restore it to, an acceptable condition.

- **Objectives of maintenance**
  - ✓ For maximum utilization of equipment.
  - ✓ To get profits by reducing down time cost
  - ✓ Maximum availability of equipment with required performance level.
- **Types of maintenance**
  - ✓ Operate to failure
  - ✓ Fixed time maintenance
  - ✓ Condition monitoring
  - ✓ Design out maintenance

- ✓ Opportunity maintenance

One can accomplish all the detailed analysis that has been covered in this book so far to ensure that the right equipment is selected, the system has been optimized for production, and the appropriate estimating factors have been used, but when the machine breaks down, the production drops to zero and the equipment starts costing money to its owner rather than making money.

Self-Check -2

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1 . --------is a combination of actions carried out to return an item to, or restore it to, an acceptable condition. .(**5points**)

A. Maintenance C. equipment

B. water levels D. Wear resistance

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1.----------

2. ----------

3.----------

Information Sheet-3	Uses of bolts, nuts, guards and attachment couplings

1.1. Bolts, Nuts and Washers

Buried Installations Bolts, nuts and washers used on buried fittings shall be Cor-Ten or stainless steel. Bolts, nuts and washers used on fittings in chambers shall be stainless steel.

If the Contractor elects to use Cor-Ten or stainless steel bolts, nuts and washers on buried valves or fittings, the entire connection shall be covered with a petrolatum tape system which shall be installed in accordance with the manufacturer's instructions.

1.2. Fastener Identification

Reports about the use of unmarked bolts, nuts and was hers have, fortunately, died off from the furor of the late 80's. The Fastener Quality Assurance Act passed by Congress certainly caught the attention of manufacturers and distributors. Unmarked fasteners are/were typically imported fasteners from question able sources purchased by a distributor. Those trying to save a buck may have been tempted to sell or use such product. Obviously, if the fasteners have not been marked properly according to ASTM requirements, the manufacturer or distributor has probably been skirting or ignoring other significant portions of the ASTM specifications. Strength, ductility and thread fit are critical to bolt performance. Were these unmarked fasteners satisfactory in these areas? Probably not. The first thing to look for is the manufacturer's mark. Nearly every single component - bolt, nut and washer - must have the manufacturer's mark either stamped into it or in raised form. Obviously, washers must use stamping only. For bolts, the head marks are typically raised. All bolts, even the lowly A307 bolt, must bear the manufacturer's mark.

- **Bolts**
  A325 bolts must clearly say"A325" on them. A Type 1 bolt may have three radial lines at 120°,but this is optional to the manufacturer. A Type 2 bolt would be identified by three radial lines at 60°. Type 2 bolts have not been manufactured domestically for several years, and if found, would be worthy of additional investigation regarding source and quality. Type 3 bolts, used for weathering steel applications, have the A325 underlined. A490 bolts must say "A490". The Type 1 has no additional markings. The Type 2,still available, has six radial lines at 30°. The Type 3 bolt for weathering steel applications will have the A490 underlined. A449 bolts, used only for bolts over 1-1/2" in diameter (the maximum diameter of A325 and A490 bolts), will not say "A449", but will have three radial lines at 120°. Only the Type 1 bolt is acceptable. The Type 2 A449 bolt carries only three radial lines at 60° (similar to the A325 Type 2), but these bolts go only to 1" diameter and are not to be used. A307 bolts will have "307A" or "307B" on them, depending

upon grade. Either grade is acceptable. The A307 bolt, until about five years ago, was not required to carry grade identification, so there are probably some legitimate A307 bolts in the market with no markings. Let the buyer and user beware. 29-9 A354 bolts may be used, per AISC specification, only for anchor bolts and as threaded rod. They should not be used for a steel-to-steel joint. A325 or 490 bolts should be used in these cases. Grade BC is the lower strength of the two and is marked with a "BC" on the head. Grade BD, with the equivalent strength of an A490, must be marked with six radial lines 60° apart and may have an optional "BD" on the head. Grade BD bolts over 2-1/2" must have the additional "BD" marking. A354 studs and threaded product must carry "BC" or "BD" on one end of the product.

Nuts

All nuts must also carry the manufacturer's mark. Nuts and washers, as commodity items, are more at risk of being unmarked.TheA563 grade C nutis identified by three circumferential arcs spaced at 120° about the face of the nut.

For C3 nuts, a "3" is added to the face of the nut. For D, DH and DH3 nuts, "D", "DH" or "DH3" will appear on the face. A194 nuts of grade 2 and 2H will carry a "2" or "2H" on the face. Acceptable nuts for A325 and A490 bolts are chosen from ASTM A563, grades C, C3, D, DH and DH3, and A194 grades 2 and 2H. Depending upon the grade of bolt, and whether it is black or galvanized, only certain combinations are acceptable.

