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AUTOMOTIVE PARTS PRODUCTION MACHINE OPERATOR

LEARNER GUIDE

National Vocational Certificate Level 3

Version 1 - October, 2019

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- **Learning Elements:**
  - This is the main content of your learner's guide with detail of the knowledge and skills (practical activities, projects, assignments, practices etc.) you will require to achieve learning outcomes stated in the curriculum
  - This section will include examples, photographs and illustrations relating to each learning outcome
- **Summary of modules**:
  - This contains the summary of the modules that make up your learner's guide
- **Frequently asked questions**:
  - These have been added to provide further explanation and clarity on some of the difficult concepts and areas. This further helps you in preparing for your assessment.
- **Multiple choice questions for self-test**:

These are provided as an exercise at the end of your learner's guide to help you in preparing for your assessment.

AUTOMOTIVE PARTS PRODUCTION MACHINE OPERATOR

Module-6
LEARNER GUIDE
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Modules

Module 6: 0716001041 Perform welding

Objective of the module: This module covers the specific skills and knowledge related to Spot-, Seam-, MIG and TIG-welding operations in automotive parts manufacturing industries, material handling and maintains machine and workplace.

Duration: 160 hours **Theory:** 32 hours **Practical:**128 hours

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1:Prepare for welding	**The trainee will be able to:** Arrange raw material as per part drawing or process sheet. Arrange consumable material. Arrange welding machine equipment as per specific job. Arrange welding jig and fixture according to	Knowledge and importance of PPEs. (i.e Protection sheet/ goggles, hand gloves, safety shoes, apron, ear plug/ muffler). Knowledge and explaining types of materials (carbon steel, stainless steel, aluminum, magnesium, copper, nickel, silicon bronze and other alloys).	Spot welding machine with accessories Seam welding machine with accessories TIG welding machine with accessories MIG welding machine with accessories

	the job.	Explaining the function and purpose of welding accessories/ components[i.e. torch body (or handle), two separate gas tubes (through the handle connected to the hoses), separate control valves, mixer chamber, flame tube, welding tip]	**PPEs** Welding helmet Protective shield Gauntlet cuff gloves Welding apron Leather gloves **tools** Chipping hammer Cross peen hammer Wire brush Wire cutter C-clamp Scriber Cooled chisel Channel lock pliers / Grip pliers Center punch CO2 Gas cylinder Argon Gas cylinder Gas cylinder regulator Sheet Gauges

			Bevel Protector Baby angle grinder Hand hacksaw Measuring tape Tri Square Set square Sprit level Bench Vicewith bench Welding bench Welding gauge set First aid box
LU2: **Prepare welding equipments and accessories**	**The trainee will be able to:** Select Electrodes for job, where applicable. Select specified welding machine. Select welding jig according to the job. Select require PPEs according to the specific job.	Knowledge of different sizes of product. Knowledge about types of electrodes (i.e. Consumable Electrodes- Non-Consumable Electrodes). Calculation of electrical current with respect to sheet thickness. Setting of gas pressure as per provided	Spot welding machine with accessories Seam welding machine with accessories TIG welding machine with accessories MIG welding machine with accessories PPEs

		material with respect to sheet thickness and its specification or parameters. Knowledge about types of welding machines (Spot Welders, Brazing/MIG Welders, Stud Welders etc.**)**	Welding helmet Protective shield Gauntlet cuff gloves Welding apron Leather gloves Chipping hammer Cross peen hammer Wire brush Wire cutter C-clamp Scriber Cooled chisel Channel lock pliers / Grip pliers Center punch CO2 Gas cylinder Argon Gas cylinder Sheet Gauges Bevel Protector Baby angle grinder Hand hacksaw

			Measuring tape Tri Square Set square Sprit level Bench Vice with bench Welding bench Welding gauge set First aid box
LU3.Perform spot welding operations	**The trainee will be able to:** Set electrode tips. Set material on spot welding electrodes. Set ampere according to material. Set holding time. Proceed with operation.	Knowledge of interpreting drawing and welding symbols. Knowledge of explaining electrode tip calculation for spot welding with the help of general formula. Knowledge and explaining the relation between holding time with the technique of job and electrode space maintaining and current calculation for spot welding.	Spot welding machine with accessories PPEs Welding helmet Protective shield Gauntlet cuff gloves Welding apron Leather gloves Chipping hammer Cross peen hammer Wire brush

			Wire cutter C-clamp Scriber Cooled chisel Channel lock pliers / Grip pliers Center punch Sheet Gauges Bevel Protector Transformer Baby angle grinder Hand hacksaw Measuring tape Tri Square Set square Sprit level Bench Vicewith bench Welding bench Welding gauge set First aid box
LU4:	**The trainee will be able to:**	Knowledge of interpreting drawing and welding	Seam welding

Perform seam welding operations	Set roller electrode. Set job on seam welding rollers. Set ampere according to material. Set pressure and speed. Proceed with operation.	symbols. Knowledge of explaining roller electrode with adjustment of RPM and pressure for seam welding. Knowledge and explaining the relation between holding time with the technique of job and electrode space maintaining and current calculation for seam welding.	machine with accessories PPEs Helmet Protective shield Gauntlet cuff gloves Welding apron Leather gloves Chipping hammer Cross peen hammer Wire brush Wire cutter C-clamp Scriber Cooled chisel Channel lock pliers / Grip pliers Center punch Sheet Gauges Bevel Protector Baby angle grinder

			Hand hacksaw Measuring tape Tri Square Set square Sprit level Bench Vice with bench Welding bench Welding gauge set First aid box
LU5: **Perform MIG/TIG welding operations**	**The trainee will be able to:** Select wire according to the job for MIG welding. Set welding machine as per job requirement. Adjust wire spool, speed and ampere. Adjust CO2 gas pressure as per requirement. Attach ground clamp with work piece. Proceed with operation. Select the electrode for TIG welding.	Knowledge about types of gases to be used in TIG/MIG welding.(i.e. Argon, CO_2). Knowledge and understanding of electrode selection as per the job requirement. Knowledge and explaining the relation between holding time with the technique of job and electrode space maintaining and current calculation for MIG/TIG welding.	TIG welding machine with accessories MIG welding machine with accessories PPEs Welding helmet Protective shield Gauntlet cuff gloves Welding apron Leather gloves Chipping hammer

	Insert electrode into the cullet. Set welding machine as per job requirement. Set argon gas pressure. Proceed with operation.		Cross peen hammer Wire brush Wire cutter C-clamp Scriber Cooled chisel Channel lock pliers / Grip pliers Center punch CO2 Gas cylinder Argon Gas cylinder Sheet Gauges Bevel Protector Baby angle grinder Hand hacksaw Measuring tape Tri Square Set square Sprit level Bench Vice with bench

			Welding bench Welding gauge set First aid box
LU6: **Inspect final work**	**The trainee will be able to:** Perform visual inspection of defects. Perform destructive testing as per job requirement. Measure dimensions for compliance as per job requirements. Complete inspection report.	Knowledge of explaining welding inspection procedures in accordance with drawing. Knowledge and understanding of welding symbols. Knowledge to make inspection report.	PPEs Welding helmet Protective shield Gauntlet cuff gloves Welding apron Leather gloves Chipping hammer Cross peen hammer Wire brush Wire cutter C-clamp Scriber Cooled chisel Channel lock pliers / Grip pliers Center punch Sheet Gauges

			Bevel Protector Hand hacksaw Measuring tape Tri Square Set square Sprit level Bench Vicewith bench Welding bench Welding gauge set First aid box
LU7: **Perform work place cleaning and maintenance**	**The trainee will be able to:** Disconnect electric connection after completion of work. Disconnect gas connections. Clean machines, work station and floor. Apply anti-rust spray/cleaning agent. Maintain tools and equipment. Keep tools and equipment at appropriate place.	Knowledge and Understanding of maintain the tools and equipment. Knowledge and Understanding Keep tools and equipment at appropriate place. Knowledge and Understanding Apply anti-rust spray/cleaning agent. Knowledge and Understanding handling waste/excess material.	PPEs Welding helmet Protective shield Gauntlet cuff gloves Welding apron Leather gloves Chipping hammer Cross peen hammer Wire brush

	Transfer wastage material into the wastage area Return excess material to store.		Wire cutter C-clamp Scriber Cooled chisel Channel lock pliers / Grip pliers Center punch CO2 Gas cylinder Argon Gas cylinder Sheet Gauges Bevel Protector Baby angle grinder Hand hacksaw Measuring tape Tri Square Set square Sprit level Bench Vice with bench Welding bench Welding gauge set First aid

Examples and Illustrations:

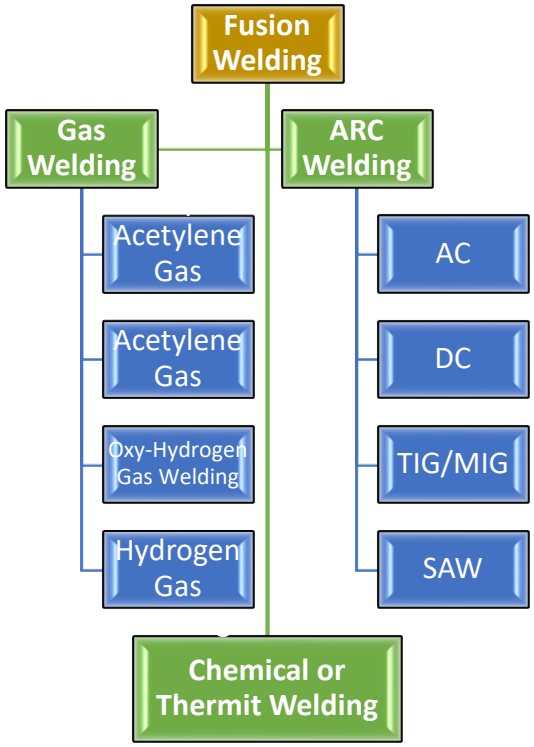
Welders join molten metal together to produce products for construction and fabrication industries. Vocational training will prepare you to work as a technician in parts manufacturing, welding and metalworking industries. You may also work in construction, manufacturing, fabrication, and quality control.

As a welder, you may perform manual welding or semiautomatic welding, where you will utilize machinery, such as a wire feeder, to perform welding tasks.

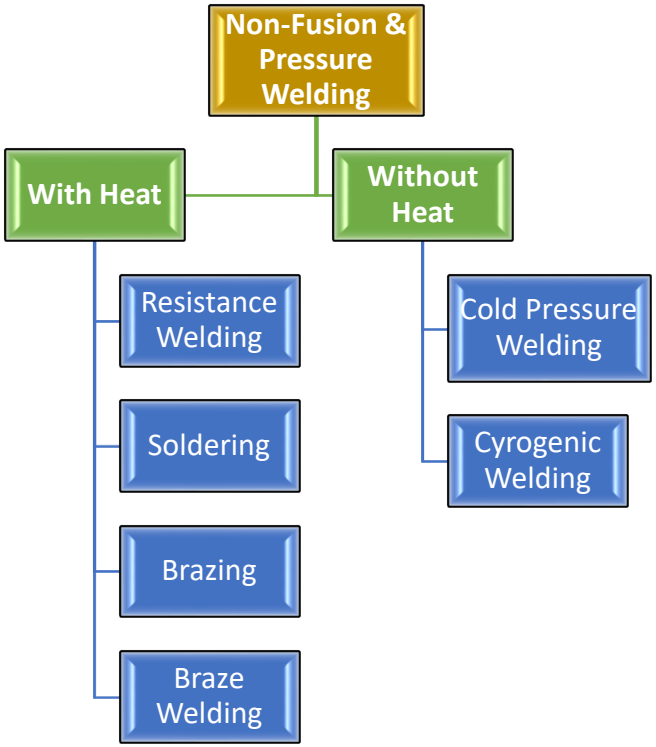
Reference:

http://victoriacollege.edu/Explore/ProgramsCourses/IndustrialTrades/Welding

Tree Diagram of Fusion Welding Process



Tree Diagram of Non-Fusion Welding Process



Tips for preparing your material before welding:

The welding process is a very important step in a variety of manufacturing and fabrication processes. All different types of metals are welded for many different types of fabrication. However, for any welding process to be accurate and effective the first time around, it is universally true that the parent material must be properly prepared.

Material preparation is so critical that it is often documented to ensure consistency in the procedure, regardless of the material. Removing coatings such as paint, oils, greases, and rust (oxides) ensures that the area to be welded is in the best possible condition.

When working with carbon steels, it is critical to remove any rust and other impurities such as mill scale. Oil-based coatings and acidic pickling chemicals also must be removed before welding takes place. Removing chromium oxide to produce a decorative finish on stainless steel alloys often is achieved in a direct process. But the subsequent cleaning of the welded area to remove any surface oxide (often seen as the discoloration next to a weld) allows for the re-formation of a protective layer that is very important in the stabilization of stainless steel alloys. This stabilization is known as passivation.

Reference:

https://www.thefabricator.com/thewelder/article/cuttingweldprep/tips-for-preparing-your-material-before-welding

Nonferrous materials present their own challenges in the weld preparation process. With metals such as aluminum and titanium, there is a shorter window of time between the surface cleaning and the welding, as oxidation can form very quickly. Cleaning large areas too early before welding often leads to the need for rework.

Spot welding this process involves applying force to adjacent surfaces and then applying an electric current near and upon the surfaces, generating intense heat. There are many variations of this technique, namely resistance welding, seam welding, butt welding, and flash welding, projection welding, and upset welding.

Reference:

https://weldinghelmetpros.com/different-types-of-welding-processes

https://ex-sound.com/spot-welding-equipment/

https://www.thefabricator.com/news/safety/rockford-systems-webinar-to-address-safety-in-spot-welding-riveting

Video:

	Topic	Hyperlink
	Resistance Spot Welding - How It Works	https://www.youtube.com/watch?v=AwL1CAg43PU

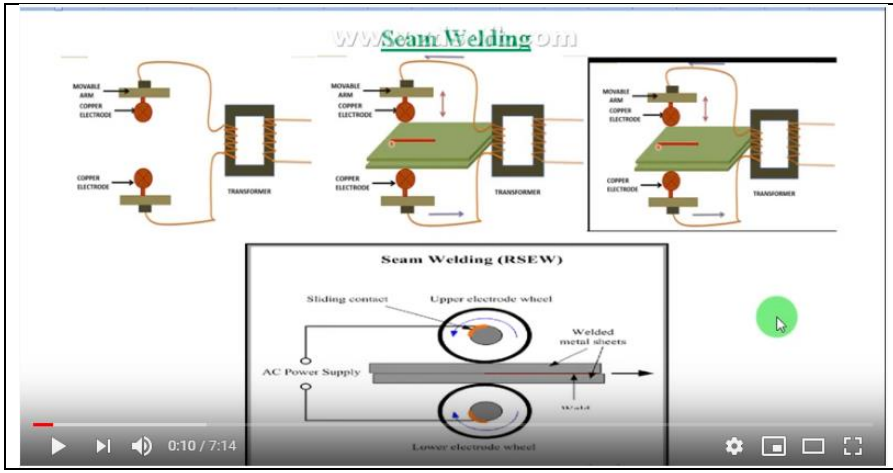
Seam welding the working principle of seam welding is similar to the working principle of resistance welding. According to the working principle of the seam welding, the heat required at the time of the welding is produced due to the resistance of the material. In a simple language, heat generation takes place due to the resistance of the material. Have you ever heard about continuous spot welding? The continuous spot welding is nothing but the seam welding. In the seam welding, we use the electrode of roller type. The two rollers have an identical size. Here, these roller type electrodes are brought in contact with the work piece. Then, the electric current is supplied to these rollers. As the supplied current is very high the interface surface between the roller and the work piece starts to melt and thus, a strong weld joint is formed. After that, these rollers start to rotate on the surface of the work piece. As these rollers move, a generation of a continuous joint is formed. Are you curious to know about the welding speed in case of the seam welding? Well, the welding speed is 60 in/min in this welding technique. This speed is assumed to be standard but if you consider the practical applications then, there are chances that this speed may increase or decrease.

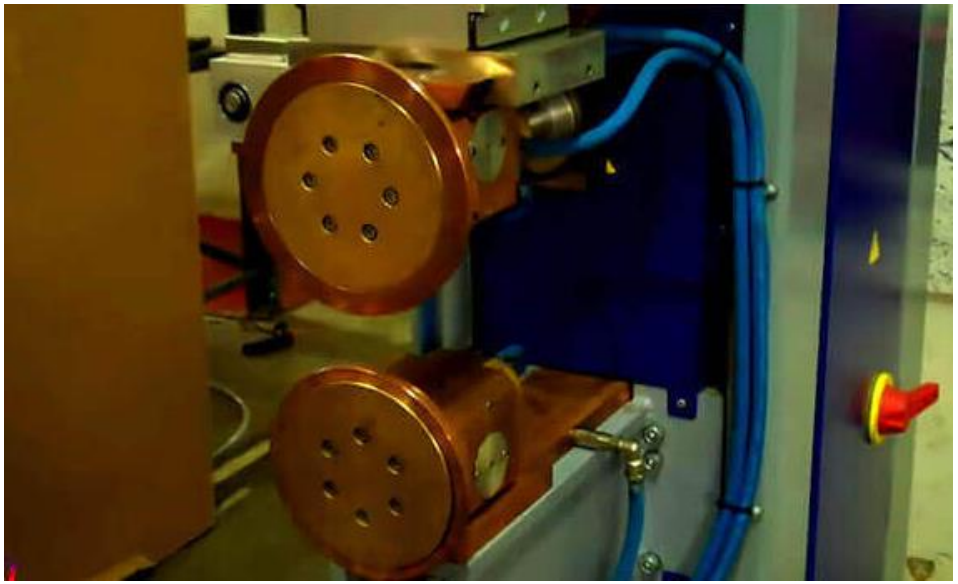
Reference:

https://www.theweldingmaster.com/what-is-seam-welding/

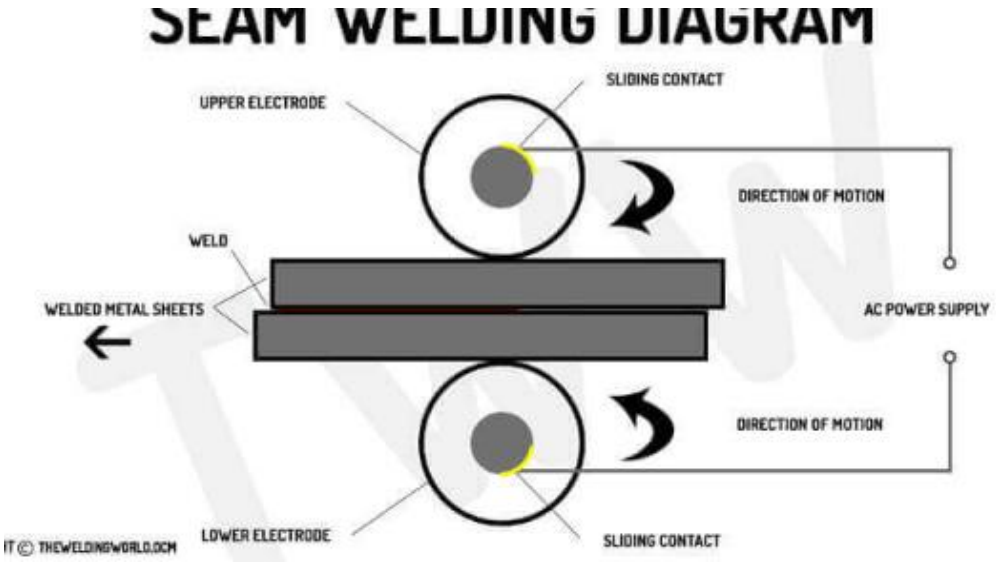
Videos:

	Topic	Hyperlink
	Seam Welding for Fuel Tank	https://www.youtube.com/watch?v=PuGgHOfEVio

	Seam Welding Process (Definition,Principle , working)	https://www.youtube.com/watch?v=OguUU4G0Ttg



https://theweldingworld.com/seam-welding/



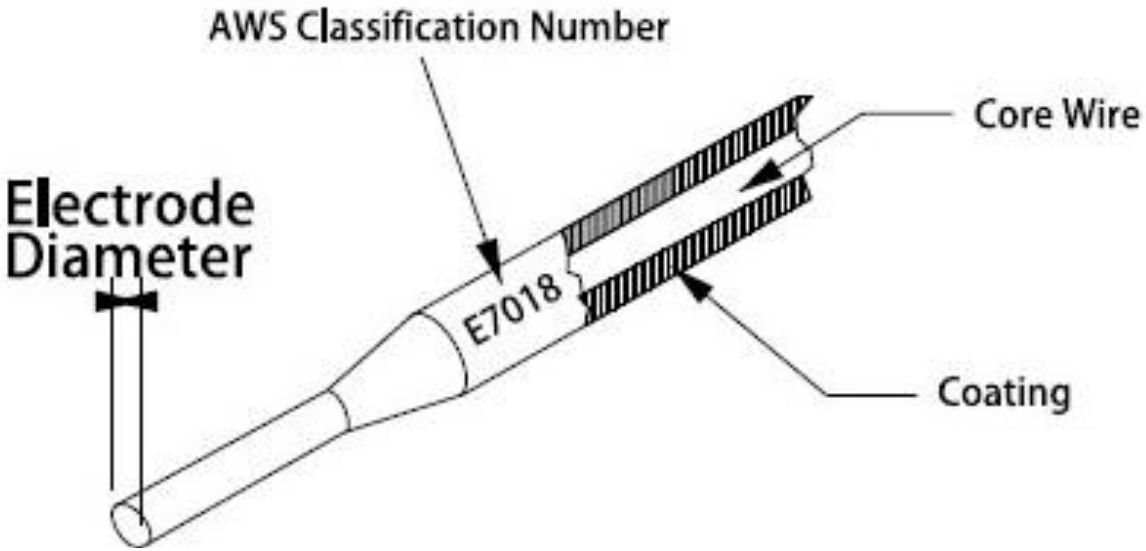
https://theweldingworld.com/seam-welding/

Arc welding uses an electrical arc to melt the work materials as well as filler material (sometimes called the welding rod) for welding joints. Arc welding involves attaching a grounding wire to the welding material or other metal surface. Another wire known as an electrode lead is placed on the material to be welded. Once that lead is pulled away from the material, an electric arc is generated. It's a little like the sparks you see when pulling jumper cables off a car battery. The arc then melts the work pieces along with the filler material that helps to join the pieces.

