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DIES AND MOULDS MAKER

LEARNER GUIDE

National Vocational Certificate Level 4

Version 1 - August, 2019

NAVTTC

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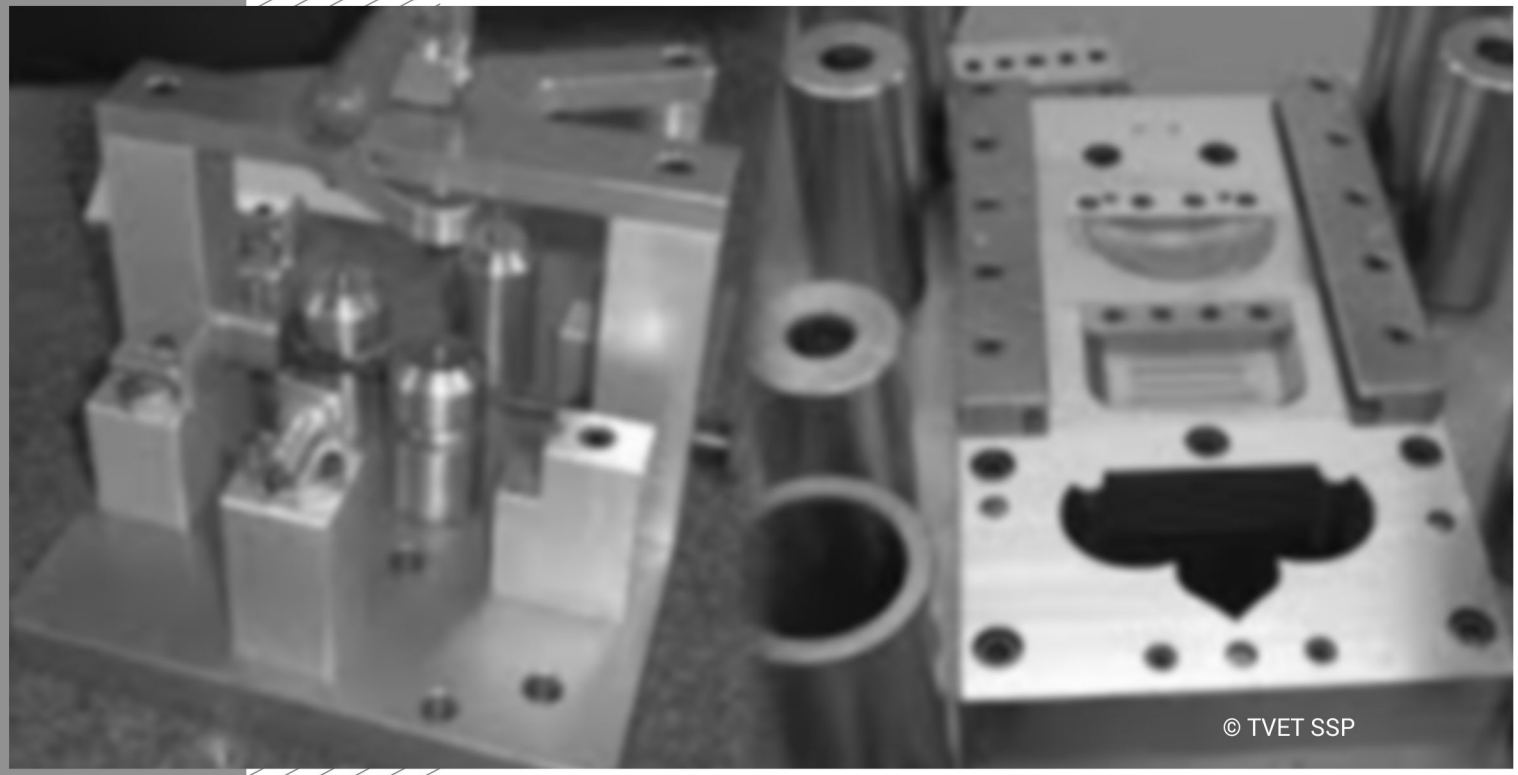

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Introduction

Welcome to your Learner's Guide for the Dies and molds maker level 4. It will help you complete the training and go on with further study or go straight into employment.

The Dies and molds maker level 4 training is to engage young people with a program of development that will provide them with the knowledge, skills and understanding to start their career in Pakistan. This qualification will not only build the capacity of existing workers of manufacturing engineering sector but also support the youth to acquire skills best fit in manufacturing industry.

The main elements of your learner's guide are:

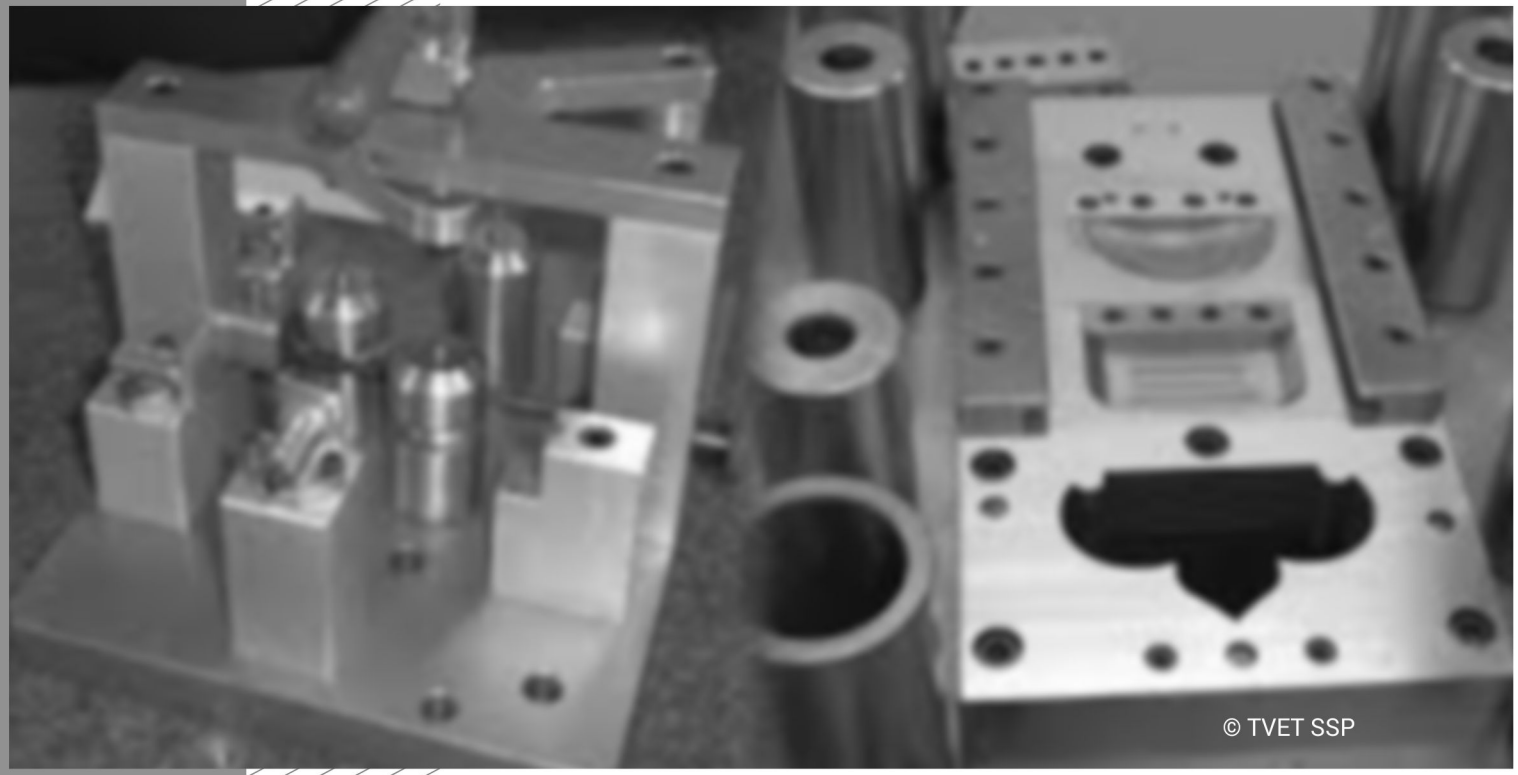
- **Introduction:**
  - This includes a brief description of your guide and guidelines for you to use it effectively
- **Modules:**
  - The modules form the sections in your learner's guide
- **Learning Units:**
  - Learning Units are the main sections within each module
- **Learning outcomes**:
  - Learning outcomes of each learning units are taken from the curriculum document
- **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.

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. How can I progress in my educational career after attaining this certificate?	You shall be eligible to take admission in a level-5, DAE or equivalent course. In certain case, you may be required to attain an equivalence certificate from The Inter Board Committee of Chairmen (IBCC).
4. 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.
5. 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 manufacturing and dies and mould making Industries as a mould maker for the production of plastic parts, sheet metal parts and house hold goods.
6. What are possible career progressions in industry after attaining this certificate?	You shall be able to progress up to the level of shop supervisor after attaining sufficient experience, knowledge and skills during the job. Attaining additional relevant qualifications may aid your career advancement to even higher levels.
7. 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.

8. Is on-the-job training mandatory for this certificate? If yes, what is the duration of on-the-job training?	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 may add your chances to get a job afterwards.
9. 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.
10. Does this certificate enable me to work as freelancer?	You can start your small business as a Dies and mould maker. You may need additional skills on entrepreneurship to support your initiative.

DIES AND MOULDS MAKER



Module-1

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Modules

Module 1: Establish and Maintain the Occupational Health and Safety System

Objective of the module: This unit covers how to establish, maintain and evaluate an occupational health and safety system in the work environment. This unit applies to workers who have either a legislated or delegated responsibility to implement OHS systems to meet the organization s policy requirements. These roles require significant role or delegated authority to allow effective implementation and review. While designed for public safety workers, this unit could be applied in a range of industries. This unit does not cover the broader implementation of organization wide OHS policy.

Duration: Hrs **Theory:** Hrs **Practical:** Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1: **Organize consultation process**	**The trainee will be able to:** Identify and invite relevant personnel or other representative personnel into the development and maintenance processes. Handle issues raised through consultation according to issue resolution procedures. Verify results from the consultation process and make it available to relevant personnel.		
LU2: **Design**	**The trainee will be able to:**		

Occupational Health and Safety framework	Identify hazards and risks correctly and confirm according to occupational health and safety legislation, codes of practice and prevailing trends. Develop procedure for ongoing identification of hazards and risks and integrated within work systems and procedures Develop occupational health and safety policies line with relevant legislation. Incorporate and define occupational health and safety responsibilities and duties into job descriptions/statements. Provide adequate resources in a timely and consistent manner. Develop and implement measures to control assessed risks in accordance with the		

	hierarchy of control, relevant occupational health and safety legislation, codes of practice and trends. Implement interim solutions until a permanent control measure. Record details clearly and efficiently according to organization policy and procedures and relevant legislation		
LU3: **Design and implement an Occupational Health and Safety awareness training program**	**The trainee will be able to:** Devise educational information on the occupational health and safety system and make it available to all relevant personnel. Provide appropriate training to all relevant personnel to enable the implementation of safety		

	procedures		
LU4: **Establish, monitor and maintain Occupational Health and safety system**	**The trainee will be able to:** Establish a system for keeping occupational health and safety records in accordance with legislative requirements. Work activities are monitored to ensure that hazard identification and risk assessment and control procedures are effectively adopted. Inadequacies in hazard identification, risk assessment and established risk control measures are identified in accordance with the hierarchy of control and reported to designated personnel. Amendments to procedures are undertaken through		

	appropriate consultation methods		
LU5: **Establish and maintain a system for accident investigation**	**The trainee will be able to:** A system is developed and implemented for reporting and investigation of all accidents/incidents in accordance with the policies and procedures. Training is provided to employees responsible for accident investigation for effective implementation of accident investigation policy. Policies and procedures for reporting and investigating all accidents/incidents are reviewed and updated as required		
LU6: **Evaluate the organization's Occupational Health and Safety system**	**The trainee will be able to:** The effectiveness of the occupational health and safety system and related policies,		

and related policies procedures and programs	procedures and programs is assessed according to the organization's occupational health and safety policy. Improvements to the occupational health and safety system are developed and implemented. Compliance with occupational health and safety legislation and codes of practice is assessed to ensure that legal occupational health and safety standards are maintained		