Self-Check -3

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Matching

A	B
1. Bolts	A. fittings
2. nuts and	B. valves
3. washers	C. buried

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1.------
2.------
3.------

Information Sheet-4	Function of controls and gauges

3.1 controls and gauges

With controlled compaction the required compaction energy is determined and automatically adjusted. In automatic mode no adjustments must be made by the driver. Rollers with ASPHALT MANAGER work with a directed exciter system; it is automatically regulated. During compaction the effective amplitude is optimally and continuously adapted to the actual conditions. Grain damages and disturbances in the structure of the asphalt are effectively prevented. Besides working in automatic mode, the roller driver is also able to pre-select a certain direction of vibration (manual mode).

There are six different directions available, ranging (similar to oscillation). Due to their excellent adaptability, rollers with ASPHALT MANAGER are highly suitable for the complete spectrum of asphalt applications. Manual mode with horizontal vibrations is recommended for the compaction of layers on bridges, on/in multi-storey car parks or in the vicinity of structures which may be sensitive to vibrations.

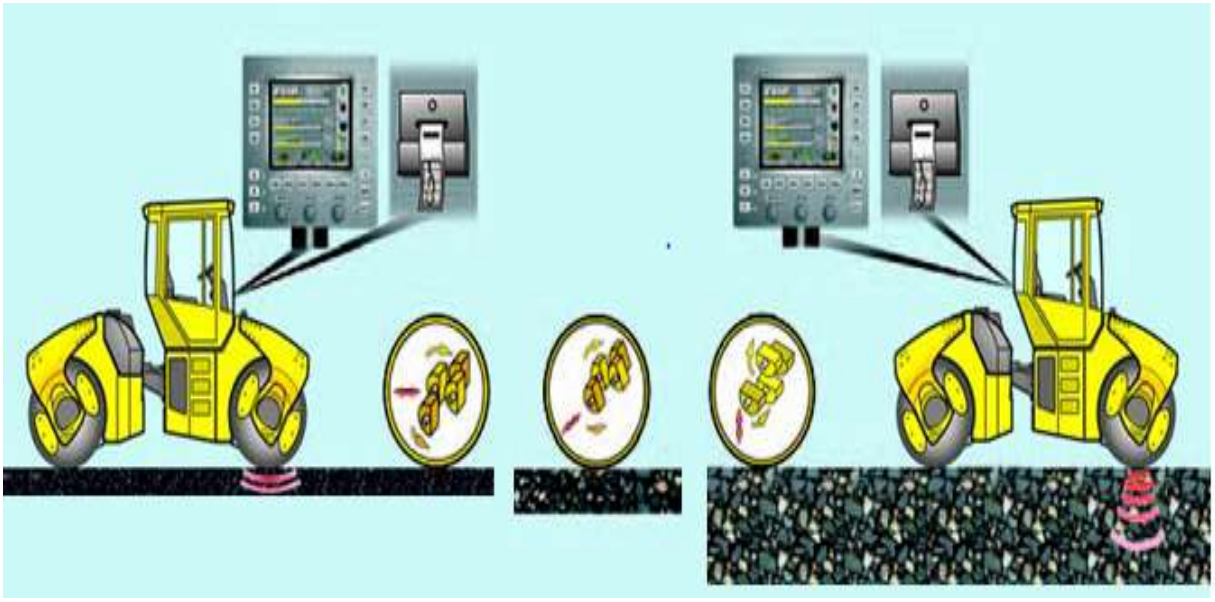


Figure3.1 Gauges

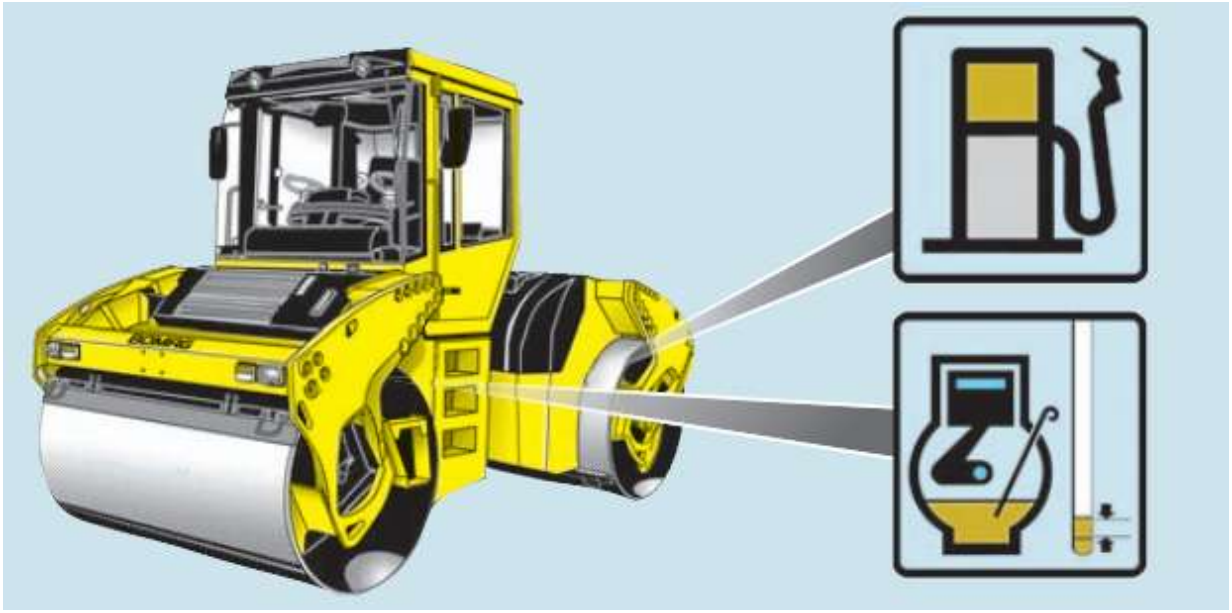


Figure3.2 Control gauge

Self-Check -4

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. --------is determined and automatically adjusted. (**4 points**)
   A. energy C. spectrum
   B. compaction D. damages

2.--------- is also able to pre-select a certain direction of vibration.(**6 points**)
   A. ranging C. roller driver
   B. bridges D. damages

Note: **Satisfactory rating – 10 points** **Unsatisfactory - below 6 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1.----------

2.----------

Information Sheet-5	Standard start-up and shutdown procedures

4.1. Start-up / shutdown procedures

Many potential hazards can be realized during start-up or shut-down of plant or process. Specific operating procedures should be provided which take account of all eventualities. For some specific plant items, start-up is know to present particular additional hazards; some examples of these are:

- Dryers – when starting up a drying system after maintenance or a plant shutdown, the actual temperature the dryer might reach before settling out with the control system may result in an increased chance of a dust explosion;
- Furnaces – explosions may occur if ignition of fuel is delayed;
- Vessels, Tanks, Reactors – ignition of flammable vapours introduced may occur for systems relying on elimination of oxygen to prevent explosions, unless inert gas purging is carried out effectively;
- Reactors – start-up of batch reactors after agitator failure may cause an uncontrollable exothermic reaction.

The start-up and shut-down procedures should be ordered and phased so that interlinked plant operations can resume or cease in a safe and controlled manner.

Emergency procedures

Further information can be found in the Technical Measures Document Emergency Response / Spill Control.

Any potential deviations to normal operation that cannot be addressed by design or control identified in the Hazard and Operability studies should be covered by emergency procedures. These should detail how to make plant and process safe, minimizing risks to operators at all stages. They should cover PPE, the level of intervention which is safe and when to evacuate. The procedures will need to tie in closely with the on and off-site emergency plans provided under COMAH.