Feeding the filler into the welding joint takes steady hands and an eye for detail. As the rod melts, the welder must continuously feed the filler into the joint using small, steady, back-and-forth motions. These motions are what gives welds their distinctive appearance. Going too fast or slow, or holding the arc too close or far away from the material can create poor welds.

Reference:https://science.howstuffworks.com/welding3.htm

https://weldinghelmetpros.com/different-types-of-welding-processes



https://www.pipingengineer.org/welding-electrode-classification-for-smaw/

Video:

	Topic	Hyperlink
	How to Arc Weld	https://www.youtube.com/watch?v=CoHVA7nr82A

MIG Welding

New welders just learning how to weld should start with metal inert gas (MIG) welding, also known as gas metal arc welding (GMAW). MIG is a type of electric arc welding, which relies on creating an electrical circuit that runs through the objects to be welded together and a welding wire, which acts as an electrode.

When the welding wire touches the metal object, the circuit is completed. The wire is then pulled back a short distance, causing an electric arc that heat up to thousands of degrees Fahrenheit, melting the wire and partially melting the two pieces of metal. This creates a melt pool where all three metals merge to become one as it cools and solidifies, leaving a bead along the welded seam.

As the welding action continues down the seam, the wire melts off and more wire is fed continuously from the tip of the welding gun. At the same time, a gas is diffused from the gun, spreading around the arc to shield the welded area from contaminants in the air, such as oxygen and nitrogen.

Reference:

https://www.industrialmetalsupply.com/blog/how-to-weld-a-beginners-guide/

https://weldinghelmetpros.com/different-types-of-welding-processes

Video:

	Topic	Hyperlink
	MIG Welding Basics	https://www.youtube.com/watch?v=U1GTgDQFE4A

TIG Welding

TIG Welding stands for Tungsten Inert Gas and is a technique that's known for using a non-consumable tungsten electrode along with an inert gas (usually argon). Tungsten is a rare, hard element that offers a high purity, high-quality weld.

In TIG welding, the heat is created by running an electric current through a tungsten electrode, creating an arc that is then used to melt a metal wire in order to create the weld pool.

TIG welding is the most popular welding technique used today because it offers a high degree of purity, a clean weld and it can be used in many industrial, residential and commercial applications. TIG is most commonly used to weld stainless steel together, although other metals like magnesium, aluminum, copper and nickel can be welded using TIG.

TIG Welding is highly popular in industries that work with nonferrous metals and it is commonly used in the manufacturing of vehicles, tubing, bicycles, as well as the maintenance and repair of tools and dies made of aluminum, magnesium and stainless steel and it is the preferred technique by engineers who demand a high degree of precision on their welds as it offers greater control over the weld area than other welding processes, although the final quality of the weld will be affected by factors such as cleanliness, operator skill, quality of the materials being used and other external factors such as rust or grit

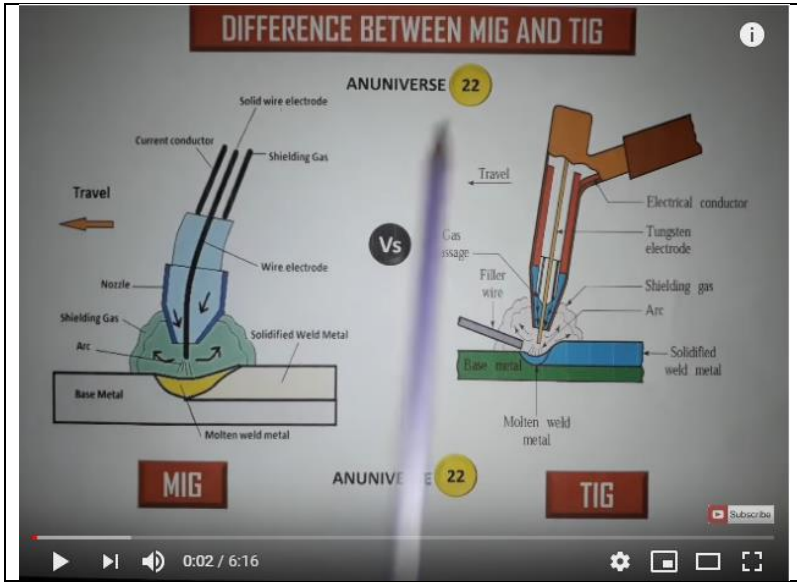
Reference:

https://weldinghelmetpros.com/different-types-of-welding-processes

https://weldinghelmetpros.com/different-types-of-welding-processes

Videos:

	Topic	Hyperlink
	TIG Welding Tips and Techniques	https://www.youtube.com/watch?v=tNYmo2_DI6c

		DIFFERENCE BETWEEN MIG WELDING AND TIG WELDING	https://www.youtube.com/watch?v=IBjMuA_D9ws

Welding Visual Inspection.

SCOPE

- This procedure covers the visual examination of welding in components such as -plates, welds, etc. by using Visual and Optical aids and Gauges.
- The Visual Examination of the welds shall be performed before, during and after welding.
- Uniformity of surface, cleanliness & sharp edges can be checked on final completion of fabrication.

TEST PARAMETERS

Lighting Conditions:

- Visual examination shall be performed in well-lit condition having minimum light intensity of 1000 Lux at the examination surface.
- Lighting used may be natural light or 100 Watt electric bulb at appropriate distance as measured by lux meter.

Surface Roughness:

- The surface to be examined shall be free from all dirt, grease, lint, oil, scale or slag.
- The surface roughness values shall be as per the drawing requirements.
- Weld surface irregularities can be removed by grinding.
- While doing grinding for removal of weld surface irregularities or excessive reinforcement, the ground surface shall be smooth curvature without leaving any sharp corner.

Position of the examiner with respect to the job condition:

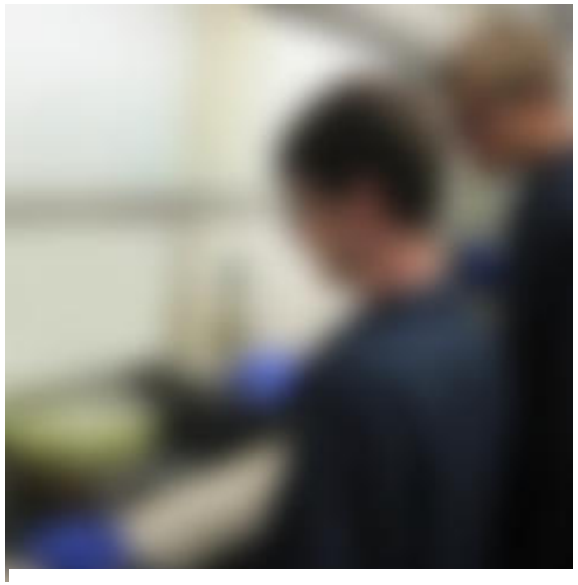
- Direct visual examination shall be carried out at locations where sufficient access is available with maximum distance between the test surface and the eyes are 600 mm
- The angle between the eyes and the test surface must be greater than 30 degrees from the test surface.
- Magnifying lens can be used for identification of the type of discontinuities but not for the acceptance of the discontinuity.

Reference:

https://webcache.googleusercontent.com/search?q=cache:oM4A1cxEPPsJ:https://etenders.dpsdae.gov.in/tender_document/tender_12214/tender_doc/Visual_inspection_procedure.pdf+&cd=24&hl=en&ct=clnk&gl=pk

https://www.123rf.com/photo_69902914_visual-inspections-of-the-weld-pipe-with-a-magnifying-glass.html

https://es.123rf.com/photo_50296131_soldadura-inspecci%C3%B3n-dimensi%C3%B3n-soldando-galga.html



https://www.labtesting.com/services/weld-testing/

Destructive weld testing methods.

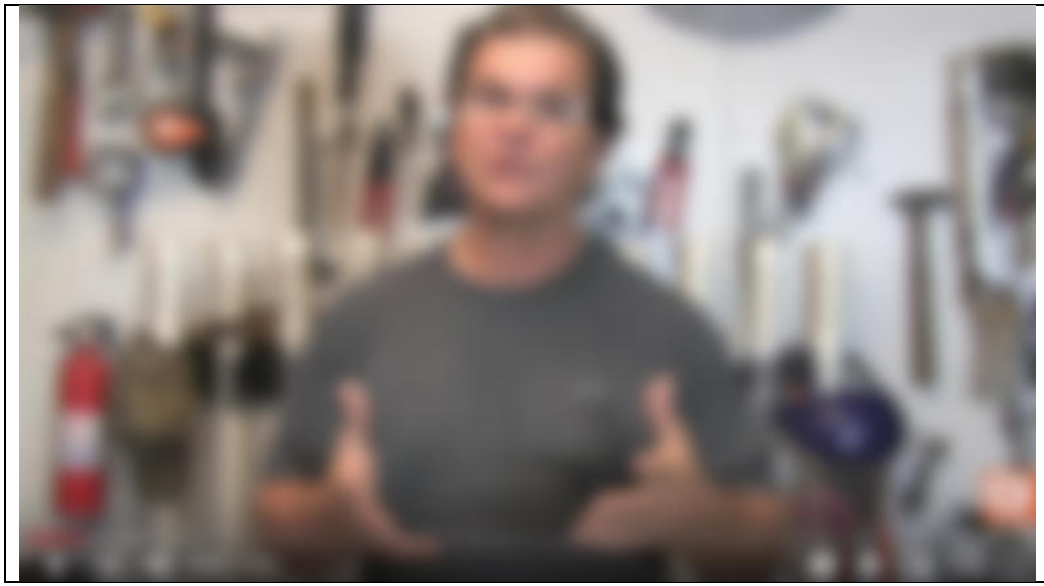
Macro etch testing.

This method requires the removal of small samples from the welded joint. These samples are then polished at their cross section and etched using a mild acid mixture, depending on the base material used. The acid etch provides a clear visual of the weld's internal structure.

Inspection of the etched sample reveals depth of penetration, as well as evidence (if any) of lack of fusion, inadequate root penetration, internal porosity, and cracking shown at the fusion line (which is the transition between the weld and the base material).

This type of inspection is a snapshot of the overall weld-length quality when used for sampling inspection of production welds. Macro etch testing is also used successfully in failure analyses to pinpoint welding problems such as crack initiation.

Video:

	Topic	Hyperlink
	Mig Welding Cut and Etch Tests	https://www.youtube.com/watch?v=9f-HRsTtx0w

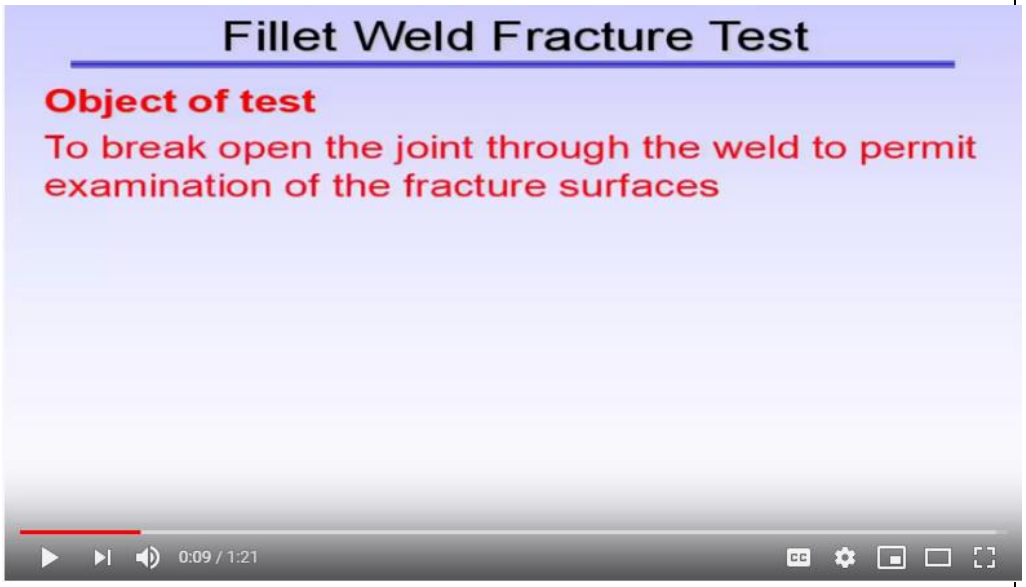
Fillet weld break test.

This type of testing involves breaking a sample fillet weld that is welded on one side only. The sample has a load applied to its unwelded side, typically in a press, and the load is increased until the weld fails. The failed sample is then inspected to establish the presence and extent of any welding discontinuities.

Fillet weld break tests provide a good indication of discontinuities within the entire length of the weld tested (normally 6 to 12 inches) rather than a cross-sectional snapshot, like the macro etch test. This type of weld inspection can detect such items as lack of fusion, internal porosity, and slag inclusions.

Though the fillet weld break test is often used on its own, it can also be used in conjunction with the macro etch test, as the two methods complement each other by providing information on similar characteristics but with different detail.

Video:

	Topic	Hyperlink
	CSWIP 3.1- Fillet weld fracture test- Mechanical testing	https://www.youtube.com/watch?v=jNYYwneo69o

Transverse tension test.

Because a large portion of design is based on tensile properties in the welded joint, it is important that the tensile properties of the base metal, the weld metal, the bond between the base and the weld, and the heat-affected zone conform to design requirements.

The transverse tension test checks all this by pulling specimens to failure and then dividing the maximum load required during testing by the cross-sectional area. The result is in units of tension per cross-sectional area.

Video:

	Topic	Hyperlink
	Weld Tensile Test Overview	https://www.youtube.com/watch?v=SHHGuDKqkbc

Guided bend test.

This is a test method that involves bending a specimen to a specified bend radius. Various types of bend tests are used to evaluate the ductility and soundness of welded joints. Guided bend tests are usually taken transverse to the weld axis and may be bent in plunger-type test machines or in wraparound bend test jigs. Face bend tests are made with the weld face in tension, while root bend tests are made with the weld root in tension. When bend testing thick plates, side bend test specimens are usually cut from the welded joint and bent with the weld cross section in tension.

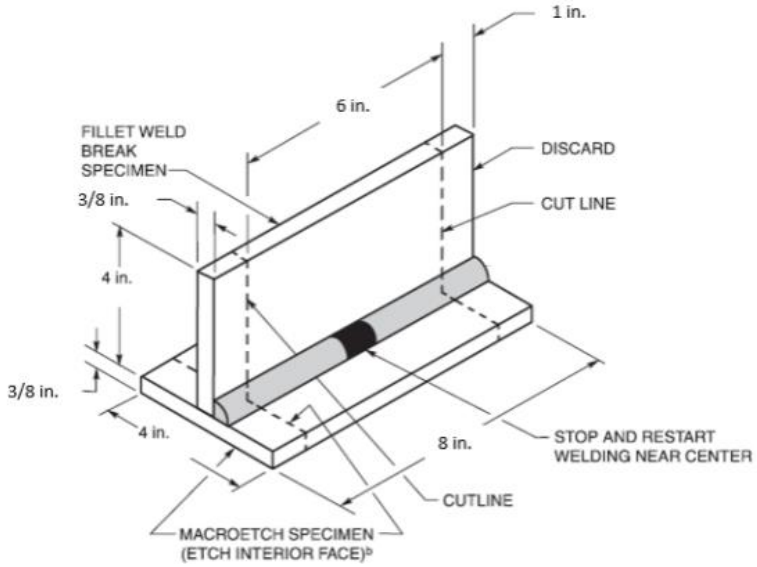
The guided bend test is most commonly used in welding procedure and welder performance qualification tests. This type of testing is particularly good at finding liner fusion defects, which will often open up in the plate surface during testing.

Reference:

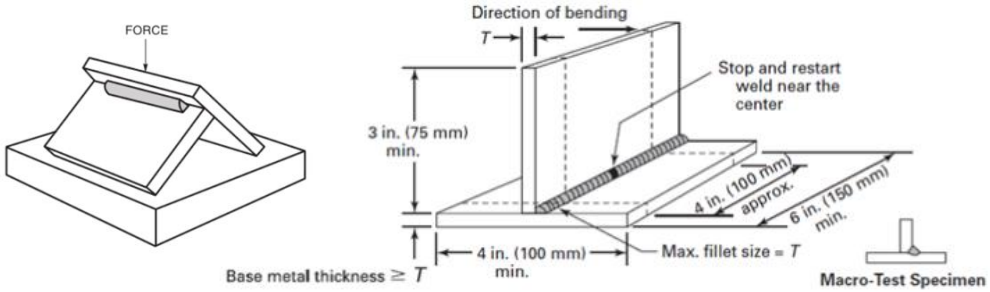
https://www.esabna.com/us/en/education/blog/destructive-testing-of-welds.cfm

Video:

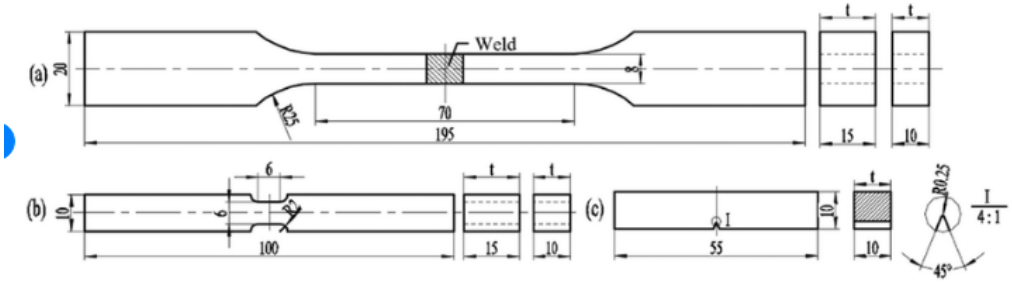
	Topic	Hyperlink
	Tips to Pass a 1G Stick Weld and BEND TEST	https://www.youtube.com/watch?v=SPfCtBbPwhc



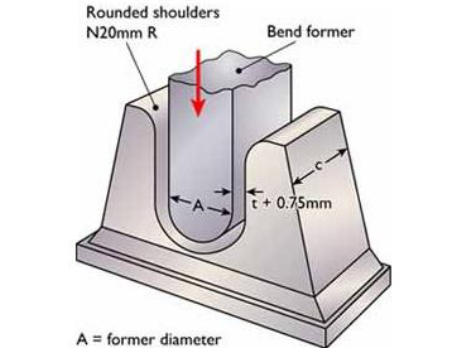
https://penetrationprofilers.weebly.com/test-procedures.html

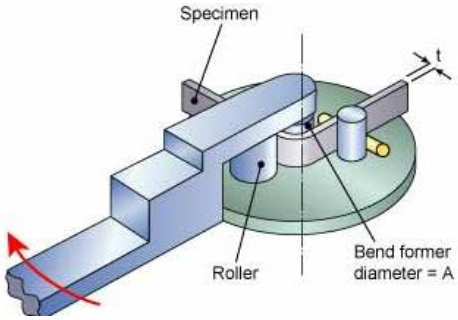


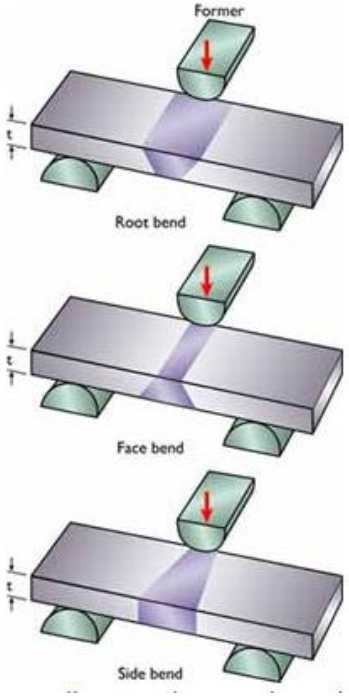
https://weldknowledge.com/2017/06/12/fillet-weld-break-test-fracture-test/



https://www.researchgate.net/figure/Specimen-geometries-for-a-transverse-tensile-tests-long-samples-b-transverse_fig6_316205137







https://www.twi-global.com/technical-knowledge/job-knowledge/bend-testing-073

Workplace Housekeeping - Basic Guide

Why should we pay attention to housekeeping at work?

