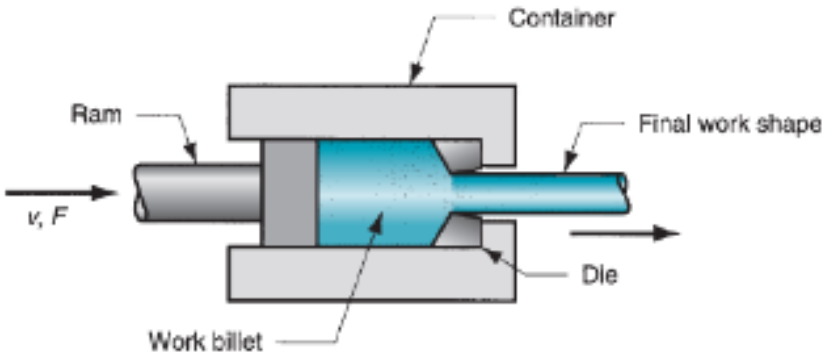
MACHINING

Level-IV

Based on October 2023, Curriculum Version II



Module Title: - Performing Advanced Machine/Process Operation

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Acronym

EDM	Electro Discharge Machining
MTTR	Mean Time to Repair
OEE	Over all Equipment Effectiveness
OHS	Occupational Health and Safety
PPE	Personal Protective Equipment
QA	Quality Assurance
RCM	Reliability Centered Maintenance
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operational Procedures
WIP	Work in Process

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Introduction to Module

In Machining occupation, **Performing Advanced Machine/Process Operation** helps the trainees to identify the different types of machines and also understand the procedures and shop rules operate Grinding machines for machining operation. So this module covers the units of. Work requirements Investigate resource usage, pre-start processes**,** machine process **and** Quality assure

This module is designed to meet the industry requirement under Machining occupational standard, particularly for the unit of competency: Perform Advanced Grinding Operations

This module covers the units:

- work requirements
- Investigate resource usage
- pre-start processes
- machine process
- Quality assure

Learning Objective of the Module

- Determine work requirements
- Investigate current practices in relation to resource usage
- Prepare pre-start processes
- Perform machine process
- Quality assure production process

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

Unit one: work requirements

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

- Interpret working drawings
- Specifications. work instructions,
- Safety equipment, guards and emergency procedures.

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:

- Interpret drawings, work instructions, specifications
- Identify safety equipment and guards.
- Understood and follow emergency procedures.

1.1. Introduction to working Drawing

A technical person can use the graphic language as powerful means of communication with others for conveying ideas on technical matters. However, for effective exchange of ideas with others, the engineer must have proficiency in (*i*) language, both written and oral, (*ii*) symbols associated with basic sciences and (*iii*) the graphic language. Engineering drawing is a suitable graphic language from which any trained person can visualize the required object. As an engineering drawing displays the exact picture of an object, it obviously conveys the same ideas to every trained eye.

1.2. Specifications and work instruction

Language has a set of rules and regulations for it to operate correctly. The same is true of engineering drawing. In the English language, there are two basic rules. The first is the word order that gives information on subject and object. The second is spelling, which gives information on the words themselves in terms of the spelling, i.e. the nouns, verbs, etc. Considering the word order, the phrase 'the cat sat on the mat' is very different from the phrase 'the mat sat on the cat'. All that has happened is that the words 'cat' and 'mat' have been swapped. Previously, the phrase described a perfectly feasible situation whereas it now describes an impossible situation. Thus, the word order gives information on which is the subject and which is the object. The second set of rules concern spelling and thus the phrase 'the cat sat on the mat' is very different from 'the bat sat on the mat' and yet this difference is the result of only one letter being changed!

In engineering drawing, there are similarly two sets of rules. The first also concerns order but in this case the order of the different orthographic views of an engineering artifact. The second is concerning how the individual views are drawn using different line thicknesses and line types, which is the equivalent of a spelling within each individual word. These are shown in Figure 1.8. The first set is the 'drawing layout rules', which define information concerning the projection method used and therefore the arrangement of the individual views and also the methodology concerning sections. The second set of rules is the 'manufacturing rules', which show how to produce and assemble an artifact. This will be in terms of the size, shape, dimensions, tolerances and surface finish. The drawing layout rules and the manufacturing rules will together make a legal specification that is binding. Both sets of rules are defined by ISO standards. When a contractor uses

these two sets of rules to give information to a subcontractor on how to make something, each part is able to operate because of the underpinning provided by ISO standards.

1.3. Necessary Data of Norm/ or Standards Drawing

Though traditional requirements analysis centers on functional needs, data requirements analysis complements the functional requirements process and focuses on the information needs, providing a standard set of procedures for identifying, analyzing, and validating data requirements and quality for data-consuming applications. Data requirements analysis is a significant part of an enterprise data management program that is intended to help in:

- Articulating a clear understanding of data needs of all consuming business processes,
- Identifying relevant data quality dimensions associated with those data needs,
- Assessing the quality and suitability of candidate data sources,
- Aligning and standardizing the exchange of data across systems,
- Implementing production procedures for monitoring the conformance to expectations and correcting data as early as possible in the production flow, and
- Continually reviewing to identify improvement opportunities in relation to downstream data needs.

During this process, the data quality analyst needs to focus on identifying and capturing more than just a list of business questions that need to be answered. Analysis of system goals and objectives, along with the results of stakeholder interviews, should enable the analyst to also capture important business information characteristics that will help drive subsequent analysis and design activities: data and information requirements must be relevant, must add value, and must be subject to availability.

A drawing is described as a technical drawing created by engineers following standard layout conventions, terminology, interpretation, and many other factors. It is also known as an engineering drawing.

The function of drawing is to accurately and thoroughly identify all the machine component's geometric features. It contains various orthographic views to convey all the product information to the manufacturer to produce that product.

Types of engineering drawing

Following are the two types of mechanical or engineering drawing:

- Manual drawing
- Computer aided drawing (CAD)

Manual drawing

In the manual drawing, the drawings are made by hand with the help of drawing instruments like pencil, sheet, ruler, protractor, and others. The manual drawing is easily misread because of ambiguity and drawing errors.

Following are the major types of manual drawings:

- Machine drawing
- Production drawing
- Part drawing
- Assembly drawing

I .Machine drawing

Machine drawing is a drawing consisting of several orthographic views pertaining to machine components. The various dimensions and shapes are completely defined in this drawing. The representation of machine drawing is shown as:

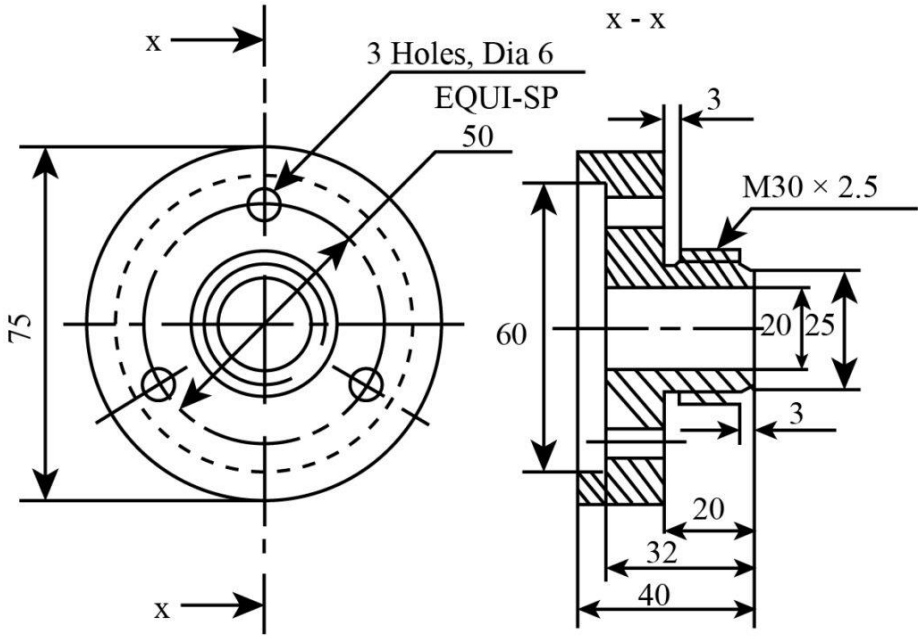


Figure 1.1 Machine drawing

II .Production drawing

Production drawing is a drawing that represents all the dimensions, limits, and tolerances along with their finishing processes like heat treatment, surface finish, drilling, and many others. It also shows the total number of parts in the assembly, the material used, etc. The representation of production drawing is shown as:

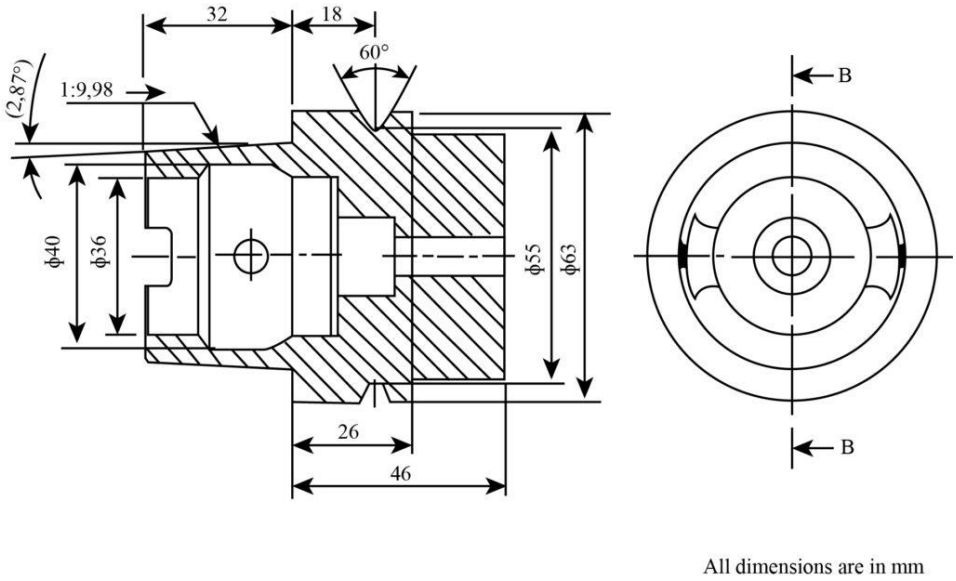


Figure1.2 | Production drawing

III .Part drawing

Part drawing is a detailed drawing of the component that helps in its manufacturing. The part drawing is based on orthographic projections. The representation of the part drawing is shown as:

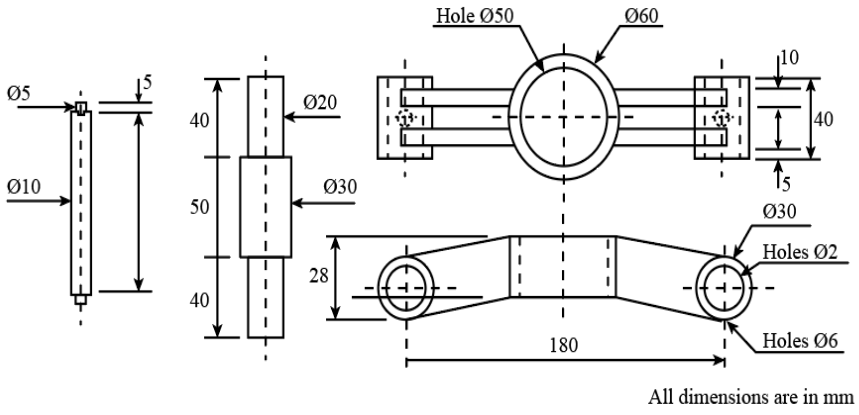


Figure 1.3 Part drawing

IV. Assembly drawing

Assembly drawing is a drawing that shows various parts of a machine in their working locations. It contains dimensions, number of parts, weight, material quantity, and many others.

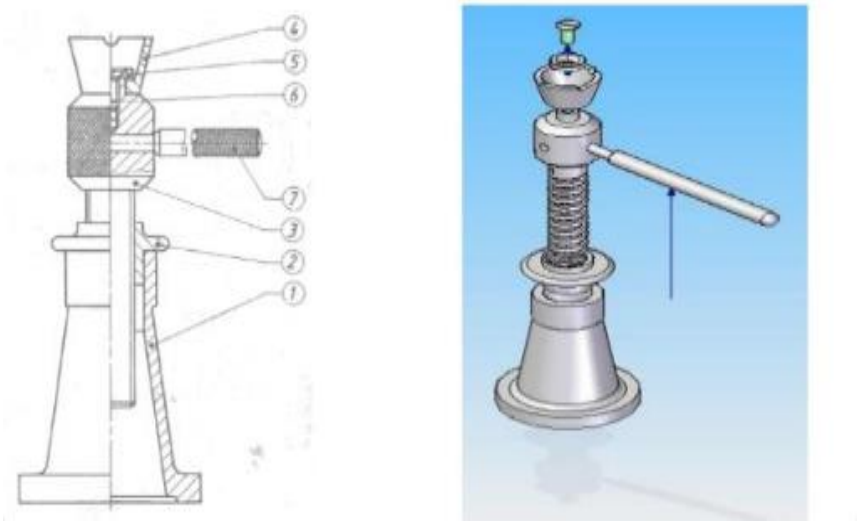


Figure 1.4 Assembly drawing

1.4. Safety Equipment, Guards and Emergency Procedures

1.4.1. Personal Protective Equipment (PPE)

The purpose of Personal Protective Equipment (PPE) is to protect employees from exposure to work place hazards and the risk of injury. Before using or assigning PPE, steps should always be taken to eliminate or control hazards and work procedures should be in place to limit exposure to these hazards. If hazards are not eliminated or controlled and work procedures do not fully protect employees than PPE should be used as a last resort for employee protection.

This section addresses general PPE requirements, including eye and face, head, foot, hand and arm, respiratory, hearing and body protection. In depth safety programs exist for respiratory protection and hearing protection as the need for participation in these programs is established through industrial hygiene monitoring.

Head Protection

Head injuries are commonly caused by impact from falling or flying objects, and falling or walking into hard objects. PPE devices such as hard hats may protect you from objects falling on your head and, in a limited way, from electrical shock or burns. Hard hats

should be worn in areas where there is potential for head injuries.Hardhats must be compliant and rated for the hazards encountered. Hardhats fall into these impact categories:

- Type I Hard Hats-Type I hard hats are intended to reduce the force of impact resulting for a blow only to the top of the head.
- Type II Hard Hats-Type II hard hats are intended to reduce the force of impact resulting from a blow which may be received off center or to the top of the head. A Type II hard hat typically is lined on the inside with thick high density foam. And these electrical classes:
- Class G (General) Class G hard hats are tested at 2200 volts. Class E (Electrical) Helmets-Class E protective helmets are tested at 20,000 volts.
- Class C (Conductive) Helmets-This class provides no electrical insulation.

Eye and Face Protection

Eye and face protection must be worn where there is potential for injury to the eyes or face from small particles, toxic chemicals, flying objects or particles, large objects, thermal or radiation hazards, and lasers. According to the types and extent of hazards, different PPE should be worn. PPE for the face and eyes includes devices such as safety glasses, goggles, and face shields. These must always remain clean and free of contaminants and must be compliant. Note: face shields are a secondary form of protection; safety glasses or goggles must still be worn underneath the face shield. Most sunglasses are not safety glasses. There will be a stamp on all approved eye/face protection.