Self-Check -5

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. ----------is know to present particular additional hazards (**5 points**)

A. Dryers C. flammable

B. start-up D. procedures

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1.----------

Operation Sheet- 1	Techniques of Standard start-up and shutdown procedures

Techniques to Standard start-up and shutdown procedures

Step 1- identify start-up and shutdown procedures

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1. Implement start-up and shutdown procedures

List of Reference Materials

- RRL, DSIR, ‘Bituminous Materials in Road Construction’, HMSO Publication.
- RRL, DSIR, ‘Soil Mechanics for Road Engineers’, HMSO Publication.
- Relevant IRC codes and MoRT & H specifications.

BASIC INFRASTRUCTUREOPERATIONS

NTQF Level I

Learning Guide-26

Unit of Competence: Operate Small Plants and Equipment

Module Title: Operating Small Plants and Equipment

LG Code: CON BIO1 M07LO3-LG-26

TTLM Code: CON BIO1 TTLM 0919v1

LO3: Use small Plant & Equipment

Instruction Sheet	Learning Guide # 26

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

- Identification of site hazards and traffic control methods
- Application of operating techniques and procedures
- operating machine
- Locating plant and equipment

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:

- Identify site hazards associated with small plant and equipment operations and establish appropriate controls in accordance with the requirements of the site safety plan
- Identify and apply operating techniques for small plant and equipment to achieve optimum output in accordance with manufacture's design specifications while maintaining specified tolerances
- Operate machine to produce results within design specifications to meet specified tolerances
- Locate plant and equipment when not in immediate use

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -47, 49, 51 and 54** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -----.**
6. Do the “LAP test” **in page – -----** (if you are ready).

Information Sheet-1	Identification of site hazards and traffic control methods

1.1.

- **Safe work procedures:**
  - ✓ Exclusion work zones established
  - ✓ Use of traffic signal for the people
  - ✓ Traffic spot within work zones
  - ✓ Installation of temporary traffic signals
  - ✓ Use of safety signs
  - ✓ Speed restriction signs displayed and enforced
  - ✓ Audible alarms & flashing lights for reversing vehicles
  - ✓ Use of temporary barriers to cordon off sections of road
  - ✓ Total closure of road
  - ✓ Use of safety signs, high visibility vests
  - ✓ Speed restriction signs displayed and enforced

- **Contact or generation of heat sources:**
  - ✓ Provide appropriate PPE and training
  - ✓ Keep workplace clear of waste or flammable materials
  - ✓ Use of fireproof blankets or other fire suppression methods or equipment
  - ✓ Prescribed Work at Hot Work Permit for non normal welding or grinding activities
  - ✓ Remove flammable materials or store correctly
  - ✓ Provide adequate firefighting equipment
  - ✓ Worker fire fighting training
  - ✓ Eliminate ignition sources from flammable atmospheres
  - ✓ Provide shade structures
  - ✓ Provide protective clothing and sunscreen
  - ✓ Reduce exposure time during in the middle of the day

