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One Stop Solution for Mechanical Engineering

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TOOL DESIGN CONCEPT

*Global Engineering Solutions
presents,
introduction to :*

TOOL DESIGN





WHAT ARE DIFFERENT TYPES OF DESIGN FIELDS ?

**1)PRODUCT DESIGN : It covers :
Thermal ,Refrigeration, SPM, etc.**

**2)MANUFACTURING ENGINEERING :It
covers :
Tool design , Industrial automation, etc.**

Here we will describe Tool Design in detail :





WHAT IS TOOL DESIGN ?

‘Tool Design’ is a process which comprises the Planning, designing, developing, and analysis of tools, methods and procedures necessary to increase manufacturing efficiency and productivity.

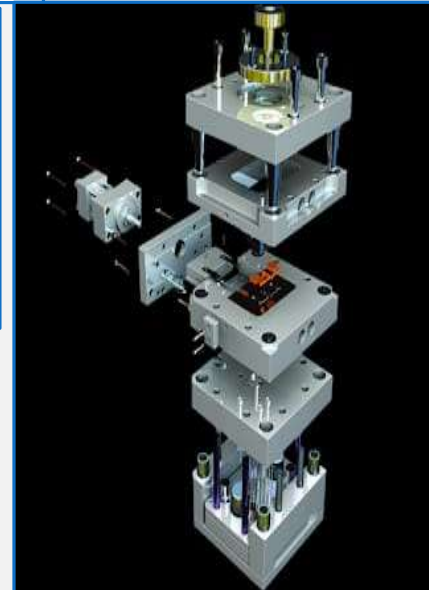
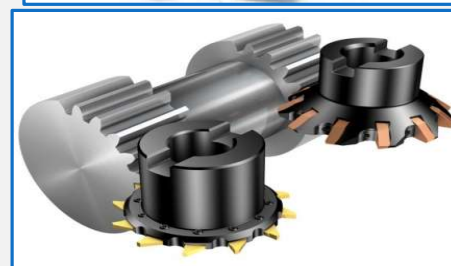
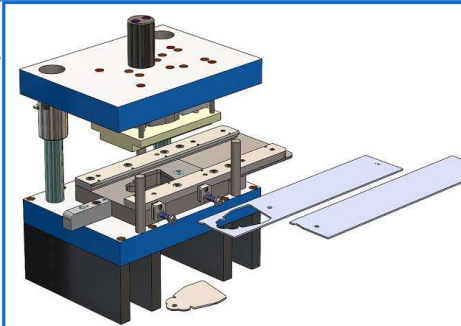
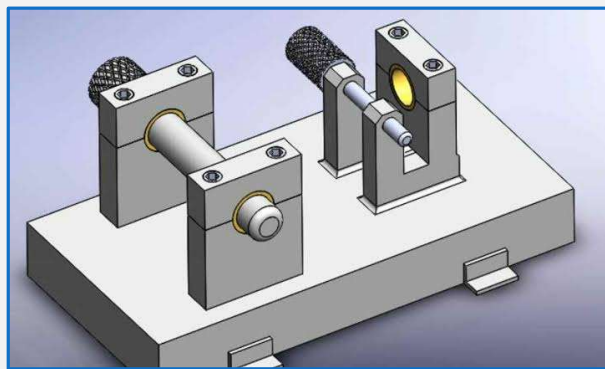




TOOL DESIGN

Tool Design covers design of :

- Cutting tools, tool holders and cutting fluids
- Machine tools
- Jigs and fixtures
- Gages and measuring instruments
- Dies for sheet metal cutting and forming
- Dies for forging, cold finishing and extrusion
- Fixtures for welding, riveting and other mechanical fastening