Effective housekeeping can help control or eliminate workplace hazards. Poor housekeeping practices frequently contribute to incidents. If the sight of paper, debris, clutter and spills is accepted as normal, then other more serious hazards may be taken for granted.

Housekeeping is not just cleanliness. It includes keeping work areas neat and orderly, maintaining halls and floors free of slip and trip hazards, and removing of waste materials (e.g., paper, cardboard) and other fire hazards from work areas. It also requires paying attention to important details such as the layout of the whole workplace, aisle marking, the adequacy of storage facilities, and maintenance. Good housekeeping is also a basic part of incident and fire prevention.

Effective housekeeping is an ongoing operation: it is not a one-time or hit-and-miss cleanup done occasionally. Periodic "panic" cleanups are costly and ineffective in reducing incidents

What is the purpose of workplace housekeeping?

Poor housekeeping can be a cause of incidents, such as:

- tripping over loose objects on floors, stairs and platforms
- being hit by falling objects
- slipping on greasy, wet or dirty surfaces
- striking against projecting, poorly stacked items or misplaced material
- cutting, puncturing, or tearing the skin of hands or other parts of the body on projecting nails, wire or steel strapping

To avoid these hazards, a workplace must "maintain" order throughout a workday. Although this effort requires a great deal of management and planning, the benefits are many.

What are some benefits of good housekeeping practices?

Effective housekeeping results in:

- reduced handling to ease the flow of materials
- fewer tripping and slipping incidents in clutter-free and spill-free work areas
- decreased fire hazards

- lower worker exposures to hazardous products (e.g. dusts, vapors)
- better control of tools and materials, including inventory and supplies
- more efficient equipment cleanup and maintenance
- better hygienic conditions leading to improved health
- more effective use of space
- reduced property damage by improving preventive maintenance
- less janitorial work
- improved morale
- improved productivity (tools and materials will be easy to find)

How do I plan a good housekeeping program?

A good housekeeping program plans and manages the orderly storage and movement of materials from point of entry to exit. It includes a material flow plan to ensure minimal handling. The plan also makes sure that work areas are not used as storage areas by having workers move materials to and from work areas as needed. Part of the plan could include investing in extra bins and more frequent disposal.

The costs of this investment could be offset by the elimination of repeated handling of the same material and more effective use of the workers' time. Often, ineffective or insufficient storage planning results in materials being handled many times and being stored in hazardous ways. Knowing the workplace layout and the movement of materials throughout it will help when planning work procedures.

Worker training is an essential part of any good housekeeping program. Workers need to know how to work safely with the products they use. They also need to know how to protect other workers such as by posting signs (e.g., "Wet - Slippery Floor") and reporting any unusual conditions.

Housekeeping order is "maintained" not "achieved." Cleaning and organization must be done regularly, not just at the end of the shift. Integrating housekeeping into jobs can help ensure this is done. A good housekeeping program identifies and assigns responsibilities for the following:

- clean up during the shift
- day-to-day cleanup
- waste disposal
- removal of unused materials
- inspection to ensure cleanup is complete

Do not forget out-of-the-way places such as shelves, basements, sheds, and boiler rooms that would otherwise be overlooked.

The final step to any housekeeping program is inspection. It is the only way to check for deficiencies in the program so that changes can be made. Examples of checklists include inspecting offices and manufacturing facilities.

What are the elements of an effective housekeeping program?

Maintenance

The maintenance of buildings and equipment may be the most important element of good housekeeping. Maintenance involves keeping buildings, equipment and machinery in safe, efficient working order and in good repair. It includes maintaining sanitary facilities and regularly painting and cleaning walls. Broken windows, damaged doors, defective plumbing and broken floor surfaces can make a workplace look neglected; these conditions can cause incidents and affect work practices. So it is important to replace or fix broken or damaged items as quickly as possible. A good maintenance program provides for the inspection, maintenance, upkeep and repair of tools, equipment, machines and processes.

Dust and Dirt Removal

Enclosures and exhaust ventilation systems may fail to collect dust, dirt and chips adequately. Vacuum cleaners are suitable for removing light dust and dirt that is not otherwise hazardous. Industrial models have special fittings for cleaning walls, ceilings, ledges, machinery, and other hard-to-reach places where dust and dirt may accumulate.

Special-purpose vacuums are useful for removing hazardous products. For example, vacuum cleaners fitted with HEPA (high efficiency particulate air) filters may be used to capture fine particles of asbestos or fiber glass.

Dampening (wetting) floors or using sweeping compounds before sweeping reduces the amount of airborne dust. The dust and grime that collect in places like shelves, piping, conduits, light fixtures, reflectors, windows, cupboards and lockers may require manual cleaning.

Compressed air should not be used for removing dust, dirt or chips from equipment or work surfaces.

Employee Facilities

Employee facilities need to be adequate, clean and well maintained. Lockers may be necessary for storing employees' personal belongings. Washroom facilities require cleaning once or more each shift. They also need to have a good supply of soap, towels plus disinfectants, if needed.

If workers are using hazardous products, employee facilities should provide special precautions as needed such as showers, washing facilities and change rooms. Some facilities may require two locker rooms with showers between. Using such double locker rooms allows workers to shower off workplace contaminants and reduces the chance of contaminating their "street clothes" by keeping their work clothes separated from the clothing that they wear home.

Smoking, eating or drinking in the work area should be prohibited where hazardous products are handled. The eating area should be separate from the work area and should be cleaned properly each shift.

Surfaces

Floors: Poor floor conditions are a leading cause of incidents so cleaning up spilled oil and other liquids at once is important. Allowing chips, shavings and dust to accumulate can also cause incidents. Trapping chips, shavings and dust before they reach the floor or cleaning them up regularly can prevent their accumulation. Areas that cannot be cleaned continuously, such as entrance ways, should have anti-slip flooring. Keeping floors in good order also means replacing any worn, ripped, or damaged flooring that poses a tripping hazard.

Walls: Light-coloured walls reflect light while dirty or dark-colored walls absorb light. Contrasting colors warn of physical hazards and mark obstructions such as pillars. Paint can highlight railings, guards and other safety equipment, but should never be used as a substitute for guarding. The program should outline the regulations and standards for colors.

Maintain Light Fixtures

Dirty light fixtures reduce essential light levels. Clean light fixtures can improve lighting efficiency significantly.

Aisles and Stairways

Aisles should be wide enough to accommodate people and vehicles comfortably and safely. Aisle space allows for the movement of people, products and materials. Warning signs and mirrors can improve sight-lines in blind corners. Arranging aisles properly encourages people to use them so that they do not take shortcuts through hazardous areas.

Keeping aisles and stairways clear is important. They should not be used for temporary "overflow" or "bottleneck" storage. Stairways and aisles also require adequate lighting.

Spill Control

The best way to control spills is to stop them before they happen. Regularly cleaning and maintaining machines and equipment is one way. Another is to use drip pans and guards where possible spills might occur. When spills do occur, it is important to clean them up immediately. Absorbent materials are useful for wiping up greasy, oily or other liquid spills. Used absorbents must be disposed of properly and safely.

Tools and Equipment

Tool housekeeping is very important, whether in the tool room, on the rack, in the yard, or on the bench. Tools require suitable fixtures with marked locations to provide an orderly arrangement. Returning tools promptly after use reduces the chance of it being misplaced or lost. Workers should regularly inspect, clean and repair all tools and take any damaged or worn tools out of service.

Waste Disposal

The regular collection, grading and sorting of scrap contribute to good housekeeping practices. It also makes it possible to separate materials that can be recycled from those going to waste disposal facilities.

Allowing material to build up on the floor wastes time and energy since additional time is required for cleaning it up. Placing scrap containers near where the waste is produced encourages orderly waste disposal and makes collection easier. All waste receptacles should be clearly labeled (e.g., recyclable glass, plastic, scrap metal, etc.).

Storage

Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual material handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should allow at least one meter (or about three feet) of clear space under sprinkler heads.

Stacking cartons and drums on a firm foundation and cross tying them, where necessary, reduces the chance of their movement. Stored materials should not obstruct aisles, stairs, exits, fire equipment, emergency eyewash fountains, emergency showers, or first aid stations. All storage areas should be clearly marked.

Flammable, combustible, toxic and other hazardous materials should be stored in approved containers in designated areas that are appropriate for the different hazards that they pose. Storage of materials should meet all requirements specified in the fire codes and the regulations of environmental and occupational health and safety agencies in your jurisdiction.

Reference:

https://www.ccohs.ca/oshanswers/hsprograms/house.html

AUTOMOTIVE PARTS PRODUCTION MACHINE OPERATOR

Module-7
LEARNER GUIDE
National Vocational Certificate Level 3

Version 1 - October, 2019

Module 7: 0716001042 Apply thread rolling operation

Objective of the module: This module covers the specific skills and knowledge related to perform for thread rolling operation, material handling, formulation/construction, defects &remedies and maintains machine and workplace.

Duration: 100 hours **Theory:** 20 hours **Practical:** 80 hours

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1. **Prepare for thread rolling**	**The trainee will be able to:** Arrange material as per drawing or process sheet. Select tools and equipment. Set the machine as per job specification.	Knowledge of interpreting drawing or process sheet. Knowledge about ypes of material (i.e. Alloy Steel, Stainless Steel, Carbon Steel, Aluminum, Titanium, Copper Beryllium Copper, Brass etc.) Knowledge and Understanding how to select the tools and equipment. Knowledge and Understanding how to set machine as per job specification.	PPEs Thread rolling machine Thread gauges different standards (ISO & BSI) Different types and size of dies Wrenches Allen-Keys Set Socket Set with handle Combination spanner set Brass Hammer Profile Projector Vernier caliper

			Micro meter Thread pitch gauge set (ISO & BSI standard) Thread ring gauge set (ISO & BSI standard) First aid box
LU2. **Conduct pre-operational checks on machine**	**The trainee will be able to:** Inspect all electrical connection. Check all mechanical fitting and joints. Check operation of emergency switches. Check and maintain correct coolant level. Check and maintain correct air pressure. Check and maintain proper lubrication. Change thread roller as per requirement. Insert material in vibrating bowl. Set the distance of tools according to the job. Check material easily shifting from vibrating bowl to slide.	Knowledge and Understanding how to check electrical connections Knowledge and Understanding how to check mechanical fitting and joints. Knowledge and Understanding how to check emergency switches. Knowledge and Understanding how to check machine lubricant, temperature, pressures and coolant. Knowledge and Understanding types of thread roller (i.e. In feed rolling (plunge, thru feed rolling). Knowledge and Understanding operation of machine. Knowledge and Understanding of tool setting.	PPEs Thread rolling machine Thread gauges different standards (ISO & BSI) Different types and size of dies Wrenches Allen-Keys Set Socket Set with handle Combination spanner set Brass Hammer Profile Projector Vernier caliper Micro meter Thread pitch gauge set

			(ISO & BSI standard) Thread ring gauge set (ISO & BSI standard) First aid box
LU3. **Prepare thread rolling die**	**The trainee will be able to:** Replace the thread roller. Check the die holder Hold the thread roller. Fasten the die by using appropriate tools and/or equipment. Set die alignment.	Understanding of how to lift roller. Understanding the method of roller clamping. Understanding of roller alignment. Understanding and importance of parameters setting. Knowledge and Understanding of trial of roller to verify the operation.	PPEs Thread rolling machine Thread gauges different standards (ISO & BSI) Different types and size of dies Wrenches Allen-Keys Set Socket Set with handle Combination spanner set Brass Hammer Profile Projector Vernier caliper Micro meter Thread pitch gauge set (ISO & BSI standard) Thread ring gauge set

			(ISO & BSI standard) First aid box
LU4. Operate machine	**The trainee will be able to:** Set all parameters. Proceed with operation. Monitor operation to ensure compliance with job requirements.	Knowledge and Understanding of speed and feed. Knowledge and Understanding thread rolling defects. Knowledge and Understanding machine selection. Understanding and importance of parameters setting. Knowledge and Understanding of thread rolling operation Knowledge of monitoring operation. Knowledge and Understanding of different parts of machine Knowledge and Understanding of types of threads. Knowledge and Understanding of fits and limits system. Knowledge and Understanding of thread standards. Knowledge and Understanding of material types. Knowledge and Understanding of types of	PPEs Thread rolling machine Thread gauges different standards (ISO & BSI) Different types and size of dies Wrenches Allen-Keys Set Socket Set with handle Combination spanner set Brass Hammer Profile Projector Vernier caliper Micro meter Thread pitch gauge set (ISO & BSI standard) Thread ring gauge set (ISO & BSI standard)

		threading (i.e. die/ roller) Knowledge and Understanding of threading techniques.	First aid box
LU5. **Inspect final product**	**The trainee will be able to:** Perform visual inspection of defects. Check blank dia before cutting. Check the thread profile. Inspect with the thread gauge. Complete inspection report.	Knowledge and Understanding of visual inspection. Understanding how to Check final product dimensionally. Knowledge and Understanding how to check with the gauges. Knowledge and Understanding how to make inspection report.	Thread gauges different standards (ISO & BSI) Brass Hammer Profile Projector Vernier caliper Micro meter Thread pitch gauge set (ISO & BSI standard) Thread ring gauge set (ISO & BSI standard) First aid box
LU. 6 **Perform workplace cleaning and maintenance**	**The trainee will be able to:** Maintain all check sheets and work instruction on machine. Perform cleaning of die, machine and floor. Apply anti-rust spray/cleaning agent. Perform lubrication on slides and die.	Knowledge and Understanding how to maintain all check sheets and work instructions of the machine. Knowledge and Understanding how to maintain tools and equipment. Knowledge and Understanding how to keep tools and equipment at their appropriate place. Knowledge and Understanding about lubricants	PPEs Thread rolling machine Different types and size of dies Wrenches Allen-Keys Set

	Maintain tools and equipment. Keep tools and equipment at appropriate place. Transfer wastage material in to the wastage area. Return excess material to store.	and lubrication. Knowledge and Understanding how to perform cleaning of machine, mould/die and floor. Knowledge and Understanding how to apply anti-rust spray/cleaning agent. Knowledge and Understanding about handling waste/excess material.	Socket Set with handle Combination spanner set Brass Hammer Profile Projector Vernier caliper Micro meter Thread pitch gauge set (ISO & BSI standard) Thread ring gauge set (ISO & BSI standard) First aid box

Examples and Illustrations:

Thread rolling is the preferred method for producing strong, smooth, precise, and uniform external thread forms. Thread rolling is different from other types of threading processes like cutting, grinding, and chasing.

Thread rolling is a cold forging process that can be performed on any ductile metal. The forming process can be used to produce other special forms, such as knurls. For the best quality threads, the process is performed on precision center less ground blanks. The blank diameter of a rolled thread is at the pitch diameter, a theoretical point between the major diameter and minor diameter.

http://horstengineering.com/threadrolling/process/thread-rolling/

Thread Rolling:

Using the process with two (2) Rolling Dies the work piece is typically placed on a supporting blade. At least one (1) rolling slide has a feed movement to perform the forming process. Simultaneously the dies are rotating synchronously in contact with the work piece, whereas the profile will be formed out.

Rolling force Parameters:

- **Hardness** - the higher, the higher the force
- **Deformation** - the bigger, the higher the force
- **Contact area** - the bigger, the higher the force

In feed rolling with Circular dies

In feed thread rolling is based on one parameter: work piece lead = rolling die lead. This results in a synchro rotational movement of part and dies. No axial movement occurs. Necessary rolling force is defined by thread diameter and length.

Biggest Advantage of in feed rolling process is the Speed. There simply is no faster process to manufacture Threads especially with big sizes.

Through feed rolling with Groove Dies

Through feed thread rolling is always used when work piece profile is longer than max. rolling die width.

Through feed dies have 3 different areas: Lead-in, Calibration area and Lead-out. The sketch pictures Groove Dies without any lead. Lead angle results from swiveling of dies.

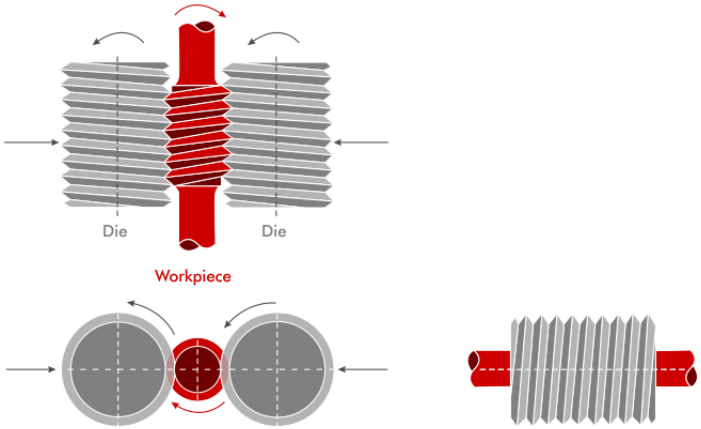
Through feed Rolling with Lead Corrected Dies:

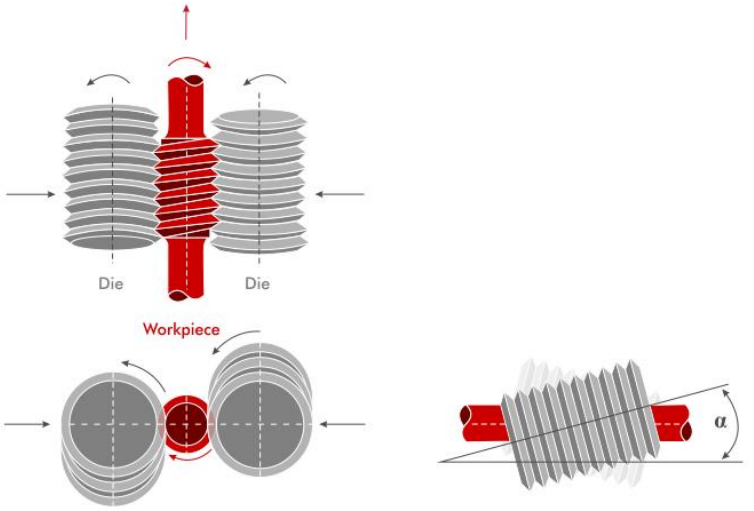
Lead corrected Dies are different from Groove Dies. They have a lead included in profile. Additionally these dies are swiveled. The sum of lead angle of dies and swivel angle = lead angle of work piece.