- **Contact with electricity:**
  - ✓ Tools and leads inspected and tagged
  - ✓ Use of portable RCD's
  - ✓ RCD's wired into construction site wiring
  - ✓ Residual current devices tested as per legislation.
  - ✓ Electrical leads kept elevated and clear of work areas or protected from damage by vehicles or pedestrian traffic
  - ✓ All electric leads kept dry

- ✓ All electric leads kept insulated
- ✓ Avoid live work situations
- ✓ Ensure Electrical Risk Assessment requirement completed for live work
- ✓ Lock-out and equipment tag procedures
- ✓ Location of services to be established
- ✓ Ensure Permission to work obtained i.e. to dig or work near high voltage lines
- ✓ Overhead cables to be protected
- ✓ High voltage overhead lines ;contact Electrical authority-tiger tail protection
- ✓ Services to be isolated when working in proximity
- ✓ Establish safe clearance distances

- **Exposed to excessive noise:**
  - ✓ Fit noise suppression to noisy plant and equipment
  - ✓ All personnel to wear appropriate PPE (e.g. hearing protectors)
  - ✓ Regulate noise generation times or periods to before or after class

- **High pressure cylinders or hose lines, abrasive blasting:**
  - ✓ Air hoses in good condition and regularly inspected
  - ✓ All hose couplings fitted with pins or chains
  - ✓ Prohibit and instruct contractors on dangers
  - ✓ Cylinders moved, stored upright and secured
  - ✓ All pressure gauges inspected regularly for defects

- **Contact with chemicals or other substances:**
  - ✓ All contractors trained in dangerous goods & environmental legal requirements
  - ✓ All contractor personnel provided with appropriate PPE and its use enforced -gloves, respirators suitable to substance, protective clothing, face shields, etc.
  - ✓ Safe work methods for use, storage and disposal followed
  - ✓ Hazardous substances & dangerous goods stored and labeled correctly
  - ✓ Provide mechanical or other types of ventilation of extraction where necessary
  - ✓ Provision of spill kits or equipment to contain accidental spill and workers trained

- **Contact or generation of radiation hazards:**
  - ✓ Welding operations shielded from other persons or general public

- ✓ All personnel to wear appropriate PPE
- ✓ Correct procedures developed and followed
- ✓ Regular equipment check
- ✓ Follow documented safe work procedures for laser

- **Caught between; crushed:**

✓ Guarding of rotating plant and hand tools
✓ Safe work procedures to be followed
✓ Pre-start daily safety inspection
✓ Personnel kept clear when operating mobile plant
✓ Provide roll-over cage protection
✓ Fit reverse alarms to plant and check operation
✓ All personnel kept clear during crane operations or loading movements
✓ Safe work procedures for moving heavy loads
✓ Load slings properly secured
✓ Use of communication systems between crane operators and doggers
✓ Prescribed certificates held by riggers, daggers & crane operators or other specified load shifting or earth moving vehicles,

- **Plant or vehicle overturns:**
  - ✓ Cranes to be set up on solid ground and away from edge of excavation
  - ✓ Mobile plant to be fitted with roll-over cage protection
  - ✓ Safe work procedures developed

Self-Check -1

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Matching

A	B
1. Exposed to excessive noise	A. Total closure road
2.Safe work procedures	B. Fit noise suppression to noisy plant and equipment
3. Contact with electricity	C. Use of portable RCD's

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Application of operating techniques and procedures

1.1. Construction equipment operators

Construction equipment operators drive, maneuver, or control the heavy machinery used to construct roads, bridges, buildings, and other structures.

Work Environment

The guidelines identify four general elements that are critical to the development of a successful safety and health management system. These are the following:

- Management leadership and employee involvement,
- Worksite analysis,
- Hazard prevention and control
- Safety and health training.

The guidelines recommend specific actions, under each of these general elements, to achieve an effective safety and health management system.

Construction equipment operators work in nearly all weather conditions. Workers often get dirty, greasy, muddy, or dusty. The vast majority of operators work full time, and some operators have irregular hours. Some construction projects, especially road building, are done at night.

Many workers learn equipment operation on the job after earning a high school diploma or equivalent, while others learn through an apprenticeship or by attending vocational schools.

Self-Check -2

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write four general elements that are critical to the development of a successful safety and health management system.. (**10 points**)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	operating machine

3.1 Operating machine

Used for separating substances of different density or particle size, when suspended in a fluid, by spinning them about an axis in a suitabcontainer.