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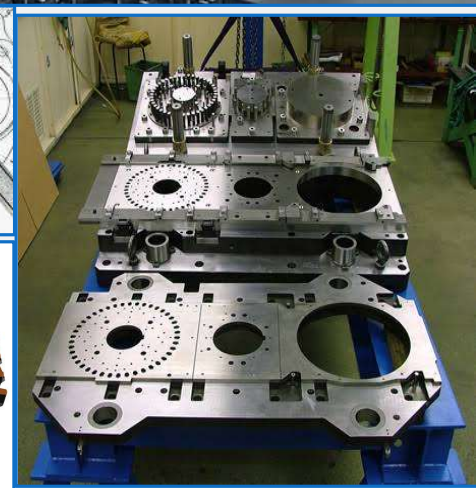
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RESPONSIBILITIES OF A TOOL DESIGNER

A TOOL DESIGNER IS RESPONSIBLE FOR DESIGN AND DEVELOPMENT OF :

- ✓ Cutting tools, tool holders and cutting fluids
- ✓ Machine tools
- ✓ Jigs and fixtures
- ✓ Gauges and measuring instruments
- ✓ Dies for sheet metal cutting and forming
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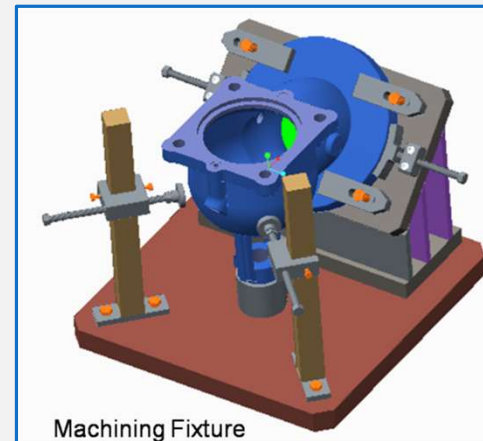
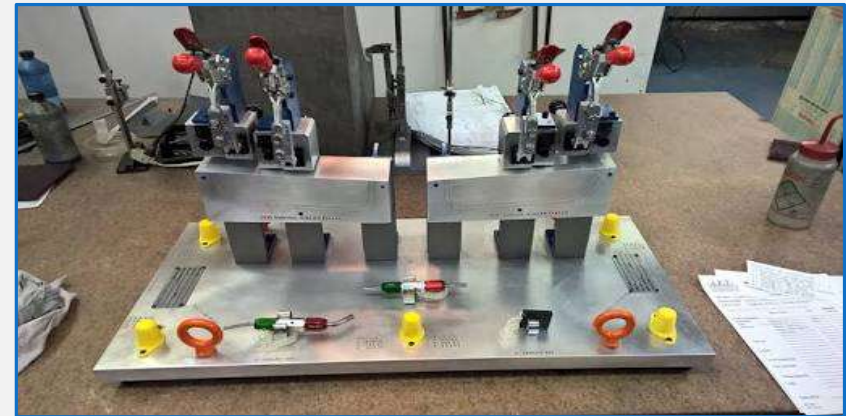


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Objectives of tool design

- Reduce the overall cost of manufacturing a product by producing acceptable parts at lowest cost.
- Increase the production rate by designing tools that will produce parts as quickly as possible.
- Maintain quality by designing tools which will consistently produce parts with the required precision.
- Reduce the cost of special tooling by making every design as cost effective and efficient as possible.
- Design tools that will be safe and easy to operate.



Machining Fixture





The Tool Design Process :

- Statement and analysis of the problem
- Analysis of the requirements
- Development of initial ideas
- Development of design alternatives
- Finalization of design ideas

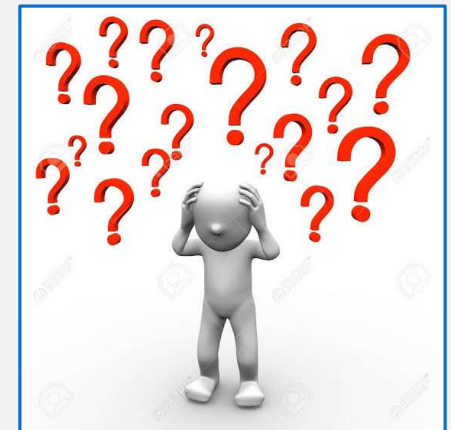




TOOL DESIGN PROCESS

Statement and Analysis of the problem :