		
Impact hazards Should provide peripheral protection, Shaded lenses available for optical radiation hazards	Impact hazards Splash protection Shaded lenses available for optical radiation hazards Dust protection Vented and non-vented	Impact hazards Face protection Shaded lenses for optical radiation hazards (welding helmets) Secondary protection (glasses or goggles must still be worn)

Figure 1.5 Eye and Face Protection

Hearing Protection

Exposure to high levels of noise may result in hearing loss. Most hearing loss will take time to develop and will depend on intensity, duration, and how often exposure to noise occurs. Popular types of hearing protection devices include canal caps, earmuffs and earplugs. Employees that work in high noise environments (boiler, compressor rooms etc.) or work with high noise output equipment (saws, trimmers, blowers, etc.) shall protect themselves using one of these devices. A good rule of thumb to keep in mind is that if you have to shout to communicate with a coworker that is just 3 ft. away from you; some type of hearing protection is needed. Please consult the full hearing conversation program for further details. EHSO maybe also contacted at (808) 956-8660 for assistance to evaluate noise levels.

			
Working with high powered equipment such as shop machinery, power tools, or gas powered equipment. Disposable	Working with high powered equipment such as shop machinery, power tools, or gas powered equipment. Reusable	Working with high powered equipment such as shop machinery, power tools, or gas powered equipment. Reusable	Working with high powered equipment such as shop machinery, power tools, or gas powered equipment. Reusable

Figure 1.6 Hearing Protection

Hand Protection

Selecting the proper gloves is very important since it is our hands that are often used to handle hazardous materials. These materials usually consist of caustic or toxic chemicals, biological substances, electrical sources, or extremely cold or hot objects that may irritate or burn your hands. In addition, traumatic injuries such as cuts, sprains and punctures may also occur. With the wide range of hazards, there also exists a wide range of gloves that may be used as PPE. It is important to know that not all gloves are protective against all chemicals and hazards and employees must choose the correct hand protection for the job. Safety Data Sheets will often provide guidance for proper glove selection when using

chemicals. If you need further assistance please contact your supervisor or the EHSO department

		  
General latex, nitrile, neoprene gloves used for minor chemical handling. Protects against contact and splash hazards. Comes in various thicknesses	Coated gloves offer minor splash protection with protection against cuts and abrasions, also adds grip in light oil and dry conditions.	Specialty gloves protect against various trade hazards. Anti-vibration gloves protect against hazards of working with vibrating equipment (trimmers, blowers etc.) Welding gloves protect against thermal hazards. Electrical gloves protect electrical workers when working with electrical equipment.

Figure 1.7 Hand Protection

Foot Protection

Injuries that may occur when the proper footwear is not worn are chemical and heat burns from spills and splashes of acids and caustics, compression injuries, electrical shocks, and slipping. Wearing the proper footwear is therefore, very important when working in areas where physical and chemical hazards are present. Close-toed, heeled shoes must always be worn in laboratory areas where chemicals are present. Foot protection should conform to standards.

Body Protection

Protective clothing, such as lab coats or Tyvek suits should be worn when handling hazardous materials. This will prevent the contamination of skin and clothing. Full Body Harnesses worn as part of a personal fall arrest system protect workers should they suffer from a falls >4’. Other body protection includes heat resistant leather jackets or sleeves for welding or arc flash suits for work around live electrical equipmen

Respiratory Protection

Respirators are used to prevent the exposure to air contaminated with harmful dusts, fogs, fumes, mists, gases, sprays, or vapors. All respirator usage (when required) which includes disposable respirators, air purifying respirators, and air supplied respirators, require annual fit testing and training prior to use. The majority of respirator use for OPF staff will be on a voluntary basis. Please consult the full respiratory protection program for further information.

			
Dust masks- Voluntary use, training on limitations needed. Protects against dusts, fumes, mists, microorganisms	Half Mask Air Purifying- Special training needed, consult with EHSO. Air purifying respirator protects against variety of particulates, vapors, dust, mists, fumes; depends on filter cartridge used	Full Face Air Purifying- Special training needed, consult with EHSO. Same as half- face, but with greater protection factor, and greater protection of eyes and face; depends on filter cartridge used	Self -Contained Breathing Apparatus (SCBA)- Special training needed, consult with EHSO. Self-Contained Breathing Apparatus is a device that provides air in an immediately dangerous to life and health (IDLH) atmosphere

Figure 1.8 Respirators

General guidelines:

- Make sure you have the correct respirator for the job.
- Inspect respirators before each use.
- Shave facial hair and put in dentures (if applicable) to ensure a good
- seal with the facemask.
- If you are working in a dangerous area, have another person present.
- Remember that contaminants can harm the body as well as the respiratory tract; wear protective clothing as appropriate.
- Return to fresh air and remove the respirator in the following conditions:You feel nauseous, dizzy, or ill. You have difficulty breathing. The canister, cartridge, or filter needs to be replaced.
- Properly clean and store all reusable respirators

1.4.2. Machine Guards

Types of Machine Guards

There are several different types of machine guards. Guards are materials that keep workers from having direct contact with moving parts and other dangerous areas of a machine. Some guards also protect workers from shavings, flying shards or metal sparks

created by working machines. Guard design and material will vary from machine to machine and from tool to tool. The most common types of machine guards are:

- Fixed guards
- Interlocking guards
- Adjustable guards
- Self-adjusting guards

Fixed Guards:

Fixed guards are permanently attached to the machine or tool, don't have any moving parts, and can't be moved while the machine is in use. They're most often used to enclose the point of operation, or other hazards that the operator doesn't need to interact with, like fan blades or flywheels. Because fixed guards are permanent features of the machine, they must be disassembled and removed to perform any kind of adjustment or maintenance.

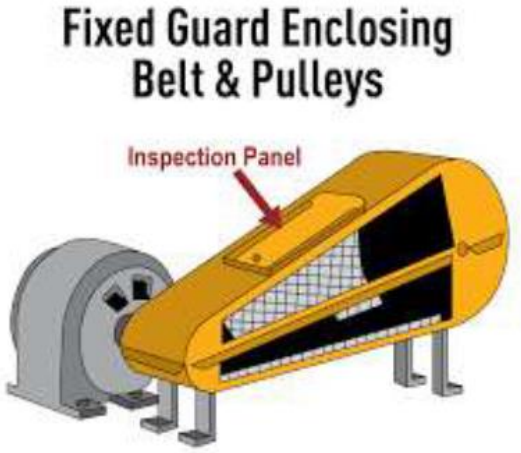


Figure 1.9 Fixed Guards

Adjustable Guards:

Adjustable guards, like fixed guards, are permanent, but they can be adjusted to allow the machine to handle different sizes of material. They must be manually adjusted and locked into place, so all employees who will operate adjustable guards must be trained on their use. If improperly adjusted or locked, adjustable guards can fail to prevent contact with moving parts, causing serious or even fatal injury.



Figure 1.10 Adjustable Guards

Self-Adjusting Guards:

Self-adjusting guards serve the same purpose as adjustable guards, but automatically adapt to the size of the material. When the machine is at rest, these guards sit all the way down. When the machine is in use, the operator feeds material into the machine, which opens the guard just enough to let the material in. These guards are commonly found on table saws and woodworking tools.

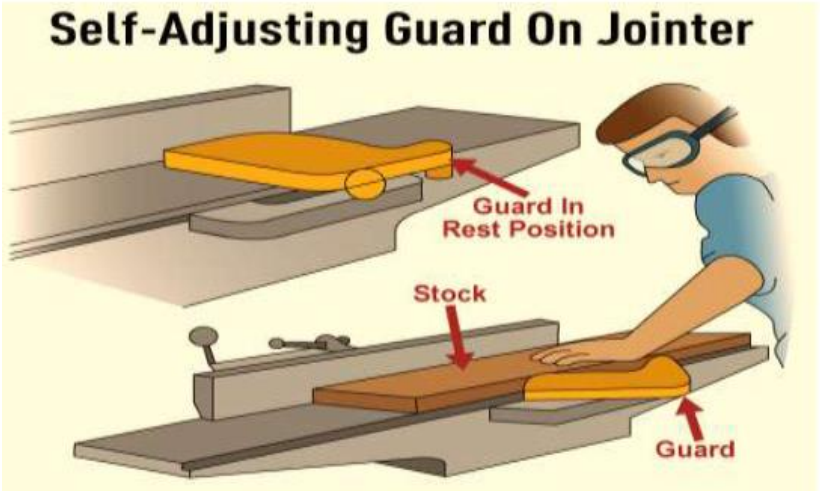


Figure 1. 11 Self-Adjusting Guards

Interlocking Guards:

Interlocking guards, also known as barrier guards, automatically shut off or disengage th power source when the guard is open or removed. These are particularly useful in situations where operators need to be able to open the guard or access the guarded parts of the machine, such as when clearing jams. These guards allow safe access to interior parts of the machine without requiring a total disassembly. However, they can be easy to open on accident and require careful adjustment and maintenance.



Figure 1.12 Interlocking Guards

General Safety Precautions

To avoid potentially life-threatening injury, employees should receive proper training before operating any machines or power tools. Employees must never operate machinery without prior training.

What is a workplace emergency?

A workplace emergency is an unforeseen situation that threatens your employees, customers, or the public; disrupts or shuts down your operations; or causes physical or environmental damage. Emergencies may be natural or manmade and include the following: loads, Hurricanes, Tornadoes, Fires, Toxic gas releases, Chemical spills, Radiological accidents, Explosions, Civil disturbances, and

Risk Management

A risk assessment of the task/machinery/equipment /process should be completed before developing safe work instructions to identify the hazards, associated levels of risk and suitable risk controls; Development Of Safe Work Instructions

- Safe work instructions (SWIs) should be written with sound, hands on experience and knowledge of the tasks;
- It is preferable to include the experience and knowledge of several staff members to enhance the effectiveness of the instructions;
- The manufacturer's user manual provided with the equipment/machinery is a good resource for safety information to include in safe work instructions (SWIs)

Format of Safe Work Instructions

The use of tables, visual diagrams, charts and flow diagrams within the safe work instructions (SWIs) may be helpful in providing a concise and effective reference and training document.

Priorities for the Development of Safe Work Instructions

It is recognized that, in some areas, the preparation of SWIs for all tasks will take some time.

The preparation of SWIs should be prioritized by:

- Firstly preparing SWIs for all existing high hazard processes, tasks or machinery and equipment currently in use, followed by lower hazard tasks and finally all other processes;
- Placing a higher priority on the tasks that are carried out by the tasks carried out most frequently;
- Preparing SWIs for all new processes, tasks or machinery and equipment before they are put into general use.

Safe Work Instructions Should Include

- Referral to the risk assessment, including specific information regarding the hazards and associated risks of the task;
- Precautions to be undertaken before commencing the task;
- The environment where the task should be undertaken;
- Personal protective equipment to be worn while undertaking the task;

- Emergency procedures specific to task and reference personnel;
- Clear instructions for undertaking the task described in a safe manner;
- Specific instructions regarding ways of reducing the risks of the task;
- Instructions to ensure that the area is left safe for others to use;
- Correct waste disposal guidelines.

Safe work instructions should be

- Reviewed, signed and dated by the area supervisor and Safety Officer;
- Displayed prominently in close proximity to the location of the machinery and equipment or where the task is to be performed;
- Listed in an electronic or physical register within the work area or included in the safety manual of the work area. The register should be readily available in each area where the tasks are carried out;

Review of Safe Work Instructions

Safe Work Instructions for current (in use) machinery and equipment, processes or tasks should be reviewed:

- when a process change or modification takes place;
- when the information in a document is found to be inadequate;
- if an incident takes place;
- at least every 3 years.

Safe Work Instructions for out-of-service machinery and equipment, processes or tasks should be reviewed before they return into general use.

Hazards & risks associated with equipment/machinery/technique/process

Hazardous chemicals/radiation/biological materials, sharps to be used, high voltage, swarf produced, speed of operation, possibility of infection/allergy

3. Before you start work:

- Location of further information about the hazards, eg material safety data sheets, radiation safety manual, laboratory safety manual risk assessment documentation;
- Preparation of area, materials, person required before commencing task

The environment where the task is to be undertaken:

Fume cupboard, glove box, local exhaust ventilation, bio-safety cabinet, radiation laboratory

Personal protective equipment to be used:

- Safety glasses/goggles/face shield, protective shoes/rubber boots/waders, gloves, laboratory coat/back-opening gown, safety helmet/hair fasteners/net, ear plugs/muffs, respiratory protection

Emergency procedures

For chemical spill, power outage, explosion Afterhours access procedures

- Specific requirements to perform activities after hours, e.g. prohibit activity, two people in room, buddy system, etc.

8Step by step procedures for task

- Process walk through - may itemise individual tasks
- Use of flow diagrams, charts or other visual diagrams can be helpful

Clean-up procedures Swarf removal, decontamination of glassware, cleaning of benches, storage of used materials, carcass removal.

Waste disposal procedures For chemical/bio hazardous/radioactive waste, broken glassware, wood dust, rags

Self-check 1

PART I: Part I: choose the correct answer from the given alternatives

1. What is the purpose of machine specifications in an industrial setting?
   A. To provide step-by-step instructions for operating the machine
   B. To outline safety guidelines and precautions
   C. To describe the capabilities and technical requirements of the machine
   D. To document maintenance and repair procedures
2. Accurate machine specifications help in:
   A. Selecting the appropriate machine for a specific task
   B. Identifying potential safety hazards in the workplace
   C. Streamlining communication between operators
   D. Monitoring production output in real-time
3. Clear work instructions are important because they:
   A. Ensure compliance with environmental regulations
   B. Facilitate efficient and safe machine operation
   C. Provide guidelines for material purchasing
   D. Specify the required maintenance intervals
4. Incorrect machine specifications can lead to:
   A. Decreased operator productivity
   B. Improved product quality
   C. Enhanced workplace safety
   D. Reduced energy consumption
5. The primary goal of work instructions is to:
   A. Optimize machine performance
   B. Maintain cleanliness in the workspace
   C. Minimize the need for operator training
   D. Standardize the machine operation process

Part II: Part II:- say true if the statement is true say false if the statement is false

1. Machine specifications provide detailed information about the capabilities, features, and technical requirements of a machine.
2. Accurate machine specifications help in selecting the appropriate machine for a specific task or process.
3. Clear work instructions outline step-by-step procedures and guidelines for operating a machine safely and efficiently.
4. Incorrect machine specifications can lead to equipment malfunctions or inefficiencies in the production process.
5. Unclear or missing work instructions can pose safety risks and result in errors or accidents during machine operatio

Unit Two: Investigate Resource Usage

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

- Enterprise Environmental regulations
- Procedures to assessed compliance with environmental regulations.
- . Analyze Current Purchasing Strategies
- Measured and resource record

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

- A play Environmental regulations at work area
- Understood purchasing strategies
- Identify job card and kanbas
- Perform different Measurements
- Record relevant information and data

2.1. Enterprise Environmental Regulations

2.1.1. Enterprise Safety, Health and Environmental Regulations

The prevention of injury and/or illness to site personnel and the public, damage to the Works and to public and private property, protection of the environment, and compliance with applicable laws, are primary objectives of CDR (the Employer). Because of the importance CDR places on meeting these objectives, selected minimum requirements are outlined in these Safety, Health and Environmental Regulations with which Contractors shall comply while working on CDR contracts. Given that these Regulations cannot cover every eventuality, the Contractor shall be expected to exercise good judgment in all such matters, even though not mentioned in these Regulations, and shall take any and all additional measures, as required or necessary, to meet his responsibility for safety, health and environmental matters during the period of the Contract.