Equipment Used: If applicable, hoods

- Centrifuge with opening interlocking
- Centrifuge without opening interlocking
- Tubes
- Chemicals

Mechanical failure of rotating parts Contact with rotating parts
Sample leaks causing aerosols, stress corrosion and contamination
Same imbalance causing machine movement /WalkingFire or explosion

Safety Pre-requisites: (eg: Lock-out Tags, Secure Access, Trained/Licensed Operator, Written Work Order, Close Supervision, Warning Signs, Personal Protective Equipment)only suitable trained persons to operate centrifuge and in accordance with the instruction manual closed shoes, laboratory coat buttoned, gloves, safety glasses keep hair, loose clothing, and body parts away from the centrifuge while it is operating centrifuge securely anchored never centrifuge hazardous materials outside of an appropriate hood or containment facility never centrifuge flammable, explosive or corrosive materials

Never put hands in the rotor area unless the rotor is completely stopped
Never fill tubes while they are in the rotor
Never move the centrifuge while the rotor is spinning
Never leave a running centrifuge unattended
Keep rotors and buckets clean

Self-Check -3

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is Operating machine? (**5 points**)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-4	Locating plant and equipment

4.1. Knowledge of basic mechanics refers to the theory of operation, terminology, usage, and characteristics of basic mechanical principles as they apply to such things as gears, pulleys, cams, pawls, power transmissions, linkages, fasteners, chains, sprockets, and belts; and including hoisting, rigging, roping, pneumatics, and hydraulic devices.

Show through education/training and work experience that you have a working knowledge of basic mechanical, pneumatic, and hydraulic principles as they apply to:

- Power transmission--such as gears, sprockets and chains, belts and pulleys

- Power translation--such as cams and cam followers, linkages, springs

- Friction reduction--such as bushings, bearings

- Fasteners--such as screws, nuts and bolts, pins, rings, clips, couplings

. Knowledge of basic electricity

Show through education/training and work experience that you have a working knowledge of basic electrical principles as they apply to:

- Hardware/components--such as relays, switches, resistors, circuit breakers, etc.

Knowledge of basic electronics refers to the theory, terminology, usage, and characteristics of basic electronic principles concerning such things as solid state devices, vacuum tubes, coils, capacitors, resistors, and basic logic circuitry.

- Knowledge of basic computer concepts refers to the terminology, usage, and characteristics of digital memory storage/processing devices such as core memory, input-out peripherals, and familiarity with programming concepts.

- Hardware--as in input-output peripherals, memory units, central processor units, etc.

Knowledge of mail processing equipment operation refers to the knowledge of machine operation such as safety considerations, start-up, shut-down, and

operating characteristics of mail processing equipment such as conveyors, letter sorters, and cancellers.

- Safety considerations--as in machine start-up, operation, shut-down

Knowledge of lubrication materials and procedures refers to the terminology, characteristics, storage, preparation, disposal, and usage techniques involved with lubrication materials such as oils, greases, and other types of lubricants.

- Lubrication materials--such as oils, greases, etc.

-Lubrication procedures--as in application techniques, storage, disposal, etc

Knowledge of cleaning materials and procedures refers to the terminology, characteristics, storage, preparation, disposal, and usage techniques involved in application and removal of cleaning materials such as alcohols, solvents, detergents, and degreasers. Included is an understanding of the use of compressed air and vacuum type cleaning procedures.

Show through training and work experience that you have a working knowledge of cleaning process as it is applied to:

- Cleaning materials--such as alcohols, solvents, detergents, degreasers

- Cleaning procedures--as in hand methods, machine methods (compressed air, vacuum cleaners)

- Machine maintenance applications--such as heat treating, tempering, machining, bending, etc.

Briefly tell of the metals you are familiar with; describe the types of maintenance applications performed.

Self-Check -4

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

MACTING

	A	B
1.	Lubrication materials.	A. techniques, storage, disposal
2.		Lubrication procedures.

B. oils, greases

C.operation

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

List of Reference Materials

ASPHALT INSTITUTE (February 1990 Edition). Research Report No. 83-1 (RR-83-1).
Deflection Method for Designing Asphalt Concrete Overlays for Asphalt Pavements.

16. AMERICAN ASSOCIATION of STATE HIGWAY and TRANSPORTATION
OFFICIALS. AASHTO Guide for Design of Pavement Structures. Volume 2 (August
1986).

17. LCPC (October 1992). VIZIR- Computer-aided method of estimating road network
maintenance needs.

18. CSRA (1983). Draft TRH 12: 1983- Bituminous Pavement Rehabilitation Design.
Pretoria, South Africa.

19. C.E.B.T.P.-L.C.P.C. (1985). Manuel pour le renforcement des chaussees souples en pays
tropicaux.

20. Yoder and Witczak (1975). Principles of Pavement Design, Second Edition (Part V:
Pavement Evaluation and Rehabilitation). John Wiley & Sons.