- Problem without tooling
Ex. Difficult to drill a hole at an Angle on a part
- What the tool is required and what it supposed to do?
Ex.- Drill jig is required for angular drilling of holes on a part
- Bottleneck: High production required
- Low productivity without tooling

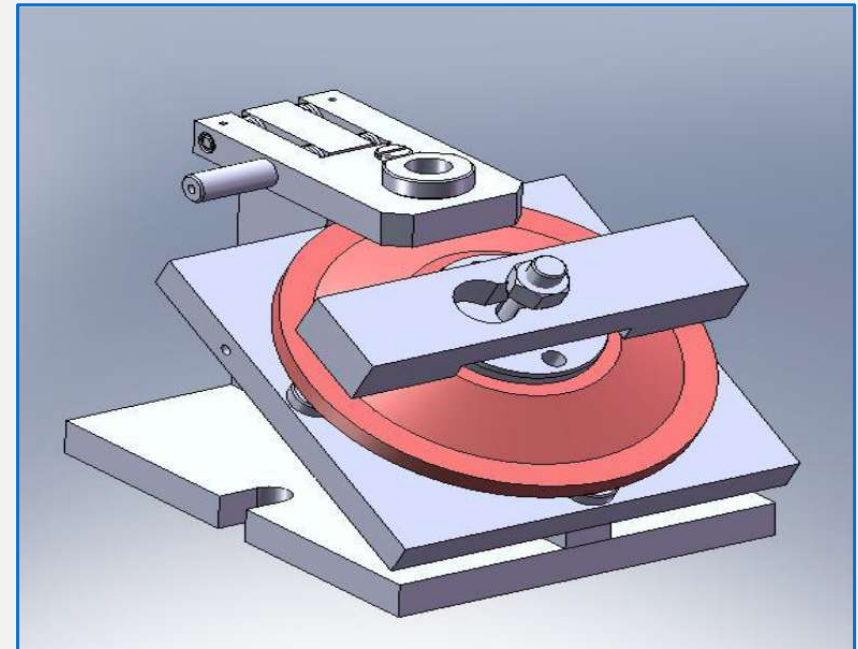




TOOL DESIGN PROCESS

Analysis of the requirements :

- ❑ Must perform certain functions
- ❑ Must meet certain minimum precision requirements
- ❑ Must keep the cost to a minimum
- ❑ Must be available when the production schedule requires it
- ❑ Must be operated safely
- ❑ Must meet other requirements such as adaptability to the machine tool, etc.



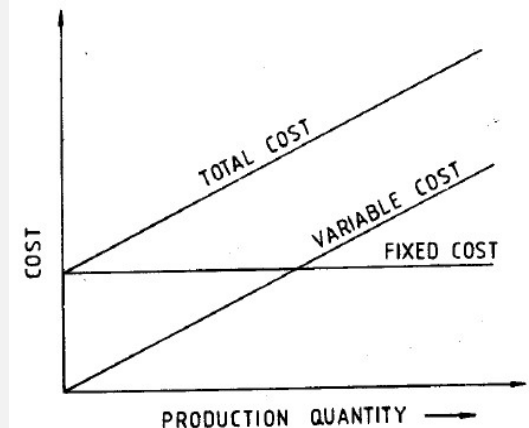


Break-Even Charts

- Break-even charts are perhaps most widely used to determine profits based on anticipated sales.
- They have other uses, however, such as for selecting equipment or for measuring the advisability of increased automation.
- To determine which of two machines is most economical, the fixed cost and variable cost of each machine are plotted.
- The total cost is composed of the sum of the fixed and variable costs.