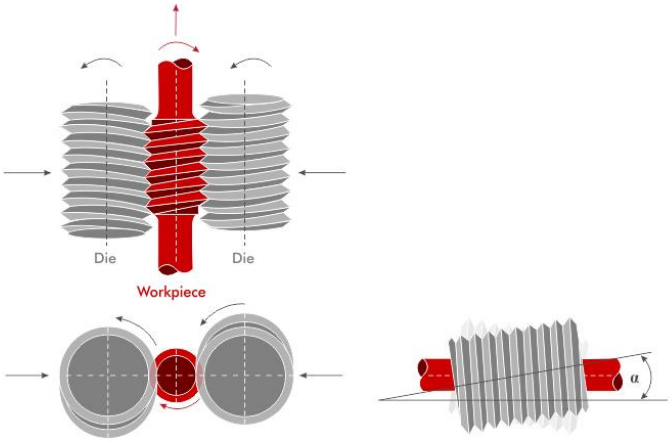
With the through feed rolling using lead corrected Rolling Dies even smaller machines with medium Rolling force can be used for big threads.

Reference:

https://www.profiroll.com/en/process/thread-and-profile-rolling/



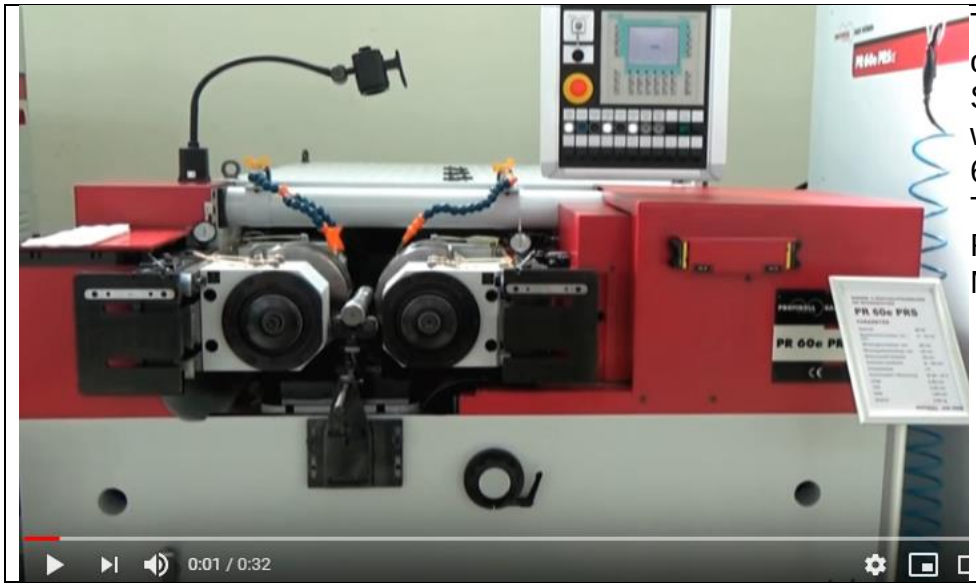




http://www.flexial.com/downloads/qp158-e.pdf

Videos:

	Topic	Hyperlink
	Thread Rolling Process	https://www.youtube.com/watch?v=rwArBBcUNr4

	Thread on a Stud bolt with a 60-tons Thread Rolling Machine	https://www.youtube.com/watch?v=HwO0eSOKESs#action=share

Inspection of External Threads:

- Checking the Major Diameter Use a micrometer and apply only light pressure so there is no damage to the part.
- Checking Root Radius. Use a CMM, comparator, or vision system to check the root radius on external threads.
- Checking the Pitch Diameter of Threads Using GO and NOGO Thread Ring Gages.
- The use of the GO gage must allow for free acceptance. This means minimal force (torque) is required to install and thread the ring gage throughout the entire length of specified thread area. Thread gage until finger-tight using 3 fingers. Do not overtorque as this will damage the gage and possibly the part. Do not use your palm or fist as this will over-torque.

- The NOGO gage should be accepted for no more than half (1/2) a turn for parts with 3 threads or less and no more than three (3) turns for parts with more than 3 threads.

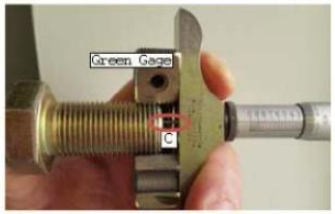
- Checking the Thread Depth or Length Measurement Using Thread Ring Gages.

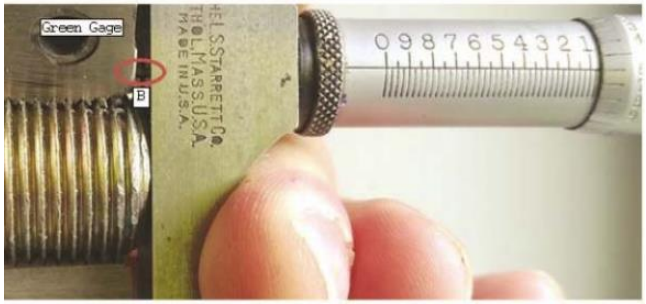
- Using a depth micrometer, measure the GO gage from the face of the ring to the center of the lead thread on the other side of the gage (A).

- Thread gage onto part and subtract or add the difference to your measurement. Depth = A - C 5.3.4.3.
  When part extends past the face of the thread ring, Depth = B + A.

Reference:

http://www.flexial.com/downloads/gp158-e.pdf





http://www.flexial.com/downloads/gp158-e.pdf

Videos:

	Topic	Hyperlink
	Identifying Thread Pitch & Size	https://www.youtube.com/watch?v=Gdvtw0pTAOs

	Tapered Thread Inspection Systems	https://www.youtube.com/watch?v=wRek5hdQNzo

Workplace Housekeeping - Basic Guide

Note: Please see the workplace housekeeping in module-6 Perform welding

AUTOMOTIVE PARTS PRODUCTION MACHINE OPERATOR

Module-8
LEARNER GUIDE
National Vocational Certificate Level 3

Version 1 - October, 2019

Module 8: 0716001043 Perform vacuum forming operation

Objective of the module: This competency standard covers the specific skills and knowledge related to perform vacuum forming operation, material handling, formulation/construction, defects & remedies and maintains machine and workplace.

Duration: 100 hours **Theory:** 20 hours **Practical:**80 hours

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1.Prepare for vacuum forming	**The trainee will be able to:** Arrange material as per drawing or process sheet. Select the tools and equipment. Set machine as per job specification	Knowledge and Understanding how to arrange material as per drawing or process sheet. Knowledge and Understanding types of material (i.e. ABS, PP, PS, PC, AS etc.) Knowledge and Understanding of selecting of tools and equipment. Understanding of machine setting as per job specification.	PPEs Vacuum forming machine Vacuum mould Checking fixture Eye bolts chains Shackles Fork lifter Hoist Wrenches Allen-Keys Socket set with handle Pliers set Screw driver set Brass hammer Digital clamp meter Testing table Measuring equipment Heater (For Vacuum forming Sheet)

			Raw material Knife Checking Fixture Measurement tape Vernier caliper First Aid box
LU2.Conduct pre-operational checks on machine	**The trainee will be able to:** Inspect all electrical connection. Check all mechanical fitting and joints. Check operation of emergency switches. Check the pneumatic connections. Check pneumatic filters. Check vacuum pump pressure. Check and maintain vacuum pump oil level. Check heater condition. Check shifting of bed gear system. Check and maintain correct hydraulic and lubrication oil levels	Knowledge and Understanding how to check electrical connections Knowledge and Understanding how to check mechanical fitting and joints. Knowledge and Understanding how to check emergency switches. Knowledge and Understanding how to check machine lubricant, temperature, pressures and coolant. Knowledge and Understanding of pneumatic system, connections and fittings. Knowledge and Understanding of Vacuum pump. Knowledge and Understanding of machine operation. Knowledge and Understanding how to check heaters.	PPEs Vacuum forming machine Vacuum mould Checking fixture Wrenches Allen-Keys Socket set with handle Pliers set Screw driver set Brass hammer Digital clamp meter Testing table Measuring equipment Heater (For Vacuum

			forming Sheet) Knife Checking Fixture Measurement tape Vernier caliper First Aid box
LU3 Prepare vacuum mould	**The trainee will be able to:** Lift mould with lifting equipment. Place the mould on the mould platen. Set mould alignment. Clamp mould with the help of bolts/ hydraulic clamps.	Knowledge and Understanding how to lift Mould. Knowledge and Understanding how to clamp Mould. Knowledge and Understanding how to check alignment of mould. Knowledge and Understanding trial of mold to verify the operation.	PPEs Vacuum forming machine Vacuum mould Checking fixture Eye bolts chains Shackles Fork lifter Hoist Wrenches Allen-Keys Socket set with handle Pliers set Screw driver set

			Brass hammer Digital clamp meter Testing table Measuring equipment Heater (For Vacuum forming Sheet) Knife Checking Fixture Measurement tape Vernier caliper First Aid box
LU4. Operate machine	**The trainee will be able to:** Set all parameters. Pull the sheet on mould. Set heater on defined temperature. Perform pre-heat the sheet on defined time. Proceed with operation. Monitor operation to ensure compliance with job requirements.	Knowledge and Understanding selection of machine as per job Knowledge and Understanding of machine setting and parameters setting Knowledge and Understanding of vacuum forming operation Knowledge and Understanding of monitoring of operation. Knowledge and Understanding of vacuum moulding parts defects. Knowledge and Understanding of different parts of	PPEs Vacuum forming machine Vacuum mould Checking fixture Wrenches Allen-Keys Socket set with handle Pliers set

		moulding machine. Knowledge of fits, limits, Hole and Shaft system.	Screw driver set Brass hammer Digital clamp meter Testing table Measuring equipment Heater (For Vacuum forming Sheet) Knife Checking Fixture Measurement tape Vernier caliper First Aid box
LU5. **Inspect final product**	**The trainee will be able to:** Perform visual inspection of defects. Check dimensionally. Check part on checking fixture. Complete inspection report.	Knowledge and Understanding about visual inspection. Knowledge and Understanding how to Check dimensionally. Knowledge and Understanding how to check with the help of gauges / Checking fixture.. Knowledge and Understanding how to make inspection report.	Checking fixture Testing table Measuring equipment Heater (For Vacuum forming Sheet) Knife Measurement tape Vernier caliper First Aid box

LU6. **Perform workplace cleaning and maintenance**	**The trainee will be able to:** Maintain all check sheets and work instruction on machine. Maintain compressor lines. Maintain heaters connections. Perform cleaning of die, machine and floor. Perform lubrication on gears, slides and die. Apply anti rust spray/cleaning agent. Maintain tools and equipment. Keep tools and equipment at appropriate place. Transfer wastage material in to the wastage area. Return excess material to store.	Knowledge and Understanding how to Maintain all check sheets and work instructions of the machine. Knowledge and Understanding how to maintain the tools and equipment. Knowledge and Understanding how to maintain compressor lines. Knowledge and Understanding of heaters. Knowledge and Understanding how to keep tools and equipment at appropriate place. Knowledge and Understanding about lubricants and lubrication. Knowledge and Understanding how to Perform cleaning of machine, mould/die and floor. Knowledge and Understanding how to Apply anti-rust spray/cleaning agent Knowledge and Understanding how to handle waste/excess material.	PPEs Vacuum forming machine Vacuum mould Checking fixture Eye bolts chains Shackles Fork lifter Hoist Wrenches Allen-Keys Socket set with handle Pliers set Screw driver set Brass hammer Digital clamp meter Testing table Measuring equipment Heater (For Vacuum forming Sheet)

			Knife Checking Fixture Measurement tape Vernier caliper First Aid box

Examples and Illustrations:

Thermoforming is one of the oldest and most common methods of processing plastic materials. Vacuum formed products are all around us and play a major part in our daily lives.

The process involves heating a plastic sheet until soft and then draping it over a mould. A vacuum is applied sucking the sheet into the mould. The sheet is then ejected from the mould. In its advanced form, the vacuum forming process utilizes sophisticated pneumatic, hydraulic and heat controls thus enabling higher production speeds and more detailed vacuum formed applications.

https://www.bpf.co.uk/plastipedia/processes/vacuum_forming.aspx

Typical Materials Used

- Acrylonitrile Butadiene Styrene **ABS**
- Polyester Copolymer **PETG**
- Polystyrene **PS**
- Polycarbonate **PC**
- Polypropylene **PP**
- Polyethylene (sheet and foamed sheet) **PE**
- Polyvinyl Chloride **PVC**
- Acrylic **PMMA**

Typical Products Produced

- Baths & Shower Trays
- Yoghurt Pots
- Ski-Boxes
- Boat Hulls
- Machinery Guards
- Vehicle Door Liners
- Refrigerator Liners
- Sandwich Boxes
- Parts of vehicle cabs
- Exterior Shop Sign

The Process:

Clamping

The clamp frame needs to be sufficiently powerful enough to ensure the plastic sheet is firmly held during the forming process. It can handle the thickest material likely to be formed on the machine – up to 6mm with a single heater and up to 10mm with the twin heater machines. If an automated process is used the operation of the moving parts must be guarded and interlocked to avoid accidental damage. In addition, a safety guard must be provided to protect the machine operator at all times.

Heating

Heaters are generally infra-red elements mounted within an aluminum reflector plate. In order to obtain the best vacuum forming results, using any material, it is essential that the sheet is heated uniformly over its entire surface area and throughout its thickness. In order to achieve this, it is necessary to have a series of zones that are controlled by energy regulators. Ceramics do have some disadvantage in that their high thermal mass makes them slow to warm up (approx 15 minutes) and slow in their response time when adjustments are made.

More sophisticated quartz heaters are available which have less thermal mass enabling more rapid response time. Pyrometers enable accurate heat temperature control by sensing the melting temperature of the sheet and interacting with the operating

process control. Precise temperature readout is also available with a computer controlled system working in unison with the pyrometers. Twin heaters are also recommended when forming thicker materials as they assist in providing more uniform heat penetration and faster cycle times.

Twin quartz heaters are advisable when forming high temperature materials with critical forming temperatures. By close control of areas of heat intensity, heat losses around the edges caused by convection air currents and absorption from clamp areas can be fully compensated for and consistent results achieved on a continuous basis. Cost savings can also be considerable if quartz heaters are specified, as there is an adjustable percentage power drop when the heaters are in the rear position during the forming process.

Sheet level (auto-level) - Not available on all the machines

A photo-electric beam is incorporated in the machine to scan between the bottom heater and the sheet of plastic. If the sheet of plastic sags down and breaks the beam, then a small amount of air is injected into the bottom chamber, thus lifting the sheet to stop it from sagging.

Pre-stretch (bubble) – Not available on all the machines

Once the plastic has reached its forming temperature or “plastic” state it can be pre-stretched to ensure even wall thickness when the vacuum is applied. The method of controlling the bubble height should be that consistent results are obtainable. Vacuum, air pressure, and optional aids such as a plug assist are then used to assist in moulding the heated, stretched plastic.

Plug assist - Not available on all the machines

Plug assisted vacuum forming (moulding) is used when straight vacuum forming is unable to distribute the thermoplastic sheet evenly to all areas of the mold. To help spread the sheet out more evenly, a device known as a plug is utilized to push the sheet into the mold before the vacuum is applied. This process enables more of the thermoplastic material to reach the bottom of the mold and thus more material is available to fill the corners of the mould and limit the plastic from thinning out.

Vacuum

Once the material is suitably pre-stretched a vacuum can be applied to assist in forming the sheet. A dry vane vacuum pump is used to draw the air trapped between the sheet and the mould. The vacuum pump should be capable of maintaining a differential pressure of approximately 27” mercury. With larger machines a vacuum reservoir is used in conjunction with a high volume capacity vacuum pump. This enables a two stages vacuum to be applied ensuring rapid moulding of the heated sheet (before the sheet temperature drops below its ideal forming temperature).

Cooling and release - Not available on all the machines

Once formed, the plastic must be allowed to cool before being released. If released too soon then deformation of the moulding will result in a reject part. To speed up the cooling cycle high speed, fans are fitted and activated once the part is formed. A spray mist option is also available whereby nozzles are attached to the fans and a fine mist of chilled water is directed onto the sheet. This, in conjunction with the fans can speed up the cooling cycle by up to 30%. Mould temperature control units are also available which regulate the temperature within the mould ensuring accurate and consistent cooling times when cooling crystalline and crystallizing polymers such as PP, HDPE and PET.

Trimming and finishing

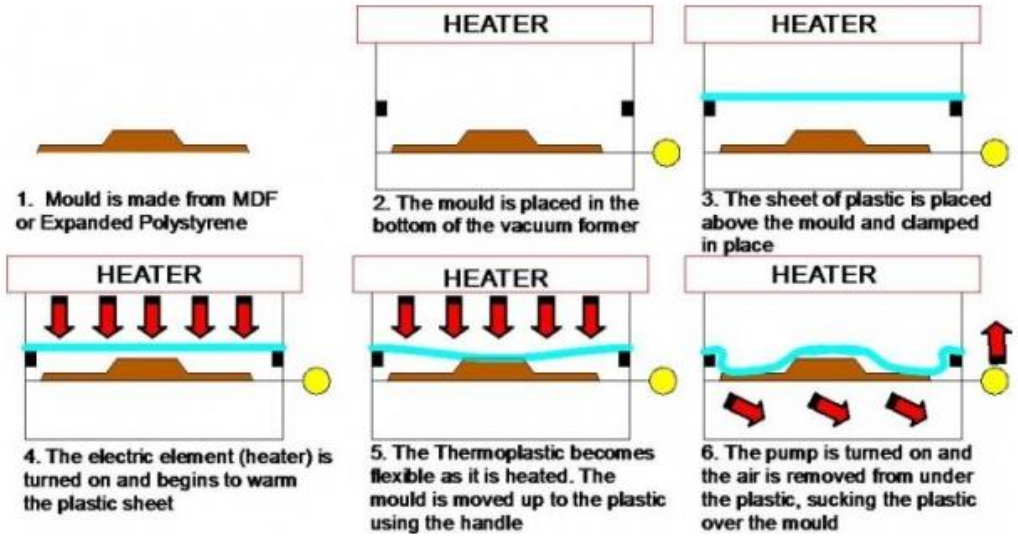
Once the formed part has cooled and been removed from the machine the excess material is removed. Holes, slots and cut-outs are then drilled into the part. Other post-forming processes include decoration, printing, strengthening, reinforcing and assembly.

A variety of different trimming methods are used to trim the product from the sheet. The type of equipment best suited depends largely on the type of cut, size of the part, draw ratio, thickness of material and the production quantity required. Thin gauge parts are normally trimmed on a mechanical trim press - otherwise known as a roller press.