CDR and its representatives shall not be held liable for any actions taken by the Contractor that are attributed to following the minimum requirements stated hereinafter.

1.2 The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein:

a) have full regard for the safety of all persons on the Site and keep the Site and the Works in an orderly state appropriate to the avoidance of danger to any person;
b) Know and understand all laws governing his activities along with any site requirements and work site hazards. Such information shall be communicated by the Contractor to his personnel and subcontractors;
c) Take all necessary measures to protect his personnel, the Employer's personnel, other persons, the general public and the environment;
d) Avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of carrying out the Works.
e) Ascertain and comply with any regulations concerning noise, pollution and other nuisance in addition to the obligations imposed by the Conditions of Contract and by law.
f) Take necessary precautions to prevent nuisance from smoke, dust, rubbish, water, polluted effluent and other causes.

Housekeeping

A user of machinery shall provide and maintain sufficient clear and unobstructed space at every machine to enable work to be carried out without danger to persons. An employer shall -

- with the exclusion of workplaces where building work is performed, make at least 2.25 square meters of effective open floor area available for every employee working in an indoor workplace;
- make available and maintain an unimpeded work space for every employee;
- keep every indoor workplace clean, orderly and free of materials, tools and similar things which are not necessary for the work done in such work place;
- keep all floors, walkways, stairs, passages and gangways in a good state of repair, skid-free and free of obstructions, waste or materials;
- keep the roof and walls of every indoor workplace sound and leak-free;
- board over or fence, or enclose with rails or guards, or take other measures which may be necessary under the circumstances to ensure the safety of persons, all openings in floors, all hatchways and all stairways and any open sides of floors or buildings through or from which persons are liable to fall: Provided that such boarding or guarding may be omitted or removed for the time and to the extent necessary for the access of persons or the movement of material; and
- Erect a catch platform or net above an entrance or passageway or above a place where persons work or pass, or fence off the danger area if work is being performed above such entrance, passageway, place or danger area and there is a possibility of persons being struck by falling objects.

No employer shall require or permit any person to, and no person shall, dispose of any article from a high place except by hoist or chute unless arrangements have been made to secure the safety who may be struck by falling objects.

Noise and hearing conservation

This regulation shall apply to all employers (herein referred to as employer) at a workplace where the equivalent noise level (equivalent sound pressure level) resulting

from activities at such workplace, to which any person in such workplace is exposed, is 85 dB (A) or higher.

Subject to the provisions of sub regulations (3) and (4), no employer shall require or permit an employee to work in an environment in which he is exposed to an equivalent noise level equal to 85 dB(A) or higher.

The employer shall reduce the equivalent noise level to below 85 dB(A) or, where this is not reasonably practicable, he shall reduce the level to as low as is reasonably practicable and take all reasonable steps to isolate the source of the noise acoustically.

Where the equivalent noise level in any workplace cannot be reduced to below 85 dB(A), as contemplated in sub regulation (3), the employer shall -

demarcate the boundaries of all noise zones in such workplace by posting up notices to that effect in conspicuous places along such boundaries and at all entrances to and exits from any room where the whole of such room constitutes a noise zone; and prohibit any person from entering a noise zone unless such person wears hearing protectors.

In the case of building work where it is not reasonably practicable to comply with the provisions of subregulation (4)(a) owing to the nature or extent of the premises, the employer shall post up such notices at all exits from and entrances to such premises or where this is not reasonably practicable, display such notices in a conspicuous place as close as possible to the actual workplace or in such place as an inspector may direct.

Whenever an inspector is of the opinion that the employer has omitted or failed to reduce the equivalent noise level in a noise zone to as low as is reasonably practicable or to isolate the source of the noise acoustically, he may require such employer, by notice in writing, to take such further steps as such inspector considers reasonable and practicable for the purpose of conserving the hearing of employees entering or working in such noise zone.

The employer shall provide, free of charge, hearing protectors to each employee who works in or, to any person who is required or permitted to enter a noise zone, and no employer shall require or permit any person to work in or enter such noise zone, and no person shall work in or enter such noise zone, unless he wears such hearing protectors in the correct manner: Provided that where the equivalent noise level to which employees are exposed, is such that the attenuation of the hearing protectors does not reduce the said noise to below 85 dB(A) the employer concerned shall limit the time during which

employees work in that noise zone in such a way that they are not exposed to an equivalent noise level equal to 85 dB(A) or higher.

The hearing protectors which the employer shall provide in terms of sub regulation shall be -

- for the sole use of a specific person: Provided that if an inspector is satisfied that the employer has taken adequate precautionary measures to ensure that the common use of hearing protectors will not result in the spreading of infectious or contagious diseases, he may in writing, authorize the common use of hearing protectors;
- maintained by the employer in an efficient and hygienic condition at all times; and
- stored in a clean, dust-free container provided by the employer when not in use.

The employer shall properly instruct any person who is required to wear hearing protectors in the use of such protectors and inform him of noise zones where the wearing thereof is compulsory.

The employer shall -

- ensure that every employee employed in a noise zone is subjected to audiometric examinations conducted in accordance with section 7 of SABS 083, by an audiometrist approved by the chief inspector;
- keep records of the results of each audiometric examination and make such records available for inspection by an inspector if he so requires; and
- keep such records for a minimum period of 30 years after termination of employment: Provided that if the employer ceases activities all such records shall be forwarded to the regional director.

In order to comply with the provisions of sub regulation the employer shall obtain the services of an approved inspection authority, or an employee whose ability is verified by an approved inspection authority to ensure that noise zones are determined in accordance with section 4

Precautions against flooding

Where a substantial risk exists that a workplace may be flooded, the employer shall take measures to be informed forthwith of any imminent flooding.

Every employer shall take measures to be informed forthwith of any imminent flooding from constructions for conserving water, or which may cause water to converge or accumulate on his premises, and shall, prior to the erection of such a construction, give notice in writing to all persons situated in the danger zone below such construction of the possibility of flooding owing to such construction.

Fire precautions and means of egress

In order to expedite the evacuation of a workplace in case of fire, every employer shall ensure that -

- any emergency escape door from any room or passage or at a staircase shall, as far as is practicable, be hung so as to open outwards;
- every door of a room in which persons may be present, and every door of a passage or at a staircase serving as a means of exit from such room, shall be kept clear and capable of being easily and rapidly opened from inside so as to ensure quick and easy evacuation;
- the provisions of paragraphs (a) and (b) shall also be complied with in respect of the outer escape exit from the workplace;
- staircases and steps leading from one floor to another or to the ground shall be provided with substantial hand-rails;
- staircases intended to be used as fire escapes shall -
    - be constructed of non-combustible material;
    - be kept clear of any material or other obstruction; and
    - not terminate in an enclosed area;

staircases, passages and exits intended for escape purposes shall be of a width and of a gradient which will facilitate the quick and safe egress of the number of persons intended to make use of them; and having regard to the size, construction and location of a workplace, the number of persons, and the activity therein, such workplace is provided with at least two means of egress situated as far apart as is practicable.

Having regard to the size, construction and location of the workplace, and the amount and type of flammable articles uses, handled or stored on the premises, an employer shall provide on the premises an adequate supply of suitable fire-fighting equipment at

strategic locations or as may be recommended by the fire chief of the local authority concerned, and such equipment shall be maintained in good working order.

Offences and penalties

10. Any person who contravenes or fails to comply with any provision of regulation shall be guilty of an offence and liable on conviction to a fine not exceeding R1 000 or to imprisonment for a period not exceeding six months and, in the case of a continuous offence, to an additional fine of R5 for each day on which the offence continues or to additional imprisonment of one day for each day on which the offence continues: Provided that the period of such additional imprisonment shall in no case exceed 90 days.

These regulations shall be called the Environmental Regulations for Workplaces,

2.1.1 Federal, State and Local Government Laws And Regulations.

Legislation

- What is an act? An act is a written law passed by Parliament.
- What is a regulation? A regulation is a rule or directive made and maintained by an authority.
- Rules designed to control or govern conduct.
- What is a code of practice? A code of practice is a set of rules or standards which have been designed in accordance with legislation and regulations, and are enforced by local government agencies.
- Is also written guidelines issued by an official body setting out recommended or preferred processes, actions or organizational structures to be applied in a given setting.

Law - legislation passed by governments which is enforceable by courts. Best practice - methods and techniques that have consistently shown superior results which are used as benchmarks .

meeting relevant laws, by-laws and regulations or best practice to support compliance in environmental performance and sustainability at each level as required (such as Environmental Protection or Biodiversity Conservation Act):

- international
- local government
- industry
- organization

2.2. Procedures to assessed compliance with environmental regulations

The Contractor shall comply with the requirements of these Safety, Health and Environmental Regulations and all other applicable regulations or requirements under Lebanese laws, laid down by relevant authorities or issued by the Employer or the Engineer concerning safety, health and the environment, in force or introduced or issued from time to time during the period of the Contract.

In so far as these Regulations are applicable, they shall apply to sites and personnel outside the Site associated with the performance of the Contract.

2.2 The Regulations equally apply to subcontractors and all other parties engaged by the Contractor and their personnel. The Contractor shall ensure all such parties are fully aware of and comply with the Regulations.

2.3 The Contractor shall comply with all notifications and written or verbal instruction regarding safety issued pursuant to these Regulations by the Employer, Engineer or relevant authorities within the time specified in the notification or instruction.

Whenever the Contractor is required to obtain the approval, agreement, permission, etc of the Engineer, such approval, agreement, permission, etc shall not relieve the Contractor of his responsibilities and obligations under these Regulations or the Contract.

2.4 The Contractor shall adopt a positive approach, awareness and responsibility towards safety, health and the environment, and take appropriate action, by:

(a) ensuring the Regulations are enforced and followed by the Contractor's personnel. Any failure by the Contractor's personnel to follow the Regulations, shall be regarded as a failure by the Contractor.

(b) paying attention to possible injury to unauthorized persons entering the site, particularly children.

2.5 Whenever in these Regulations the Contractor is required to provide test certificates for equipment and personnel or to comply the relevant authorities' requirements and no independent test facilities are available or no relevant authorities exist in Lebanon, the Contractor shall provide:

a) in lieu of independent test certificates:

- for equipment - details of the tests and the date of the tests that have been carried out by the Contractor and a written statement that the Contractor has satisfied himself that the item of equipment is fit and safe for use;

2.3. Analyze Current Purchasing Strategies

Analyzing current purchasing strategies involves evaluating and understanding how an organization approaches its procurement processes and identifying areas for improvement. Here are some steps you can take to analyze current purchasing strategies:

1. Review existing purchasing documentation: Start by examining any existing purchasing policies, procedures, and guidelines that are in place. This includes reviewing contracts, purchase orders, vendor agreements, and any other relevant documents. Understand the current processes, roles, and responsibilities involved in purchasing.
2. Gather data: Collect data related to purchasing activities, such as purchase history, spending patterns, supplier performance, lead times, and pricing information. This data can be obtained from your organization's financial records, procurement systems, and supplier databases.
3. Identify key performance indicators (KPIs): Determine the KPIs that are important for evaluating the effectiveness of your purchasing strategies. Common KPIs include cost savings, supplier performance, on-time delivery, inventory levels, and contract compliance. Set benchmarks or targets for each KPI to serve as a basis for comparison.

4. Evaluate supplier relationships: Assess the relationships with your current suppliers. Consider factors such as their reliability, quality of products or services, pricing competitiveness, and responsiveness to your organization's needs. Determine if there are any areas for improvement or if alternative suppliers should be considered.
5. Conduct a SWOT analysis: Perform a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis specific to your purchasing strategies. Identify the strengths and weaknesses of your current approaches, as well as any opportunities for improvement or potential risks or threats that may impact your purchasing function.

6. Seek feedback from stakeholders: Engage with internal stakeholders involved in the purchasing process, such as end-users, department heads, and finance teams. Understand

their perspectives, challenges, and requirements. Solicit feedback on the current purchasing strategies and any areas they believe could be improved.

7. Benchmark against industry best practices: Research and benchmark your purchasing strategies against industry best practices. Look for case studies, industry reports, and success stories to gain insights into innovative approaches and strategies that are being used by leading organizations in your industry.

8. Identify improvement opportunities: Based on the findings from the previous steps, identify specific areas where your purchasing strategies can be enhanced. This may include optimizing supplier selection and negotiation processes, streamlining procurement workflows, implementing technology solutions, or improving contract management practices.

9. Develop an action plan: Create an action plan that outlines the recommended improvements and initiatives to enhance your purchasing strategies. Prioritize the initiatives based on their potential impact and feasibility. Define clear objectives, timelines, and responsibilities for each initiative.

10. Monitor and measure progress: Implement the recommended improvements and continuously monitor and measure the progress against the defined KPIs. Regularly assess the effectiveness of the updated purchasing strategies and make adjustments as needed.

Remember that analyzing current purchasing strategies is an ongoing process. It requires regular monitoring, evaluation, and adaptation to ensure continuous improvement and alignment with organizational goals and objectives. Certainly! Here are some examples of industry best practices for purchasing strategies:

1. Strategic Sourcing: Adopt a strategic sourcing approach that involves analyzing spend data, identifying cost-saving opportunities, and developing long-term relationships with key suppliers. This practice focuses on leveraging purchasing power, optimizing the supply base, and achieving overall cost reduction while maintaining quality.

2. Supplier Relationship Management: Establish and nurture strong relationships with suppliers. This includes regular communication, performance evaluations, and collaboration to drive continuous improvement. Engaging in strategic partnerships with suppliers can lead to better pricing, improved quality, and increased innovation.

3. Vendor Evaluation and Selection: Implement a robust vendor evaluation and selection process. This includes conducting thorough due diligence, assessing factors such as

financial stability, capabilities, quality assurance, reliability, and ethical practices. Utilize supplier scorecards or evaluation frameworks to objectively assess potential suppliers.

4. Supplier Diversity: Promote supplier diversity by actively seeking and engaging with vendors from diverse backgrounds, including minority-owned, women-owned, and small businesses. Supplier diversity programs can foster innovation, drive economic growth, and contribute to a more inclusive supply chain.

5. Contract Management: Establish effective contract management practices to ensure compliance, mitigate risks, and optimize supplier performance. This includes clearly defining contract terms, monitoring contract milestones, implementing contract tracking systems, and establishing mechanisms for dispute resolution.

6. Continuous Improvement: Foster a culture of continuous improvement within the purchasing function. Encourage feedback from stakeholders, regularly evaluate processes, and seek opportunities for streamlining and enhancing efficiency. Embrace technology solutions, such as e-procurement systems or automation tools, to streamline workflows and reduce manual effort.

7. Risk Management: Proactively identify and mitigate risks associated with the supply chain. Develop risk management strategies to address potential disruptions, such as supplier failures, natural disasters, or geopolitical events. Diversify supplier sources and maintain contingency plans to ensure business continuity.

8. Data-Driven Decision Making: Leverage data analytics to drive informed purchasing decisions. Utilize spend analysis tools to identify cost-saving opportunities, monitor supplier performance, and optimize procurement processes. Data-driven insights can lead to improved negotiations, better contract terms, and enhanced overall purchasing effectiveness.

9. Sustainability and Corporate Social Responsibility (CSR): Integrate sustainability and CSR principles into purchasing strategies. Consider environmental impacts, social responsibility, and ethical sourcing practices when selecting suppliers. Engage with suppliers that align with your organization's sustainability goals and actively promote responsible sourcing.