$$TC = FC + VC \cdot N$$

- ◆ TC = total cost
- ◆ FC = fixed cost
- ◆ VC = variable cost per piece
- ◆ N = production quantity

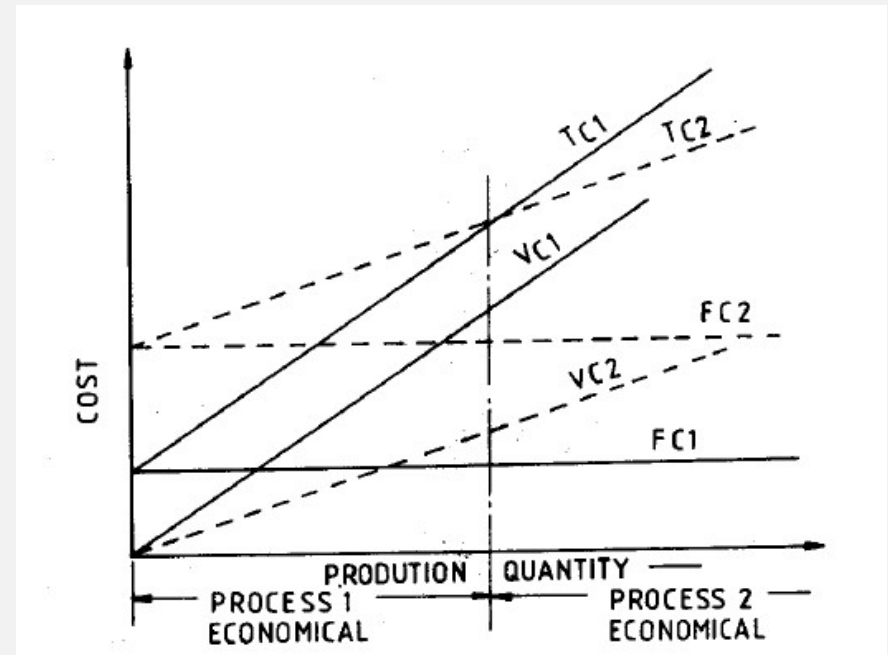


Break-Even Charts

$$F C_1 + V C_1 \cdot N = F C_2 + V C_2 \cdot N$$

$$N = \frac{F C_2 - F C_1}{V C_1 - V C_2}$$

N = Break even quantity



Break-Even Charts

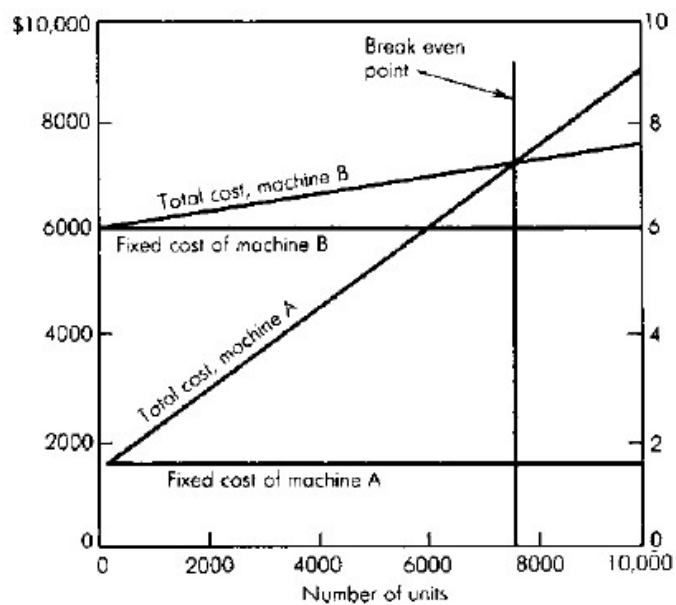
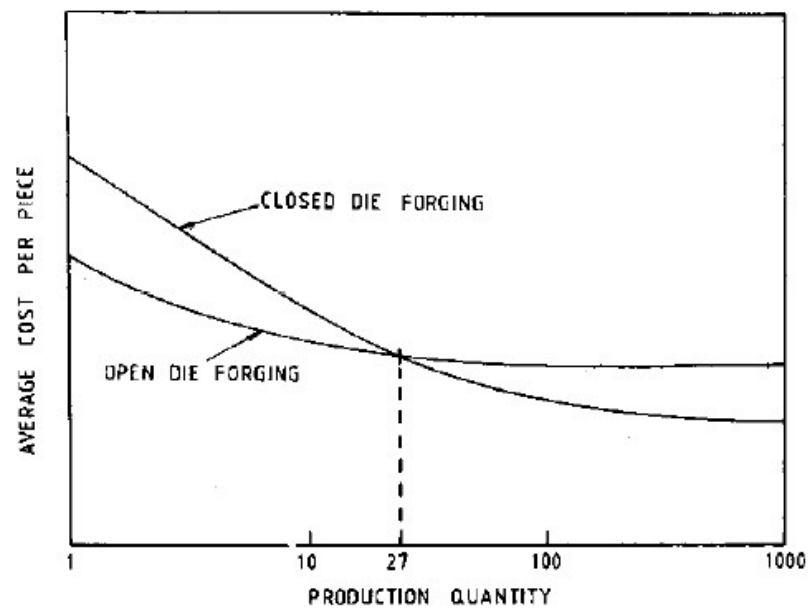