Reference:

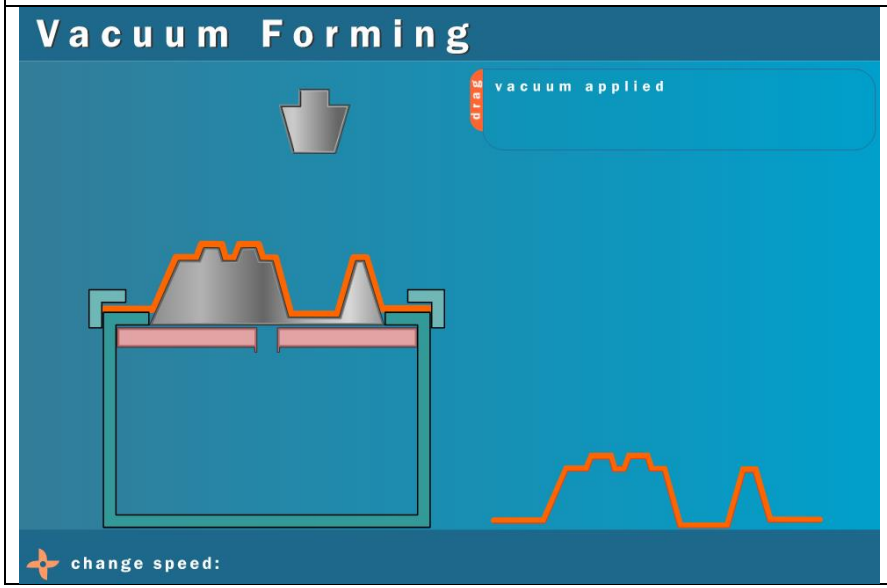
https://www.bpf.co.uk/plastipedia/processes/vacuum_forming.aspx

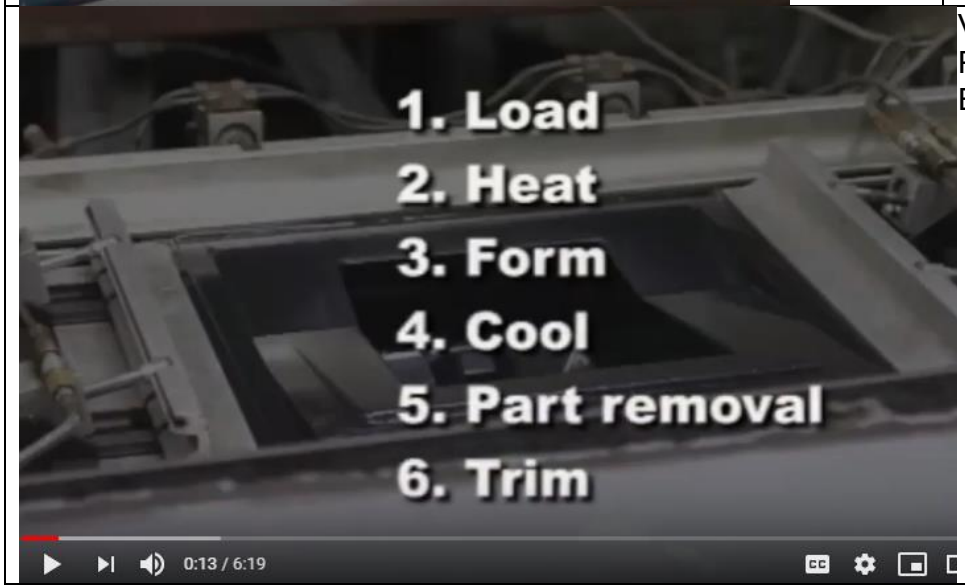
https://www.bpf.co.uk/plastipedia/processes/vacuum_forming.aspx



http://graphicproducts.weebly.com/vacuum-forming.html

Videos:

	Topic	Hyperlink
	Vacuum forming	https://www.bpf.co.uk/data/iframe/vacuumform1.html

	Thermoplastic Vacuum Forming Process	https://www.youtube.com/watch?v=DnYMbExC_oE
	Vacuum/Thermal Forming Explained	https://www.youtube.com/watch?v=HWX_XxS4zY8

AUTOMOTIVE PARTS PRODUCTION MACHINE OPERATOR

Module-9
LEARNER GUIDE
National Vocational Certificate Level 3

Version 1 - October, 2019

Workplace Housekeeping - Basic Guide

Note: Please see the workplace housekeeping in module-6 Perform welding

Module 9: 0716001044 Perform pressing operation

Objective of the module: This module covers the specific skills and knowledge related to perform Pressing/stamping operations, material handling, and inspection techniques and maintain hydraulic, pneumatic and mechanical press machines and work place.

Duration: 150 hours **Theory:** 30 hours **Practical:**120 hours

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1. Prepare for pressing	**The trainee will be able to:** Arrange material as per drawing or process sheet. Select tools and equipment. Select die. Set machine as per job specification.	Knowledge of interpreting drawing and symbols with its material specification. Knowledge types of stamping machines and tools. Knowledge to define uses and application of stamping machine with tools. Knowledge to explain stamping machine maintenance Knowledge to explain tools repair procedure Knowledge to explain lifting machines and its	PPEs Tool trolley Lifter Hoist Shackle Chain Mechanical press Hydraulic press (with

		applications. .	Hydraulic Pump) Pneumatic press Press brake Repair manual Socket setwith handle Socket Wrench Allen Key Set Screwdriver set Shop towel Needle nose pliers Impact screw driver Inspection lamp Hydraulic Jack Adjustable barrier guard Sheet metal dies (i.e Blanking, Bending, Piercing, Draw etc.) Checking fixture Combination spanner set Vernier caliper

			Micro meter Sheet gauge set Air Compressor First aid box
LU2. Conduct pre-operational checks on machine	**The trainee will be able to:** Inspect all electrical connections. Check all mechanical fitting and joint. Check operation of emergency switches. Check friction brakes on mechanical press. Inspect master cylinder for external leaks and proper operation in hydraulic or pneumatic press. Inspect brake lines, hose pipes and fittings for dents, leaks, rust, crack and loose fittings. Ensure working of two hand operational button Check and maintain correct brake fluid and hydraulic fluid level. Check all limit switches..	Knowledge and understanding of Inspection procedures for braking system (Mechanical, Hydraulic & Pneumatic) with its main components. Knowledge and Understanding how to check electrical connections. Knowledge and Understanding how to check mechanical fitting and joints. Knowledge and Understanding cylinder leakages. Knowledge and Understanding to inspect brake lines, hose pipes and loose fittings. Knowledge and Understanding how to check emergency switches. Knowledge and Understanding how to check machine lubricant, temperature, pressures and coolant. Knowledge and Understanding of pneumatic	PPEs Tool trolley Lifter Hoist Shackle Chain Mechanical press Hydraulic press (with Hydraulic Pump) Pneumatic press Press brake Repair manual Socket set with handle Socket Wrench Allen Key Set

		system, connections and fittings.	Screwdriver set Shop towel Needle nose pliers Impact screw driver Inspection lamp Hydraulic Jack Adjustable barrier guard Sheet metal dies (i.e Blanking, Bending, Piercing, Draw etc.) Checking fixture Combination spanner set Vernier caliper Micro meter Sheet gauge set Air Compressor First aid box
LU3. Prepare die	**The trainee will be able to:** Lift the die with lifting equipment. Set die alignment.	Knowledge and Understanding about how to lift die. Knowledge and Understanding about alignment of die.	PPEs Tool trolley Lifter

	Clamp the die on press with bolts/ hydraulic clamps.	Knowledge and Understanding about die clamping.	Hoist Shackle Chain Mechanical press Hydraulic press (with Hydraulic Pump) Pneumatic press Press brake Repair manual Socket set with handle Socket Wrench Allen Key Set Screwdriver set Shop towel Needle nose pliers Impact screw driver Inspection lamp Hydraulic Jack Adjustable barrier guard Sheet metal dies (i.e Blanking, Bending,

			Piercing, Draw etc.) Checking fixture Combination spanner set Vernier caliper Micro meter Sheet gauge set Air Compressor First aid box
LU4. **Operate mechanical press machine**	**The trainee will be able to:** Load die-set. Set all parameters. Fasten the bolts of ram. Proceed with operation. Monitor operation to ensure compliance with job requirements.	Knowledge and understanding of main components of mechanical press machine. Knowledge and understanding how to set parameters Knowledge and understanding how to clamp die Understanding function of each component. Knowledge and understanding about how to monitor operation.	PPEs Tool trolley Lifter Hoist Shackle Chain Mechanical press Hydraulic press (with Hydraulic Pump) Pneumatic press Press brake

			Repair manual Socket set with handle Socket Wrench Allen Key Set Screwdriver set Shop towel Needle nose pliers Impact screw driver Inspection lamp Hydraulic Jack Adjustable barrier guard Sheet metal dies (i.e Blanking, Bending, Piercing, Draw etc.) Checking fixture Combination spanner set Vernier caliper Micro meter Sheet gauge set Air Compressor

			First aid box
LU5. Operate hydraulic press machine	**The trainee will be able to:** Load die-set. Set all parameters. Fasten the bolts of ram. Proceed with operation. Monitor operation to ensure compliance with job requirements	Knowledge and understanding of main components of hydraulic press machine. Knowledge and understanding how to set parameters. Knowledge and understanding how to clamp die. Understanding function of each component. Knowledge and understanding about how to monitor operation.	PPEs Tool trolley Lifter Hoist Shackle Chain Mechanical press Hydraulic press (with Hydraulic Pump) Pneumatic press Press brake Repair manual Socket set with handle Socket Wrench Allen Key Set Screwdriver set Shop towel Needle nose pliers Impact screw driver Inspection lamp

			Hydraulic Jack Adjustable barrier guard Sheet metal dies (i.e Blanking, Bending, Piercing, Draw etc.) Checking fixture Combination spanner set Vernier caliper Micro meter Sheet gauge set Air Compressor First aid box
LU6. **Operate pneumatic press machine**	**The trainee will be able to:** Load die-set. Set all parameters. Fasten the bolts of ram. Proceed with operation.	Knowledge and understanding of main components of pneumatic press machine. Understanding of function of each component Knowledge and understanding how to set parameters. Knowledge and understanding how to clamp die. Knowledge and understanding about how to	PPEs Tool trolley Lifter Hoist Shackle Chain Mechanical press

	Monitor operation to ensure compliance with job requirements.	monitor operation.	Hydraulic press (with Hydraulic Pump) Pneumatic press Press brake Repair manual Socket set with handle Socket Wrench Allen Key Set Screwdriver set Shop towel Needle nose pliers Impact screw driver Inspection lamp Hydraulic Jack Adjustable barrier guard Sheet metal dies (i.e Blanking, Bending, Piercing, Draw etc.) Checking fixture Combination spanner set

			Vernier caliper Micro meter Sheet gauge set Air Compressor First aid box
LU7. **Inspect final product**	**The trainee will be able to:** Perform visual inspection of defects. Check dimensionally. Check fitment on checking fixture. Complete inspection report.	Knowledge and understanding of visual inspection. Understanding how to use measuring equipments (i.e. Vernier caliper, micro meter, sheet gauge, measuring tape etc.) Understanding about limits and fit System (Hole & shaft system). Knowledge and understanding how to make inspection report.	PPEs Repair manual Inspection lamp Checking fixture Vernier caliper Micro meter Sheet gauge set First aid box
Perform workplace cleaning and maintenance	**The trainee will be able to:** Maintain all check sheets and work instruction on machine. Perform cleaning of die, machine and floor. Apply Anti-rust spray/Cleaning agent. Perform lubrication on slides and die Maintain tools and equipment.	Knowledge and understanding about work instructions and check sheet. Knowledge and understanding about how to maintain tools and equipment. Knowledge and Understanding how to keep tools and equipment at appropriate place. Knowledge and Understanding about lubricant and lubrication.	PPEs Tool trolley Lifter Hoist Shackle Chain

	Keep tools and equipment at appropriate place. Transfer wastage material in to the wastage area. Return excess material to store	Knowledge and Understanding how to Perform cleaning of machine, mould/die and floor. Knowledge and Understanding how to Apply anti-rust spray/cleaning agent. Knowledge and Understanding how to handle waste/excess material.	Mechanical press Hydraulic press (with Hydraulic Pump) Pneumatic press Press brake Repair manual Socket setwith handle Socket Wrench Allen Key Set Screwdriver set Shop towel Needle nose pliers Impact screw driver Inspection lamp Hydraulic Jack Adjustable barrier guard Sheet metal dies (i.e Blanking, Bending, Piercing, Draw etc.) Checking fixture Combination spanner

			set Vernier caliper Micro meter Sheet gauge set Air Compressor First aid box

Examples and Illustrations:

Metal stamping is a manufacturing process used to convert flat metal sheets into specific shapes. It is a complex process that can include a number of metal forming techniques — blanking, punching, bending and piercing, to name a few.

There are thousands of companies across the U.S. that offer metal stamping services to deliver components for industries in automotive, aerospace, medical, and other markets. As global markets evolve, there is an escalated need for quickly-produced large quantities of complex parts.

https://www.esict.com/what-is-metal-stamping/

In **sheet metal stamping processes** are included a wide variety of **associated operations**:

Cutting

Cutting is perhaps the most common operation performed in a stamping die. The metal is severed by placing it between two bypassing tool steel sections that have a small gap between them. This gap, or distance, is called the cutting clearance.

Cutting clearances change with respect to the type of cutting operation being performed, the metal's properties, and the desired edge condition of the piece part. The cutting clearance often is expressed as a percentage of the metal's thickness. The most common cutting clearance used is about 10 percent of the metal's thickness.

Very high force is needed to cut metal. The process often introduces substantial shock to the die and press. In most cutting operations, the metal is stressed to the point of failure, which produces a cut edge with a shiny portion referred to as the cut band, or shear, and a portion called the fracture zone, or break line (see **Figure 2**).

There are many different cutting operations, each with a special purpose. Some common operations are:

Trimming—The outer perimeter of the formed part or flat sheet metal is cut away to give the piece part the desired profile. The excess material usually is discarded as scrap (see **Figure 3**).

Notching—Usually associated with progressive dies, notching is a process in which a cutting operation is performed progressively on the outside of a sheet metal strip to create a given strip profile (see **Figure 4**).

Blanking—A dual-purpose cutting operation usually performed on a larger scale, blanking is used in operations in which the slug is saved for further pressworking. It also is used to cut finished piece parts free from the sheet metal. The profiled sheet metal slug removed from the sheet by this process is called the blank or starting piece of sheet metal that will be cut or formed later (see **Figure 5**).

Piercing—Often called perforating, piercing is a metal cutting operation that produces a round, square, or special-shaped hole in flat sheet metal or a formed part. The main difference between piercing and blanking is that in blanking, the slug is used, and in piercing the slug is discarded as scrap. The cutting punch that produces the hole is called the pierce punch, and the hole the punch enters is called the matrix (see **Figure 6**).

Lancing—In lancing, the metal is sliced or slit in an effort to free up metal without separating it from the strip. Lancing often is done in progressive dies to create a part carrier called a flex or stretch web (see **Figure 7**).

Shearing—Shearing slices or cuts the metal along a straight line. This method commonly is used to produce rectangular and square blanks (see **Figure 8**).

Reference:

https://www.thefabricator.com/article/stamping/die-basics-101-intro-to-stamping

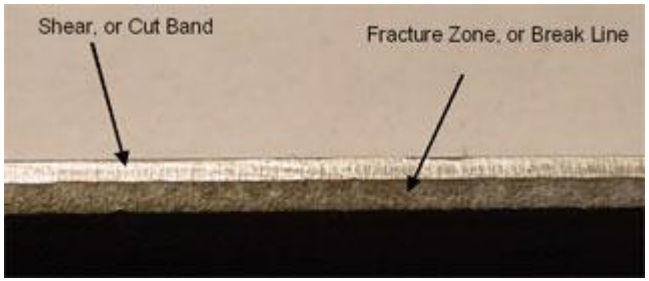


Figure 2
Typical Cut Edge of a Stamped Part

Figure 3
Trimming

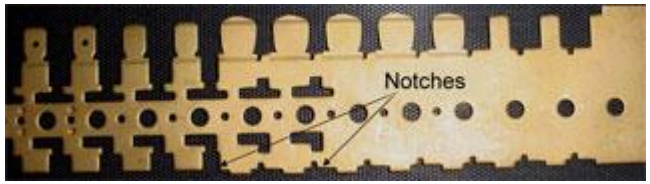


Figure 4
Notching

https://www.esict.com/what-is-metal-stamping/

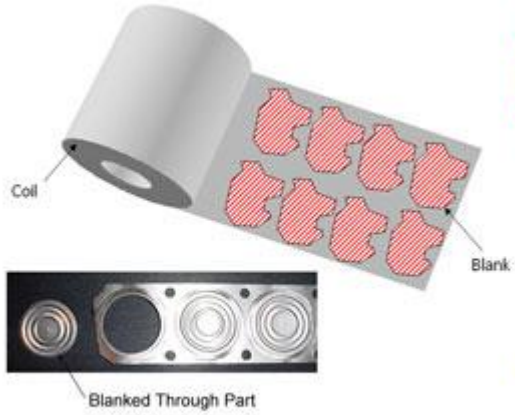


Figure 5
Blanking

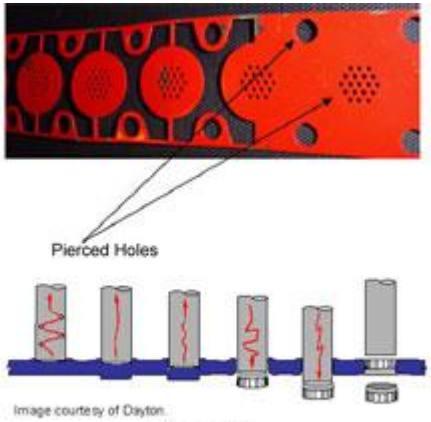


Figure 6
Piercing

Figure 7
Lancing

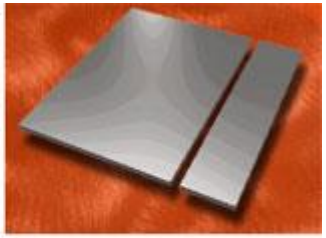


Figure 8
Shearing

https://www.thefabricator.com/article/stamping/die-basics-101-intro-to-stamping

Mechanical Presses

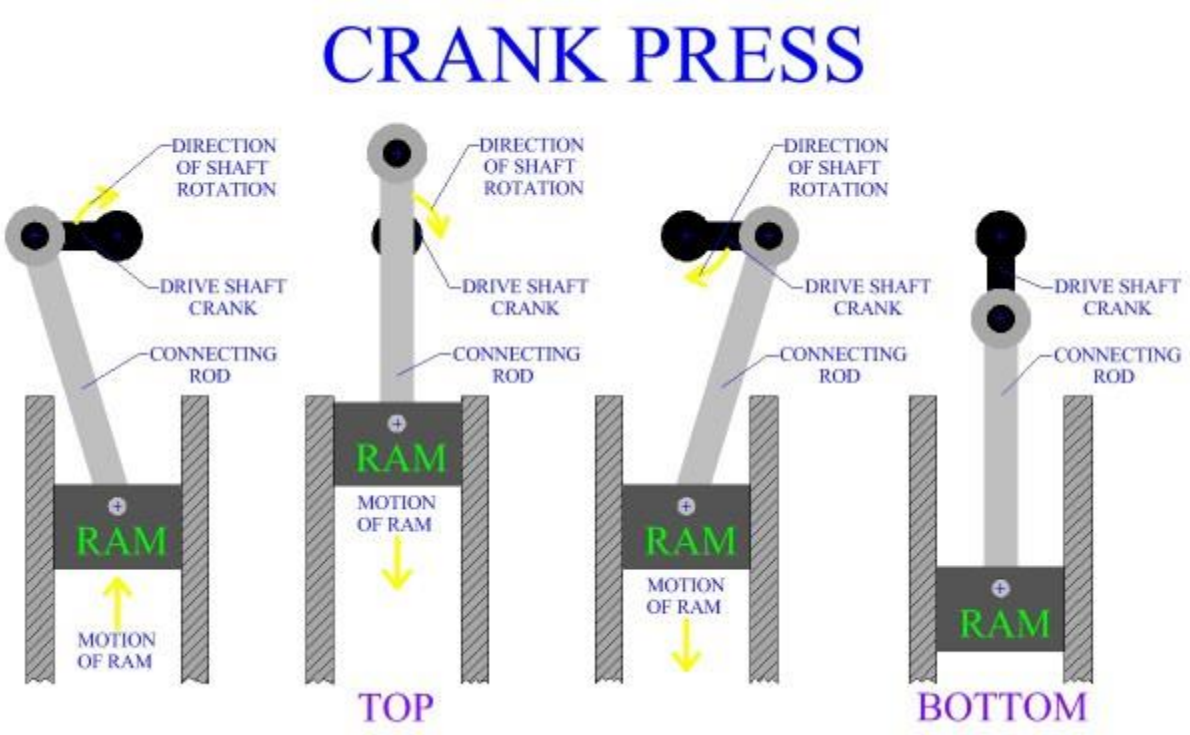
Mechanical presses belong to a class of machine tools that encompass a wide range of different machine types. Primarily, the mechanical press transforms the rotational force of a motor into a translational force vector that performs the pressing action. Therefore, the energy in a mechanical press comes from the motor. These types of presses are generally faster than hydraulic or screw presses, (actually the screw press may also be classified as a mechanical press). Unlike some presses, in a mechanical press, the application of force varies in both speed and magnitude throughout the distance of the stroke. When performing a manufacturing operation using a mechanical press, the correct range of the stroke is essential.