10. Collaboration and Cross-Functional Alignment: Foster collaboration and cross-functional alignment between purchasing, finance, operations, and other relevant departments. Promote communication, share information, and involve stakeholders in the

decision-making process. This collaborative approach ensures that purchasing strategies are aligned with overall business objectives.

These are just a few examples of industry best practices for purchasing strategies. The specific best practices that are most relevant will depend on the nature of your organization, industry, and procurement requirements.

2.4. Measure Current Resource

Once you have identified the resources used, you will need to calculate a usage rate. This will provide a basis for tracking and monitoring your progress towards becoming more efficient. Some resource usage may be readily available by reviewing supplier invoices. Current water and electricity bills provide usage rates that can easily be compared over time. To determine your organization's current resource use, you will need to conduct an assessment. Firstly, you will need to determine what resource usage you are going to look at.

The next step is to determine how you will measure the resources use. You can either:

- Conduct a desktop assessment
- Conduct a physical assessment.

A desktop assessment will involve reviewing reports and records

You will need to determine which records can provide you with the information needed to determine energy usage. The records needed may include:

- Purchasing logs.
- Receipts.

Water or energy bills.

- Waste bills.
- Equipment lists and specifications.

A physical assessment will involve physically counting items or observing employees. You may want to undertake a workplace inspection.

Appropriate techniques to resource usage include:

- examining and documenting resources in work area
- examining invoices from suppliers
- examining relevant information and data

- measuring resource usage under different conditions
- reports from other parties involved in the process of identifying and implementing improvements

Resource Use, Waste Generation and Efficiency Profile

The purpose of establishing your resource use, waste generation and efficiency profile is to collect and analyze baseline data for your premises. This baseline data can then be used to identify an appropriate efficiency indicator and track your progress as you implement your environmental strategies.

There are five steps in the process

Step 1 – Collect data

Step 2 – Analyze data

Step 3 – Establish a baseline period

Step 4 – Identify activities

Step 5 – Estimate resource use and waste generation for the key activities.

Step 1 – Collect Data

To undertake this assessment, you need to collect the following information:

- The quantity of resources used by type
- The quantity of production or activity at the site by type
- The quantity of waste generated by type
- The quantity of greenhouse gas emissions associated with each input and output
- If possible, a separation or estimation of the amount of water used for fire testing.

Where possible, this data should be collected over a 2-year period and recorded on a monthly basis. Having monthly data collected over this timeframe will help you identify seasonal trends.

Step 2 – Analyze Data

Look for patterns in your data and consider the seasonal aspects that affect your resource use or waste generation. If your data allows, look for variations within weeks to identify trends on a weekly basis as well as on a monthly basis.

Compare the resource consumption and waste generation to your business activities. Some industries have resource efficiency indicators that are already set.

Step 3 – Establish a Baseline Period

Using the information collected, you will need to establish baseline data. This is the data you will use to evaluate your improvements against. The data you use should be current (i.e. no more than 2 years old) and contain at least 12 months data.

The baseline data needs to be reviewed against your 2-year period data. You need to determine if it represents a typical year at your workplace. If not, you should indicatewhy and estimate what a typical year will look like.

Step 4 – Identify Activities

When analyzing your data, it is preferable to divide it by activities at your workplace rather than departments or sections.

Use of resources and the waste generated is usually relevant to particular activities so this will give you more accurate information to work with. You will need to start by listing all the common activities.

Step 5 – Estimate Resource Use and Waste Generation for Key Activities

As the use of resources and the wastes generated are often inter-related, you should firstly undertake an integrated mass and energy balance for the whole site.

When estimating the resource use and waste generation for each activity, remember these key principles:

- Sum (individual activity resources/wastes) = Total resource/wastes
- Sum (inputs) = sum (outputs)

2.3.1 Plant meters and gauges

Gauges are instruments or devices used to measure and display various types of data or information. They are commonly used in a wide range of applications, including automotive, industrial, and scientific fields. Gauges are designed to provide visual or numerical representations of measurements, allowing users to monitor and interpret the data easily.

There are different types of gauges available, each tailored to measure specific parameters. Here are a few common types:

1. Pressure Gauges: Pressure gauges are used to measure the pressure of gases or liquids. They typically consist of a dial or digital display and a sensing element that converts pressure into a mechanical or electrical signal.
2. Temperature Gauges: Temperature gauges are used to measure the temperature of a substance or environment. They can employ various principles, such as expansion of a liquid or gas, electrical resistance, or infrared technology, to measure temperature.
3. Speedometers: Speedometers are gauges found in vehicles that measure and display the speed at which the vehicle is traveling. They usually have a dial or digital display with units in miles per hour (mph) or kilometers per hour (km/h).
4. Fuel Gauges: Fuel gauges are commonly found in vehicles and are used to indicate the amount of fuel in the fuel tank. They typically have a dial or digital display that shows the fuel level in terms of a percentage or volume.
5. Voltmeters and Ammeters: Voltmeters measure electrical voltage, while ammeters measure electrical current. They are essential tools for electrical testing and troubleshooting and are used in various electrical systems and circuits.
6. Depth Gauges: Depth gauges are used to measure the depth or height of a particular object or substance. They are often used in applications such as carpentry, machining, and surveying.
7. Tachometers: Tachometers are gauges used to measure the rotational speed of an engine or other rotating machinery. They are commonly found in vehicles, industrial equipment, and power tools.

These are just a few examples of the many types of gauges available. Gauges play a crucial role in monitoring and controlling various parameters in different fields, allowing users to make informed decisions and maintain optimal conditions.

2.3.2 Job cards kanbans

A job card, also known as a work order or job order, is a document used to track and manage tasks or assignments within a business or organization. Its purpose is to provide a detailed description of a specific job, task, or project and to facilitate its completion in a structured and organized manner.

The main objectives of a job card are as follows:

1. Task Definition: A job card clearly outlines the nature of the job, including its scope, objectives, and requirements. It provides essential information about what needs to be done, such as the task description, specifications, and any relevant instructions or guidelines.
2. Assignment and Tracking: Job cards are used to assign tasks to individuals or teams, ensuring that responsibilities are clearly defined and delegated. They serve as a reference point for tracking the progress of the job, allowing supervisors or managers to monitor its status and make informed decisions.
3. Resource Allocation: Job cards often include information about the resources required to complete the job, such as materials, equipment, or personnel. By specifying these requirements in advance, job cards help facilitate resource planning, procurement, and allocation.
4. Time Management: Job cards typically include timelines and deadlines for task completion. They enable effective time management by establishing clear expectations and priorities, allowing individuals or teams to prioritize their work and allocate time appropriately.
5. Documentation and Record-Keeping: Job cards serve as a documentation tool, providing a record of the tasks performed, resources utilized, and outcomes achieved. They can be used for future reference, performance evaluations, or audits, ensuring accountability and maintaining an organized record of job-related activities.

Overall, job cards streamline the workflow, enhance communication, and improve efficiency by providing a structured framework for managing and executing tasks within an organization.

[Any additional notes, comments, or observations related to the job]

This is a general structure, and the specific details and sections may vary depending on the organization and the nature of the job. The job card can be in a digital or physical

format, and it's often shared among the relevant stakeholders involved in the job's execution.

Kanbans cared

A kanban board is a visual tool used for managing and organizing work in a project management context. It provides a visual representation of tasks, their statuses, and the flow of work within a project. Kanban boards originated from the lean manufacturing principles of the Toyota Production System and have been adapted for various industries, including software development, marketing, and other knowledge-based work.

Typically, a kanban board consists of columns representing different stages or statuses of work, such as "To Do," "In Progress," and "Done." Tasks or work items are represented as cards or sticky notes, which are moved across the columns as they progress through the workflow. This visual representation allows team members to have a shared understanding of the project's progress, identify bottlenecks, and collaborate effectively.

Here are some key benefits of using a kanban board in project management:

1. Visualize workflow: Kanban boards provide a clear visual representation of the work process, making it easier to understand the status of each task and the overall flow of work.
2. Limit work in progress (WIP): Kanban emphasizes limiting the number of tasks in progress at any given time, reducing multitasking and improving focus. This helps prevent overloading team members and improves overall productivity.
3. Enhance transparency and collaboration: By providing a shared view of tasks and their status, kanban boards promote transparency and enable better collaboration among team members. Everyone can see what tasks are assigned to whom, what stage they are in, and what tasks are upcoming or blocked.
4. Identify bottlenecks and optimize workflow: Visualizing the flow of work allows teams to identify bottlenecks and areas where work is getting stuck. This enables them to take corrective actions, redistribute tasks, or improve the process to optimize workflow and increase efficiency.
5. Continuous improvement: Kanban encourages a culture of continuous improvement by regularly reviewing and refining the process. Teams can analyze their performance metrics, such as cycle time and throughput, and make adjustments to enhance their productivity and delivery speed.

Overall, kanban boards provide a practical and flexible approach to project management, enabling teams to visualize work, collaborate effectively, and continuously improve their processes.

2.3.2 Record and file documentation

Organizations record information, create documents and file them for future use as part of daily business activity. Filing can be one of the most frustrating jobs for any employee, but when it is done in a structured way it can be done quickly and save a lot of time when a document is required in the future. You need to select the most appropriate method for recording information based on what you are recording, the nature of your organization and any particular procedures and guidelines that already exist. You need to ensure you familiarize yourself with your organization's requirements.



Figure 2.1 Record and file documentation

- **Why record and file documents?**

The previous section explained the importance of measuring resource usage.

This is because it helps provide information on how effectively an environmental initiative has reduced resource usage, identifies opportunities for improvement and helps us understand any cost savings.

It is important that this data is recorded and filed for future access. Some reasons for this are listed below.

Compliance

There may be workplace policies and procedures in place that require this data to be collected and stored for a period of time.

Often these procedures are to support legal requirements, so it is important that the records are kept and stored for audit purposes

Record usage

How often you collect resource usage data will depend on the type of document you use to record your information.

Generally, if you are collecting data regularly, it is most useful to record that data in a database format, whether in a spreadsheet or a database.

It is helpful, though not necessary, to name date columns with numbers, rather than text, as this helps keep them in order in some applications. For example, if you sorted months alphabetically your list would start with April, August, December – and end with September. Putting the year before the month means that it is easier to compare the same month in different years without confusion.

How you structure your table will depend on how you wish to present your data.

For future analysis, it is helpful to keep one master table that summarizes the key information and then select different fields to create any graphs or diagrams. If data is stored in several places, it's much harder to analyses results.

File documents

Documents are filed so that they can be easily accessed at a future date, whether for further business use or for legal compliance requirements. Filing can be done either electronically or in hard copy. Files are increasingly being stored electronically, as this is much simpler for organizations to manage and it is easier to control access.

Self-Check 2

Part I: Choose the correct Answer from the following Alternative

1. Which government agency is responsible for enforcing environmental regulations in machine shops?
   a) Environmental Protection Agency (EPA)
   b) Occupational Safety and Health Administration (OSHA)
   c) Department of Transportation (DOT)
   d) Food and Drug Administration (FDA)
2. Which of the following is a common environmental regulation in machine shops?
   a) Proper disposal of hazardous waste
   b) Maximum noise levels in the workplace
   c) Minimum temperature requirements
   d) Mandatory use of biodegradable lubricants
3. What is the purpose of implementing machine coolant management practices in compliance with environmental regulations?
   a) To reduce the risk of fires in the machine shop
   b) To ensure the safety of machine operators
   c) To minimize the environmental impact of coolant waste
   d) To improve machine performance and productivity
4. Which of the following is an example of an environmental regulation related to air quality in machine shops?
   a) Proper ventilation and exhaust systems
   b) Regular calibration of machine tools
   c) Training on proper lifting techniques
   d) Mandatory use of personal protective equipment (PPE)
5. Why is it important for machine shops to comply with environmental regulations?
   a) To avoid legal penalties and fines
   b) To maintain a positive public image
   c) To protect the health and safety of employees
   d) All of the above

Part II: Write True if the Sentence is correct and Write False if it is Incorrect

1. Recording relevant information and data in a machine shop is essential for maintaining accurate production records and tracking performance metrics.

2. The recording of data in a machine shop is only necessary for compliance purposes and does not contribute to process improvement or optimization.
3. Recording information such as machine settings, tooling parameters, and material specifications helps ensure consistency and repeatability in machining operations.
4. The recorded data in a machine shop should include details of any deviations or anomalies encountered during the machining process to aid in troubleshooting and root cause analysis.
5. Effective recording and documentation practices in a machine shop are crucial for quality control, traceability, and meeting customer requirements.

Unit three: Pre-Start processes

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

- Program operational maintenance.
- Pre-start .machine processes
- equipment, raw material and tools
- Plan and schedule machining processes.

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

- prepare maintenance program
- Checking machining processes
- Identify types of equipment, raw material and tools
- Prepare Plan and schedule machining processes.

3.1. Program Operational maintenance

Operational maintenance refers to the ongoing activities and processes aimed at ensuring the efficient and reliable operation of equipment, machinery, or systems. It involves regular inspections, preventive maintenance, troubleshooting, repairs, and other tasks performed to keep equipment in optimal working condition. Here are a few key aspects related to operational maintenance:

Preventive Maintenance: This involves scheduled inspections, cleaning, lubrication, adjustments, and component replacements to prevent equipment failures and extend its lifespan. Preventive maintenance tasks are typically based on equipment manufacturers' recommendations or industry best practices.

Corrective Maintenance: When equipment malfunctions or fails, corrective maintenance is performed to identify and fix the problem. This includes troubleshooting, diagnosis, repair, and restoration of equipment to its normal operating condition.

Predictive Maintenance: Predictive maintenance uses techniques such as condition monitoring, data analysis, and predictive modeling to anticipate and detect potential equipment failures. By analyzing equipment performance data, organizations can schedule maintenance activities proactively, reducing unplanned downtime and optimizing maintenance resources.

Equipment Inspections: Regular inspections are conducted to assess the condition, performance, and safety of equipment. Inspections may involve visual checks, measurements, non-destructive testing, or other techniques to identify any signs of wear, damage, or potential issues that require attention.

Spare Parts Management: An effective operational maintenance strategy includes managing an inventory of critical spare parts. This involves identifying essential components, establishing reorder points, tracking usage, and ensuring timely availability of spare parts to minimize equipment downtime.

Work Order Management: Work orders are used to document and track maintenance tasks. A well-organized work order management system helps prioritize and assign maintenance tasks, track progress, record labor and material costs, and maintain a historical record of maintenance activities.

Training and Skills Development: Providing adequate training and development opportunities for maintenance personnel is essential. This ensures they have the necessary

skills and knowledge to perform maintenance tasks effectively and safely, and to stay updated with emerging technologies and best practices.

Performance Metrics and Continuous Improvement: Establishing performance metrics, such as equipment uptime, mean time between failures (MTBF), or maintenance costs, helps monitor the effectiveness of operational maintenance efforts. Regularly analyzing these metrics and implementing continuous improvement initiatives can optimize maintenance processes and drive efficiency.

By implementing a comprehensive operational maintenance program, organizations can minimize equipment downtime, improve reliability, reduce costs, and ensure the smooth operation of critical assets.

There are several common performance metrics that organizations use to evaluate the effectiveness of their operational maintenance efforts. These metrics provide insights into the reliability, efficiency, and cost-effectiveness of maintenance activities. Here are some examples:

Equipment Uptime: Equipment uptime is a fundamental metric that measures the amount of time equipment is available and operational within a specified period. It indicates how well maintenance activities are preventing unplanned downtime and ensuring continuous operation.