Figure 1-7. Break-even chart for machine selection; choice is based upon volume production.





Tool Drawings :-

- Draw and dimension with due consideration for someone using the drawing to make the item in the tool room.
 - *Do not crowd views or dimensions.*
 - *Analyze each cut to be sure it can be done with standard tools.*
- Use only as many views as necessary to show all required detail.
- Surface roughness must be specified.
- Tolerances and fits peculiar to tools need special consideration.
- It is not economical as a rule to tolerance both details of a pair of mating parts as is required on production part detailing.
- In cases where a hole and a plug are on different details to be made and mated, the fit tolerance should be put on the male piece and the hole should carry a nominal size.
- The stock list of any tool drawings should indicate all sizes required to obtain the right amount for each detail.
 - *As far as possible, stock sizes known to be on hand should be used, but in all cases, available sizes should be specified.*
 - *A proper, finished detail is dependent upon starting with the right material.*





Tool Drawings :-

- Use notes to convey ideas that cannot be communicated by conventional drawing. Heat treatments and finishes are usually identified as specification references rather than being spelled out on each drawing.
- Secondary operations such as surface grinding, machining of edges, polishing, heat treating, or similar specifications should be kept to a minimum.
 - Only employ these operations when they are important to the overall function of the tool; otherwise these operations will only add cost, not quality to the tool.
- Apply tolerances realistically. Overly tight tolerances can add a great deal of additional cost with little or no added value to the tool.
- The function of the detail should determine the specific tolerance, not a standard title block tolerance value.





Tooling Layout:

- Indicate all clamping requirements for the part.
- Be careful to avoid marking or deforming finished or delicate surfaces.
- Consider the clamping movements of the operator so injury to the hands or unsafe situations are eliminated.
- Be sure it is possible to load and unload the part.
- Use full scale in the layout if possible.
- Identify each different item or detail of any design by the use of balloons with leaders and arrows pointing to the detail in the view that best shows the outline of the item. These should not go to a line that is common to other details.





Safety as Related to Tool Design :

- Safety should be designed into the tooling.
- Cutting should never be performed against a clamp, because of vibration and tool chatter. Instead, parts should be nested against pins in order to take the cutter load.
- Rigidity and fool proofing should always be built into the tooling.
- Make drill jigs large enough to hold without the danger of spinning.
- Small drill jigs should always be clamped in a vise or against a bar or backstop.





Thank you for your attention

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