Presses are chosen based on the characteristics of the manufacturing process. Mechanical press machine tools are commonly used in metal forging manufacture, and sheet metal working. The desired application of force will dictate the type of machine required. Extrusion will often necessitate a more consistent force over a longer distance. However, a mechanical press may often be a good choice for impact extrusion, since a fast, quickly repeatable application of force over a limited distance is what is needed for that type of manufacturing process. The most powerful mechanical presses in modern manufacturing industry will have a press capacity of about 12,000 tons, (24,000,000 lbs).

Crank Press

The crank press uses a crank link attached to a drive shaft. The crank link rotates with the drive shaft and is attached to a connecting rod by a rotational joint. The connecting rod rocks back and forth during the motion of the crank. The connecting rod is, in turn, attached to a ram by a rotational joint. The ram operates in a slider joint and travels a one dimensional path in both directions. It is through this path that the crank press delivers its force. The crank press does allow for a stoke of a relatively long distance.

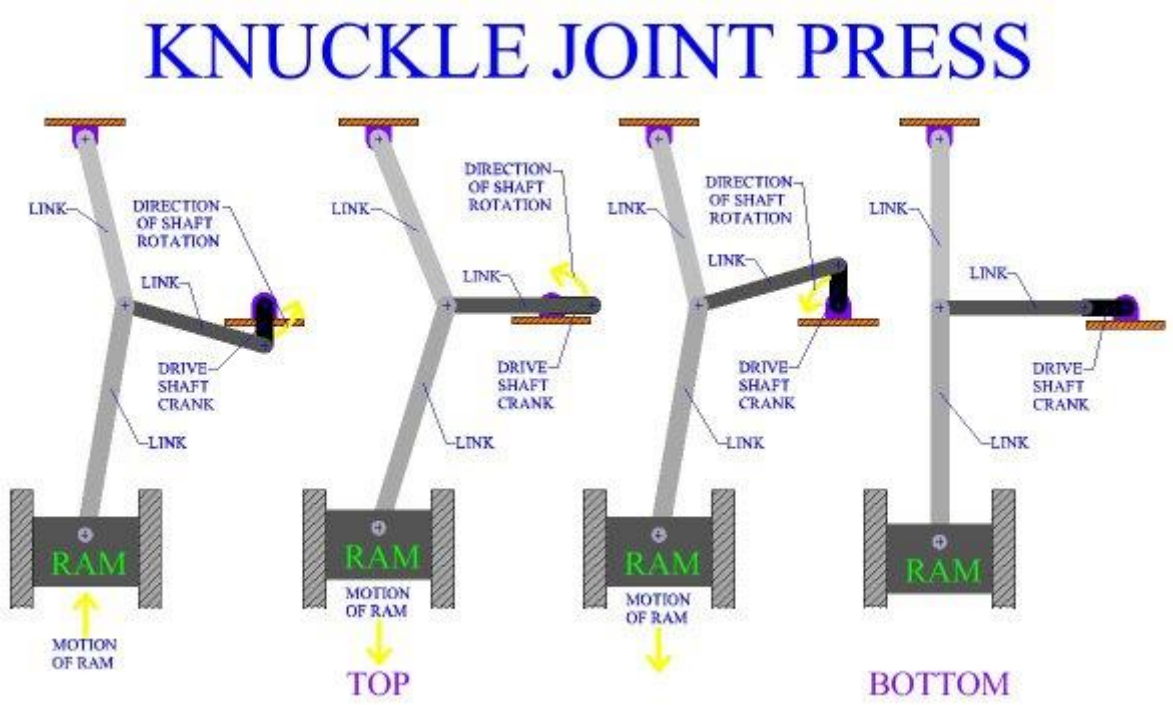
Figure:178



Knuckle Joint Press

The knuckle joint press translates the energy of a motor through a powerful linkage design, and is capable of delivering a tremendous amount of force. The drive shaft crank rotates completely. The links are well grounded to support such pressure.

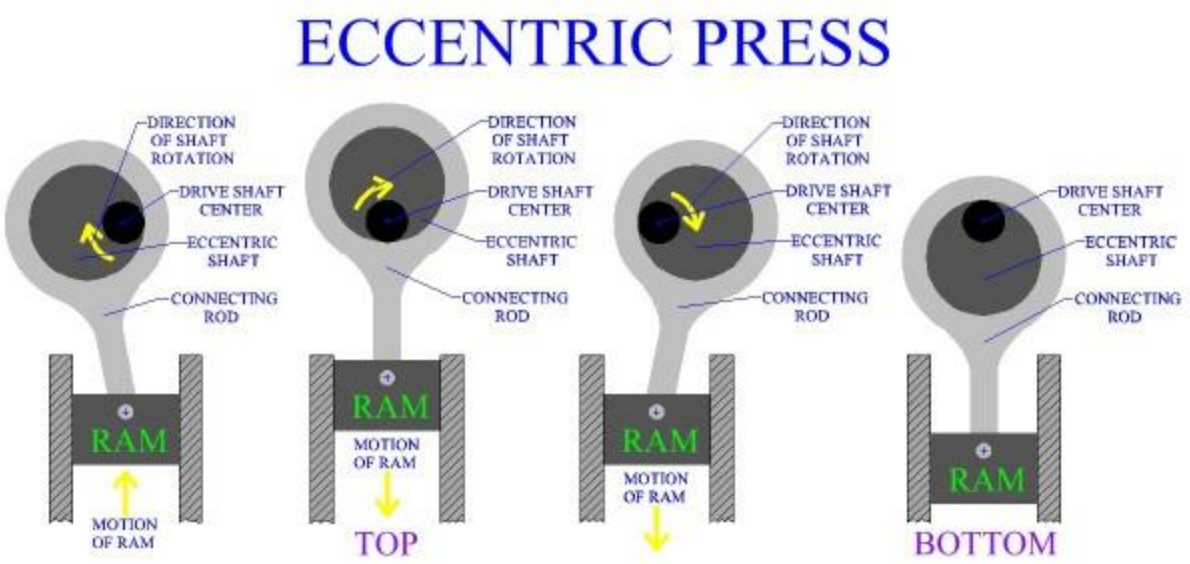
Figure:179



Eccentric Press

The eccentric press uses a motor to drive an eccentric shaft, rotating in a connecting rod. The connecting rod moves a ram in a slider joint one dimensionally. The eccentric shaft itself is round, therefore it may completely rotate within the connecting rod. The center of the drive is not the center of the overall shaft. As the motor rotates, the center of the drive remains stable but the overall center of the shaft changes. This causes the shaft to change position, providing motion. The actual principle of an eccentric press is very similar to a crank press.

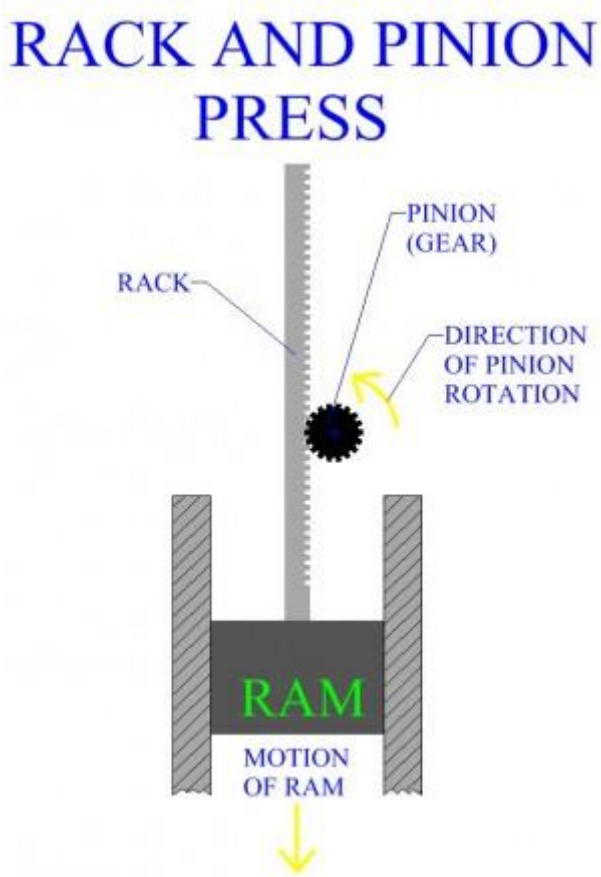
Figure:180



Rack And Pinion Press

The rack and pinion press delivers the motors energy from a gear directly connected to the drive shaft. The rack is actually a round gear of infinite radius. A rotating gear (pinion), provides force through the rack. This gives the one dimensional, translational motion desired of press machines.

Figure:181

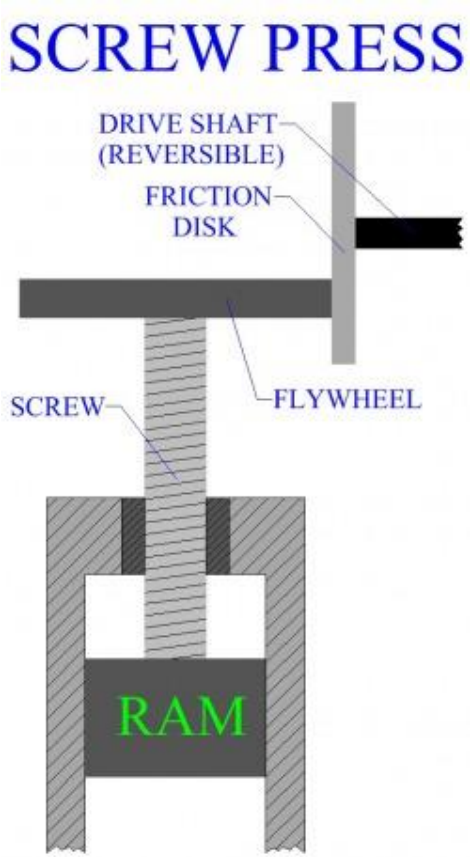


Screw Presses

Screw presses use the rotational energy of a motor to turn a large screw. Typically, a friction disk is used to translate the force from the drive shaft to the screw's head. The screw pushes a ram with great mechanical advantage. Screw presses are similar to hydraulic presses in that they are relatively slow and require a longer contact with the work. Screw presses are also similar to hydraulic presses in that they can produce

a constant amount of force over a long stroke. Some screw press machine tools in modern industry can produce 31,000 tons, (62,000,000 lbs), of force.

Figure:182



Reference:

https://thelibraryofmanufacturing.com/presses.html#targetText=Mechanical%20presses%20belong%20to%20a,press%20comes%20from%20the%20motor.

Hydraulic Press (Definition)

The hydraulic press is a kind of machine which uses the liquid as a working medium to transfer energy based on PASCAL's principle.

Generally, hydraulic press machine consists of three main parts:

- The machine (main frame)
- The Power system
- The Hydraulic control system

Introduction of Hydraulic press:

Hydraulic press is a machine that makes use of the static pressure of the liquid to process metal, rubber, wood, powder products. It is often used in pressing and press forming processes, such as forging press, stamping, cold extrusion, bending, sheet drawing, powder metallurgy, pressing, etc.

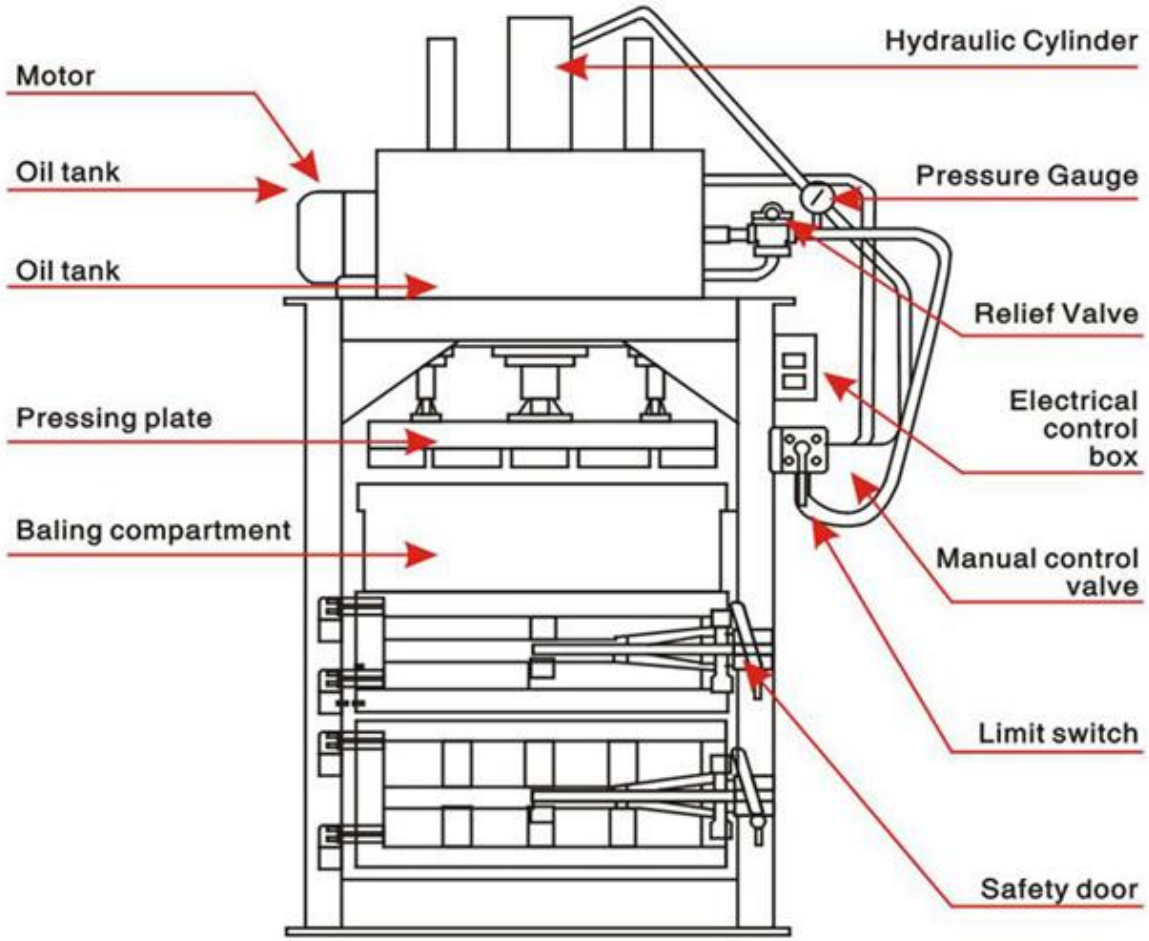


Fig.2 Hydraulic Press Machine Structure

Types of Hydraulic Press

According to structure form, the hydraulic press is mainly divided into:

- Four column hydraulic press
- Single column hydraulic press (C type)
- Horizontal hydraulic press
- Vertical frame hydraulic press
- Universal hydraulic press

Four column hydraulic press

Single column hydraulic press (C type)

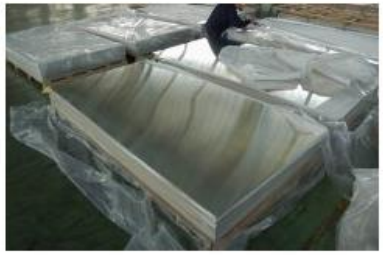
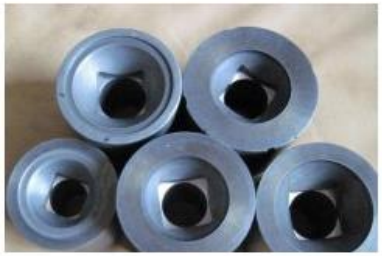
Horizontal hydraulic press

If, classified by tonnage, the hydraulic press can be divided into:

- 60T hydraulic press
- 100T hydraulic press
- 150T hydraulic press
- 200T hydraulic press
- 250T hydraulic press
- Up to 800T hydraulic press

Application of Hydraulic press

Hydraulic press can be used for the process of drawing, forming, bending and stamping of sheet metal parts. It can also be used in general pressing technology by adding blanking buffer, moving table devices according to user needs. Some hydraulic press produce parts are described below.



Reference:

https://www.machinemfg.com/hydraulic-press-machine/

Pneumatic Presses

Definition, Function, Use

Pneumatic presses are used when the manpower is not strong enough to generate the force required, or the number of parts to be machined is too large.

Pneumatic presses are manufactured with various force transmission mechanisms. Their movement is based on compressed and dried air. Usually the air pressure applied is in between 3 bar to 6 bar (44 psi to 87 psi). Pneumatic presses reach their nominal force at 6 bar (87 psi). A controller is needed t operate a pneumatic. Normally 2-hand controllers are used at manual work stations. In case the pneumatic press is integrated into an automated process a plc takes over the control.

Pneumatic presses are manufactured in three different force transmissions: The toggle mechanism, direct acting, and hydro-pneumatic transmission.

The optimum transmission ratio of the toggle lever produces large forces at the end of the stroke and ensures low air consumption. The relatively high ram speed and the defined length of the stroke are the advantage of the toggle mechanism. Pneumatic toggle presses are therefore especially used for riveting, punching, and edge cutting.

Direct acting pneumatic presses are the most widely used pneumatic presses. Their advantage is that they produce a constant force over the whole length of stroke. The air pressure used is directly related to the generated force of the press. A particular advantage of the direct-acting pneumatic press is the precise adjustment of the stroke length. This allows for flexible use in various applications: such as assembling, bending, press-fit, and crimping.

Hydro-pneumatic presses are a variation of direct acting pneumatic presses. Hydro-pneumatic presses are driven with compressed air only, but have integrated high pressure oil chamber in which the high force of this press type is generated. With hydro-pneumatic presses, therefore, a distinction is made between the pneumatic rapid stroke and the hydraulic power stroke. In the pneumatically driven rapid stroke, the workpiece is approached with high speed and low force. The hydraulic power stroke is then activated automatically when resistance of the work piece is encountered. Now a plunger is pressurized with compressed air, moves out and closes an oil chamber causing the power transmission to take place. The ram overs out at reduced speed and with increased force in the power stroke. Hydro-pneumatic presses are perfect, if high pressure over a short stroke is needed: for example for press-fit, assembling, and embossing.

Reference

https://www.maederpressen.de/English:Info-Druckluftpressen:Kurz.asp

Method of Operation
Pneumatic presses function on similar principles to Hydraulic presses, but instead of fluid—usually a type of oil, the driver for their movement is a compressed air.

Maintenance
Pneumatic presses do not typically require much in terms of maintenance. If there is a leak, for example, then only air escapes, which can be easily replaced once the leak has been repaired. Conversely, if a hydraulic machine leaks, it loses fluids, creates a mess that requires time to clean up, causing increased expense for both the lost fluid and the downtime.

Capabilities
Pneumatic presses often operate at very high speeds, whereas hydraulic presses are much slower in their movements. Since pneumatic presses operate with air instead of liquid, they cannot achieve the same level of consistency in their application of force that a hydraulic press can. The optimal choice between a pneumatic press and a hydraulic press often comes down to the speed and pressure requirements of the intended application.

Reference:

https://www.joraco.com/content/how-does-pneumatic-press-work#targetText=How%20Does%20a%20Pneumatic%20Press%20Work%3F,to%20the%20actual%20press%20mechanism.