BASIC INFRASTRUCTURE OPERATIONS

NTQF Level I

Learning Guide-27

Unit of Competence: Operating Small Plants and Equipment

Module Title: Operating Small Plants and Equipment

LG Code: CONBIO1M07Lo-04LG-27

TTLM Code: CONBIO1TTL19v1

LO4: Carry out Operator Maintenance

Instruction Sheet	Learning Guide # 27

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

- Maintenance of plant/equipment
- Inspection and fault finding
- removing and replacing defective parts of equipment
- Execution of programmed maintenance

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:

- Shutdown plant/equipment and prepare it for maintenance.
- Perform inspection and fault finding in accordance with the manufacture's specifications and/or organizational requirements
- Remove and replace defective parts safely and Effectively
- Carry out regular programmed maintenance tasks in accordance with the manufacturer's and/or organizational requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page 59, 61, 66 and 69** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1” **in page ---.**
6. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	Maintenance of plant/equipment

1.1. Plant and equipment is carried out to prevent problems arising, to put faults right, and to ensure equipment is working effectively.

Maintenance may be part of a planned program or may have to be carried out at short notice after a breakdown. It always involves non-routine activities and can expose those involved (and others) to a range of risks.

Why is maintenance of plant and equipment important?

An effective maintenance program will make plant and equipment more reliable. Fewer breakdowns will mean less dangerous contact with machinery is required, as well as having the cost benefits of better productivity and efficiency.

Additional hazards can occur when machinery becomes unreliable and develops faults. Maintenance allows these faults to be diagnosed early to manage any risks. However, maintenance needs to be correctly planned and carried out. Unsafe maintenance has caused many fatalities and serious injuries either during the maintenance or to those using the badly maintained or wrongly maintained/repaired equipment.

If you are an employer and you provide equipment for use, from hand tools and ladders to electrical power tools and larger plant, you need to demonstrate that you have arrangements in place to make sure they are maintained in a safe condition.

Failing to correctly plan and communicate clear instructions and information before starting maintenance can lead to confusion and can cause accidents. This can be a particular problem if maintenance is during normal production work or where there are contractors who are unfamiliar with the site.

Self-Check -1

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. ---------is carried out to prevent problems arising, to put faults right, and to ensure equipment is working effectively..(**5 points**)

2. A. Maintenance.
C. equipment

3. B. hazards
D. Plant and equipment

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1---------

Information Sheet-2	Inspection and fault finding

3.1. Check to ensure accuracy and dependable operation of the proposed equipment and methods prior to the start of concreting operations and after making any changes in the location or arrangement of the batching plant. Plant calibration is the responsibility of the Producer/Contractor.

Check the general layout of the plant before the equipment is erected to ensure efficient operation and adequate space for stockpiling and handling materials in compliance with specification requirements.

Self-Check -2

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. ---------is the responsibility of the Producer/Contractor. 5 points)

A. Plant calibration. C. equipment

B. Toole D. Wheelbarrow

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1.----------

Information Sheet-3	Removing and replacing defective parts of equipment

1.1. Removing and replacing defective parts of equipment

Many types of heavy equipment use a hydraulic system to work their mechanisms. Hydraulic hoses deteriorate over time and could start leaking, and the equipment won't work properly until you replace worn-out hoses. Start by locating the hose that is damaged. Then remove it by unscrewing it from the equipment. Finally, find a matching replacement hose and install it to get the system going again.

A spare part, spare, service part, repair part, or replacement part, is an interchangeable part that is kept in an inventory and used for the repair or replacement of failed units

- Put on goggles and gloves to protect yourself from the hydraulic fluid. Hydraulic fluid is toxic and will damage any body part it contacts. Protect yourself with goggles and gloves while you're handling any hydraulic materials. Don't take them off until the job is done.

Also consider wearing long sleeves and pants while changing the pipe to protect the rest of your skin.

If you're not working in a well-ventilated area, also wear a mask or respirator.

Contact your local poison control center right away if any fluid gets on your skin, in your eyes, or in your mouth.

- Release all the pressure from the hydraulic system. Never work on a hydraulic machine while pressure is in the system. This could result in hydraulic fluid spraying out and hurting you. The process for releasing the pressure varies for different equipment. Consult your owner's manual for the exact procedure.[2]
- Commonly, hydraulic equipment has a lever that releases the pressure. Pull this lever first. Then shut off all the power to the hydraulic system. Finally, work the hydraulic lever back and forth a few times to push excess pressure out.
- If you're working on a piece of equipment that raises, like a backhoe, lower the mechanism completely to the ground before doing any work.
- Lay a sheet or bucket underneath the hose you're removing. Hydraulic fluid will leak out of the hose when you remove it. Prevent contamination of the area by collecting the fluid as it leaks. A thick drop cloth or a bucket will stop the oil from

spreading.

- If the hose is in an awkward spot to put a sheet or bucket, try stuffing rags underneath it instead.
- Remove any coverings that get in the way of the hose attachment. Some machines have hoods or coverings that protect the hoses, especially at the attachment point. If your equipment has any covering like this, remove it so you can work on the hoses.[4]
- Keep track of everything you remove from your equipment. Take a picture of the machine before you remove anything so you know how it should look when you replace the parts.
- Remember to consult your owner's manual for the exact process of hose removal. Different equipment may have a different process.
- Wash off the connectors on both sides of the hose. Dirt, dust, and grime have probably built up on both ends of the hose over time. This can all get into the hydraulic system when you remove the hose and damage it. Before removing the hose, spray around the hose attachments with window cleaner or a similar fluid. Then use a rag and wipe off any dirt.