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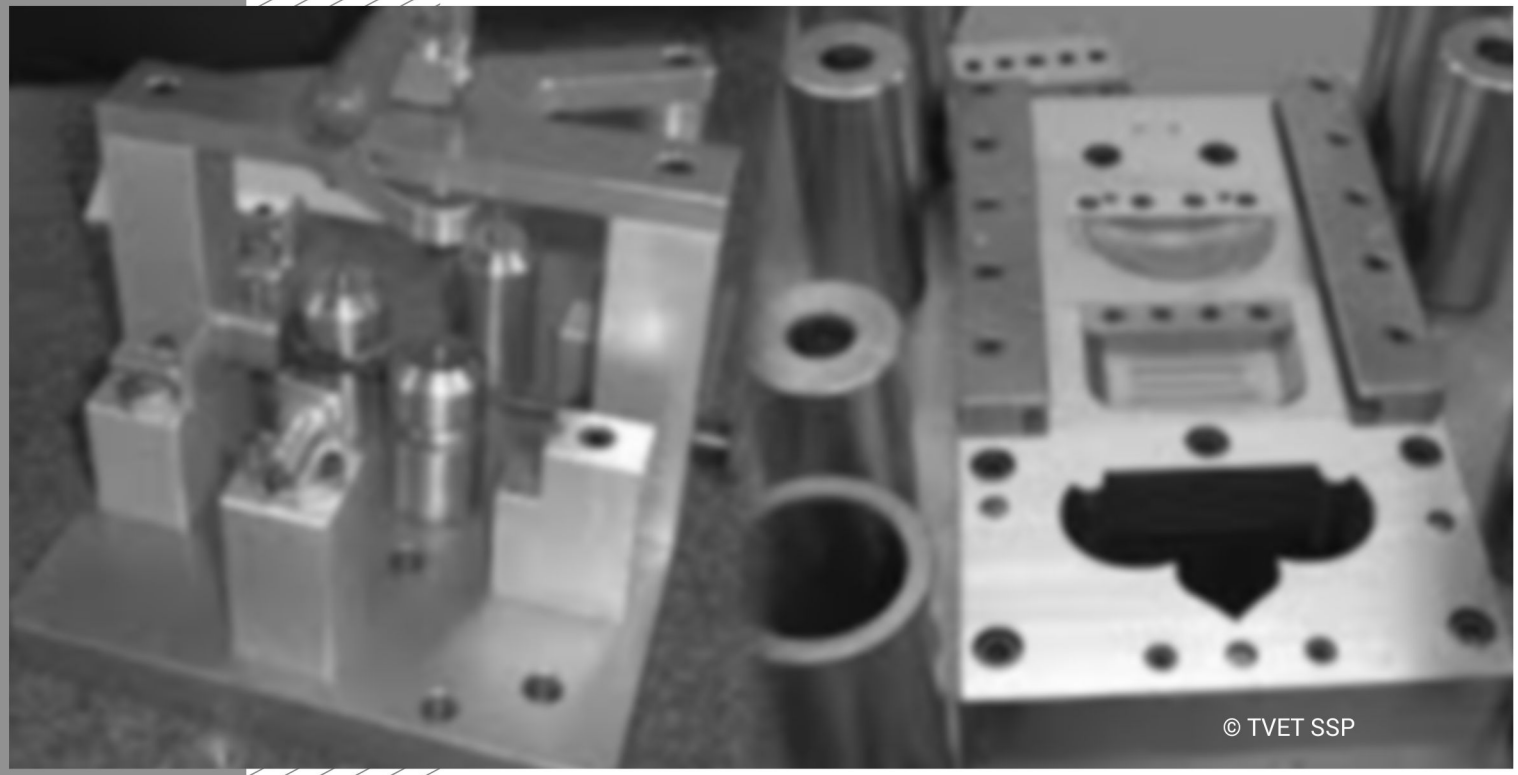

Module-2

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Module 2: 071500975 Finalize Dies and Mold

Objective of the module: This standard defines the advanced knowledge, skills and understanding needed to finalize dies & molds and inspect dies & molds as per standard procedure

Duration: 150 Hrs **Theory:** 25 Hrs **Practical:** 1250 Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1: **Interpret drawing and sketches**	**The trainee will be able to:** Interpret assembly drawing Check & verify the detailed drawing with assembly drawing Arrange the drawings of dies & molds for assembly process Identify the Individual's role and responsibilities within the team	Interpretation of a die and mold assembly drawing for die and mold components. **Mold design details:** • Mold base/ mold shoe. • Ejector system. • Feeding system (Runners & Gates types). • Cavity and Punch. • Cooling system • Undercut (split molds) **Die design details:** • Die base. • Punch and die. • Stock guiding system • Striping system • Sheet control system (beads and blank holder). • Ejector system of components	Die and mold assembly assembly drawing
LU2: **Carryout final assembly according to the sequence**	**The trainee will be able to:** Perform fitting of guiding system Perform fitting of punch & die in the respective plates	Sequence of fitting a mold and die	Dies and mold assembly Hoist crane Screw driver set Spanner set Allen key set

	as per drawing Perform fitting of punch & die back plates as per drawing Perform fitting of ejection system as per drawing Perform fitting of stripper / blank holder in the die Perform fitting of feeding system Perform fitting of heating/cooling system Ensure punch & die are hardened & ground Ensure proper fitting of inserts Ensure tagging (identification marking) of all components		Fitting bench Fasteners Clamping devices Touching color Wax /plasticine Feeler gauge Hammer Mallet File set Needle file set Pin grinder
LU3: **Perform Die spotting**	**The trainee will be able to:** Check & verify tool assy. (mold & die) according to the tool drawing	Knowledge of basic components of tool Know the method of mounting and clamping the tool on a die spotting machine Knowledge of bearing faces	Die spotting machine Hoist crane Screw driver set Spanner set

	Load & clamp the die/mold on die spotting press Check, verify all bearing faces & cutting edges by applying touching paste. Match all bearing/ matching faces of tool Verify ejection system Finalize the die spotting	Method of die spotting	Allen key set Fitting bench Fasteners Clamping devices Touching color Feeler gauge Mallet File set Needle file set Pin grinder
LU4: **Perform polishing**	**The trainee will be able to:** Select the required polishing materials and aids according to the required surface finish. Select and protect all edges & surfaces need to be protected before start procedure. Perform final polishing according to the required surface finish Verify surface finish	Knowledge of surface finishing grades and unit Knowledge of polishing aids and techniques. Abrasive grit size concept. Knowing the method of protecting surfaces not required to polish. Safe procedure of polishing	Oil stone Polishing sticks Polishing abrasive Polishing paste Polishing kit Polishing machine Emery papers

	according to the required specification		
LU5: **Verify all functions of dies and molds**	**The trainee will be able to:** Verify all the aligned & matching parts of the tool Verify function of all cooling channels of molds Verify the feeding system according to function of tool Verify hydraulic core functions (if required) Verify spring/cushion functions for dies	Attributes of a die and mold guiding system Methods of maintaining mold temperature. **Methods:** cooling channels, heaters etc. Types of gates and runners. Types of punches or moving parts. **Types:** inserts, hydraulic punches, sliders, undercut ,inclined pillars, dog legs etc.	Mold with external punches and sliders
LU6: **Perform tool trial**	**The trainee will be able to:** Select appropriate machine for trial Select & use appropriate material handling devices Load the tool on the machine as per standard procedure Arrange & connect all relevant attachment as per	Types of molding machines. **Types,** horizontal and vertical injection machines, blow molding machine, hand molding machine Types of die press **Types:** mechanical, hydraulic. Knowledge of material handling devices i.e. tool trolley, chain hoist, stacker etc. Know the method of loading a mold on injection molding machine Method of connecting external attachments i.e. cooling system, heating system, hydraulic cores etc. Knowledge of materials for trial purpose of a mold. Knowledge of troubleshooting	Injection molding machines Blow molding machine Blow mold Injection mold Press tool Mechanical press Hydraulic press

	requirement Select specified material for the trial purpose Carry out trial of the tool as per trial procedure Verify the dimension of the sample & make necessary changes for next trial (where required)	Knowledge of adjusting machine parameters i.e. clamping force, material melting temperature, injection pressure etc.	
LU7: **Inspect Dies and molds before delivery**	**The trainee will be able to:** Ensure mounting holes are according to the specified press Ensure safety/holding strips on dies & molds Ensure provision of lifting is available Ensure locating ring/ shank size according to the machine Ensure holes for ejector rod	Check points for a finalized Die and mold before delivery for production or client. Knowledge of safety / holding strips Knowledge of lifting provision in a mold Knowledge of locating ring / shank size. Knowledge of ejector rod provision How to prepare a check list	Check list

	is according to the machine specification Verify final check list / packing list.		
LU8: **Demonstrate safe working practice & housekeeping**	**The trainee will be able to:** Select & use appropriate PPEs. Maintain cleanliness at the workplace Follow & apply standard lifting procedure	Knowledge of PPEs used in a general machine shop Advantages of maintaining cleanliness at work place Safe procedures of using lifting aids	

Examples and illustrations

Mold design details:

- A mold is a device made of metal to produce plastic products faster, less expensive, and more consistently.
- Mold base / mold shoe. (May be defined as an assemblage of mould parts, the plates which conform to an accepted structural shape and size)

- Ejector system.

  (The mechanism used to take out molded part from the mold, there are various type of ejection systems e.g. pin ejection, stripper ejection, sleeve ejection and blade ejection)

- Feeding system (Runners & Gates types).
  (A passage used for melt flow to the cavity (impression) called runner and a small passage allows melt to enter into cavity called gate. Edge gate, flash gate, pin point gate, submarine, ring gate, tab gate and tunnel gate.

- Cavity and Punch.
  (Cavity produces outer shape of the component whereas punch used for internal shapes of the components)

- Cooling system
  (Used to maintain required mold temperature by circulating cooling media that is water or oil in designed channels according to requirements and it also play vital role in cycle time)

- Undercut (split molds)
  (The undercut are the internal or external projection which can not be easily released by ordinary manners and we use sliders and lifters for such components)

Die design details:

- A die is a device made of metal to produce stamping products faster, less expensive, and more consistently.

- Die base.
  (May be defined as an assemblage of die parts, the plates which conform to an accepted structural shape and size)

- Punch and die.
  (Punch produces internal profiles and cavity external profiles)

- Stock guiding system
  Guide way used for feeding strip easily in the die)

- Striping system
  (The method used to release strip from the punches)

- Sheet control system (beads and blank holder).
  (The system used to hold the sheet before stamping operations called blank holder and beads are designed profiled along die edges to easily flow of sheets during forming operations)

- Ejector system of components
  (The system used to take out components from the dies or from mould, Stripper and pressure pads used for this purpose)

Sequence of fitting a mold and die:

(The method used for assemblage of parts and plates with respect to their locations and sizes with the help of different tools and techniques (Bench Fitting)

Mark reference on each part during fitting to ensure proper location during assembly and fitting work

Knowledge of basic components of tool:

The key components of molds and dies are cavity, punch, guide pillars, guide bushes, Tool locating ring, sprue bush, ejector pins, return pins (Push Back), Plates, pressure pad and blank holder.

Know the method of mounting and clamping the tool on a die spotting machine

- Knowledge of bearing faces.
  (The bearing faces are the mating surfaces of the mold and dies, it is also known as shut off faces)

- Method of die spotting.
  (A press used to check shut off areas of mould and dies during manufacturing to ensure proper matching of parts)

Knowledge of surface finishing grades and unit:

The surface finish used in molded components may be mirror finish (Glossy) or matt finish (Textured) and sometimes combination of gloss and textures. The standard VDI and Raum units scale used for surface finishes

Knowledge of polishing aids and techniques:

(The aids used for polishing are emery papers,emry cloths, files, felt cloths, cottons, ceramic sticks, hand pieces (ratrofil), oil stones and diamond paste and tubes of different grades)

Abrasive grit size concept.