Mean Time Between Failures (MTBF): MTBF calculates the average time between equipment failures. A higher MTBF indicates longer intervals between failures, demonstrating improved reliability and effectiveness of maintenance activities.

Mean Time to Repair (MTTR): MTTR measures the average time required to repair equipment after a failure occurs. A lower MTTR suggests quicker response and resolution of equipment failures, minimizing downtime and improving operational efficiency.

Overall Equipment Effectiveness (OEE): OEE is a comprehensive metric that assesses equipment performance by measuring availability, performance efficiency, and quality. It provides a holistic view of how well equipment is utilized and highlights areas for improvement.

Maintenance Cost: Maintenance cost metrics evaluate the financial impact of maintenance activities. This includes costs associated with labor, spare parts, tools, and

any external services. Monitoring maintenance costs helps identify opportunities for cost optimization and efficiency.

Planned Maintenance Percentage: This metric represents the percentage of maintenance activities that were planned in advance versus reactive or unplanned maintenance. A higher planned maintenance percentage indicates a more proactive maintenance approach, reducing the likelihood of unexpected equipment failures.

Backlog of Maintenance Work Orders: The backlog metric measures the number of pending maintenance work orders at a given time. It reflects the workload and capacity of the maintenance team and helps identify bottlenecks or resource constraints that may impact maintenance effectiveness.

Schedule Compliance: Schedule compliance measures the percentage of maintenance tasks that are completed within the planned timeframe. It reflects the ability to adhere to maintenance schedules and helps identify areas where improvements in planning or execution are needed.

Safety Metrics: Safety metrics evaluate the effectiveness of maintenance efforts in maintaining a safe working environment. This may include metrics such as the number of safety incidents, near misses, or compliance with safety procedures during maintenance activities.

Energy Efficiency: Energy efficiency metrics assess the energy consumption of equipment or systems before and after maintenance activities. They help identify opportunities to optimize energy usage, reduce costs, and improve sustainability.

It's important to note that the selection of performance metrics should align with the organization's goals, context, and industry standards. By monitoring and analyzing these metrics, organizations can identify areas for improvement, make data-driven decisions, and optimize their operational maintenance efforts.

There are several industry standards and frameworks that provide guidance on performance metrics for operational maintenance. Here are some commonly referenced standards

ISO 55000: ISO 55000 is an international standard for asset management that provides a framework for organizations to establish and maintain their asset management systems. It emphasizes the use of performance metrics to evaluate asset management effectiveness, including maintenance performance.

SMRP Metrics: The Society for Maintenance and Reliability Professionals (SMRP) has developed a set of maintenance and reliability metrics that are widely used in the industry. These metrics cover various aspects such as maintenance costs, equipment reliability, workforce effectiveness, and planning and scheduling performance.

Key Performance Indicators (KPIs) for Maintenance: Various organizations and industry experts have identified key performance indicators specific to maintenance operations. These KPIs may include metrics like equipment availability, maintenance backlog, mean time between failures (MTBF), mean time to repair (MTTR), planned maintenance percentage, and others.

4Maintenance Maturity Models: Maintenance maturity models, such as the Maintenance Excellence (MEX) Model or the Maintenance Management Maturity Matrix (M3), provide a framework for assessing and improving maintenance practices. These models often include performance metrics as part of the assessment process to measure maturity levels and identify areas for improvement.

Reliability Centered Maintenance (RCM): RCM is a methodology that focuses on optimizing maintenance strategies for critical assets. It emphasizes the use of metrics like failure rate, reliability, maintainability, and risk levels to support decision-making in maintenance planning and optimization.

Total Productive Maintenance (TPM): TPM is a holistic approach to maintenance that aims to maximize the productivity of equipment and processes. TPM often includes metrics such as overall equipment effectiveness (OEE), mean time between failures (MTBF), and mean time to repair (MTTR) to assess equipment performance and maintenance effectiveness.

When selecting industry standards for performance metrics, it is important to consider the specific needs, goals, and context of your organization. These standards can serve as valuable references and provide a starting point for defining and implementing performance metrics that align with your organization's objectives and industry best practices.

3.2. Pre- start machine processes

Before starting machine operations, it is crucial to follow a series of steps to ensure safety, proper setup, and efficient operation. While specific steps may vary depending on the type of machine and industry, here are some general steps to consider:

Read and Understand the Manual: Familiarize yourself with the machine's operation and safety instructions by thoroughly reading the manufacturer's manual. Pay attention to warnings, precautions, and recommended operating procedures.

Wear Personal Protective Equipment (PPE): Put on the appropriate personal protective equipment for the specific machine and task. This may include safety glasses, ear protection, gloves, and any other necessary equipment to protect against hazards like flying debris, noise, or chemicals.

Conduct a Pre-Startup Inspection: Inspect the machine for any signs of damage, wear, or malfunction. Check for loose or missing parts, leaks, frayed cables, or any other potential issues that could affect the safe operation of the machine. Ensure that all safety guards and devices are in place and functioning correctly.

Clear the Work Area: Remove any unnecessary items or debris from the work area. Ensure that the space around the machine is clean and organized to prevent tripping hazards and interference during operation.

Secure the Workpiece: If applicable, properly secure the workpiece in the machine's holding or clamping mechanism. Ensure that it is firmly positioned and will not move or shift during operation.

Set Up Machine Parameters: Set up the machine's parameters, such as speed, feed rate, depth of cut, or any other relevant settings, based on the requirements of the specific task and material being worked on. Refer to the machine manual or work instructions for guidance.

Check Tooling and Tool Conditions: Inspect the cutting tools or tooling being used for sharpness, wear, or damage. Replace or re-sharpen tools as necessary to ensure optimal cutting performance and prevent accidents or poor quality results.

Verify Power and Utilities: Ensure that the machine is properly connected to a reliable power source and that all necessary utilities (such as compressed air or coolant) are available and functioning correctly.

Test Run and Warm-Up: Before performing actual production or machining, conduct a test run or warm-up cycle to ensure that the machine is operating smoothly and all components are functioning as intended.

Confirm Safety Measures: Double-check that emergency stop buttons, safety interlocks, or other safety features are in proper working order and easily accessible in case of an emergency.

Communicate and Clear the Area: Inform nearby workers or colleagues about the upcoming machine operation, and make sure they are at a safe distance from the machine. Remove any unnecessary personnel from the immediate vicinity of the machine.

Start the Machine: Once all necessary preparations and checks have been completed, follow the machine's startup procedure as outlined in the manual or per standard operating procedures. Observe the machine's initial operation to ensure everything is functioning correctly.

Remember, these steps are general guidelines and may need to be adjusted or expanded based on the specific machine, industry, and safety regulations in your workplace. Always prioritize safety and consult the machine's manual and relevant guidelines for detailed instructions specific to the machine you are operating.

Certainly! Here are some more specific steps for setting up machine parameters:

Identify the Material and Operation: Determine the type of material you will be working with (e.g., metal, wood, plastic) and the specific machining operation you will be performing (e.g., milling, turning, drilling).

Refer to Guidelines: Consult the machine's manual, work instructions, or industry guidelines for recommended parameters based on the material and operation. These guidelines may provide suggested cutting speeds, feed rates, tooling recommendations, and other relevant information.

Determine Cutting Speed: The cutting speed refers to the speed at which the cutting tool or workpiece moves relative to each other. It is usually specified in surface feet per minute (SFPM) or meters per minute (m/min). Refer to guidelines to determine the appropriate cutting speed for your material and tooling.

Calculate Feed Rate: The feed rate is the speed at which the cutting tool advances through the material. It is typically specified in inches per minute (IPM) or millimeters per minute (mm/min). Use the recommended feed rate for your material and tooling, taking into account factors such as tool diameter, number of cutting edges, and desired chip load.

Set Depth of Cut: Determine the desired depth of cut, which is the amount of material removed by each pass of the cutting tool. It is usually specified in inches (or millimeters) and can depend on factors such as the material's hardness, machine stability, and tooling capabilities. Ensure that the depth of cut is within the machine's capacity and the tool's capabilities.

Consider Coolant or Lubrication: Depending on the machining operation and material, coolant or lubrication may be necessary to improve cutting performance, chip evacuation, and tool life. Consult the guidelines to determine if coolant or lubrication is recommended, and set up the necessary systems accordingly.

Adjust Tooling: Install the appropriate cutting tool or tooling based on the material and operation. Ensure that the tool is properly secured and aligned in the machine's tool holder or spindle.

Enter Parameters into Machine Control: Using the machine's control panel or interface, input the determined cutting speed, feed rate, depth of cut, and any other relevant parameters. Follow the machine's specific instructions for entering and confirming the parameters.

Validate Setup: Before starting actual production, perform a trial run or test cuts to validate the setup. Monitor the machine's performance, observe the quality of the machining process, and make any necessary adjustments to the parameters if needed.

Document Parameters: Maintain a record of the machine parameters used for each setup. This documentation can serve as a reference for future operations or troubleshooting.

It's important to note that these steps are general guidelines, and the specific setup steps may vary depending on the machine type, control system, and industry requirements. Always refer to the machine's manual and follow the manufacturer's instructions for setting up machine parameters to ensure safe and accurate operation.

Yes, there are several important safety precautions to keep in mind when setting up machine parameters. Here are some specific safety precautions to consider:

Follow Lockout/Tagout Procedures: Before making any adjustments or setting up machine parameters, ensure that the machine is properly isolated from its power source and that lockout/tagout procedures are followed. This helps prevent unexpected machine startup and protects against electrical hazards.

Wear Personal Protective Equipment (PPE): Always wear the appropriate personal protective equipment for the specific machine and task. This may include safety glasses, hearing protection, gloves, and any other necessary equipment to protect against potential hazards.

Work in a Well-Ventilated Area: If using coolant or lubrication during machining, ensure that the work area is adequately ventilated to prevent the buildup of hazardous fumes or vapors. Follow any specific guidelines or safety data sheets for the coolant or lubricant being used.

Be Mindful of Moving Parts: When setting up machine parameters, be cautious of any moving parts or rotating components. Keep your hands and clothing clear of the machine's moving parts to avoid entanglement or injury.

Use Proper Tooling Techniques: Follow safe tooling practices when installing or adjusting cutting tools. Handle sharp tools with care, and avoid touching the cutting edges. Use appropriate tool holders or fixtures to securely mount the tooling in the machine.

Double-Check Machine Limitations: Verify that the machine's capabilities and specifications align with the parameters being set. Ensure that you are not exceeding the machine's maximum speed, feed rate, or depth of cut, as doing so could lead to machine malfunction or failure.

Monitor the Setup Process: During the parameter setup, closely observe the machine's behavior, paying attention to any unusual sounds, vibrations, or unexpected movements. If you notice anything out of the ordinary, stop the setup process and investigate the issue before proceeding.

Be Prepared for Emergency Situations: Familiarize yourself with the location and operation of emergency stop buttons, safety interlocks, and other safety features on the machine. Ensure that they are easily accessible and functional in case of an emergency.

Follow Standard Operating Procedures: Adhere to the established standard operating procedures for setting up machine parameters. These procedures should outline the specific safety steps and precautions to follow for your organization or industry.

Seek Training and Guidance: Ensure that you have received proper training on the specific machine and its setup procedures. If you are unsure about any aspect of the setup process, seek guidance from a qualified supervisor, trainer, or experienced operator.

Remember, these safety precautions are general guidelines, and you should always consult and follow the safety guidelines provided by the machine manufacturer, your organization, and applicable regulatory bodies. Safety should always be the top priority when working with machinery.

3.3. Equipment, Raw Material and Tools

Machine shops employ various tools and equipment to perform machining operations. Here are some commonly used tools in a machine shop:

Lathe: A lathe is a machine tool used for rotating a workpiece against a cutting tool to remove material and shape the workpiece.

Milling Machine: A milling machine uses rotary cutters to remove material from a workpiece, producing flat or contoured surfaces. It is commonly used for milling, drilling, and boring operations.

Drill Press: A drill press is a machine used to drill holes in a workpiece. It consists of a rotating spindle and a vertically adjustable table.

Bandsaw: A bandsaw is a power saw with a continuous band of toothed metal stretched between two or more wheels. It is used to cut various materials, including metal, wood, and plastic.

Surface Grinder: A surface grinder is a machine tool used to provide a smooth and flat surface finish on a workpiece. It uses an abrasive wheel to remove material from the workpiece.

CNC Machines: Computer Numerical Control (CNC) machines are automated machines that use computer programming to control their movements. They include CNC mills, lathes, routers, and more, and are widely used in machine shops for precise and complex machining operations.

Vernier Caliper: A vernier caliper is a measuring instrument used to measure the dimensions of a workpiece with high accuracy. It consists of a main scale and a sliding vernier scale.

Micrometer: A micrometer, also known as a micrometer screw gauge, is a precision measuring instrument used to measure small distances or thicknesses. It provides highly accurate measurements.

Taps and Dies: Taps and dies are cutting tools used for threading operations. Taps create internal threads, while dies create external threads.

Cutting Tools: Various cutting tools such as end mills, drills, reamers, and inserts are used in machine shops for specific machining operations like milling, drilling, reaming, and turning.

. Welding Equipment: Welding equipment, including welding machines, torches, and protective gear, is used to join metal parts together through fusion.

Grinding Wheels: Grinding wheels, made of abrasive material, are used on grinding machines to remove material and provide a fine finish on workpieces.

These are just a few examples of the tools used in a machine shop. The specific tools and equipment can vary depending on the type of machining operations performed and the complexity of the work being done.

Machine shops work with a wide range of raw materials to fabricate and machine various parts and components. The specific materials used depend on the requirements of the project, such as the desired properties of the finished part, its application, and the manufacturing processes involved. Here are some common raw materials used in machine shops:

Metals:

Steel: Various types of steel, including carbon steel, alloy steel, stainless steel, and tool steel, are commonly used in machine shops due to their strength, durability, and machinability. Aluminum: Aluminum and its alloys are lightweight, corrosion-resistant, and have good thermal and electrical conductivity, making them suitable for a wide range of applications. Brass: Brass, an alloy of copper and zinc, is known for its excellent machinability, corrosion resistance, and attractive appearance. Copper: Copper is valued for its high electrical and thermal conductivity, making it suitable for electrical components and heat exchangers. Titanium: Titanium and its alloys offer high strength-

to-weight ratio, excellent corrosion resistance, and resistance to extreme temperatures, making them suitable for aerospace and medical applications.

Cast Iron: Cast iron is known for its excellent castability and good wear resistance, making it suitable for applications requiring strength and durability.

Plastics:

Acrylic: Acrylic, also known as PMMA (Polymethyl Methacrylate), is a transparent thermoplastic with good impact resistance and weather ability. Polyethylene: Polyethylene is a versatile thermoplastic known for its chemical resistance, low friction, and excellent electrical insulation properties. Polypropylene: Polypropylene is a thermoplastic with good chemical resistance, low density, and high stiffness, making it suitable for a wide range of applications. Nylon: Nylon is a strong and durable thermoplastic known for its wear resistance, low friction, and high tensile strength. Polycarbonate: Polycarbonate is a transparent thermoplastic with high impact resistance, making it suitable for applications requiring strength and clarity.

Other Materials:

Wood: Wood and its derivatives may be used in machine shops for various applications, such as tooling, jigs, and fixtures. Composites: Composite materials, such as carbon fiber composites, fiberglass composites, and reinforced plastics, offer high strength-to-weight ratios and are used in industries like aerospace and automotive.