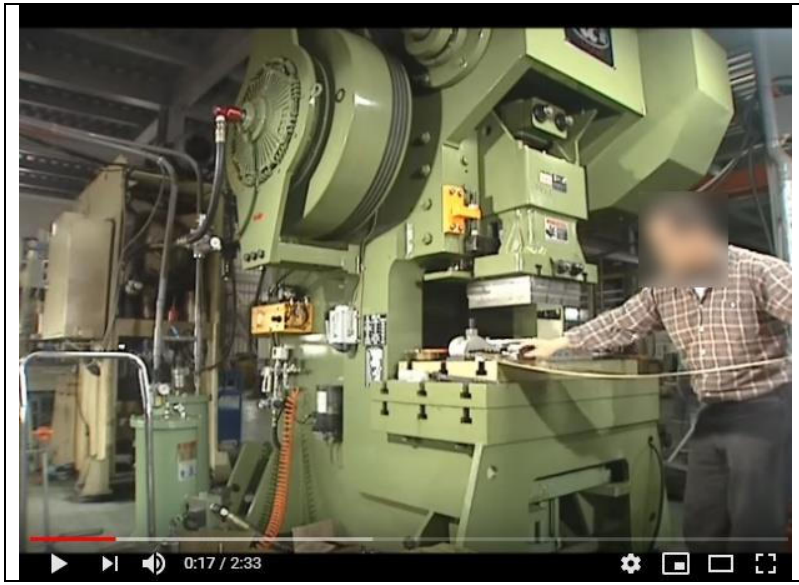
Workplace Housekeeping - Basic Guide

Note: Please see the workplace housekeeping in module-6 Perform welding

Videos:

	Topic	Hyperlink
	Sheet Metal Stamping Dies & Processes	https://www.youtube.com/watch?v=5CuJjSk4U38

	Sheet Metal Stamping Presses	https://www.youtube.com/watch?v=Fy_czoSfbRE
	The Metal Stamping Process: How Parts Are Made	https://www.youtube.com/watch?v=OT1WWYvFMYI

	STAMPING PROCESS	https://www.youtube.com/watch?v=aTkwx-51iSo

AUTOMOTIVE PARTS PRODUCTION MACHINE OPERATOR

Module-10
LEARNER GUIDE
National Vocational Certificate Level 3

Version 1 - October, 2019

Module 10: 0716001045 Perform periodic operator maintenance

Objective of the module: This module covers the specific skills and knowledge related to work on periodic maintenance, making the workplace free from hazards and capable to report and record the maintenance activity performed on the machine and workplace

Duration: 90 hours **Theory:** 18 hours **Practical:**72 hours

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1. Prepare for maintenance	**The trainee will be able to:** Arrange the recommended machine oil and oil filter. Arrange the recommended hydraulic seals and fluid. Arrange the recommended hydraulic hose and clamps. Arrange recommended bearings. Arrange the recommended pneumatic hose and couplers. Arrange the recommended relays, fuses, Sensors, switches and circuit breakers. Arrange the machine cleaning agents and cotton rag. Select the repairing tools and equipment.	Understanding the types and importance of machine oil grades, and oil filter defined as per standard. Ensure that Compatibility of seal is decided upon the particular operating medium or restraints due to pressure, fluid type, temperature Understanding and ensure that properly fastening of hydraulic pipe, tube and hose clamp in a place as per standard define. Understanding and ensure that inner and outer size of bearing would specify (i.e. ball bearing, roll bearing, tapper or plane bearing etc.) Understanding and ensure that coupling and fitting for pneumatic hose size as per gauge requirement and standard define. Understanding and ensure that switches, relays, sensor and Circuit breaker use as per voltage and current define by manufacturer.	PPEs Machine oil (Different grades) Grease Machine service manual Fusses Relays Switches Pneumatic hoses Hydraulic hoses Couplers Hydraulic joints Adjustable Spanner Pipe Wrench Combination Spanner

	Arrange the recommended floor marking and machine colours.	Understanding how to obtain cleaning agents WD-40, degreaser, rough cotton etc. Understanding how to actively repair machine with the help of appropriate tools and equipment. Understanding and ensure red and white color use to mark the floor in front of electrical panels and hazardous areas.	Set Socket Set with handle Torque Wrench Screw Driver Set Allen Key Set Tool Box/trolley Circuit breakers Ladder Manual Lifter Safety Harness Belt Measurement Tape Sprit Level Vernier Caliper Plier Set Digital clamp meter Wire Stripper Wire crimper Blower Tongue & groove plier

			Hand hacksaw Hammer Mallet (Soft Hammer) Flash light Anti-rust spray (WD40) Bench wise with bench Hand grinder Hand drill Drill bits Impact screw driver Utility knife Marking tape Retractable safety barrier with post First aid box Bearing puller
LU2. Isolate and shut down equipment and machine	**The trainee will be able to:** Clean the workplace and identify the faulty components. Identify and eliminate hazards at workplace.	Understanding and Identify the faulty part and components and do work within the 5S standard procedure. Knowledge and understanding of hazards on workplace and remove it.	PPEs Machine oil (Different grades) Grease Machine service manual

	Change the oil and oil filter under specified procedure. Replace the hydraulic oil, seals and hoses. Replace the pneumatic hoses and coupler. Replace the recommended relay, sensors, fuses and circuit breakers. Paint the recommended floor marking and machine floor area.	Knowledge and understanding of changing machine oil that would be specified by its manufacturer, as well as oil filter. Knowledge and understanding of changing hydraulic pipe, tube and hose clamp in a place as per standard define. Knowledge and understanding how to change Pneumatic hose and coupler. Knowledge and understanding how to change the fuses, relays, circuit breaker. Knowledge and understanding of floor paint marking near machine with different color.	Fusses Relays Switches Pneumatic hoses Hydraulic hoses Couplers Hydraulic joints Adjustable Spanner Pipe Wrench Combination Spanner Set Socket Set with handle Torque Wrench Screw Driver Set Allen Key Set Tool Box/trolley Circuit breakers Ladder Manual Lifter Safety Harness Belt Measurement Tape

			Sprit Level Vernier Caliper Plier Set Digital clamp meter Wire Stripper Wire crimper Blower Tongue & groove plier Hand hacksaw Hammer Mallet (Soft Hammer) Flash light Anti-rust spray (WD40) Bench wise with bench Hand grinder Hand drill Drill bits Impact screw driver Utility knife Marking tape Retractable safety barrier

			with post First aid box Bearing puller
LU3. Inspect equipment and machine	**The trainee will be able to:** Operate the machine and verify all functions. Inspect the leakage in hydraulic system. Inspect the leakage in pneumatic hoses with soap water. Inspect and verify the correct installation, working of electronics parts. Check the dryness of paint on floor.	Knowledge and understanding how to actively operate machine and confirm all its function working properly. Knowledge and understanding how to keep ensure that there are no leakages of oil in hydraulic machine. Knowledge and understanding how to keep and ensure that no air leakage in pneumatic system with help of soap bubbles. Knowledge and understanding how to keep and ensure that supply voltage of all electronics components would be working correctly. Knowledge and understanding how to keep and ensure that no one would move on floor marking paint until it's dry.	PPEs Machine oil (Different grades) Grease Machine service manual Fusses Relays Switches Pneumatic hoses Hydraulic hoses Couplers Hydraulic joints Adjustable Spanner Pipe Wrench Combination Spanner Set Socket Set with handle Torque Wrench

			Screw Driver Set Allen Key Set Tool Box/trolley Circuit breakers Ladder Manual Lifter Safety Harness Belt Measurement Tape Sprit Level Vernier Caliper Plier Set Digital clamp meter Wire Stripper Wire crimper Blower Tongue & groove plier Hand hacksaw Hammer Mallet (Soft Hammer) Flash light

			Anti-rust spray (WD40) Bench wise with bench Hand grinder Hand drill Drill bits Impact screw driver Utility knife Marking tape Retractable safety barrier with post First aid box Bearing puller
LU4. **Conduct preventive maintenance**	**The trainee will be able to:** Follow preventive maintenance chart and update according time period. Identify and eliminate the minor hazards.	Knowledge and understanding how to obtain information from preventive maintenance chart of working equipment regularly in order to minimize disaster. Knowledge and understanding of small hazards and reduce by following working standard define.	PPEs Machine oil (Different grades) Grease Machine service manual Fusses Relays Switches Pneumatic hoses

			Hydraulic hoses Couplers Hydraulic joints Adjustable Spanner Pipe Wrench Combination Spanner Set Socket Set with handle Tongue & groove Plier Hand hacksaw Hammer Mallet (Soft Hammer) Flash light Anti-rust spray (WD40) Bench wise with bench Hand grinder Hand drill Drill bits Impact screw driver Utility knife Marking tape

			Retractable safety barrier with post First aid box
LU5. **Report faults**	**The trainee will be able to:** Create job card as per the machine faults. Coordinate with maintenance/service department for further necessary action. Follow up for the repair/maintenance performed.	Knowledge and understanding, detailed description of work that are going to performed for work order. Knowledge and understanding of service and maintenance section for advance action. Knowledge and understanding of further examination in order to perform maintenance.	PPEs Machine oil (Different grades) Grease Machine service manual Fusses Relays Switches Pneumatic hoses Hydraulic hoses Couplers Hydraulic joints Adjustable Spanner Pipe Wrench Combination Spanner Set Socket Set with handle

			Torque Wrench Screw Driver Set Allen Key Set Tool Box/trolley Circuit breakers Ladder Manual Lifter Safety Harness Belt Measurement Tape Sprit Level Vernier Caliper Plier Set Digital clamp meter Wire Stripper Wire crimper Blower Tongue & groove plier Hand hacksaw Hammer Mallet (Soft Hammer)

			Flash light Anti-rust spray (WD40) Bench wise with bench Hand grinder Hand drill Drill bits Impact screw driver Utility knife Marking tape Retractable safety barrier with post First aid box Bearing puller
LU6. **Record Maintenance**	**The trainee will be able to:** Maintain log book. Record the consumable and spare parts used. Prepare comprehensive report.	Knowledge and understanding how to keep your record organize for help in future. Knowledge and understanding how to maintaining record for consumable items and spare parts Knowledge and understanding how to keep maintaining complete maintenance expenses records.	PPEs Machine oil (Different grades) Grease Machine service manual Fusses Relays Switches

			Pneumatic hoses Hydraulic hoses Couplers Hydraulic joints Adjustable Spanner Pipe Wrench Combination Spanner Set Socket Set with handle Torque Wrench Screw Driver Set Allen Key Set Tool Box/trolley Circuit breakers Ladder Manual Lifter Safety Harness Belt Measurement Tape Sprit Level Vernier Caliper Plier Set

			Digital clamp meter Wire Stripper Wire crimper Blower Tongue & groove plier Hand hacksaw Hammer Mallet (Soft Hammer) Flash light Anti-rust spray (WD40) Bench wise with bench Hand grinder Hand drill Drill bits Impact screw driver Utility knife Marking tape Retractable safety barrier with post First aid box Bearing puller

Examples and illustrations

MAINTENANCE CONCEPTS

Preventive maintenance (PM) is a time-based or interval-based planned service to detect and prevent potential failures and extend the life of equipment. It is planned maintenance of a plant and its equipment that is designed to improve equipment life and avoid any unplanned maintenance activity. PM includes painting, lubrication, cleaning, adjusting, and minor component replacement to extend the life of equipment and facilities.
Predictive maintenance (PdM) is the application of modern analytical techniques to decrease both the cost of maintenance and production downtime by means of early identification of imminent equipment failure (achieved through monitoring changes n condition). Its purpose is to minimize breakdowns and excessive depreciation. In its simplest form, predictive maintenance can be compared to the service schedule for an automobile. It is the key to reliability and integrity for a company.

General

Preventive maintenance has been around for many years. For instance, our ancestors sharpened their knives, packed animal fat in the hubs of wagons, cleaned pots after dying fabrics, and oiled their muskets. This is because, to keep equipment functional, maintenance is required.

In the US, the average equipment breakdown rate was about 20% in the 1950s, but in the 1990s, the rate went to about 60%. Why? The operator was taken out of the equation due to specialization. This meant fewer people were looking at the equipment less often.
Preventive maintenance is performed by:

- The production team through daily interaction with the equipment (touching, listening, etc.). This is called *Type 1 PM*.
- Maintenance through periodic and more complex tasks. This is called *Type 2 PM*.

Necessity for Preventive Maintenance

Why we do preventive maintenance:

- To minimize the number of failures of critical equipment
- To reduce the loss of production from equipment failures
- To acquire meaningful data from the equipment history so we can make more intelligent decisions on repair, overhaul, and replacement to maximize the return on capital employed
- To provide tasks for planning and scheduling for minimal production disruption

- To promote better safety, health, and environmental conditions for our workforce
- To reduce overtime costs and provide more economical use of maintenance mechanics due to working on a scheduled basis instead of an emergency basis to repair breakdowns
- To use timely, routine repairs to bring about fewer large-scale repairs
- To reduce product rejects, rework, and scrap through better overall equipment condition
- To identify equipment with excessive maintenance costs, indicating the need for corrective maintenance, operator training, or replacement of obsolete equipment
- To better care for assets and increase the life span of assets, thereby eliminating premature replacement of machinery and equipment
- To increase the life span of equipment

Preventive maintenance includes:

- Non-destructive testing
- Periodic inspections
- Lubrication tasks
- Preplanned maintenance activities
- Minor repairs

Major repairs are considered *corrective maintenance* and should be captured accordingly. Just remember that 25% of all PM is unnecessary, and 20% cause issues. Although PM can include cleaning, lubrication, testing, and scheduled replacements, the most important task in PM is *inspection*. Inspection helps to detect any early signs of changes in condition, which may be a warning of impending failure.

Risks of Preventive Maintenance

Preventive maintenance is not without risk. Sometimes, PM can cause failure soon after the PM is performed. Typically, the following are the types of errors or damage that can occur during PM and other types of maintenance outages:

- Damage to nearby equipment during a PM task
- Damage to the equipment receiving the PM task, to include such things as:
    - Damage during the performance of an inspection, repair, adjustment, or installation of a replacement part
    - Installing material that is defective, incorrectly installing a replacement part, or incorrectly reassembling material
- Reintroducing infant mortality by installing new parts or materials (parts with early failure rates)
- Damage due to an error in reinstalling equipment into its original location

Optimizing Preventive Maintenance

Preventive maintenance can always be improved. The following are ways to perfect maintenance:

1. Eliminate low-value tasks (waste)
2. Review PM-related failures shortly after they occur
3. Replace intrusive PM tasks with non-intrusive Condition based maintenance **(CBM)** or predictive maintenance
4. Clearly develop Type 1 and Type 2 PM tasks
5. Align Environmental Health Safety (**EHS**) requirements with specific PM tasks
6. Review PM procedures regularly to improve them

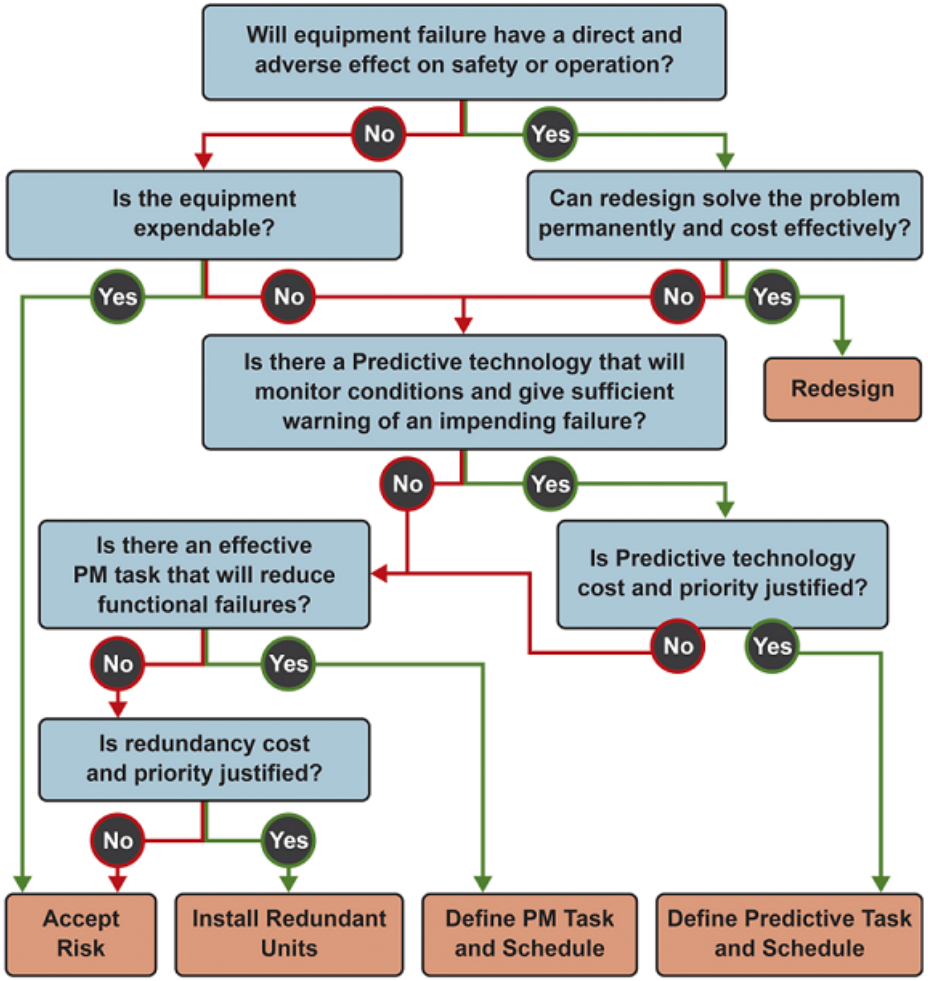


Figure 1: Choosing Reactive, Preventive, or Predictive Maintenance

Making PM (Predictive Maintenance) Successful

The key to a successful preventive maintenance program is scheduling and execution. Scheduling should be automated to the maximum extent possible, which may mean having to update your systems with meter information. Priority should be given to preventive maintenance and a very aggressive program to monitor work and ensure it is completed according to a schedule that should be in place.
Start with your most critical equipment first and use it as a showcase to prove the value of PM. Before you start, develop baseline costs and failures to be able to compare to later. Three forms of data are needed to develop PM:

1. Manufacturer's recommendations
2. A review of breakdowns and repairs
3. Consultation with operators, mechanics, and supervisors

Inspections

Frequency of inspections is determined by the type of equipment, its age, its condition, and the consequences of failure. Most inspection frequencies are:

Table 1: Inspection Frequencies per Type of Preventive Maintenance

Inspection Frequency	Type
Daily	more suitable for Type 1
Weekly	more suitable for Type 1
Biweekly	more suitable for Type 2
Monthly	more suitable for Type 2
Quarterly	more suitable for Type 2
Semiannually	more suitable for Type 2
Annually	more suitable for Type 2

Reliability Measurement

The mean time between failures (MTBF) is a reliability measurement calculated by dividing the number of failures by the operating time. It usually is stated in hours. For most construction equipment, use meter hours. MTBF is calculated as

$$\frac{\text{total number of failures}}{\text{total operating hours}} =$$

- i.e.: 15 failures in 12,000 hours = MTBF is 800 hours

Maintenance field uses of MTBF are:

1. Establishing failure-finding task frequency
2. Aiding in the determination of whether scheduled maintenance is worth executing
3. Assisting in determining a protective piece of equipment's desired availability

Preventive Replacements

To schedule preventive replacements, you must have these three conditions:

1. The total cost of replacement (parts, labor, and lost production) is less than the cost of failure.
2. You have a good idea of the average time between failures (MTBF) and can reasonably predict preventive replacement intervals.
3. The potential consequences of failure (other than costs) are far greater than the cost and loss required by preventive replacement.
    - Predetermined parts replacement should be minimal and done only where statistical evidence clearly indicates wear-out characteristics that can be predicted.

Lubrication

Lubrication is the essential for mechanical equipment. It is science, not an art. There are three primary types of lubrication:

- Lube oils
- Solids (mica, graphite, molybdenum disulfide, etc.)
- Greases (lube oil with organic or inorganic thickener)

Lubes are determined by their viscosity and their additives for service.
It only takes 20 ppm of water to halve the life of a bearing. Lube containers (drums) left outside collect moisture from the change in temperature, which can contaminate the contents. All fill containers should be sealed.
Over-greased bearings are often in more neglect than under-greased ones. Manufacturers specify lube amounts, but we often ignore them. This can lead to equipment failure. Lubrication check sheets contain the lubrication requirements of the equipment for the specified PM frequency. The mechanical, electrical, and instrumentation check sheets contain the steps required to perform a thorough examination of your equipment to identify any existing or potential equipment problems.