Knowing the method of protecting surfaces which not required to polish.

Safe procedure of polishing

(The dust free environment required for polishing work)

Attributes of a die and mold guiding system

(The Guide pillars and Guide Bushes used for mould and die guiding systems)

Methods of maintaining mold temperature.

(The chillers and MTC (mold temperature controller) used for maintaing mold temprature)

Methods: cooling and heating.

Types of gates and runners.

Edge gate, Submarine gate, Tab Gate, Ring Gate, Flash gate, Pin pint gate, Fan gate, tunnel gate

Types of punches or moving parts.

Types: inserts, hydraulic punches, sliders, undercut ,inclined pillars, dog legs (Cam) etc.

Types of molding machines.

Types, horizontal and vertical injection machines, blow molding machine, hand molding machine, compression and transfer moulding press, pressure die casting hot and cold chamber machines

Types of die press

Types: mechanical, hydraulic.

Knowledge of material handling devices i.e. tool trolley, chain hoist, stacker etc

.

Know the method of loading a mold on injection molding machine:

Know the tonnage, shot weight, plasticizing capacity, distance b/w tie bars, knock out systems

Method of connecting external attachments i.e. cooling system, heating system, hydraulic cores etc.

Knowledge of materials for trial purpose of a mold.

Name and grade of material with Properties, melt temperature, processing temperature and pre drying temperature

Knowledge of troubleshooting

Shot filling, flashes, jetting, streak marks, blistering, voids, air bubles, flow marks, weld line, sink mark

Knowledge of adjusting machine parameters i.e. clamping force, material melting temperature, mold temperature, injection pressure and cycle time

Check points for a finalized Die and mold before delivery for production or client.
Prepare components list, inspection reports of parts and samples,

Knowledge of safety / holding strips
Mold should be packed in wooden box and paste details of mould on it before dispatching

Knowledge of lifting provision in a mold
Use eye bolt and lifting bar for mold handling and for mounting on machine. Use parting locks during mold or die lifting

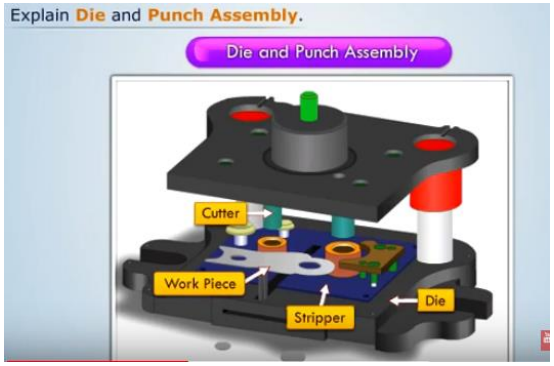
Knowledge of locating ring / shank size.
Used to mount tool on machines

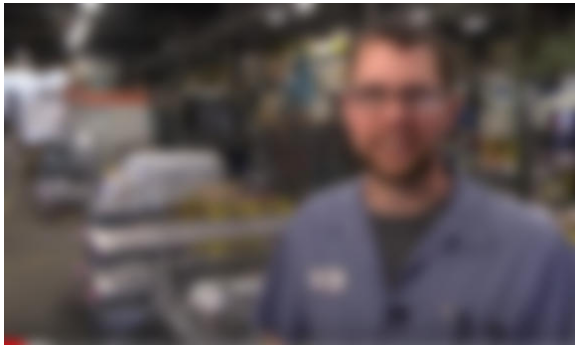
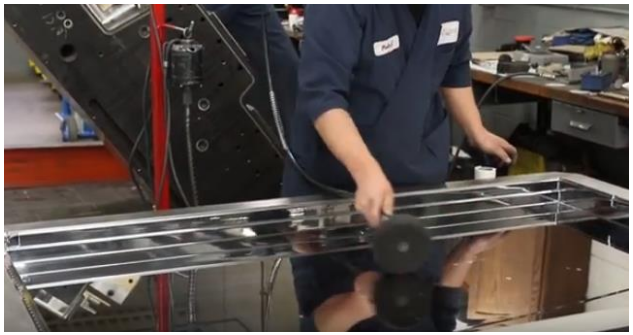
Knowledge of ejector rod provision
Ejector rod used to operate ejector mechanism

How to prepare a check list
Enlist each part of mold and die in check list to verfiy that they all are mouted and are in OK conditions, including all systems e.g ejector mechanism, sliders and lifters and also ensure cooling check (leakage)

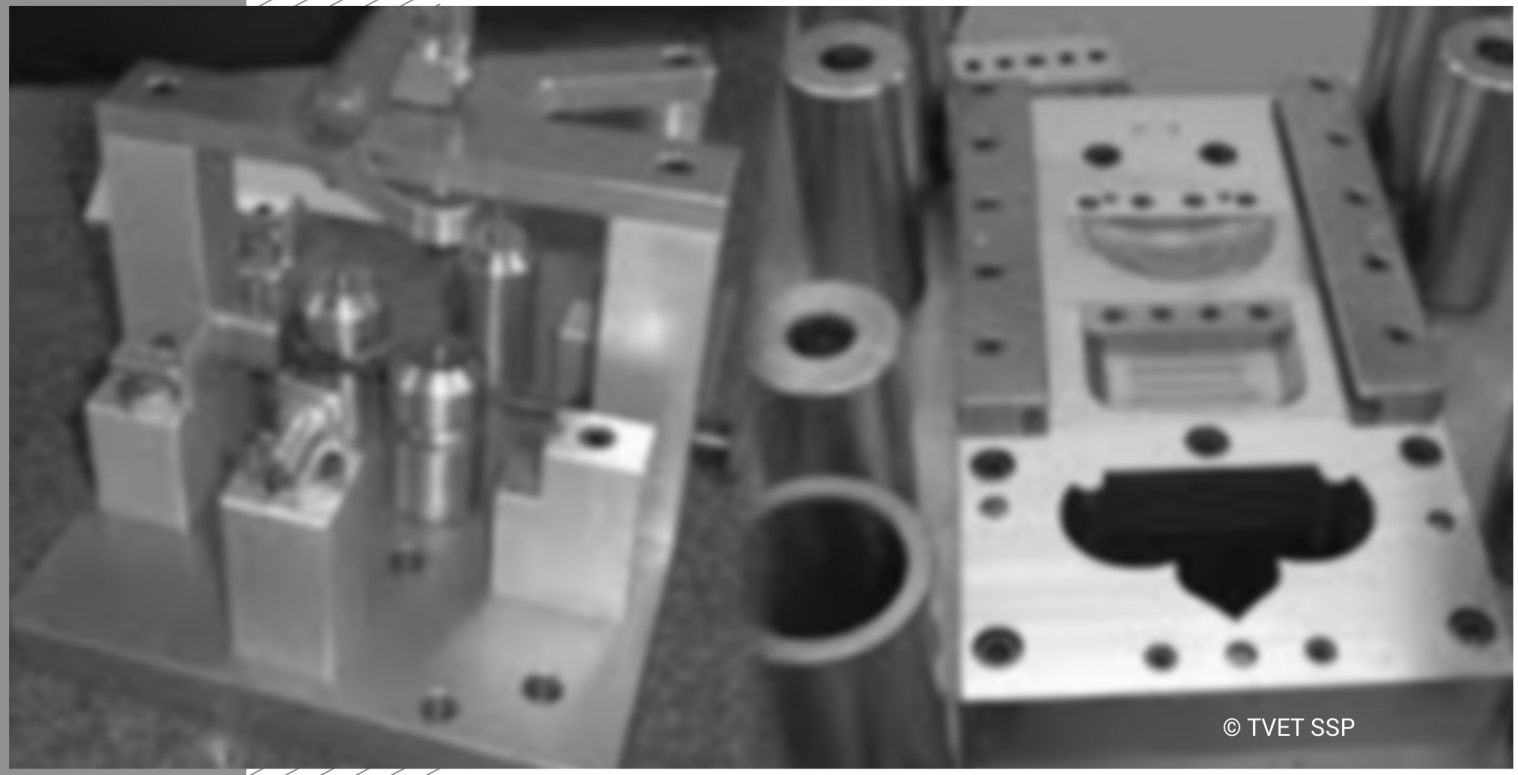
Knowledge of PPEs used in a general machine shop
Advantages of maintaining cleanliness at work place
Safe procedures of using lifting aids

VIDEOS:

	How to assemble a plastic injection mold https://www.youtube.com/watch?v=DWi1vtfmMVk&t=630s
	Die and Punch Assembly https://www.youtube.com/watch?v=zbG3Bo7PIIE

	MNLW Die Spotting Press Machine https://www.youtube.com/watch?v=JHo0uNndmZc
	MoldMaking Matters: MoldMaking Your Road to Success https://www.youtube.com/watch?v=gi-XcsNM0AE
	Ultra Polishing Virtual Tour https://www.youtube.com/watch?v=uPE8cm55Xs4

DIES AND MOULDS MAKER



Module-3

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Module 3: 071500976 Fabricate a Die

Objective of the module: This competency standard covers the skills and knowledge required to fabricate a die as per tool design.

Duration: 220 Hrs **Theory:** 20 Hrs **Practical:** 200 Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1: **Interpret drawing**	**The trainee will be able to:** Make list of material required.(BoM) Identify machining process required Identify material heat treatment process Identify surface finish required for different components Identify standard fasteners required Identify limits, fits and tolerances for different parts	Interpretation of a Die assembly drawing. To make BOM. Purpose of deferent machining processes i.e. lathe, milling, grinding, boring etc. Knowledge of heat treatment processes used for die making Knowledge of surface finish grades Knowledge of Types of standard fasteners i.e. Nut and bolts, washers, dowel pins etc. Knowledge of tolerances Types of fits	Tool designs Assembly & sub assembly drawing of dies
LU2: **Carryout Machining process of die**	**The trainee will be able to:** Check available raw material with measuring	Use of general measuring tools. Scale, measuring tape, Vernier caliper etc. Knowledge of machining processes.	Tool room machine shop setup Measuring and Inspection

components	tools Plan machining operations as required Perform required machining operations Perform heat treatment of required components Perform finishing operation according to the drawings Perform final inspection as per drawing	**Machines:** lathe, milling, surface and cylindrical grinding, drilling and boring, Special Purpose Machines (SPM) i.e. EDM Wire cut, CNC etc. Knowledge of heat treatment process Interpretation of tool assembly drawing Know the use of inspection tools	Tools
LU3: **Carryout assembly of die**	**The trainee will be able to:** Collect all manufactured parts at assigned area Assemble die side according to the standard procedure Assemble punch side according to the standard procedure Assemble both halves	Knowledge of basic components of a die. **Components**: punch plate, punch back plate, die plate, Die back plate, striper plate, springs, cushions, guide pillar and bushes, pressure pad, knock out pin, polyurethane, Gas spring, drawing beads, blank holder, pilots, guides Knowledge of assembly sequence for a press tool.	Parts of die Hoist crane Screw driver set Spanner set Allen key set Fitting bench Fasteners Clamping devices Touching color Feeler gauge Hammer (8-10lb) Mallet

	(punch & die side)		File set Needle file set Pin grinder
LU4: **Perform Inspection**	**The trainee will be able to:** Mount die on die spotting press. Check clearance between punch & die (for cutting dies) Check die spotting in case of forming die Check over all assembly	Knowledge of cutting clearances Know the method of mounting die on press Know the method of checking clearance Knowledge of physical inspection of draw and cutting components Knowledge of dimensional inspection Knowledge of filling data sheet related to dimensional inspection	Press tools Die spotting machine Measuring tools Inspection gauges

Examples and illustrations

Interpretation of a Die assembly drawing. To make BOM.
Purpose of deferent machining processes i.e. lathes milling, grinding, boring etc.

Knowledge of heat treatment processes used for die making
Stress relieving, hardening, quenching and tempring.

Knowledge of surface finish grades
(Use roughness charts, roughness value and Raum device to check surface finish)

Knowledge of Types of standard fasteners i.e. Nut and bolts, washers, dowel pins etc.