- Use 2 wrenches to unscrew the fittings securing the hose. Hydraulic hoses are usually secured by an attachment with 2 fittings that spin in opposite directions. Hold the fitting closest to the hose with one wrench. Then use the other wrench to loosen the fitting closer to the machine by turning it counterclockwise. Spin until the hose detaches from the fitting. Then repeat this process for the other side of the hose.
- The size of the wrenches depends on your hose type. Typical wrench sets come with a variety of sizes that should fit most equipment. Try out a few wrenches to see which fits your hose attachments.
- Installing a New Hose
- Get a new hose to the exact specifications of the old hose. There are many types of hydraulic hoses, so make sure you get the correct one by matching the new hose to the old one. It should be the same width and thickness. Also check the pressure rating on the hose, which is usually marked on the hose itself in
- If you don't know where to start, bring the old hose with you to the store and ask an employee for the same type.
- When you select a hose, have the supplier cut and crimp the hose with an attachment. Crimping the hose requires special equipment and you can't do it at home.
- When the supplier crimps the hose, they will attach a new fitting to the end. You can screw this fitting into the old fitting attached to your machine.
- Slide an abrasion sleeve over the hose if it rubs against anything. If your hose is in a position where it rubs against the machine or other hoses, consider

getting an abrasion sleeve. This is a piece of fabric that slides over the hose and protects it from damage. If you've had a problem with abrasions on your hoses in the past, this could solve the issue and make your hoses last longer.[

- Abrasion sleeves are available from hydraulic hose suppliers.
- Wipe off all of the hose fittings and connectors before installing it. Dirt or grime can get into the hydraulic system and damage it. Make sure all the connectors are clean before installing the hose. Use a damp rag and rub all the connectors to remove any dirt.
- Screw one side of the hose into the fitting. Inserting the first side of the hose is easy because one side is still free. Insert the end of the hose into the fitting and rotate it clockwise to tighten it. When the hose stops spinning, it's fully tightened.
- Don't over-tighten the hose. Once the hose stops spinning, it's snug enough. Pushing it further can rupture the attachment and cause leaks.
- Use 2 wrenches to screw in the final side. Installing the final side of the hose is a bit trickier because the hose can't rotate freely. Insert the hose into the connector. Then hold it in place with a wrench. Use a second wrench to rotate the connector attached to the machine. Stop rotating when the connector doesn't spin any further.
- Replace any coverings that you removed before the installation. Make sure all the pieces you removed are back where they belong before you test the hydraulic system. Refer to the pictures you took or the owner's manual to double-check the correct positions.

Figure 3.2

Figure 3.2

Figure 3.3

Figure 3.4

Self-Check -

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. _____ are usually secured by an attachment with 2 fittings that spin in opposite directions. (**6 points**)

   A. Hydraulic hoses C. equipment

   B. wrenches D. fittings

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-4	Execution of programmed maintenance

1.2. Execution of programmed maintenance

Construction equipment maintenance programs generally consist of three major components: preventive maintenance, routine maintenance, and major repairs. If the first two programs are both aggressively applied and well managed, the major repair program is minimized, and even more importantly, the first two programs occur as scheduled under the owners' control whereas major repairs occur randomly and usually at times when they seem to create the most distress to the project. Thus, to understand effective construction equipment management, one must also understand effective construction equipment maintenance.

1.3. Need for a maintenance program

As would be expected in equipment-intensive projects, the major capital investment is for the equipment needed in the field. It constitutes a big percentage of the total project cost and as a consequence, the effectiveness of equipment management during project execution is a very important factor in project profitability. Many factors affect the productivity of a machine. Weather, operator efficiency, and operating site conditions all have an impact and are often not possible for the project manager to control. However, the one truly controllable factor is machine availability.

1.4. Designing the maintenance program

There are many factors involved in designing an effective maintenance program. They include the following:

- ✓ Clearly defining program objectives and goals
- ✓ Developing a good communication system
- ✓ Furnishing the proper maintenance organization
- ✓ Providing precise clarification of the maintenance procedures
- ✓ Maintaining complete control of the maintenance performance
- ✓ Active evaluation of maintenance results
- ✓ Strong upper management support

The most frequent cause of poor maintenance program execution is the failure to define the program effectively and to communicate goals to both consolidated maintenance facility and field mechanics.