Improving Predictive and Preventive Maintenance

Steps to improving predictive and preventive maintenance (PPM) are as follows:

1. Acknowledge there is a issue or cost/impact of not doing PPM

- Expensive parts shipment
- Unscheduled downtime
- Costly parts and materials
- Excessive overtime
- Missed deliveries

2. Establish a PPM or reliability policy

- Define what PPM is and is not
- Identify management, operation, and maintenance roles in supporting PM and PdM
- Describe measures and monitoring processes
- Have the policy signed and issued by management

3. Gain operational buy-in

- Educate others on the need for commitment
- Provide support and assistance for access to equipment
- Provide a willingness to monitor and track metrics (results and processes)

4. Establish an equipment data record to document information

- Model and type
- Physical location of equipment
- Name plate data and serial number
- Asset or equipment number
- Critical spare parts list
- Update and modification records

- Manufacture date
- Modifications and dates

5. Assign PM type and criticality

- Differentiate between Type 1 (operator-performed) and Type 2 (maintenance-performed) PM tasks
- Based on failure consequences, identify the most critical equipment
- Determine which path is most logical: PPM, run-to-failure, or redesign

6. Develop checklists and job plans for PM

- Train internal personnel or contract PdM services
- Develop a consistent format
- Identify running versus stationary for scheduling
- Solicit feedback (actual condition), findings, comments, and corrections
- Define pass/fail (go/no-go) criteria for objective inspections
- Offer responses (okay, work order, adjusted)

7. Develop PM routes and work orders

- Create a work order format; use the Computerized Maintenance Management Systems (**CMMS**) format
- Organize PPM by scheduling for close proximity

8. Develop PM schedules (based on frequencies)

- Organize based on frequency
- *Examine manufacturer's recommendations along with failure frequencies
- Continue to change frequencies (monitor for condition changes)

9. Maintain equipment history and develop a close-out process

- Develop a process to record comments and findings
- Choose findings/activities that will initiate changes/review

10. Develop a reporting process

- Analyze PPM results
- Display and report monthly progress
- Track corrective actions from PPM inspections (**CP**, Cost of Preventive Maintenance)
- Develop a method to respond to problems or variances
- Have metrics in place
    1. % PM of total maintenance hours
    2. % PM schedule compliance
    3. MTBF on critical equipment
    4. % PM review (revised PM)
    5. % Corrective from PPM
    6. PM versus CM ratio

11. Organize PPM (suggested)

- PPM discipline is improved by dedicated personnel
- Assign most experienced tasks

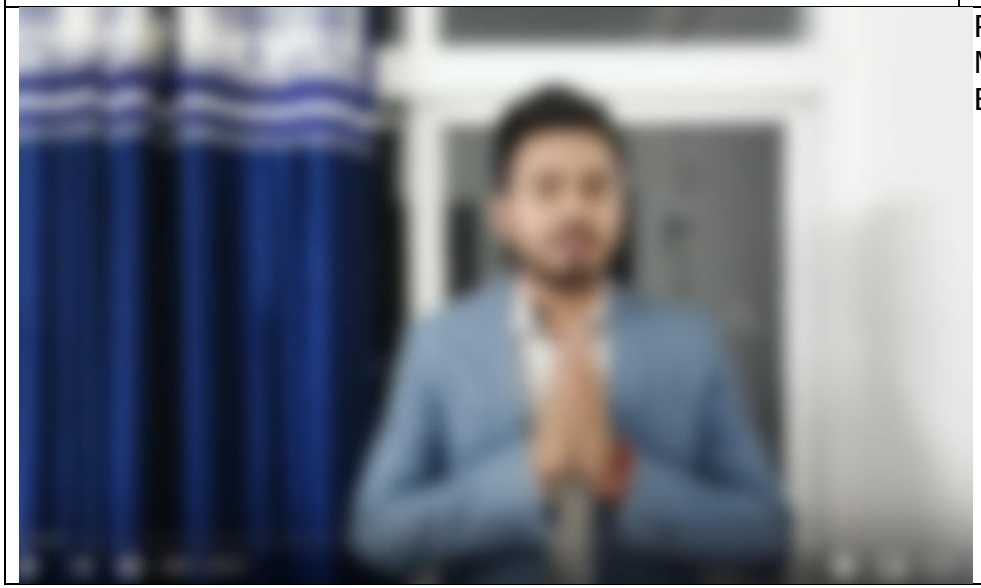
A quality preventive maintenance program requires a highly motivated preventive maintenance crew. To provide proper motivation, the following activities are suggested:

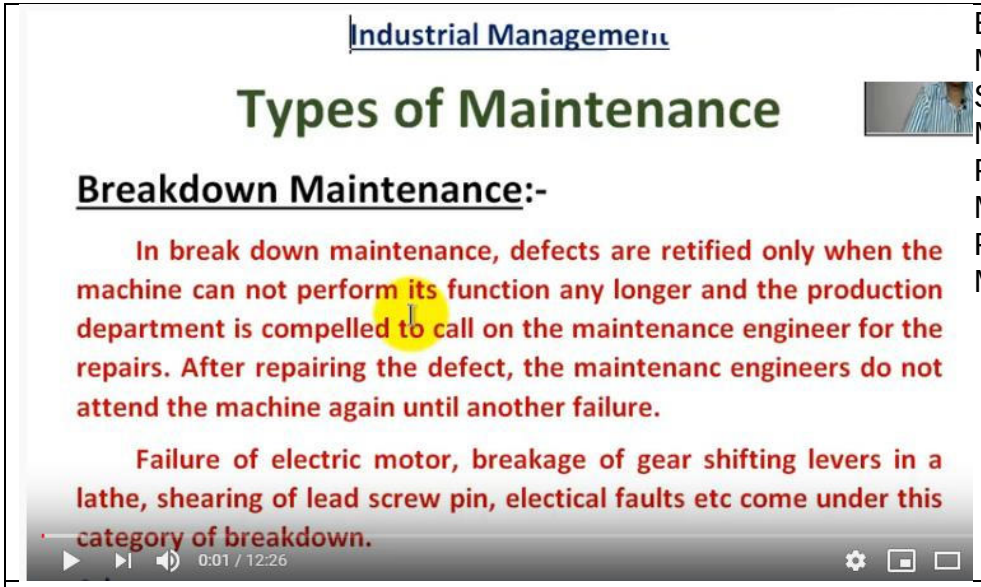
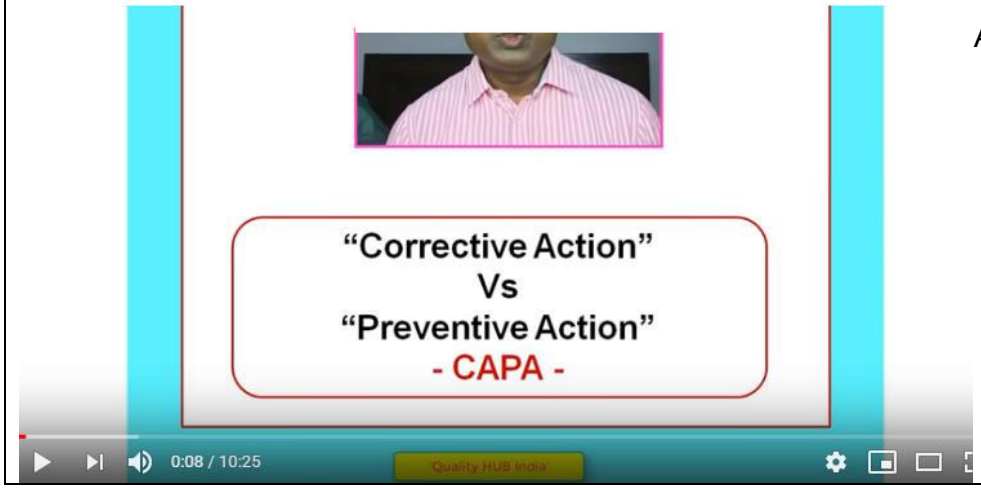
- Establish inspection and preventive maintenance as a recognized, important part of the overall maintenance program
- Assign competent, responsible people to the preventive maintenance program
- Monitor and follow-up on tasks to ensure quality performance and to show everyone that management does care
- Provide training in precision maintenance on specific equipment
- Set high standards
- Publicize reduced costs with improved up-time and revenues, which are the result of effective preventive maintenance
- Measure and audit

Reference:

https://www.myodesie.com/wiki/index/returnEntry/id/2965

Videos:

	Topic	Hyperlink
	PREVENTIVE MAINTENANCE	https://www.youtube.com/watch?v=qE-djQuO8LQ

	Breakdown Maintenance - Scheduled Maintenance - Preventive Maintenance - Predictive Maintenance	https://www.youtube.com/watch?v=TcCE9pBxe5Q
	Corrective Action' VS 'Preventive Action	https://www.youtube.com/watch?v=11669QoKDyc

Summary of the module:

Module Title and Aim	Learning Units	Timeframe of modules
Module 1: Apply Work Health and Safety Practices (WHS). **Aim:** The Aim of this module is to describe the skills to work with safety and participate in hazard assessment activities, follow emergency procedures and participate OHS practices in process.	**LU1:** Implement safe work practices at work place. **LU2:** Participate in hazard assessment activities at work place. **LU3:** Follow emergency procedures at workplace. **LU4:** Participate in OHS consultative processes.	30 Hours
Module 2: Identify and Implement Workplace Policy and Procedures. **Aim:** The Aim of this module is to describe the skills and knowledge required to develop and implement a workplace policy & procedures and to modify the policy to suit changed circumstances. It applies to individuals with managerial responsibilities who undertake work developing approaches to create, monitor and improve strategies and policies within workplaces and engage with a range of relevant stakeholders and specialists.	**LU1:** Identify workplace policy & procedures. **LU2:** Implement workplace policy & procedures. **LU3:** Communicate workplace policy & procedures. **LU4:** Review the implementation of workplace policy & procedures	20 hours

Module Title and Aim	Learning Units	Timeframe of modules
Module 3: Communicate at Workplace **Aim:** The Aim of this module is to describe the performance outcomes, skills and knowledge required to develop communication skills in the workplace. It covers gathering, conveying and receiving information, along with completing assigned written information under direct supervision.	**LU1:** Communicate within the organization. **LU2:** Communicate outside the organization. **LU3:** Communicate effectively in workgroup. **LU4:** Communicate in writing**.**	30 Hours
Module 4:Perform Computer Application Skills **Aim:** The Aim of this module is to describe the skills and knowledge required to use spreadsheet applications, prepare in page documents, develops familiarity with Word, Excel, Access, PowerPoint, email, and computer graphics basics. It applies to individuals who perform a range of routine tasks in the workplace using a fundamental knowledge of spreadsheets, Microsoft office and computer graphics in under direct supervision or with limited responsibility.	**LU1:** Prepare In-page documents as per required information. **LU2:** Prepare Spreadsheets as per required information. **LU3:** Use MS Office as per required information. **LU4:** Perform computer graphics in basic applications. **LU5:** Create Email account for communications.	40 Hours

Module Title and Aim	Learning Units	Timeframe of modules
Module 5:Manage Personal Finances **Aim:** The Aim of this module is to describe the outcomes required to develop, implement and monitor a personal budget in order to plan regular savings and manage debt effectively.	**LU1:** Develop a personal budget. **LU2:** Develop long term personal budget. **LU3:** Identify ways to maximize future finances.	30 Hours
Module 6:Perform welding **Aim:** The aim of this module is to cover the specific skills and knowledge related to Spot-, Seam-, MIG and TIG-welding operations in automotive parts manufacturing industries, material handling and maintains machine and workplace.	**LU1:** Prepare for welding. **LU2:** Prepare welding equipments and accessories. **LU3:** Perform spot welding operations. **LU4:** Perform seam welding operations. **LU5:** Perform MIG/TIG welding operations. **LU6:** Inspect final work. **LU7**: Perform work place cleaning and maintenance	160 Hours
Module 7: Apply thread rolling operations **Aim:** The aim of this module is to cover the specific skills and knowledge related to perform for thread rolling operation, material handling, formulation/construction, defects &remedies and maintains machine and workplace.	**LU1:** Prepare for thread rolling. **LU2:** Conduct pre-operational checks on machine. **LU3:** Prepare thread rolling die. **LU4:** Operate machine. **LU5:** Inspect final product. **LU6:** Perform workplace cleaning and maintenance.	100 Hours

Module Title and Aim	Learning Units	Timeframe of modules
Module 8: Perform vacuum forming operations **Aim:** The aim of this module is to cover the specific skills and knowledge related to perform vacuum forming operation, material handling, formulation/construction, defects & remedies and maintains machine and workplace.	**LU1:** Prepare for Vacuum forming. **LU2:** Conduct pre-operational checks on machine. **LU3:** Prepare vacuum mould. **LU4:** Operate machine. **LU5:** Inspect final product. **LU6:** Perform workplace cleaning and maintenance.	100 Hours
Module 9: Perform pressing operation **Aim:** The aim of this module is to cover the specific skills and knowledge related to perform Pressing/stamping operations, material handling, inspection techniques and maintain hydraulic, pneumatic and mechanical press machines and work place.	**LU1:** Prepare for pressing. **LU2:** Conduct pre-operational checks on machine. **LU3:** Prepare die. **LU4:** Operate mechanical press machine. **LU5:** Operate hydraulic press machine. **LU6:** Operate pneumatic press machine. **LU7:** Inspect final product. **LU8:** Perform workplace cleaning and maintenance.	150 Hours

Module Title and Aim	Learning Units	Timeframe of modules
Module 10: Perform periodic operator maintenance **Aim:** The aim of this module is to cover the specific skills and knowledge related to work on periodic maintenance, making the workplace free from hazards and capable to report and record the maintenance activity performed on the machine and workplace.	**LU1:** Prepare for maintenance. **LU2:** Isolate and shut down equipment and machine. **LU3:** Inspect equipment and machine. **LU4:** Conduct preventive maintenance. **LU5:** Report faults. **LU6:** Record maintenance.	90 Hours

Frequently asked questions

1. What is Competency Based Training (CBT) and how is it different from currently offered trainings in institutes?	Competency-based training (CBT) is an approach to vocational education and training that places emphasis on what a person can do in the workplace as a result of completing a program of training. Compared to conventional programs, the competency based training is not primarily content based; it rather focuses on the competence requirement of the envisaged job role. The whole qualification refers to certain industry standard criterion and is modularized in nature rather than being course oriented.
2. What is the passing criterion for CBT certificate?	You shall be required to be declared “Competent” in the summative assessment to attain the certificate.
3. What are the entry requirements for this course?	The entry requirement for this course is Matriculation or National Vocational Certificate level 2, in (Machinist or relevant)
4. How can I progress in my	You shall be eligible to take admission in the National Vocational Certificate Level-4

educational career after attaining this certificate?	in Automotive Parts Production Machine Operator.
5. If I have the experience and skills mentioned in the competency standards, do I still need to attend the course to attain this certificate?	You can opt to take part in the Recognition of Prior Learning (RPL) program by contacting the relevant training institute and getting assessed by providing the required evidences.
6. What is the entry requirement for Recognition of Prior Learning program (RPL)?	There is no general entry requirement. The institute shall assess you, identify your competence gaps and offer you courses to cover the gaps; after which you can take up the final assessment.
7. Is there any age restriction for entry in this course or Recognition of Prior Learning program (RPL)?	There are no age restrictions to enter this course or take up the Recognition of Prior Learning program
8. What is the importance of this certificate in National and International job market?	This certificate is based on the nationally standardized and notified competency standards by National Vocational and Technical Training Commission (NAVTTC). These standards are also recognized worldwide as all the standards are coded using international methodology and are accessible to the employers worldwide through NAVTTC website.
9. Which jobs can I get after attaining this certificate? Are there job for this certificate in public sector as well?	You shall be able to take up jobs in the Automotive industries in the functions of Machine operator, Die/Mould Setter, Production executive etc.
10. What are possible career progressions in industry after attaining this certificate?	You shall be able to progress up to the level of supervisor after attaining sufficient experience, knowledge and skills during the job. Attaining additional relevant qualifications may aid your career advancement to even higher levels.
11. Is this certificate recognized by any competent authority in Pakistan?	This certificate is based on the nationally standardized and notified competency standards by National Vocational and Technical Training Commission (NAVTTC). The official certificates shall be awarded by the relevant certificate awarding body.
12. Is on-the-job training mandatory for this certificate? If yes, what is the	On-the-job training is not a requirement for final / summative assessment of this certificate. However, taking up on-the-job training after or during the course work

duration of on-the-job training?	may add your chances to get a job afterwards.
13. How much salary can I get on job after attaining this certificate?	The minimum wages announced by the Government of Pakistan in 2019 are PKR 17,500. This may vary in subsequent years and different regions of the country. Progressive employers may pay more than the mentioned amount.
14. What is the teaching language of this course?	The leaching language of this course is Urdu and English.
15. Is it possible to switch to other certificate programs during the course?	There are some short courses offered by some training institutes on this subject. Some institutes may still be offering conventional certificate courses in the field.
16. What is the examination / assessment system in this program?	Competency based assessments are organized by training institutes during the course which serve the purpose of assessing the progress and preparedness of each student. Final / summative assessments are organized by the relevant qualification awarding bodies at the end of the certificate program. You shall be required to be declared “Competent” in the summative assessment to attain the certificate.

Test Yourself (Short & Multiple Choice Questions)

Module-6

Question	Candidate’s answer
1. Explain Arc Welding Principle?	

Question	Candidate's answer
2. Which gas is used in TIG welding?	
3. Enlist any three advantages and disadvantages of TIG Welding?	
4. Name of the welding in which electrode are not consumed?	
5. Enlist any three methods of welding inspection?	
6. Enlist any three types of joint in arc welding?	

Question	Candidate's answer
7. Which tip material used in TIG Welding? a. Tungsten b. Copper c. Aluminum	
8. Which gas is used in MIG welding? a. Helium b. Argon c. CO_2	
9. How much gap between object and electrode maintain in arc welding? a. 1.5 mm to 3 mm b. 1.5 cm to 3 cm c. 4 mm to 8 mm d. 4 cm to 8 cm	
10. Identify the welding symbols? a)  b) 	

Module-7

Question	Candidate's answer
11. Define two standards of thread types?	
12. What are the measuring methods of pitch thread?	
13. Enlist any three advantages of thread rolling?	
14. Enlist the any three techniques of thread cutting?	
15. What is the abbreviation of ISO & BSI	

Question	Candidate's answer
16. What is the major Diameter of M10 thread? a) Diameter 9 mm b) Diameter 9.2 mm c) Diameter 10mm d) Diameter 11 mm	
17. What is the angle of acme thread? a) 29^o b) 39^o c) 49^o d) 59^o	
18. AISI 1040 material is used for high tensile bolt? a) True b) False	
19. What is the least count of analog Vernier Caliper? a) 0.05 b) 0.07 c) 0.09	

Module-8

Question	Candidate's answer
20. Enlist any three vacuum forming process defects?	
21. Enlist any five material used in vacuums forming?	
22. Enlist the advantages of vacuum performing machine?	
23. Define vacuum forming operation?	
24. Which is the common manufacturing method of vacuum mould?	

Question	Candidate's answer
25. Which of following is correct deformation temperature of poly carbonate? a) 400 C^o b) 425 C^o c) 450 C^o d) 480 C^o	
26. Can wood material is used as a part material in vacuum forming process? a. True b. False	
27. Abbreviation of ABS? a) Acetylene butadiene styrene b) Acrylonitrile butadiene styrene c) Acrylonitrile butadiene surface	
28. What is the abbreviation of PPE's?	
29. Vacuum forming mould has single half / side? a. True b. False	

Module-9

Question	Candidate's answer
30. Enlist the types of press machine?	
31. Enlist any five pre- operational checks?	
32. Name any 05 types of stamping dies in press machine?	
33. Define the shut height of press machine?	
34. Define the use of checking fixture production operation.	

Question	Candidate's answer
35. Enlist any three names of the defects that found on part during press operation.	
36. Forming dies are used in blanking and piercing operation. a. True b. False	
37. Shackle is the basic accessory is used during Loading/ Unloading die on press machine. a. True b. False	
38. The operation of flanging die is…. a) Cut the piece b) Bend the edges c) Draw d) Blanking	
39. What is the purpose of double push button in the press machine?	

Module-10

Question	Candidate's answer

Question	Candidate's answer
40. What are the three basic benefits of periodic maintenance?	
41. Which are the basic routine maintenance of machines?	
42. Define the KIAZEN?	
43. Enlist the any three types of maintenance?	
44. What are the difference b/w periodic and break down maintenance?	
45. Name the three maintenance activity that is not included in periodic maintenance?	

Question	Candidate's answer
46. Select the right tool to open the flange. a. Hammer b. Chisel c. Spanner d. Torque wrench	
47. Grease is used as lubricant in machine? a. True b. False	
48. The Faulty accessories (Fuse, Sensor, Relays, and Switch) are recommended to repair and refit again? a. True b. False	
49. Select the right abbreviation of OHSA? a) Occupational Health and safety Administration. b) Occupational Health and safety Association c) Occupational Hazard and safety Administration. d) Occupational Health and safety Addition.	

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