Knowledge of tolerances
(Tolerance zones, Basic hole and shaft system, limits and fits)

Types of fits
(Slide fit, press fit, loose fit, interfering fits)

Use of general measuring tools.
Scale, measuring tape, vernier caliper etc.

Knowledge of machining processes.
Machines: lathe, milling, surface and cylindrical grinding, drilling and boring, Special Purpose Machines (SPM) i.e. EDM Wire cut, CNC etc.

Knowledge of heat treatment process
Material and hardening temprature

Interpretation of tool assembly drawing

Detail and assembly drawing of tools

Know the use of inspection tools

Use verniers, micrometers, feeler gauges, touching paste for shut off surfaces, bevel protractor and depth gauge

Knowledge of basic components of a die.

Components: punch plate, punch back plate, die plate, Die back plate, striper plate, springs, cushions, guide pillar and bushes, pressure pad, knock out pin, polyurethane, Gas spring, drawing beads, blank holder, pilots, guides

Knowledge of assembly sequence for a press tool

Knowledge of cutting clearances

Cutting clearance mainly depends on material of the component

Know the method of mounting die on press

Know the method of checking clearance

Knowledge of physical inspection of draw and cutting components

Knowledge of dimensional inspection

Knowledge of filling data sheet related to dimensional inspection

Cuttiong force Formula:

For more details please visit: http://www.wisetool.com/formular/formula.htm#1

Cutting force	**F= A x Tß** F = Cutting force S = Material thickness L = Total cutting length A = L x S = Shear area Tß = Shear strength Note : Shear strength = 80% of tensile strength

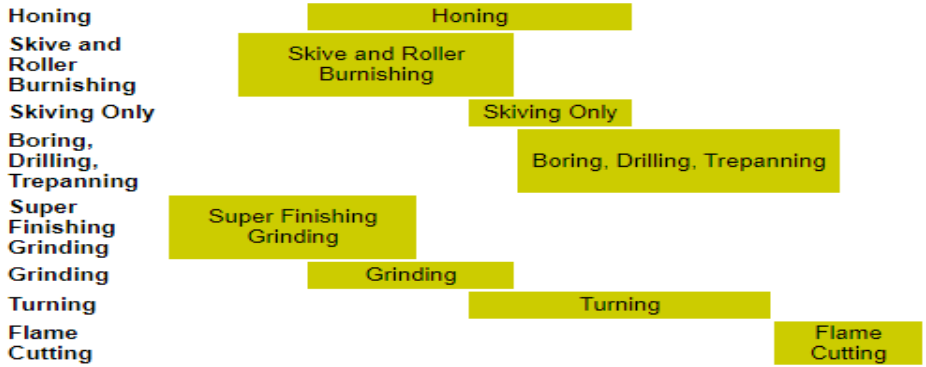
Stripping force calculation:

Stripping force	**P= (L x S x Tß) / 10** P = Stripping force S = Material thickness L = Total cutting length A = L x S = Shear area Tß = Shear strength

Surface finish grades:

For more details please visit: http://www.wisetool.com/surfacefinish.htm

Surface finish	Ground, Honed Roller, Burnished						Turned, Boreed, Drilled				Rough Machined	
Micro Meter	0.025	0.050	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50
Rt	8.7	17.4	34.8	69.6	139	278	548	1,088	2,175	4,350	8,700	17,400
Rz (ISO)	7.6	15.2	30.4	60.8	122	243	479	950	1,900	3,800	7,600	15,200



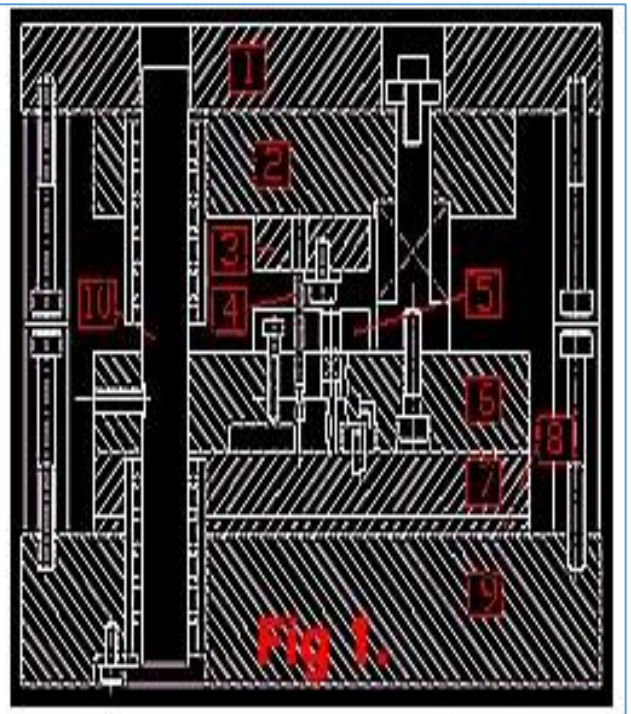
A Basic Die set:

For more details please visit: http://www.wisetool.com/manufacturing/tooldie.htm

A typical die set design can be seen on **Figure 1**.

Name of Tooling components:-

1. Top Die shoe
2. Top thrust plate
3. Punch holder plate or punch plate
4. Punch
5. Stripper backing plate (some tools without this plate)
6. Stripper plate
7. Die plate
8. Die backing plate
9. Lower Die shoe
10. Guide pillar and bush



Common Die making materials:

For more details please visit: http://www.wisetool.com/designation/toolsteel.htm

High carbon tool steel

AISI Code	AISI Designation	Type of Tool steel
W	W1 to W7	High carbon water hardening steel
	W1 A - 1B	Carbon
	W2 - W3	Carbon Vanadium
	W4 - W5	Carbon Chromium
	W7	Carbon Chromium Vanadium

Cold work tool steel

A	A2 - A10	Air hardening, Medium alloys
D	D2 - D7	High carbon, high chromium
O	O1 - O7	Oil hardening, Low carbon

Hot work tool steel

H	H 10, H11, H12, H13	Chromium, Molybdenum
	H14, H16, H19, H23	Chromium, Tungsten
	H20, H21, H22, H24, H25, H26	Tungsten
	H15, H41, H42, H43	Molybdenum

Tool steels:

For more details please visit: http://www.wisetool.com/designation/steelgrade.htm

Tool steel equivalent chart, compare difference maker and standard. Assab, Bohler, Thyssen, Hitachi

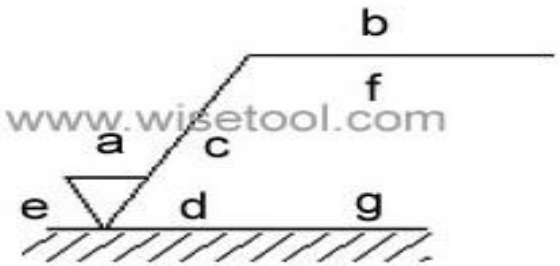
Steel Classification	Standard			Assab	Bohler	Edelstahl Buderus	Thyssen	Hitachi
	DIN	JIS	AISI					
Plastic Mould Steel	1.1203		1055	-	-	-	CK 55	
	1.2311		P20	718	W330	2311 iso BM	2311	
	1.2312		P20+S	Holdax	M200	2312	2312	
	1.2738	SUS 420 J2	P20+Ni	Impax	-	-	2738	SCS 2
	1.2316		-	RaMaxS	M300	-	2316	
	1.2083		420	Stavax	M310	2083	2083	
	1.2085		420+S	-	M304	21 MnCr 5	-	
	1.2162		-	Prexi	M100	-	2162	
Hot Work Steel	1.2344	SKD 61	H13	8407	W302	2344 ISO B	2344	DAC
	1.2714	SKT 4	L6	SOMDIE	W500	2714	2714	DM
	1.2367	-	-	QRO90	W303	2367 ISO B	2367	-
	1.2767	-	-	Grane	K600	X45CrNiMo4	-	-

Surface texture symbol and grades:

For more details please visit: http://www.wisetool.com/surfacetexture.htm

Surface texture & its symbol

A surface roughness value, cut off value or reference length. The processing method, grain direction (machining direction) are indicated around the surface texture symbol as shown below :-



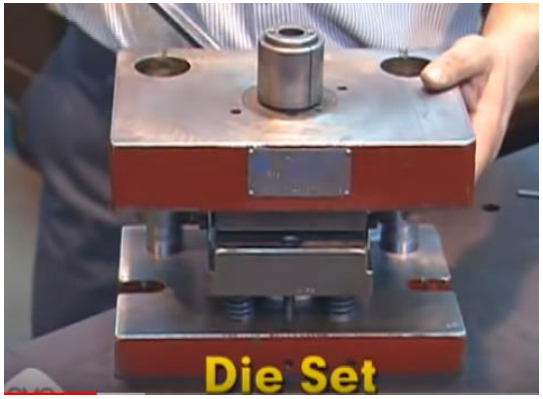
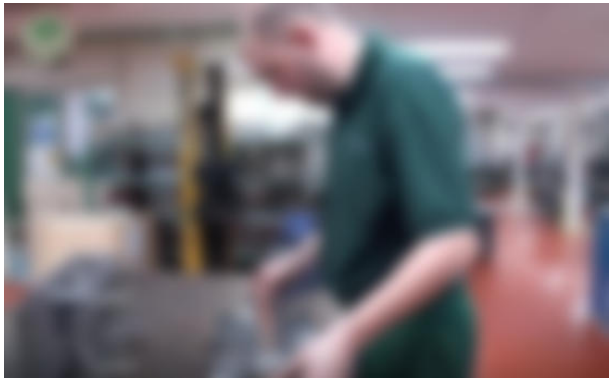
a = Ra Value
b = Machining method
c = Cut off value, length
d = Grain direction
e = Parameter
f = Parameter other than Ra value
g = Surface undulation

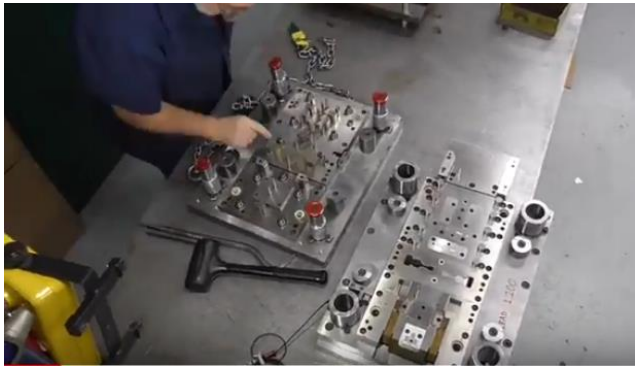
ISO tolerances for Hole:

For more details please visit: http://www.wisetool.com/fit.htm

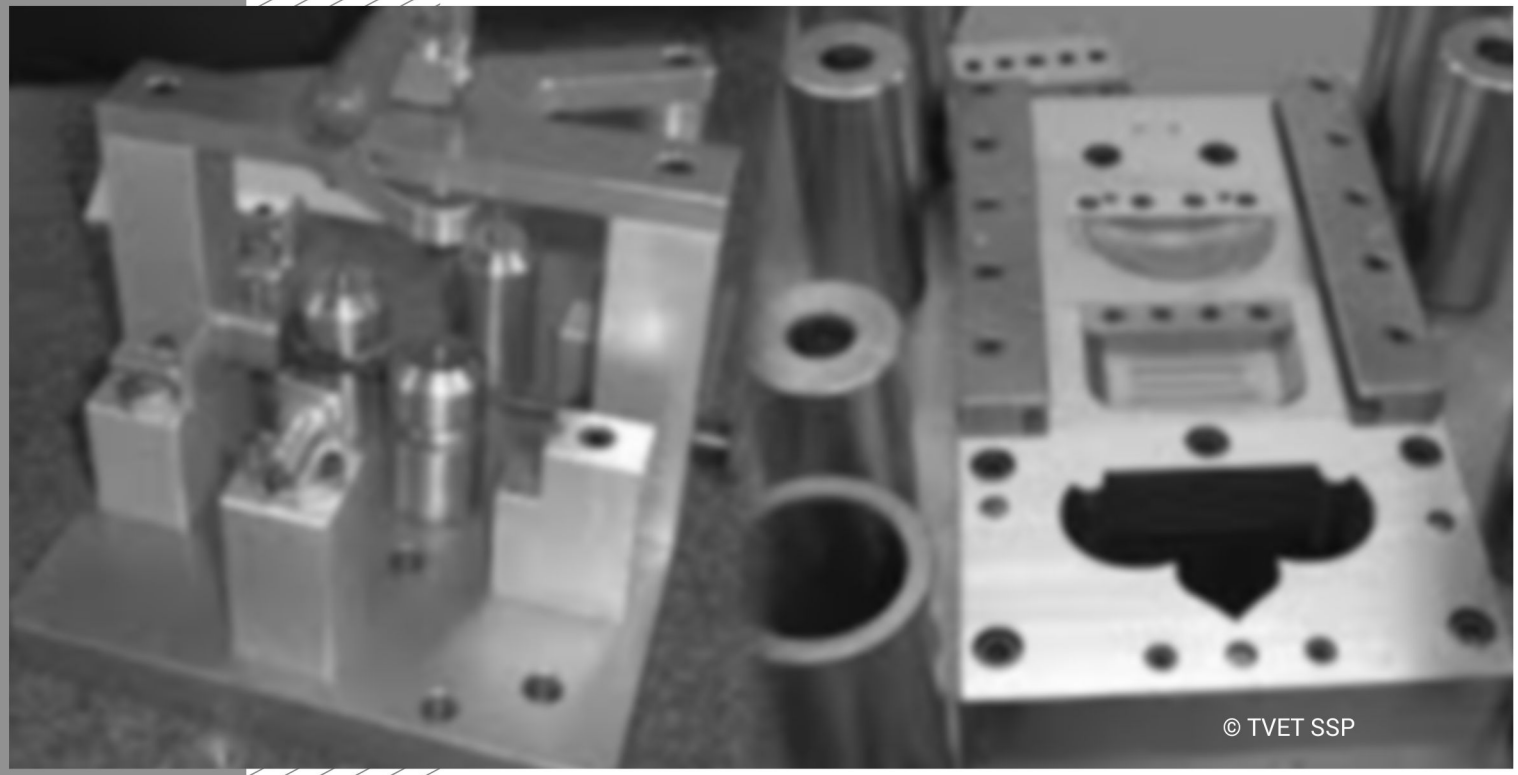
ISO Tolerances for Holes (ISO 286-2)																			
Nominal hole sizes (mm)																			
over																			
inc.	6	10	18	30	40	50	65	80	100	120	140	160	180	200	225	250	280	315	355	400
micrometres																			
E6	+28 +20	+34 +25	+43 +32	+53 +40	+66 +50	+79 + 60	+94 +72	+110 +85		+129 +100				+142 +110		+161 +125			
E7	+32 +20	+40 +25	+50 +32	+61 +40	+75 +50	+90 + 60	+107 +72	+125 +85		+146 +100				+162 +110		+185 +125			
E11	+95 +20	+115 +25	+142 +32	+170 +40	+210 +50	+250 + 60	+292 +72	+335 +85		+390 +100				+430 +110		+485 +125			
E12	+140 +20	+175 +25	+212 +32	+250 +40	+300 +50	+360 + 60	+422 +72	+485 +85		+560 +100				+630 +110		+695 +125			
E13	+200 +20	+245 +25	+302 +32	+370 +40	+440 +50	+520 + 60	+612 +72	+715 +85		+820 +100				+920 +110		+1 015 +125			
F6	+18 +10	+22 +13	+27 +16	+33 +20	+41 +2	+49 + 30	+58 +36	+68 43		+79 +50				+88 +56		+98 +62			

VIDEOS:

	Stamping Dies https://www.youtube.com/watch?v=ieLdyW-OiYI
	Precision Stampings https://www.youtube.com/watch?v=xCQplqp6CVg

	Tool & Die Assembly https://www.youtube.com/watch?v=0t_kie_sBLw

DIES AND MOULDS MAKER



Module-4

LEARNER GUIDE

National Vocational Certificate Level 4

Version 1 - August, 2019

Module 4: 071500977 Fabricate a Mold

Objective of the module: This competency standard covers the skills and knowledge required to fabricate a mold as per tool design.

Duration: 220 Hrs **Theory:** 20 Hrs **Practical:** 200 Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1: **Interpret drawing**	**The trainee will be able to:** Make list of material required.(BoM) Identify machining process required. Identify material heat treatment process Identify surface finish required for different components Identify standard fasteners required. Identify limits, fits and tolerances for different parts	Interpretation of a mold assembly drawing to prepare BOM Knowledge of machining processes. **Machines:** lathe, milling, planner / shaper, surface and cylindrical grinding, drilling and boring, SPM etc. Knowledge of heat treatment processes used for molds' parts Knowledge of surface finish grades Knowledge of Types of standard fasteners i.e. Nut and bolts, washers, dowel pins etc Knowledge of limit, fits & tolerances	Assembly, sub assembly & part drawing

LU2: **Carryout machining process of mold components**	**The trainee will be able to:** Check available raw material with measuring tools. Plan machining operations as required Perform required machining operations Perform heat treatment of required components Perform finishing operation according to the drawings Perform final inspection as per drawing	Use of general measuring tools. Scale, measuring tape, Vernier caliper etc. Knowledge of machining processes. **Machines:** lathe, milling, planner / shaper, surface and cylindrical grinding, drilling and boring, SPM etc. Knowledge of heat treatment process Interpretation of tool assembly drawing Know the use of inspection tools & equipment	Mold drawing Raw material Tool room machines with all standard accessories
LU3: **Carryout assembly of mold**	**The trainee will be able to:** Collect all manufactured parts at assigned area Assemble cavity side according to the standard procedure. Assemble core side	Knowledge basic component of a mold. **Components:** cavity plate, cavity back plate, guide pillar and bushes, punch, punch plate, spacer, ejector pins, ejector plates, push backs, ejector back plates, sliders, inclined pillars Knowledge of assembly sequence for a mold.	A disassembled mold Spanner set Keys Standard fasteners

	according to the standard procedure. Assemble both halves (moving & fixed side).		
LU4: **Perform inspection**	**The trainee will be able to:** Mount mold on spotting machine Check alignment of cavity & core Check mold spotting in case of bearing faces/sliders /lifters (loose core) Check over all assembly	Know the method of mounting mold on a spotting machine press. Know the method of checking gape between punch and cavity. Know the purpose of bearing faces, parting lines, slides removable cores Knowledge of checking the cooling system Know the method of spotting a mold	A simple mold Spotting press Spotting strips / color

Examples and illustrations

Interpretation of a mold assembly drawing to prepare BOM

Knowledge of machining processes.

Machines: lathe, milling, planner / shaper, surface and cylindrical grinding, drilling and boring, SPM etc.

Knowledge of heat treatment processes used for molds' parts

Knowledge of surface finish grades

Knowledge of Types of standard fasteners i.e. Nut and bolts, washers, dowel pins etc

Knowledge of limit, fits & tolerances

Use of general measuring tools.

Scale, measuring tape, Vernier caliper etc.

Knowledge of machining processes.

Machines: lathe, milling, planner / shaper, surface and cylindrical grinding, drilling and boring, SPM etc.

Knowledge of heat treatment process

Interpretation of tool assembly drawing

Know the use of inspection tools & equipment

Knowledge basic component of a mold.

Components: cavity plate, cavity back plate, guide pillar and bushes, punch, punch plate, spacer, ejector pins, ejector plates, push backs, ejector back plates, sliders, inclined pillars

Knowledge of assembly sequence for a mold.

Know the method of mounting mold on a spotting machine press.

Know the method of checking gap between punch and cavity.

Know the purpose of bearing faces, parting lines, slides removable cores

Knowledge of checking the cooling system

Know the method of spotting a mold

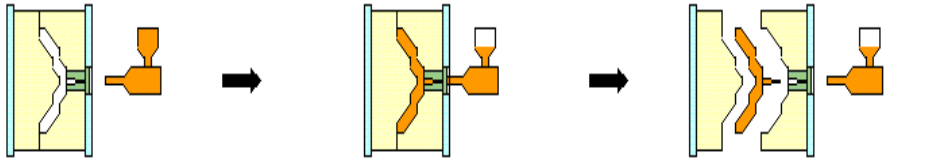
Injection Molding:
For more details please visit: http://www.apiwat.ie.engr.tu.ac.th/molddesign/step1/index12.htm

Injection Molding

This chapter explains the process, advantages and disadvantages as well as the operation of an injection mold.

Injection molding is one of the major methods for plastics molding. This method is widely used for various molded products because it is possible to
a low cost and in a short time.

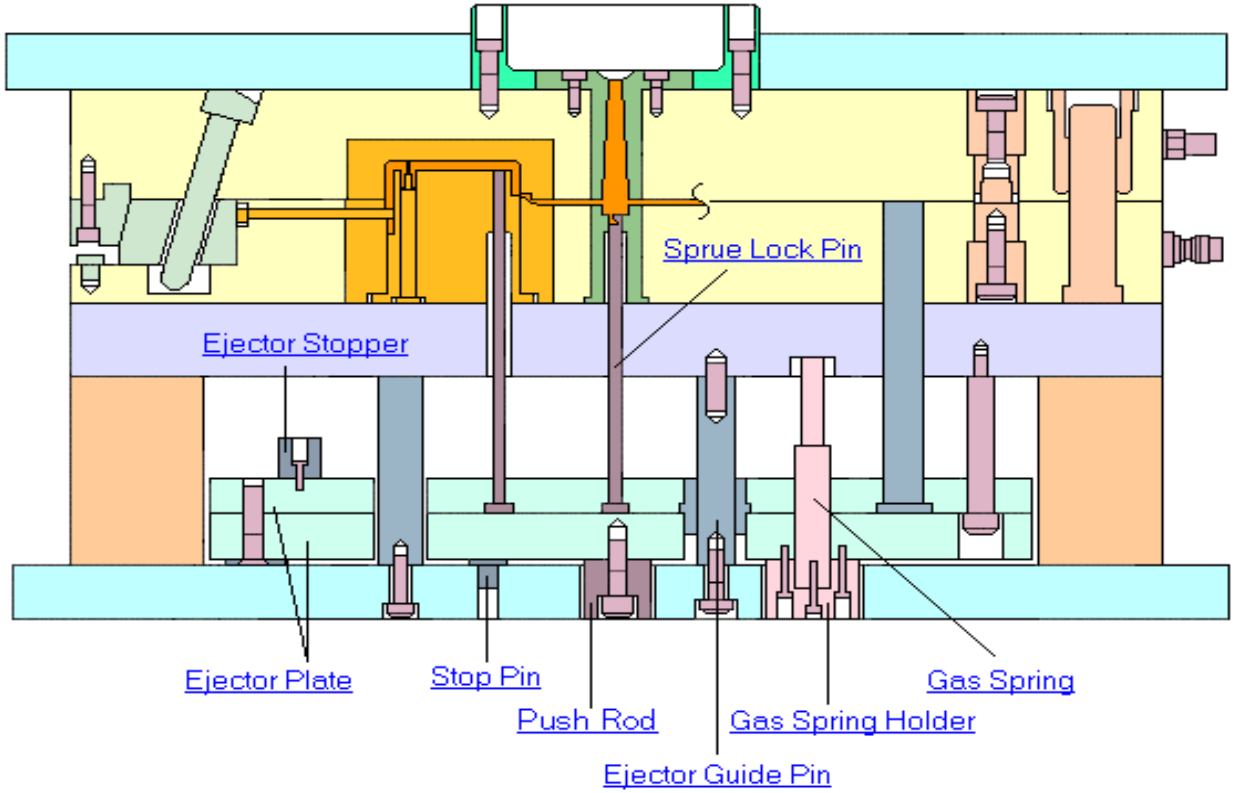
Molding by injecting a material into the mold.



(1) Melt the material in the barrel. (2) Inject the material into the mold. (3) Cool down and remove the part.