These are just a few examples of the raw materials used in machine shops. The selection of materials depends on factors like mechanical properties, chemical compatibility, cost, and the specific requirements of the project.

Machine shops require a variety of equipment to carry out machining operations and fabricate parts. The specific equipment used can vary depending on the type of machining, the size and complexity of the parts being produced, and the capabilities of the machine shop. Here are some common types of equipment found in machine shops:

CNC Machines: Computer Numerical Control (CNC) machines are automated machines that use computer programming to control their movements and operations. CNC machines include CNC milling machines, CNC lathes, CNC routers, CNC grinders, and more. They offer high precision and are capable of producing complex parts with consistent quality.

Manual Machines: Manual machines are operated by skilled machinists and require manual control for operations such as milling, turning, drilling, and grinding. Examples include manual milling machines, engine lathes, drill presses, and surface grinders.

Cutting Tools: A range of cutting tools is used in machine shops, including end mills, drills, reamers, taps, dies, inserts, and tool bits. These tools are mounted on machines such as milling machines, lathes, and drilling machines to remove material and shape the workpiece.

Measuring Tools: Accurate measurements are essential in machine shops, and various measuring tools are used, including calipers (vernier, digital, or dial), micrometers, depth gauges, height gauges, dial indicators, gauges, and coordinate measuring machines (CMMs).

Welding Equipment: Welding equipment, such as welding machines, torches, and safety gear, is used to join metal parts together through fusion. Common welding processes include arc welding, TIG (tungsten inert gas) welding, MIG (metal inert gas) welding, and spot welding.

Grinding and Finishing Equipment: Grinding machines, surface grinders, and other finishing equipment are used to achieve precise dimensions, smooth surfaces, and desired surface finishes on parts. These machines utilize abrasive wheels or belts to remove material or polish surfaces.

Sawing Equipment: Bandsaws, circular saws, and other sawing equipment are used to cut raw materials into desired lengths and shapes. These machines may have manual or automated controls.

Heat Treatment Equipment: Heat treatment is often required to provide desired material properties to parts. Machine shops may have heat treatment equipment such as furnaces, ovens, and quench tanks for processes like annealing, tempering, and hardening.

Inspection and Quality Control Equipment: Machine shops employ various tools for quality control and inspection, including coordinate measuring machines (CMMs), optical comparators, surface roughness testers, hardness testers, and gauges for dimensional accuracy and material properties.

Tooling and Workholding Equipment: Machine shops use tooling equipment such as tool holders, collets, chucks, vices, clamps, and fixtures to secure workpieces and cutting tools during machining operations.

Material Handling Equipment: Forklifts, cranes, hoists, and other material handling equipment are used to move heavy raw materials, workpieces, and finished parts within the machine shop.

These are just examples of the equipment commonly found in machine shops. The specific equipment used can vary widely based on the capabilities and specialization of the machine shop.

3.4. Planning and Scheduling Machining

Planning and scheduling machining processes involves organizing and optimizing the manufacturing operations to ensure efficient utilization of resources and timely delivery of machined parts. Here are the key steps involved in planning and scheduling machining processes:

Understand the Requirements: Start by thoroughly understanding the machining requirements, including the specifications, quantities, and quality standards of the parts to be machined. Review engineering drawings, CAD models, and any other relevant documentation to gain a clear understanding of the machining operations involved.

Evaluate Resource Availability: Assess the availability of key resources required for machining, such as machines, tools, materials, and skilled personnel. Consider factors like machine capabilities, capacity, maintenance schedules, tooling availability, and the skill set of operators. This evaluation helps determine the constraints and limitations of the machining process.

Sequence Operations: Determine the optimal sequence of machining operations based on factors such as part geometry, material properties, and tooling requirements. Consider the logical order of operations that minimizes setup time, tool changes, and material handling. This sequencing ensures efficient workflow and minimizes non-value-added activities.

Estimate Machining Times: Estimate the time required for each machining operation based on historical data, machine capabilities, tooling, and the complexity of the part. Consider factors like cutting speeds, feeds, tool changes, setup time, and any additional processes like inspection or debarring. Accurate time estimation helps in creating realistic schedules.

Develop a Master Production Schedule: Create a master production schedule that outlines the planned start and completion dates for each machining operation. Consider

the desired delivery dates, lead times, and any other dependencies or constraints. Ensure that the schedule aligns with the overall production plan and customer requirements.

Allocate Resources: Assign machines, tools, and operators to specific machining operations based on resource availability, capabilities, and skill sets. Consider factors such as machine compatibility with the part, tooling requirements, and operator expertise. Optimize resource allocation to balance workloads and minimize bottlenecks.

Consider Setup and Changeover: Account for setup and changeover times between different machining operations. Minimize changeovers by grouping similar parts or operations together, if feasible. Optimize tooling setups and consider tool presetting techniques to reduce setup time and increase productivity.

Monitor Progress: Regularly monitor the progress of machining operations against the schedule. Track actual machining times, identify any delays or deviations, and take corrective actions as needed. Maintain clear communication channels with operators and supervisors to address any issues or constraints promptly.

Adapt to Changes: Be prepared to adapt the schedule and plan in response to unexpected events, such as machine breakdowns, material shortages, or changes in customer requirements. Maintain flexibility in the schedule to accommodate changes while minimizing the impact on delivery timelines.

Continuous Improvement: Continuously review and improve the machining process. Analyze performance metrics such as cycle times, utilization rates, and on-time delivery. Seek opportunities to optimize processes, reduce waste, and enhance efficiency. Incorporate feedback from operators and other stakeholders to drive ongoing improvement.

By following these steps, you can effectively plan and schedule machining processes to optimize resource utilization, minimize lead times, and meet customer requirements in a timely manner.

Self-check 3

PART I: Part I: choose the correct answer from the given alternatives

1. What is the purpose of a pre-start inspection in machining operations?

   A. To ensure the machine is properly set up
   B. To identify any potential safety hazards
   C. To verify the availability of necessary materials and tools
   D. All of the above

2. Which of the following should be checked during a pre-start inspection?

   A. Power supply and connections
   B. Lubrication levels
   C. Cutting tool condition
   D. All of the above

3. What is the primary goal of a pre-start warm-up in machining operations?

   A. To allow the machine to reach optimal operating temperature
   B. To test the machine's functionality before actual operation
   C. To check for abnormal noises or vibrations
   D. To ensure the machine is properly calibrated

4. Who is typically responsible for conducting a pre-start inspection in machining operations?

   A. Machine operators
   B. Maintenance technicians
   C. Quality control personnel
   D. All of the above

5. How often should a pre-start inspection be performed in machining operations?

   A. Once a day
   B. Once a week
   C. Before every shift
   D. Once a month

Part II: Part II:- say true if the statement is true say false if the statement is false

1. A pre-start inspection in machining operations is primarily focused on checking the availability of necessary materials and tools.

2. Lubrication levels of the machine do not need to be checked during a pre-start inspection.
3. The purpose of a pre-start warm-up in machining operations is to ensure the machine is properly calibrated.
4. Only machine operators are responsible for conducting a pre-start inspection in machining operations.
5. A pre-start inspection in machining operations should be performed once a day.
6. Describe the importance of a thorough pre-start inspection in machining operations and its impact on overall operational efficiency.
7. Discuss the key components that should be included in a pre-start checklist for machining operations, and explain why each component is important.
8. Explain the potential risks and safety hazards that can be identified and mitigated through a comprehensive pre-start inspection in machining operations.
9. Describe the steps involved in conducting a pre-start warm-up in machining operations and explain why it is necessary for optimal machine performance.
10. Discuss the role of effective communication and collaboration among machine operators, maintenance technicians, and quality control personnel in ensuring a successful pre-start inspection process in machining operations.

Unit Four: Perform machine process

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

- Standard operation procedures
- Machine/process.
- Handle production materials
- Monitor machine/process production.
- Data. . Record

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

- prepare maintenance program
- Checking machining processes
- Monitoring machine/process
- Identify types of equipment, raw material and tools
- Recording data

4.1. Standard operation procedures (SOP)

A Standard Operating Procedure (SOP) is a set of written instructions that document a routine or repetitive activity followed by an organization. The development and use of SOPs are an integral part of a successful quality system as it provides individuals with the information to perform a job properly, and facilitates consistency in the quality and integrity of a product or end-result. The term "SOP" may not always be appropriate and terms such as protocols, instructions, worksheets, and laboratory operating procedures may also be used. For this document "SOP" will be used.

SOPs describe both technical and fundamental programmatic operational elements of an organization that would be managed under a work plan or a Quality Assurance (QA)

Purpose

SOPs detail the regularly recurring work processes that are to be conducted or followed within an organization. They document the way activities are to be performed to facilitate consistent conformance to technical and quality system requirements and to support data quality. They may describe, for example, fundamental programmatic actions and technical actions such as analytical processes, and processes for maintaining, calibrating, and using equipment. SOPs are intended to be specific to the organization or facility whose activities are described and assist that organization to maintain their quality control and quality assurance processes and ensure compliance with governmental regulations.

Benefits

The development and use of SOPs minimizes variation and promotes quality through consistent implementation of a process or procedure within the organization, even if there are temporary or permanent personnel changes. SOPs can indicate compliance with organizational and governmental requirements and can be used as a part of a personnel training program, since they should provide detailed work instructions. It minimizes opportunities for miscommunication and can address safety concerns. When historical data are being evaluated for current use, SOPs can also be valuable for reconstructing project activities when no other references are available. In addition, SOPs are frequently used as checklists by inspectors when auditing procedures. Ultimately, the benefits of a valid SOP are reduced work effort, along with improved comparability, credibility, and legal defensibility.

Writing Styles

SOPs should be written in a concise, step-by-step, easy-to-read format. The information presented should be unambiguous and not overly complicated. The active voice and present verb tense should be used. The term "you" should not be used, but implied. The document should not be wordy, redundant, or overly lengthy. Keep it simple and short. Information should be conveyed clearly and explicitly to remove any doubt as to what is required. Also, use a flow chart to illustrate the process being described. In addition, follow the style guide used by your organization

SOP Preparation

The organization should have a procedure in place for determining what procedures or processes need to be documented. Those SOPs should then be written by individuals knowledgeable with the activity and the organization's internal structure. These individuals are essentially subject-matter experts who actually perform the work or use the process. A team approach can be followed, especially for multi-tasked processes where the experiences of a number of individuals are critical, which also promotes “buy-in” from potential users of the SOP.

4.2. Machine/process

4.2.1. Electro Discharge Machining (EDM)

Introduction

Electro Discharge Machining (EDM) is an electro-thermal non-traditional machining process. Electrical energy is used to generate an electrical spark, and material removal mainly occurs due to the thermal energy of the spark.
EDM is mainly used to machine difficult-to-machine materials and high-strength temperature-resistant alloys. EDM can be used to machine complex geometries in small batches or even on a job-shop basis. Work material to be machined by EDM must be electrically conductive

process.

In EDM, a potential difference is applied between the tool and work piece. Both the tool and the work material are to be conductors of electricity. The tool and the work material are immersed in a dielectric medium. Generally, kerosene or deionized water is used as the dielectric medium. A gap is maintained between the tool and the work piece.

Depending upon the applied potential difference and the gap between the tool and work piece, an electric field would be established.

Generally, the tool is connected to the negative terminal of the generator, and the work piece is connected to the positive terminal. As the electric field is established between the tool and the job, the free electrons on the tool are subjected to electrostatic forces.

Process Parameters

The process parameters in EDM are mainly related to the waveform characteristics.

The waveform is characterized by the: -

- The open-circuit voltage -
- The working voltage -
- The maximum current –
- The pulse on time – the duration for which the voltage pulse is applied - ton
- The pulse off time -
- The gap between the work piece and the tool – spark gap - δ
- The polarity – straight polarity – tool
- The dielectric medium
- External flushing through the spark gap.

Characteristics of EDM

(The process can be used to machine any work material if it is electrically conductive.

Material removal depends on mainly thermal properties of the work material rather than its strength, hardness, etc.

In EDM, there is a physical tool, and the geometry of the tool is the positive impression of the hole or geometric feature machined.

The tool must be electrically conductive as well. The tool wear once again depends on the thermal properties of the tool material.

Though the local temperature rise is relatively high, due to a minimal pulse on time, there is not enough time for the heat to diffuse, and thus, almost no increase in bulk temperature occurs. Thus, the heat-affected zone is limited to 2 – 4 μm of the spark crater. However, rapid heating and cooling and local high temperature leads to surface hardening, which may be desirable in some applications.

Though there is a possibility of taper cut and overcut in EDM, they can be controlled and compensated.

Electro Discharge Machining

Dielectric

As discussed earlier in EDM, material removal mainly occurs due to thermal evaporation and melting as thermal processing is required to be carried out in the absence of oxygen so that the process can be controlled, and oxidation avoided. Oxidation often leads to poor surface conductivity (electrical) of the work piece, hindering further machining. Hence, the dielectric fluid should provide an oxygen-free machining environment. Further, it should have enough strong dielectric resistance so that it does not break down electrically too quickly but at the same time ionize when electrons collide with its molecule. Moreover, during sparking, it should be thermally resistant as well. Generally, kerosene and deionized water are used as dielectric fluid in EDM. Tap water cannot be used as it ionizes too early and thus breakdown due to the presence of salts as impurities occur. Dielectric medium is generally flushed around the spark zone. It is also applied through the tool to achieve efficient removal of molten material.

Electrode Material

Electrode material should be such that it would not undergo much tool wear when it is impinged by positive ions. Thus, the localized temperature rise has to be less by tailoring or correctly choosing its properties, or even when temperature increases, there would be less melting. Further, the tool should be easily workable as intricate shaped geometric features are machined in EDM. Thus, the essential characteristics of electrode materials are:

- High electrical conductivity – electrons are cold emitted more quickly, and there is less bulk electrical heating.
- High thermal conductivity – for the same heat load, the local temperature rise would be less due to faster heat conducted to the bulk of the tool and thus minor tool wear.
- Higher density – for the same heat load and same tool wear by weight, there would be less volume removal or tool wear and thus less dimensional loss or inaccuracy.
- High melting point – high melting point leads to minor tool wear due to less tool material melting for the same heat load.
- Easy manufacturability Cost – cheap

Common Plastic Production

Processing

- Extrusion
- Injection Molding
- Blow Molding
- Vacuum Forming
- Compression Molding
- Rotational Molding

Plastic Injection Molding

Introduction: Injection molding is a manufacturing process for producing parts by injecting molten material into a mold. Injection molding can be performed with a host of materials mainly including metals (for which the process is called die-casting), glasses, elastomers, confections, and most commonly the thermoplastic and thermo setting polymers. Injection molding is used to create many things such as wire spools, packaging, bottle caps, automotive parts and components, toys, pocket combs, some musical instruments (and parts of them), onepiece chairs and small tables, storage containers, mechanical parts (including gears), and most other plastic products available today. Injection moulding is the most common modern method of manufacturing plastic parts; it is ideal for producing high volumes of the same object. Injection molding machine molds can be fastened in either a horizontal or vertical position. The majority of machines are horizontally oriented, but vertical machines are used in some niche applications such as insert molding, allowing the machine to take advantage of gravity.

Types of Injection Molding Machine:

These Machines are classified primarily by the type of driving systems they use:
hydraulic, mechanical, electrical, or hybrid.

Hydraulic: Hydraulic presses have historically been the only option available to molders until Nessie Plastic Industrial Co., LTD introduced the first all electric injection molding machine in 1983.