This section will consider six major factors that relate to designing a maintenance program:

- ✓ Define objectives and goals
- ✓ Establish responsibility and authority
- ✓ Define actions to be taken
- ✓ Establish control procedures
- ✓ Establish financial control procedures
- ✓ Provide feedback and performance indexes

Self-Check -4

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Writ six major factors that relate to designing a maintenance program: (**10 points**)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

BASIC INFRASTRUCTURE OPERATIONS

NTQF Level I

Learning Guide-28

Unit of Competence: Operating Small Plants and Equipment

Module Title: Operating Small Plants and Equipment

LG Code: CONBIO1M07LO5-LG-28

TTLM Code: CONBIO1TTL19v1

LO5: Clean up

Instruction Sheet	Learning Guide # 28

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

- Clear work area
- Safe-keeping of plant, equipment and tools

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:

- Clear work area and dispose of or recycle materials in accordance with project environmental management plan
- Clean, check, maintain and store plant, equipment and tools in accordance with manufacturer's recommendations and standard work practices

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -73 and 75, and** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1” **in page -.**
6. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	Clear work area

The designated plant operator must be responsible person for the site tidiness and for the daily maintenance cleanliness of his plant (e.g. pedestrian roller, hand spray, chip spreader, concrete mixer, wheelbarrows etc.), in accordance with the manufacturer's instructions as applicable and good housekeeping.

Accidents due untidy site are slipping or falling over materials, stepping on nails projecting from timber etc….

Steps for site tidiness:

- Clean up as you go
- Platforms, stairways, gangways free from materials not in immediate use
- Clean up spilled oil & grease
- Materials dumping at a recognized disposal point.
- Removal of any projected nails

Self-Check -1

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Enumerate Steps for site tidiness (**6 points**)

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Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1. **----------**

Information Sheet-2	Safe-keeping of plant, equipment and tools

Safe-keeping of plant, equipment and tools

Safe and effective operational use of tools, small plant and equipment

Hand tools

Tools should be issued every morning to the labor force by the storekeeper and record must be kept of the tools issued in the site issue book. Tools should be returned at the end of the day and signed off by the storekeeper.

Equipment

Equipment (shutters, screeds, gauges, etc.) should be issued every morning to the labor force by the storekeeper and record kept of the equipment issued in the site issue book.

Equipment must be kept clean as the work progresses as well as at the end of the day, when it should be returned and signed off by the storekeeper.

Plant

The designated plant operator must be responsible for the daily maintenance cleanliness of his plant (e.g. pedestrian roller, hand spray, chip spreader, concrete mixer, wheelbarrows etc.), in accordance with the manufacturer's instructions (as applicable) and good housekeeping.

At the start of each day he must check oil, fuel and lubricant levels as applicable, and at the end of the day he should clean down the plant and do the required maintenance before the next day's work. All plant should be securely stored in the camp site when not in use.

Self-Check -1

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Matching

A	B
1. Equipment	A. hand spray
2. Hand tools	B. gauges
3. Plant	C. hammer
	D. google

Note: **Satisfactory rating – 12 points** **Unsatisfactory - below 7 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

1. **----------**
2. **----------**
3. **----------**

List of Reference Materials

- ETHIOPIAN ROADS AUTHORITY. Pavement Design Manual, Volume 1 – Flexible
- Pavements and Gravel Roads-2002.

- ETHIOPIAN ROADS AUTHORITY. Pavement Design Manual, Volume 2 – Rigid
- Pavements-2002.

- AMERICAN ASSOCIATION of STATE HIGWAY and TRANSPORTATION
- OFFICIALS (1993). AASHTO Guide for Design of Pavement Structures. Washington,
- D.C.

- HUDSON, W.R., R. HAAS, AND R.D. PEDIGO (1979). Pavement Management System
- Development, NCHRP Report 215.

- BCEOM (1998). Pavement Management System. Draft Final Report.

- ASPHALT INSTITUTE Manual Series No 16 (MS-16): Asphalt in Pavement
- Maintenance.

- PIARC International Road Maintenance Handbook, Volume III. Maintenance of Paved
- Roads.

- TRANSPORT AND ROAD RESEARCH LABORATORY. Overseas Road Note 1 (2nd
- Edition, Reprinted 1995). Maintenance Management for District Engineers.

- WORLD BANK. Technical Paper 46, Guidelines for Conducting and Calibrating Road
- Roughness Measurements

Answer Sheet		Learning Guide # 24,25,26,27,28		
Self-Chack-1	**Self-Chack-1**	**Self-Chack-1**	**Self-Chack-1**	**Self-Chack-1**
1.C	**1 C**	**1.B**	**1.D**	**1.B**
	2 D	**2.A**		**2.D**
	3 A	**3.C**		**3.3**
	4 B			
Self-Chack-2	**Self-Chack-2**	**Self-Chack-2**	**Self-Chack-2**	
1.B	**1`. A**	1.Management leadership and employee involvement,	**1.A**	
2.B	**2 A**	2.Worksite analysis,		
3.D	**3.B**	3.Hazard prevention and control		
		4.Safety and health training.		
Self-Chack-3	**Self-Chack-3**	**Self-Chack-3**	**Self-Chack-3**	
1.A	**1.B**		**1.A**	
	2A			
Self-Chack-4	**Self-Chack-4**	**Self-Chack-4**	**Self-Chack-4**	
1.D	**1.B**	**1.B**		
2.A	**2C**	**2.A**		
3.E	**3 A**			
4.C	**4D**			
Self-Chack-5	**Self-Chack-5**			
1.C	**1.C**			
2.D	**2.A**			
3.B				
4.E				

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FASELTATER

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