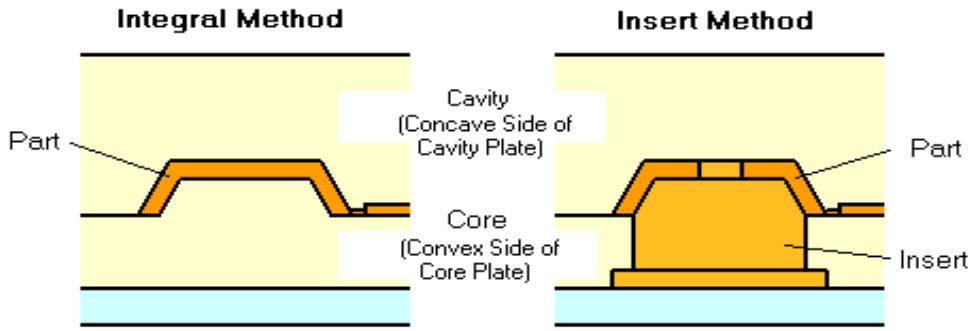
View Animation

Basic Mold components:
For more details please visit: http://www.apiwat.ie.engr.tu.ac.th/molddesign/step2/index22.htm

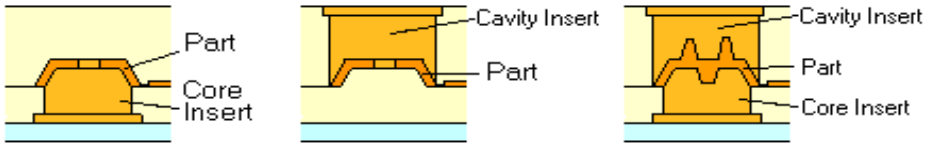


Molding methods:

For more details please visit: http://www.apiwat.ie.engr.tu.ac.th/molddesign/step3/index30.htm



An insert attached to the cavity side is called a cavity insert. An insert that is attached to the core side is called a core insert.



The following factors determine whether an insert is used.

Mold Condition	Molding Condition		
Mold Material	Single part	Multiple part	Special Shape
S55C	Integral	Core insert	Core insert, Cavity insert
Special Steel	Core insert, Cavity insert		

Spur, Runner and gates:
For more details please visit: http://www.apiwat.ie.engr.tu.ac.th/molddesign/step3/index32.htm

Sprue

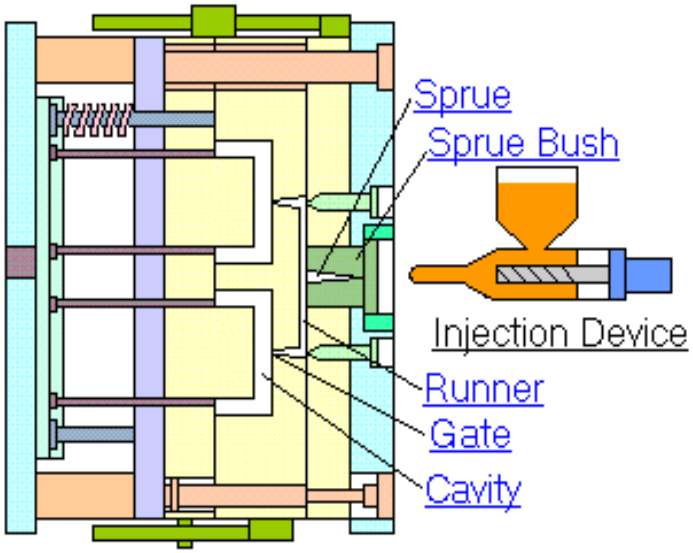
A sprue is a channel through which to transfer molten plastics injected from the injector nozzle into the mold. It is a
mold.

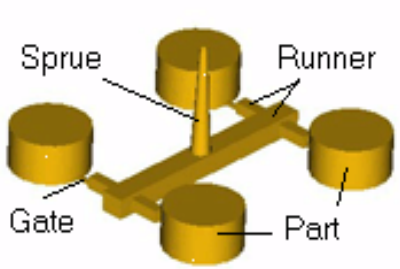
Runner

A runner is a channel that guides molten plastics into the cavity of a mold.

Gate

A gate is an entrance through which molten plastics enters the cavity.





Undercuts:

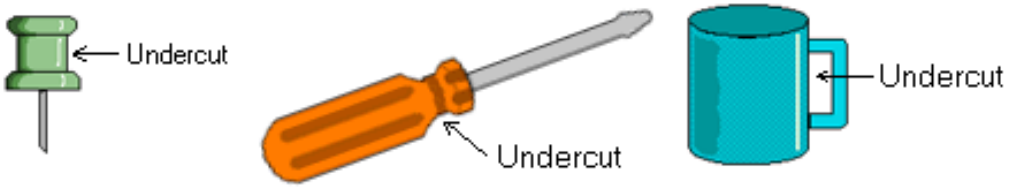
For more details please visit: http://www.apiwat.ie.engr.tu.ac.th/molddesign/step3/index35.htm

Undercut Process

In this chapter you will learn about the process for an undercut pa

Undercut refers to the convex or concave area of part. When removing the part from the mold, you need some device so t be moved to remove the part from the mold since the part will not be removable directly without the device.
This process is called Undercut process.
Undercut process uses different methods depending upon whether the undercut is outside or inside the part.

Here are some examples of parts with undercut.



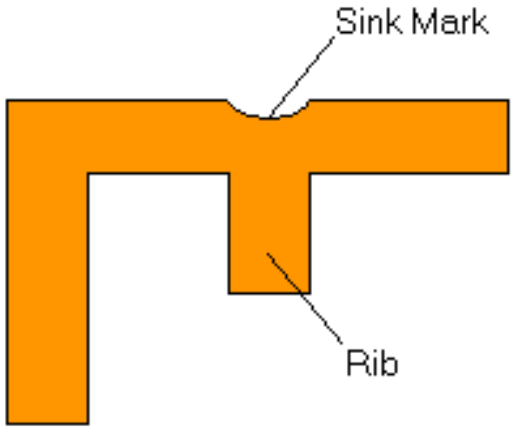
Push-pin Grip of a driver Grip of a cup

Sink Marks:

For more details please visit: http://www.apiwat.ie.engr.tu.ac.th/molddesign/step7/index71.htm

•Sink Mark

This is the phenomenon where a dent appears on the surface of the product.
It is often observed on crystalline plastics with a high shrinkage rate.
When there is a rib in the back of bumper, a sink mark is created on the surface.



Cause

This is caused by shrinkage of the molten plastics du
accompanies inconsistent cooling solidification.
This means that pressure is not applied to every part

Solution

Raise injection pressure and lower the temperature of
Make the gate and runner thick and add a gate where
Maintain uniform plastics thickness.

•Warpage

This is the phenomenon where the part is warped or twisted on removal from the mold.
Since molten plastics becomes solidified while flowing, there can be deformation left within the
from the mold and pressure is released.

Quality of mold parts:

For more details please visit: http://www.apiwat.ie.engr.tu.ac.th/molddesign/step4/index4.htm

Quality of Molded Parts

Injection molding is a straight forward and economical molding method that allows for mass-production of co
of the molded parts is largely determined by the performance of the injection-molding machine as well as by t
greatly by the molding material. Various combined factors involve molding production; a high-quality moldin

The following are the specific factors:

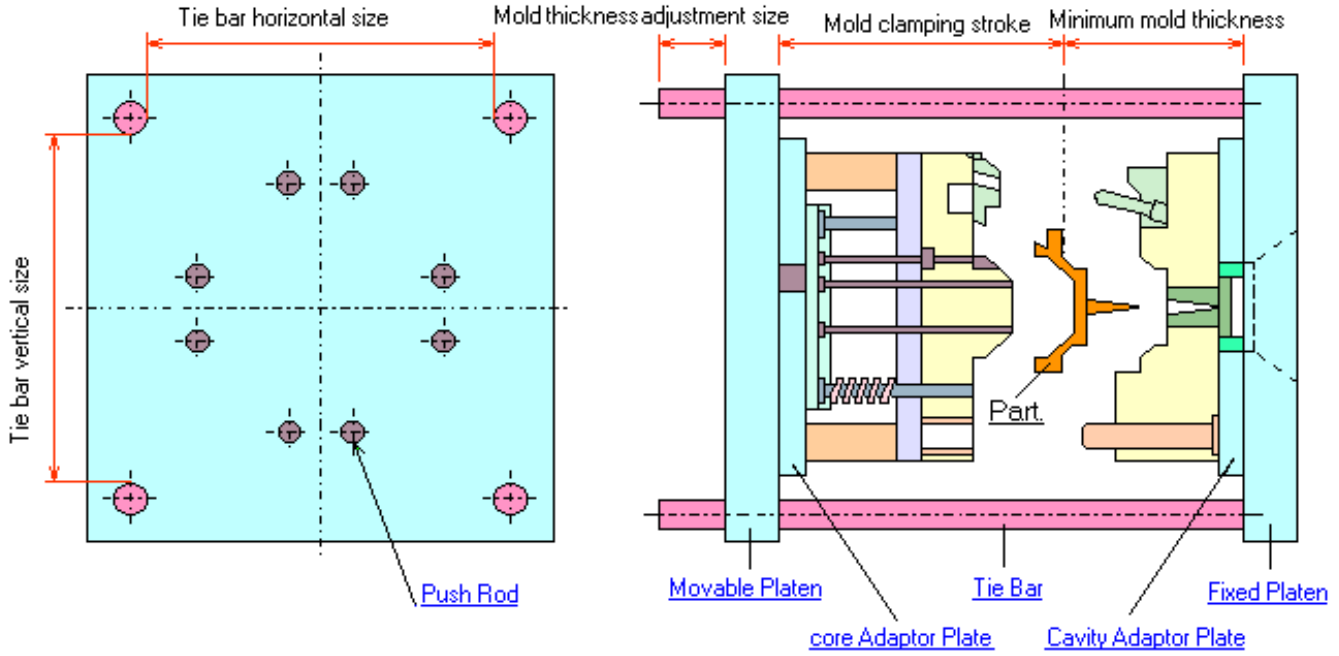
MATERIAL
Type, Price, physical properties
DESIGN
Dimensions, Dimension tolerances, handling of the underc
MOLD
Type of the mold, design of each part, design of ejector, et
ENVIRONMENT
Production capacity and facilities in the manufacturing pla
MOLDING MACHINE
Capabilities of the molding machine (clamping force, injec
CONDITION
Molding condition or molding cycle

Mold details:

For more details please visit: http://www.apiwat.ie.engr.tu.ac.th/molddesign/step3/index39.htm

More details

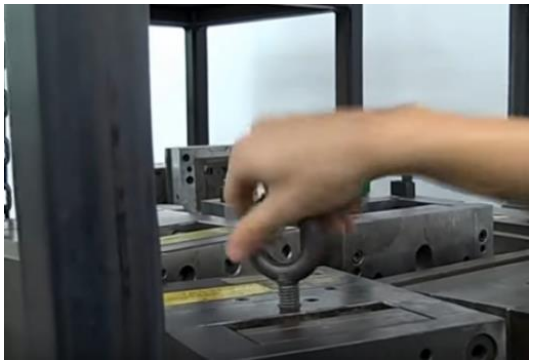
There are two types of mold clamping device: straight hydraulic type and toggle type.
As straight hydraulic type utilizes hydraulic cylinder, mold clamping is available anywhere within the stroke range.
On the other hand, since toggle type utilizes a mechanical device, mold clamping is only available at the maximum mold clamping stroke.
device has a mold pressure adjustment device.