Hydraulic machines, although not nearly as precise, are the predominant type in most of the world, with the exception of Japan.

Mechanical: Mechanical type machines use the toggle system for building up tonnage on the clamp side of the machine. Tonnage is required on all machines so that the clamp side of the machine does not open (i.e. tool half mounted on the platen) due to the injection pressure. If the tool half opens up it will create flash in the plastic

product.

Electric: The electric press, also known as Electric Machine Technology (EMT), reduces operation costs by cutting energy consumption and also addresses some of the environmental concerns surrounding the hydraulic press. Electric presses have been shown to be quieter, faster, and have a higher accuracy; however the machines are more expensive. Hybrid injection (sometimes referred to as "Servo-Hydraulic") molding machines claim to take advantage of the best features of both hydraulic and electric systems, but in actuality use almost the same amount of electricity to operate as an electric injection molding machine depending on the manufacturer.

Extrusion Process

Introduction:

Extrusion is a compression process in which the work metal is forced to flow through a die opening to produce a desired cross-sectional shape. As shown in figure (4.1)

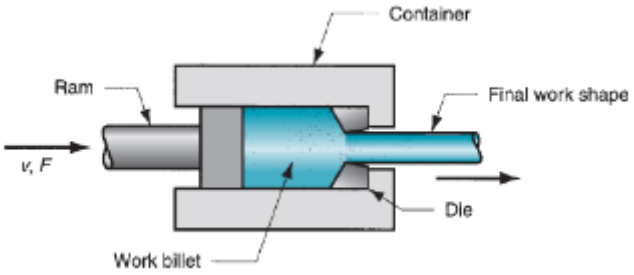


Figure (4.1) Extrusion process (direct extrusion)

4.2 Advantages of the extrusion process:

There are several advantages of the modern extrusion process

1. A variety of shapes are possible, especially with hot extrusion.
2. Grain structure and strength properties are enhanced in cold and warm extrusion.
3. Fairly close tolerances are possible, especially in cold extrusion.
4. Little or no wasted material is created.

However, a limitation is that the cross section of the extruded part must be uniform throughout its length.

4.3 types of extrusion process: There are many classifications for the extrusion processes, it may classify depending on the extrusion direction as direct and indirect another classification is by working temperature as cold or warm or hot extrusion.

4.3.1 Direct extrusion (also called forward extrusion) is illustrated in Figure (6.1). A metal billet is loaded into a container, and a ram compresses the material, forcing it to

flow through one or more openings in a die at the opposite end of the container. As the ram approaches the die, a small portion of the billet remains that cannot be forced through the die opening.

This extra portion, called the Butt, is separated from the product by cutting it just beyond the exitof the die. One of the problems in direct extrusion is the significant friction that exists between the work surface and the walls of the container as the billet is forced to slide toward the die opening. This friction causes a substantial increase in the ram force required in direct extrusion. In hot extrusion, the friction problem is aggravated by the presence of an oxide layer on the surface of the billet. This oxide layer can cause defects in the extruded product. To solve these problems, a dummy block is often used between the ram and the work billet. The diameter of the dummy block is slightly smaller than the billet diameter, so that a narrow ring of work metal (mostly the oxide layer) is left in the container, leaving the final product free of oxides.

Hollow sections (e.g., tubes) are possible in direct extrusion by the process setup in

The starting billet is prepared with a hole parallel to its axis .This allows passage of a mandrel that is attached to the dummy block. As the billet is compressed, the material is forced to flow through the clearance between the mandrel and the die opening

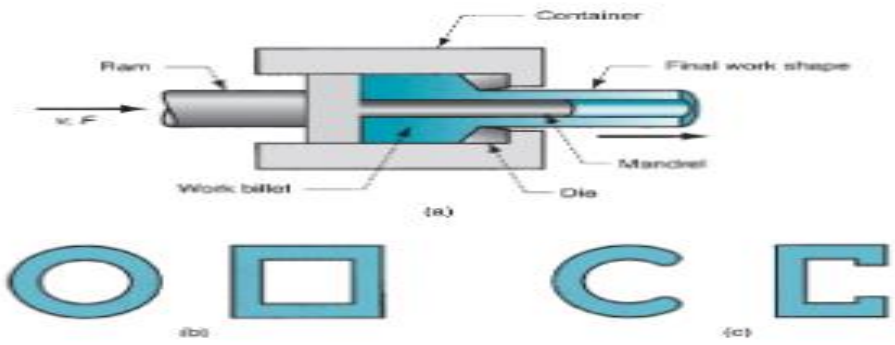


Figure 4.2. (a) Direct extrusion to produce a hollow or semi –hollow cross section; (b) Hollow and(c) Semi-hollow cross sections. This friction causes a substantial increase in the ram force required in direct extrusion. In hot extrusion, the friction problem is aggravated by the presence of an oxide layer on the surface of the billet. This oxide layer can cause defects in the extruded product. To solve these problems, a dummy block is

often used between the ram and the work billet. The diameter of the dummy block is slightly smaller than the billet diameter, so that a narrow ring of work metal (mostly the oxide layer) is left in the container, leaving the final product free of oxides. Hollow sections (e.g., tubes) are possible in direct extrusion by the process setup in Figure (6.2). The starting billet is prepared with a hole parallel to its axis .This allows passage of a mandrel that is attached to the dummy block. As the billet is compressed, the material is forced to flow through the clearance between the mandrel and the die opening Figure (4.2) (a) Direct extrusion to produce a hollow or semi –hollow cross section; (b) Hollow and(c)Semi-hollow cross sections.

4.3.2 Indirect extrusion, also called backward extrusion and reverse extrusion, Figure 6.3(a), the die is mounted to the ram rather than at the opposite end of the container. As the ram move, the metal is forced to flow through the clearance in a direction opposite to the motion of the ram. Since the billet is not forced to move relative to the container, there is no friction at the container walls, and the ram force is therefore lower than in direct extrusion. Limitations of indirect extrusion are imposed by the lower rigidity of the hollow ram and the difficulty in supporting the extruded product as it exits the die.

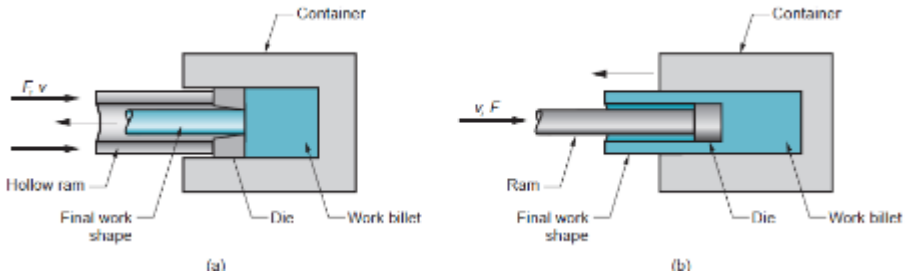


Figure (4.3) indirect extrusion to produce (a) a solid cross section and (b) a hollow cross section

Indirect extrusion can produce hollow (tubular) cross sections, as in Figure 6.3(b). There are practical limitations on the length of the extruded part that can be made by this method. Support of the ram becomes a problem as work length increases.

4.3.3. Hot extrusion involves prior heating of the billet to a temperature above (0.4Tm). This reduces strength and increases ductility of the metal, permitting more extreme size reductions and more complex shapes to be achieved in the process. Additional advantages include reduction of ram force, increased ram speed. Cooling of the billet as it contacts

the container walls is a problem, and isothermal extrusion is sometimes used to overcome this problem.

4.3.4. Cold extrusion and warm extrusion are generally used to produce discrete parts, often in finished (or near finished) form. Some important advantages of cold extrusion include increased strength due to strain hardening, close tolerances, improved surface finish, absence of oxide layers, and high production rates. Cold extrusion at room temperature also eliminates the need for heating the starting

4.3. Handle Production materials

Machine /materials/ handling procedures

Materials handling is the movement and storage of materials at the lowest possible cost through the use of proper methods and equipment.

- Materials handling is the moving of materials or product by any means, including storage, and all movements except processing operations and inspection.
- Materials handling is the art and science of conveying, elevating, positioning, transporting, packaging and storing of materials.

In one of the definitions, all the functions of materials handling have been referred to which are conveying, elevating, positioning, transporting, packaging and storing. Storage or warehousing is very much a part of materials handling.

Materials handling uses different equipment and mechanisms called Materials Handling Equipment. Though in one of the definitions, processing operations and inspection have been specifically excluded from scope of materials handling operations, it is worth mentioning that in specific cases processing or inspection of materials may be accomplished simultaneously with handling activity. One definition also covers the important objective of materials handling which is lowest cost solution.

4.4. Monitor machine/process production.

Monitoring is the continuous collection of data on specified indicators to assess for a development intervention (project, programmed or policy) its implementation in relation to activity schedules and expenditure of allocated funds, and its progress and achievements in relation to its objectives. Evaluation is the periodic assessment of the design, implementation, outcomes and impact of a development intervention. It should

assess the relevance and achievement of objectives, implementation performance in terms of effectiveness and efficiency, and the nature, distribution and sustainability of impacts. It is clear that monitoring and evaluation are different yet complementary. Monitoring is the process of routinely gathering information with which to make informed decisions for project management. Monitoring provides project managers with the information needed to assess the current project situation and assess where it is relative to specified targets and objectives – identifying project trends and patterns, keeping project activities on schedule, and measuring progress toward expected outcomes. Monitoring can be carried out at the project, programme or policy levels.

Monitoring provides managers and other stakeholders with regular information on progress relative to targets and outcomes. It is descriptive and should identify actual or potential successes and problems as early as possible to inform management decisions. A reliable flow of relevant information during implementation enables managers to keep track of progress, to adjust operations to take account of experience and to formulate budgetary requests and justify any needed increase in expenditure. Indeed, an effective management information system that performs these functions is an essential part of good management practice. Evaluation, on the other hand, gives information about why the project is or is not achieving its targets and objectives. Some evaluations are carried out to determine whether a project has met (or is meeting) its goals. Others examine whether or not the project hypothesis was valid, and whether or not it addressed priority needs of the target population. Depending on the purpose of a particular evaluation, it might assess other areas such as achievement of intended goals, cost-efficiency, effectiveness, impact and / or sustainability. Evaluations address: ‘why’ questions, that is, what caused the changes being monitored; ‘how’ questions, or what was the sequence or process that led to successful (or unsuccessful) outcomes; and ‘compliance and accountability’ questions, that is, did the promised activities actually take place and as planned? Evaluations are more analytical than monitoring, and seek to address issues of causality. A baseline study is the first phase of a project evaluation. It is used to measure the ‘starting or reference points’ of indicators of effect and impact.

Frequent evaluation of progress is good management practice. It seeks to establish causality for the situations and trends recorded by monitoring. Clearly evaluation should respond when monitoring identifies either problems or opportunities to enhance

achievements. Managers should use evaluation results to make adjustments to the design and implementation of their project or other interventions. Periodically this can be formalized to involve the recipient government and donor in one or more formal reviews such as a mid-term evaluation. Terminal evaluations are similarly formalized and typically conducted at the end of the intervention to provide the information for completion reports. An ex post evaluation may be completed a further period aftercompletion, when it is reasonable to expect the full impacts of the intervention to have

taken place .Ongoing, 'process' or informal evaluation occurs during the course of the project as part of good management practice to assess activities or functions and to make recommendations for improving project implementation. Summative evaluations are **carried out at the end of a funding period to assess positive and negative impacts and** examine the effectiveness of a project. These are often termed 'impact assessments'. Lessons learned from final evaluations should contribute to the formation of future projects and programs. Such formalized and periodic evaluations are important for the internal reporting and auditing procedures of the organizations involved, and as a means to document experience and feed back into the planning of future interventions. It should be recognized, however, that evaluation is always available as a mode of analysis that can help managers and other stakeholders to understand all aspects of the work at hand. This applies from design stages, through implementation and on to completion and final outcomes. The terms 'informal' or 'ongoing' evaluation can be used to describe evaluation that is conducted primarily by managers themselves as a key part of effective management and project implementation.

Project level systems should overlap with and feed into public sector management information systems. These generally place emphasis on the use of information streams that are more or less continuous, and which can be trusted and used in real time for decision-making. When monitoring and evaluation is effective knowledge should accumulate in the experience and expertise of staff, in the documented institutional memory of the organization and its partners, and in their planning and management procedures. Section Summary

The section explained why monitoring and evaluation are important and defined these concepts and the differences between them.

The main types of monitoring are:

- Baseline monitoring – 'Where are we now?'
- Validation monitoring – 'Will it work?' This type of monitoring includes:
- Pre-commissioning validation
- Validation of critical control points (CCP)
- Re-validation
- Operational monitoring – 'Is it working now?'
- Verification monitoring – 'Did it work?'
- Commissioning verification
- Ongoing verification.

The relationship between monitoring types is shown in Figure 1. Baseline and validation monitoring inform what operational monitoring should take place. CCP monitoring is an activity undertaken within operational monitoring. Verification monitoring supports operational monitoring by confirming that risks are being adequately managed.

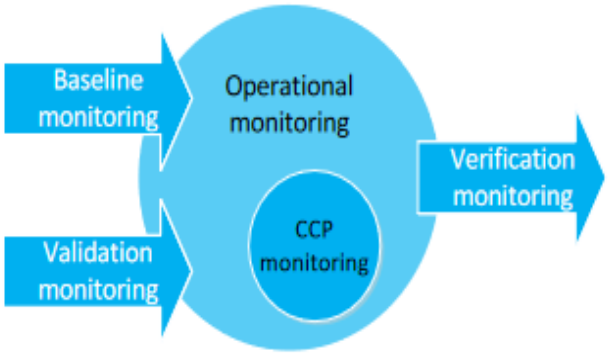


Figure 4.4: Relationship between types of monitoring

4.5 Data recording system

During machine operation, there are several common methods for recording data. Here are a few examples:

Manual Log Sheets: Using a pen and paper or a pre-designed log sheet, operators can manually record data such as machine settings, production counts, downtime events, quality issues, or any other relevant information. This method is simple and requires minimal equipment but may be more time-consuming and prone to human error.

Digital Spreadsheets: Operators can use digital spreadsheets, such as Microsoft Excel or Google Sheets, to record and track machine data. This allows for easy organization,

manipulation, and analysis of data. Spreadsheets can be customized to include specific parameters, timestamps, formulas, and automated data entry. Data can be entered manually or automatically imported from data collection systems or machine interfaces.

Machine Data Collection Systems: Many modern machines have built-in data collection systems that automatically record and store various operational parameters. These systems capture data such as cycle times, production rates, energy usage, tool wear, temperature, and more. The data can be stored locally on the machine or transmitted to a centralized database for analysis and reporting.

Data Acquisition Systems: Data acquisition systems consist of sensors and software that collect and record data from various machine sensors and inputs. These systems can capture data on factors such as temperature, pressure, vibration, force, and more. The recorded data can be stored and analyzed for machine performance monitoring, maintenance planning, or process optimization.

SCADA Systems: Supervisory Control and Data Acquisition (SCADA) systems are commonly used in industrial settings to monitor and control machines and processes. SCADA systems typically include data recording and logging capabilities, allowing operators to track machine parameters, alarms, and events. The recorded data can be visualized in real-time or stored for historical analysis.

Internet of Things (IoT) Platforms: IoT platforms enable the connection and communication of machines and devices over a network. These platforms can collect and aggregate data from multiple machines, providing real-time monitoring and historical data recording. The data can be accessed remotely and analyzed for predictive maintenance, performance optimization, and production analytics.