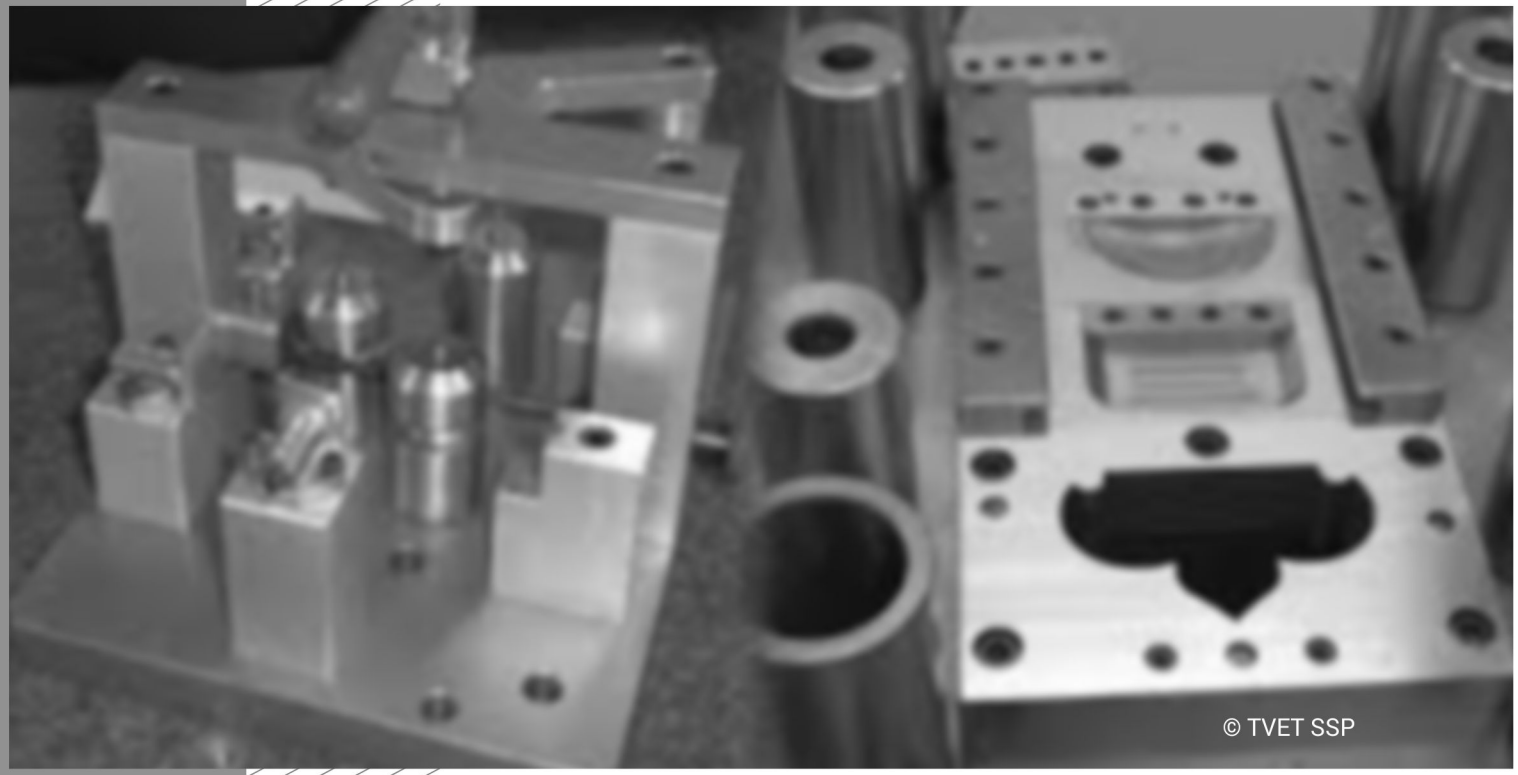
(Click a name in the figure to view the explanation.)

Videos:

	How to make the Plastic injection molds https://www.youtube.com/watch?v=J2mOuK5qksA
	How to assemble a plastic injection mold https://www.youtube.com/watch?v=DWi1vtfmMVk

	Injection mold assembly process https://www.youtube.com/watch?v=j6lpPGitC84
	Machining an INJECTION MOLD! https://www.youtube.com/watch?v=YrbQIN2TBhM
	Install Injection Mold 1 https://www.youtube.com/watch?v=JWcLSruj0dY

DIES AND MOULDS MAKER



Module-5

LEARNER GUIDE

National Vocational Certificate Level 4

Version 1 - August, 2019

Module 5: 071500978 Carryout Maintenance of Dies and Molds

Objective of the module: This standard defines the advanced knowledge, skills and understanding required to carry out preventive & breakdown maintenance of dies & molds

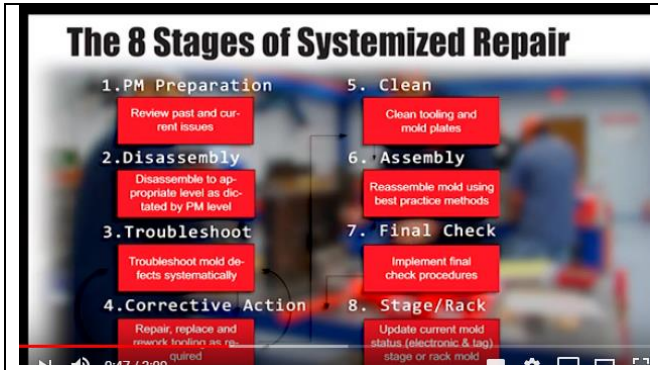
Duration: 120 Hrs **Theory:** 10 Hrs **Practical:** 110 Hrs

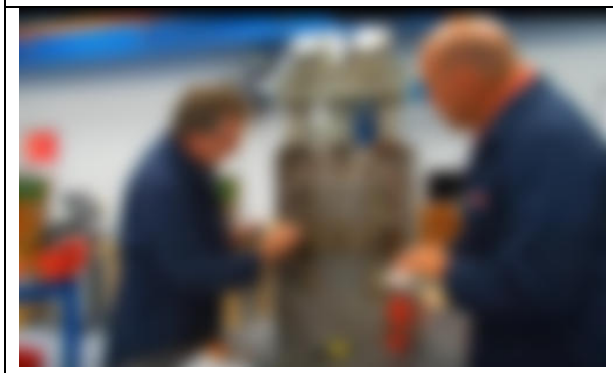
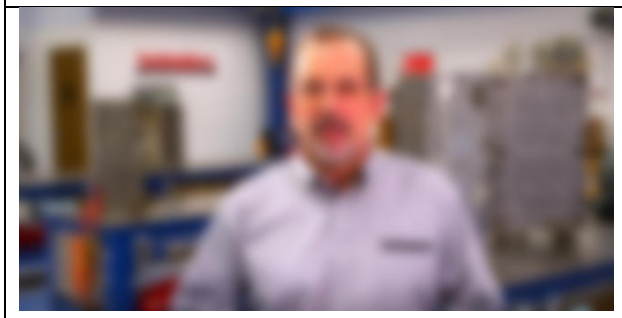
Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1: **Prepare maintenance plan**	**The trainee will be able to:** Identify type of dies and molds Identify minimum number of shots / production for maintenance Prepare check list Identify relevant skilled person for maintenance	Knowledge of types of dies and molds. **Molds:** single cavity, multi cavity, slider, three plate etc. **Dies:** single operation die (blanking / piercing etc.), compound die, progressive die, forming die, deep drawing die etc. Know the check list for a mold / die.	Different types of dies and molds Computer station with printer
LU2: **Perform Preventive maintenance**	**The trainee will be able to:** Clean the tool from dirt and dust. Check all the screws, if found loosen tighten it. Check worn out parts and replace if required. Lubricate all moving parts & surfaces.	Understand routine maintenance chart Know the disadvantages of dirt, moist or dust on metal parts. Know the method of replacing parts Know the method and advantages of lubrication of a mold Know the importance of marking the mold and its components and store at designated place properly. Know the method of preparing preventive maintenance check list Knowledge of maintenance cooling channels Method of reporting mold maintenance activities	A simple assembly of die or mold Measuring tools

	Insure tool number & store the tool at designated place. Follow preventive maintenance schedule/check list. Generate final report & maintain the records		
LU3: **Perform shutdown / breakdown maintenance**	**The trainee will be able to:** Interpret the shutdown/breakdown report Carry out visual inspection to check out damages Disassemble the dies/mold Rectify/ replace damaged parts where required. Assemble the dies/mold. Do the lubrication where	Knowledge of shut down or breakdown maintenance and its importance. Knowledge of possible cause of damages to a mold i.e. damage, broken parts, wear out etc. Know the sequence of disassemble a mold. Know the method of replacing damaged parts of mold and safety measures. Method of reporting mold maintenance activities.	A malfunctioned die or mold (if available) Measuring tools Fastening tools

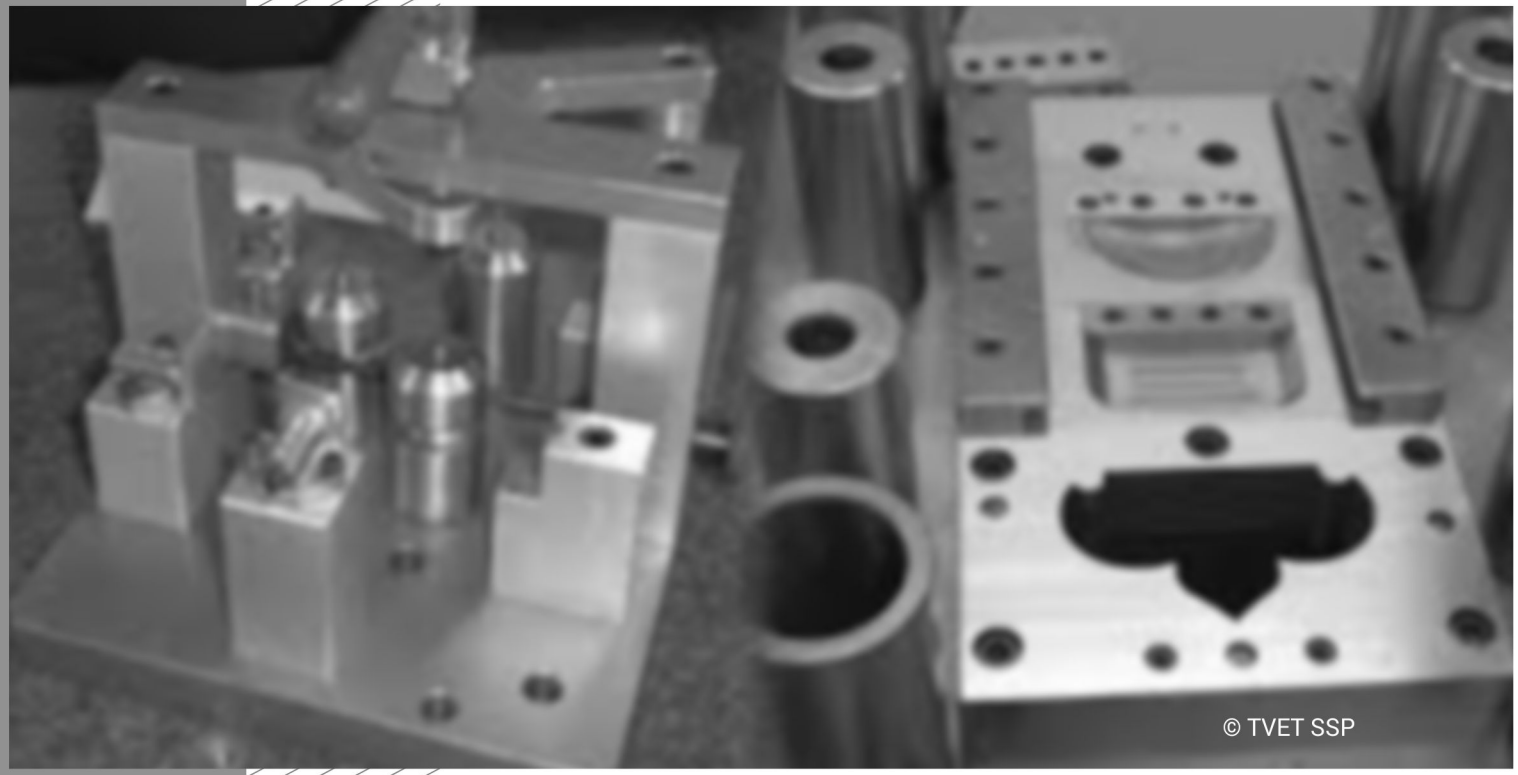
	required Prepare maintenance report & maintain the records		

Examples and illustrations
Videos:

	Tooling Docs Level 1 Mold Maintenance & Repair Certification Training https://www.youtube.com/watch?v=Pfj1b6-qnDU
	Injection mold maintenance procedure https://www.youtube.com/watch?v=DSQcd-iP92M

	Tooling Docs Desensamble de Moldes https://www.youtube.com/watch?v=LSgY19igsQc
	Tooling Docs Video Tour https://www.youtube.com/watch?v=Es0uig_Rd84
	Tooling Docs Toolroom Maintenance Manager Certification Training https://www.youtube.com/watch?v=z9oGDWSfqkk

DIES AND MOULDS MAKER



Module-6

LEARNER GUIDE

National Vocational Certificate Level 4

Version 1 - August, 2019

Module 6: Perform Advance Communication

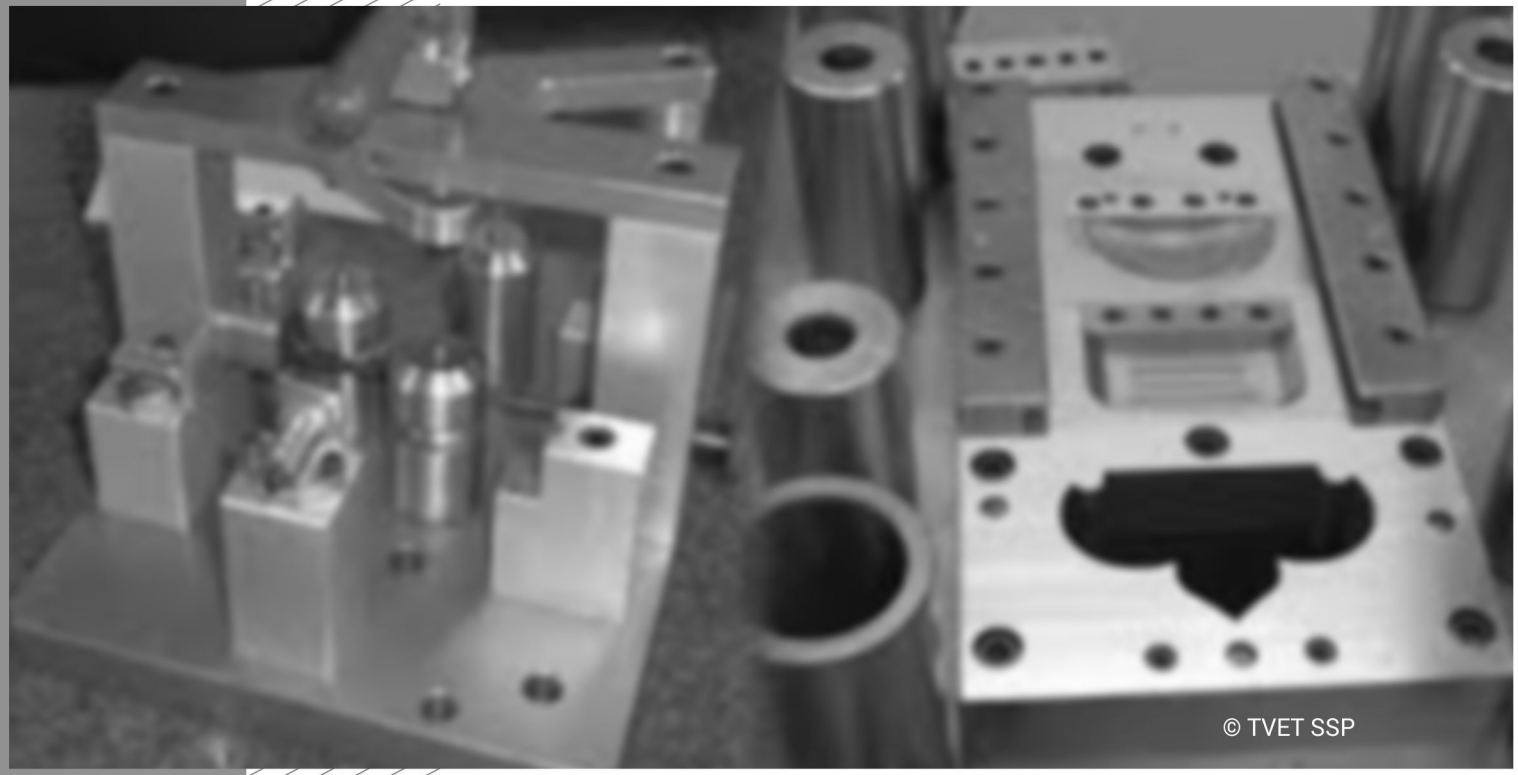
Objective of the module: This competency standard covers the skills and knowledge required to perform advance communication including the training of sub ordinates.

Duration: Hrs **Theory:** Hrs **Practical:** Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1: **Demonstrate professional skills**	**The trainee will be able to:** Communicate within and outside the organization using effective communication skills Use different modes of communication to communicate e.g.: presentation, speaking, writing, listening, visual representation, reading etc. Use specific business terms used in the market Upgrade professional skills by attending trainings, webinars, conferences etc.		
LU2: **Provide trainings at workplace**	**The trainee will be able to:** Identify the training requirement of the		

	working teams Conduct formal or informal training sessions to transfer knowledge and skills Manage the Training as per the needs of workplace Measure the efficiency of the Training Assess Trainees feedback.		

DIES AND MOULDS MAKER



Module-7

LEARNER GUIDE

National Vocational Certificate Level 4

Version 1 - August, 2019

Module 7: Perform Remedial Measures at work to manage waste

Objective of the module: This unit involves the skills and knowledge required to avoid the impact of work/occupation on the environment. The environment includes all living and non-living beings around.

Duration: Hrs **Theory:** Hrs **Practical:** Hrs

Learning Unit	Learning Outcomes	Learning Elements	Materials Required
LU1: **Procure Green Material / products**	**The trainee will be able to:** Identify available local green resources, products, and services Compare the potential impact of using one product, resource or service over another on the environment. Order the products/service.		
LU2: **Perform site remediation**	**The trainee will be able to:** Conduct necessary thermal remediation activities Conduct necessary biological remediation activities		

	Conduct necessary chemical remediation activities Conduct necessary containment remediation activities		
LU3: **Perform site restoration**	**The trainee will be able to:** Conduct landscaping Conduct tree-planting Conduct habitat restoration Ensure that best practices are followed in the restoration process		

Module summary

Module	Learning Unit	Duration
Module 1: Establish and maintain the occupational health and safety system **Aim:** This unit covers how to establish, maintain and evaluate an occupational health and safety system in the work environment. This unit applies to workers who have either a legislated or delegated responsibility to implement OHS systems to meet the organization s policy requirements. These roles require significant role or delegated authority to allow effective implementation and review. While designed for public safety workers, this unit could be applied in a range of industries	**LU1:** Organize consultation process **LU2:** Design occupational health and safety framework **LU3:** Design and implement an occupational health and safety awareness program **LU4:** Establish, monitor and maintain occupational health and safety **LU5:** Establish and maintain a system for accident investigation **LU6:** Evaluate the organization's occupational health and safety system and related policies procedures and program	30 hrs
Module 2: Finalize Dies and Mold **Aim:** This standard defines the advanced knowledge, skills and understanding needed to finalize dies & molds and inspect dies & molds as per standard procedure	**LU1:** Interpret drawing and sketches **LU2:** Carryout final assembly according to the sequence **LU3:** Perform die spotting **LU4:** Perform polishing **LU5:** Verify all functions of dies and molds **LU6:** Perform tool trail **LU7:** Inspect dies and molds before delivery **LU8:** Demonstrate safe working practice & house keeping	150 hrs

Module	Learning Unit	Duration
Module 3: Fabricate a Die **Aim:** This standard defines the competence is required to manufacture the die according to the Tool Design. Can be manufactured all die parts according to machining competency. The understand knowledge of material & tool Design.	**LU1:** Interpret drawing **LU2:** Carryout machining process of die components **LU3:** Carryout assembly of die **LU4:** Perform inspection	220 hrs
Module 4: Fabricate a Mold **Aim:** This standard defines the competence is required to manufacture the Mold according to the Tool Design. It will make the candidate able to manufacture all mold parts according to machining competency and understand knowledge of Material & Tool Design.	**LU1:** Interpret drawing **LU2:** Carryout machining process of mold component **LU3:** Carryout assembly of mold **LU4:** Perform inspection	220 hrs

Module	Learning Unit	Duration
Module 5: Carryout maintenance of Dies and Mold **Aim:** This standard defines the knowledge, skills and understanding needed to perform maintenance of dies & molds	**LU1:** Prepare maintenance plan **LU2:** Perform preventive maintenance **LU3:** Perform shutdown / breakdown maintenance	120 hrs
Module 6: Perform advance communication **Aim:** This competency standard covers the skills and knowledge required to perform advance communication including the training of sub ordinates.	**LU1:** Demonstrate professional skills **LU2:** Provide trainings at workplace	

Module	Learning Unit	Duration
Module 7: Perform remedial measures at work to manage waste **Aim:** This unit involves the skills and knowledge required to avoid the impact of work/occupation on the environment. The environment includes all living and non-living beings around.	**LU1:** Procure green material / product **LU2:** Perform site remediation **LU3:** Perform site restoration	

Short Questions/Answers:

Test Yourself (Multiple Choice Questions)

MODULE	**2**			
Question	**1**	Which produces moulding external shape	A	Punch or Core
			B	Cavity
			C	Runner
			D	Sprue
	2	Molten material injected into the impression through	A	Core
			B	Sprue Bush
			C	Locating Ring

			D	Core or Punch Plate
	3	In blanking clearance is provided on	**A**	Punch
			B	Die
			C	Die and Punch
			D	None of the above

Question	**4**	Channel connecting runner to the impression is known as	A	Side core
			B	Gate
			C	Insert
			D	Cavity
Question	**5**	Thin cylindrical moulding ejected with	**A**	Sleeve Ejection
			B	Blade Ejection
			C	Air Ejection
			D	Pin Ejection
Module	**3**			

Question	**6**	What are the basic components of a die and mold assembly	**A**	Punch and die
			B	Punch and die set
			C	Die and bolster plate
			D	Ram and punch
Question	**7**	What is the purpose of a stripper on a die?	A	Feeds the material to the next progression
			B	Reduces the material thickness by 1/3
			C	Removes material from the punch
			D	Pierces holes and openings in the material

Question	**8**	The main function of the air cushion is to:	**A**	Control metal flow
			B	Provide resistance
			C	Remove dirt from the die and piece part
			D	Knock slugs from the die blocks
Question	**9**	What is the function of pilots in a progressive die?	A	Pierce holes in the strip
			B	Align the strip to the proper location before the spring stripper or Punches clamp the part to the die block
			C	Cut the scrap into manageable lengths
			D	Clamp the strip in place before the die block enters the strip

Question	**10**	The main function of the guide Pillars (leader pins) on a die set is:	A	Nest the part in the die block
			B	Align the ram of the press to the bolster plate
			C	Keep both halves of the die set aligned
			D	Act as stop blocks for correct shut height adjustment

Multiple Choice Questions Answers Scheme

MODULE	**2**			
Question	**1**	Which produces moulding external shape	B	Cavity
Question	**2**	Molten material injected into the impression through	**B**	Sprue Bush
Question	**3**	In blanking clearance is provided on	**A**	Punch
Question	**4**	Channel connecting runner to the impression is known as	**B**	Gate
Question	**5**	Thin cylindrical moulding ejected with	**A**	Sleeve Ejection
Module	**3**			
Question	**6**	What are the basic components of a die and mold assembly	**A**	Punch and die
Question	**7**	What is the purpose of a stripper on a die?	**C**	Removes material from the punch
Question	**8**	The main function of the air cushion is to:	**A**	Control metal flow

Question	**9**	What is the function of pilots in a progressive die?	**B**	Align the strip to the proper location before the spring stripper or Punches clamp the part to the die block
Question	**10**	The main function of the guide Pillars (leader pins) on a die set is:	**C**	Keep both halves of the die set aligned

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