When selecting a method for recording machine data, consider factors such as the type and complexity of the data to be recorded, the level of automation desired, the scalability of the solution, and the specific requirements of your industry or organization.

Using SCADA (Supervisory Control and Data Acquisition) systems for recording machine data offers several advantages. Here are some key benefits:

Real-time Monitoring: SCADA systems provide real-time visibility into machine operations. Operators can monitor critical parameters, such as temperature, pressure,

speed, and status, in real-time. This enables quick detection of abnormalities, deviations, or potential issues, allowing for prompt response and corrective actions.

Centralized Data Collection: SCADA systems collect and store machine data in a centralized database. This allows for easy access, organization, and retrieval of historical data. Centralization also enables data comparison, trend analysis, and performance tracking across different time periods and machines.

Enhanced Data Visualization: SCADA systems offer advanced visualization capabilities, such as dynamic graphs, charts, and dashboards. These visual representations make it easier for operators and management to understand complex data patterns, trends, and anomalies. Clear visualizations facilitate data-driven decision-making, troubleshooting, and process optimization.

Alarm Management: SCADA systems provide alarm management functionalities to notify operators of abnormal conditions or system faults. Alarms can be set up based on predefined thresholds or specific events, ensuring that operators are promptly alerted to critical issues. This helps in minimizing downtime, preventing accidents, and maintaining machine reliability.

Remote Access and Control: SCADA systems often support remote access and control, allowing authorized personnel to monitor and interact with machines from anywhere with an internet connection. Remote access enables real-time monitoring, troubleshooting, and adjustment of machine parameters, reducing the need for on-site presence and enhancing operational efficiency.

Integration with Other Systems: SCADA systems can integrate with other systems, such as ERP (Enterprise Resource Planning) or MES (Manufacturing Execution System), creating a seamless flow of data across different functional areas. Integration enables data sharing, synchronization, and interoperability, facilitating comprehensive analysis, reporting, and decision-making.

Historical Analysis and Reporting: SCADA systems store historical machine data, allowing for in-depth analysis and reporting. By analyzing historical data, operators can identify patterns, correlations, and performance trends. This information can be used for

predictive maintenance, process optimization, energy efficiency improvements, and overall operational enhancements.

Scalability and Flexibility: SCADA systems are often scalable, accommodating the addition of new machines or expanding the system's capacity as needed. They can also be flexible, supporting various communication protocols and interfaces to connect with different types of machines and devices.

Overall, SCADA systems provide a powerful toolset for recording and managing machine data, enabling real-time monitoring, historical analysis, and data-driven decision-making. They enhance operational visibility, efficiency, and reliability in industrial and manufacturing environments.

Self-check 4

Directions: Answer all the questions listed below.

Part I: choose the correct answer from the given alternatives

1. Which of the following steps is typically included in the machine operation process?
   A. Powering on the machine
   B. Conducting a risk assessment
   C. Performing routine maintenance
   D. Analyzing production data
2. Which of the following is NOT a common method of material handling in machine processes?
   A. Conveyors
   B. Forklifts
   C. Robots
   D. Screwdrivers
3. Which type of material handling equipment is typically used for lifting and moving heavy objects in a machine process?
   A. Pallet jacks
   B. Cranes
   C. Trolleys
   D. Automated guided vehicles (AGVs)
4. What is the purpose of material handling in machine processes?
   A. To ensure the safety of operators
   B. To minimize production downtime
   C. To optimize production efficiency
   D. To reduce material waste
5. Which of the following factors should be considered when selecting material handling equipment for a machine process?
   A. Load capacity
   B. Speed and accuracy
   C. Environmental conditions
   D. All of the above

Part II:- say true if the statement is true say false if the statement is false

1. A machine process data recording system captures and stores data related to various aspects of a machine's operation, such as performance metrics, environmental conditions, and maintenance activities.
2. Machine process material handling refers to the movement, transportation, and storage of materials within a manufacturing or production environment.
3. : A machine process data recording system is used to capture and store data related to the operation of machines, including parameters such as temperature, pressure, and speed.

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Unit Five: Quality assure

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

- Faults/Deviations
- Deviations are Rectified.
- Quality Controlled

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

- Identify deviations.
- Control quality

5.1. Introduction

Quality Assurance Section - QC activities are designed to allow self-verification of the quality and consistency of the work. Describe the preparation of appropriate QC procedures (self-checks, such as calibrations, recounting, re identification) and QC material (such as blanks - rinsate, trip, field, or method; replicates; splits; spikes; and performance evaluation samples) that are required to demonstrate successful performance of the method. Specific criteria for each should be included. Describe the frequency of required calibration and QC checks and discuss the rationale for decisions. Describe the limits/criteria for QC data/results and actions required when QC data exceed QC limits or appear in the warning zone. Describe the procedures for reporting QC data and results.

Reference Section - Documents or procedures that interface with the SOP should be fully referenced (including version), such as related SOPs, published literature, or methods manuals. Citations cannot substitute for the description of the method being followed in the organization. Attach any that are not readily available.

5.1.1 Faults/Deviations

Faults or deviations refer to abnormalities, errors, or deviations from the normal or expected behavior, specifications, or standards. In various contexts, faults or deviations can occur in different systems, processes, products, or behaviors. Here are a few examples:

Manufacturing: In manufacturing processes, faults or deviations can occur when products do not meet the specified standards or requirements. This could include defects in the product's physical appearance, size, functionality, or performance. Faults can result from errors in production, quality control issues, or equipment malfunctions.

Software and Technology: In software development, faults or deviations may refer to bugs, errors, or glitches in computer programs or applications. These faults can lead to software crashes, malfunctions, or incorrect outputs. Deviations from expected behavior can also occur in hardware components, such as malfunctioning sensors or faulty circuits.

Engineering and Construction: In engineering and construction projects, faults or deviations can arise when the actual results or measurements differ from the intended design or specifications. For example, if a building's foundation is not constructed according to the planned dimensions or if structural elements do not meet the required

load-bearing capacity, these would be considered faults or deviations.

Process Control: In industrial processes, faults or deviations can occur when the actual process parameters deviate from the desired or optimal values. This can lead to inefficiencies, product defects, or safety hazards. Process deviations can result from equipment failures, incorrect settings, material inconsistencies, or operator errors.

Human Behavior: Faults or deviations can also relate to human behavior. For example, in organizational contexts, deviations from established procedures or ethical standards can be considered faults. Similarly, in personal conduct, deviations from societal norms or expected behavior may be seen as faults or deviations.

Identifying and addressing faults or deviations is crucial in achieving quality, reliability, and safety in various domains. Fault detection, analysis, and correction processes are often implemented to minimize the impact of faults and deviations and ensure that systems, processes, and products meet the desired standards or specifications.

In manufacturing processes, faults or deviations are typically detected and addressed through a combination of quality control measures, inspections, testing, and corrective actions. Here are the common steps involved in detecting and addressing faults or deviations in manufacturing:

Quality Control Systems: Manufacturing processes often have quality control systems in place to monitor and control product quality. These systems may include process controls, standard operating procedures, and quality assurance measures. By implementing these systems, manufacturers can proactively prevent faults and deviations from occurring and ensure adherence to specifications.

Inspections and Testing: Inspection and testing procedures are conducted at various stages of the manufacturing process. This includes inspecting raw materials, components, and sub-assemblies for quality and conformance to specifications. Additionally, in-process inspections and testing are performed during production to detect any faults or deviations. This can involve visual inspections, measurements, functional tests, and other quality checks.

Statistical Process Control (SPC): SPC techniques involve monitoring and analyzing process data to detect any variations or deviations from the desired specifications.

Statistical tools such as control charts, process capability analysis, and trend analysis are used to identify patterns and trends that may indicate the presence of faults or deviations. SPC allows manufacturers to take timely corrective actions and maintain process stability.

Root Cause Analysis: When a fault or deviation is detected, manufacturers conduct root cause analysis to identify the underlying factors or causes. This involves investigating the process, equipment, materials, and other relevant factors to determine why the fault occurred. By identifying the root cause, manufacturers can implement targeted corrective actions to prevent similar faults from recurring.

Corrective Actions: Once the root cause is identified, appropriate corrective actions are implemented. This may involve adjusting process parameters, reworking or repairing faulty products, updating procedures, modifying equipment, or providing additional training to personnel. The goal is to address the fault or deviation and prevent its recurrence in the future.

Continuous Improvement: Manufacturing processes often incorporate continuous improvement methodologies, such as Lean Manufacturing or Six Sigma. These approaches focus on systematically identifying and eliminating faults, deviations, and waste from the manufacturing processes. By continuously improving processes, manufacturers aim to reduce faults, improve product quality, and enhance overall efficiency.

It is worth noting that the specific methods and techniques used to detect and address faults or deviations may vary depending on the industry, product type, and specific manufacturing processes involved. Manufacturers often tailor their quality control and corrective action strategies to meet their unique requirements and ensure consistent product quality.

Lean Manufacturing and Six Sigma are two methodologies that are widely used in manufacturing to improve quality, efficiency, and reduce faults or deviations. While they have distinct approaches, they both contribute to the detection and addressing of faults in manufacturing processes. Here's how each methodology helps:

Lean Manufacturing: Lean Manufacturing focuses on eliminating waste, improving flow, and optimizing processes. It aims to create a smooth and efficient production system by

identifying and eliminating non-value-added activities. In relation to detecting and addressing faults, Lean Manufacturing helps in the following ways:

a) Visual Management: Lean Manufacturing emphasizes visual management techniques, such as visual controls, Kanban boards, and standard work instructions. These visual cues make it easier to identify abnormalities or deviations from the standard process, allowing for prompt detection and corrective action.

b) Error-Proofing (Poka-Yoke): Lean Manufacturing promotes the use of error-proofing devices or mechanisms to prevent faults from occurring. These devices can be physical or procedural and are designed to eliminate or reduce the likelihood of human errors that may lead to faults. By proactively designing processes to minimize errors, Lean Manufacturing helps prevent faults before they happen.

c) Continuous Improvement: Lean Manufacturing encourages a culture of continuous improvement, where all employees are engaged in identifying and addressing faults and deviations. Through practices like Kaizen events and suggestion systems, employees are empowered to contribute their knowledge and insights to improve processes and eliminate faults.

.Six Sigma: Six Sigma focuses on reducing process variation and improving process performance. It utilizes statistical tools and methodologies to identify and address the root causes of faults or deviations. Key elements of Six Sigma that aid in detecting and addressing faults include:

d) DMAIC Methodology: Six Sigma follows the DMAIC (Define, Measure, Analyze, Improve, Control) methodology to systematically solve problems and improve processes. This structured approach helps in identifying faults, measuring their impact, analysing the root causes, implementing improvements, and establishing control measures to prevent recurrence.

e) Statistical Analysis: Six Sigma employs statistical tools and techniques, such as control charts, process capability analysis, and hypothesis testing, to analyze process data and identify sources of variation that contribute to faults. By

analyzing data, Six Sigma helps in pinpointing the critical factors causing faults and deviations.

f) Root Cause Analysis: Six Sigma employs rigorous root cause analysis techniques, such as the Five Whys and Fishbone (Ishikawa) diagrams, to identify the underlying causes of faults. By systematically probing deeper into the factors contributing to faults, Six Sigma helps in developing effective corrective measures.

g) Design for Six Sigma (DFSS): DFSS is a methodology within Six Sigma that focuses on designing new processes or products that are defect-free from the start. By incorporating DFSS principles, manufacturers can proactively prevent faults or deviations by designing robust processes and products that are less susceptible to variation.

Both Lean Manufacturing and Six Sigma methodologies promote a data-driven and systematic approach to problem-solving, allowing manufacturers to identify faults, understand their causes, and implement targeted corrective actions. By implementing these methodologies, manufacturers can improve process efficiency, product quality, and reduce the occurrence of faults or deviations in their manufacturing processes.

Self-Check 5

Part I: Choose the correct Answer form the give alternatives

1. Which statement best describes Quality Procedures in machine processes?
   A. They involve regular maintenance and calibration of machines to ensure accuracy and reliability.
   B. They focus on optimizing machine speed and output without considering product quality.
   C. They are only applicable in large-scale manufacturing industries.
   D. They primarily involve training machine operators on safety protocols.
2. Which of the following is an example of a fault in an advanced machine process operation?
   A. **M**inor variation in product dimensions
   B. Consistent and precise output within tolerance limits
   C. Efficient utilization of raw materials
   D. Optimal energy consumption
3. Deviation in an advanced machine process operation refers to:
   A. Consistent adherence to quality standards
   B. Achieving maximum production output
   C. Departure from desired process parameters or specifications
   D. Sustaining a steady workflow
4. What is the primary purpose of identifying faults in advanced machine process operations?
   A. To minimize downtime and maximize productivity
   B. To reduce training requirements for machine operators
   C. To streamline administrative tasks
   D. To improve management reporting
5. Which of the following techniques is commonly used to detect faults in advanced machine process operations?
   A. Statistical process control
   B. Human observation only
   C. Trial and error approach
   D. Random sampling
6. The impact of faults or deviations in advanced machine process operations can include:
   A. Reduced product quality and increased waste
   B. Improved overall efficiency and cost savings
   C. Increased employee satisfaction and motivation
   D. Expansion of market share

Part II:- say true if the statement is true say false if the statement is false

1. Faults in advanced machine process operations can lead to decreased product quality.
2. Deviations in advanced machine process operations always result in increased production efficiency.
3. 3Identifying and addressing faults promptly can minimize downtime in advanced machine process operations.
4. Statistical process control is a commonly used technique to detect faults in advanced machine process operations.
5. Faults or deviations in advanced machine process operations have no impact on overall productivity.

Operation sheet

Operation Title: Turing operation

Purpose: To turn the cylindrical shaft

Conditions or situations for the operations:

- Safe working area
- Properly operated tools and equipment
- Appropriate working cloths fit with the body

Equipment Tools and Materials:

- Cutting tool
- Vanier clipper

Quality Criteria: Assured performing of all the activities according to the procedures

Precautions:

- Wearing proper clothes, eye glass, glove
- Make working area hazard free
- Read and interpret manual which guide you how to use tools and equipment.

Steps in doing the task

Process Steps

Step 1: Power On and Setup

- Ensure the machine is connected to a power source.
- Turn on the machine using the power switch.
- Perform any necessary setup procedures, such as loading tools or adjusting machine settings.

Step 2: Load Material

- Prepare the material required for the operation.
- Safely load the material into the designated area of the machine, following proper handling procedures.

Step 3: Program Execution

- Load the appropriate program for the desired operation.
- Input any specific parameters or variables required for the program.
- Verify the program and settings before proceeding.

Step 4: Start Operation

- Initiate the machine operation according to the programmed instructions.

- Monitor the machine for any abnormalities or deviations from expected behavior

Step 5: Quality Control

- Perform periodic checks to ensure the produced output meets quality standards.
- Inspect the material for any defects or irregularities.
- Take necessary corrective actions if deviations are identified.

Step 6: Maintenance and Cleaning

- Conduct routine maintenance tasks as specified in the machine manual.
- Clean the machine and remove any debris or waste generated during the operation.

Step 7: Shutdown- Safely shut down the machine after completing the operation.

- Disconnect the power supply.
- Remove any remaining material and clean the workspace.

Part IV:- LAP Test

Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction: Perform the following tasks

Task: perform Turning operations

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