

ME8793 PROCESS PLANNING AND COST ESTIMATION

UNIT 2 PROCESS PLANNING ACTIVITIES

2. SELECTION OF JIGS AND FIXTURES:

INTRODUCTION

From the drawing interpretation, the process planner has to identify the need for a work holding device or a jig or a fixture for the selected operation. The process planner will communicate the identified requirements of the work holding device to a specialist tool engineer for the detailed design and drawings that are needed for manufacturing it.

In the following sections, the overview of the function, types, principles and selection of jigs and fixtures are presented.

WORKHOLDING DEVICE

The main purpose of any work holding device is to position and hold a workpiece in a precise location while the manufacturing operation is being performed.

Types of workholding devices: The work holding devices can be broadly classified into two:

1. General workholding devices

- ❖ Vices
- ❖ Clamps and abutments
- ❖ Chucks
- ❖ Collet
- ❖ Centres
- ❖ Mandrels
- ❖ Face plates

2. Specialist workholding devices

- ❖ Jigs
- ❖ Fixtures

Jigs

A jig may be defined as a work holding device which locates and holds the workpiece for a specific operation. It is also provided with tool guiding elements.

Jigs are usually lighter in construction and direct the tool to the correct position on the workpiece. Jigs are rarely clamped on the machine table because it is necessary to move on the table to align the bushes in the jig with the machine spindle. Jigs are used on drilling, reaming, tapping and counterboring operations.

Functions of jigs are:

1. To locate and position the workpiece relative to the cutting tool.
2. To clamp the workpiece during drilling, reaming or tapping.
3. To guide the tool (drill, reamer or tap) into the proper position on the workpiece.

Fixtures

A fixture may be defined as a work holding device which only holds and positions the workpiece. It does not guide the cutting tool. Sometimes, there is a provision in the fixture for setting the tool with respect to the workpiece.

- ❖ Fixtures are often clamped to the machine table.
- ❖ Fixtures are used in turning, milling, grinding, shaping, planing and boring operations.

Functions of fixtures are:

1. To locate and position the workpiece relative to the cutting tool.
2. To clamp the workpiece during machining, welding, inspection or assembly.

Jigs Vs. Fixtures

S.No	Characteristics	Jig	Fixtures
1.	Definition	Locates and hold the work and guides the cutting tool in true position of the work	Only holds and positions the work, but doesn't guide the work
2.	Elements	Work locating elements, tool guiding elements and work clamping elements	Work locating elements, tool setting elements and work clamping elements
3.	Construction	Light	Heavy
4.	Applications	Drilling, reaming, tapping, counter boring, countersinking	Milling, turning, grinding, broaching etc
5.	Special Features	Drill bushes used for tool guiding	Feeler gauges, setting blocks to adjust position of tool in relation to work

Reasons for Using Jigs and Fixtures

The purpose and advantages of jigs and fixtures are as follows:

1. It reduce/ eliminates the efforts of marking, measuring and setting of work piece on a machine.
2. The workpiece and tool are relatively located at their exact positions before the operation automatically within negligible time. So it reduces product cycle time,
3. It reduces the production cycle time and hence increases production capacity.
4. Interchangeability of manufacture is achieved by enabling the production of identical parts.
5. The operating conditions like speed, feed rate and depth of cut can be set to higher values due to rigidity of clamping of workpiece by jigs and fixtures.
6. Operators working become comfortable as his efforts in setting the workpiece can be eliminated.

7. Semi-skilled operators can be assigned the work so it also saves the cost of manpower.

8. It reduces the cost of inspection as the products are produced with less defects.

Elements of Jigs and Fixtures

The three basic elements of jigs and fixtures are given below.

1. Clamping elements

Clamping elements are used to exert a force to press the workpiece against locating surfaces and they hold the action of cutting forces.

2. Locating elements

Locating elements are used to position the workpiece accurately with respect to the tool guiding or setting elements in the fixture.

3. Tool guiding and setting elements

Tool guiding elements are used in jigs where a hardened bushing is fastened to sides of the jig to guide the tool to its proper position in the work.

Tool setting elements are used in fixtures where a target or set block is used to set the location of the tool with respect to the workpiece within the fixture.

PRINCIPLES OF JIGS AND FIXTURES DESIGN

The main consideration of jigs and fixture design are summarized below;

1. Location

- ❖ Locating surfaces should be as small as possible and the location must be done from the machined surface.
- ❖ Sharp corners in the locating surfaces must be avoided.
- ❖ Locating pins should be easily accessible and visible to the operator.
- ❖ Adjustable locators should be provided for rough surface,

2. Clamping

- ❖ Clamping should always be arranged directly above the points supporting the work.
- ❖ Quick acting clamps should be used wherever possible.
- ❖ Clamps should not cause deformation of the workpiece.
- ❖ Position of clamps should provide best resistance to the cutting tool.
- ❖ Cutting forces of the tool should act against the solid part of the jig and not against the clamps.
- ❖ All the clamps and adjustments should be on the sides.
- ❖ Clamps should allow rapid loading and unloading of the components.

3. Loading

- ❖ The loading and unloading process of the workpiece should be as easy as possible.
- ❖ Loading and supporting surface usually made of hardened material and also it should be renewable wherever possible.
- ❖ Enough space should be Left for hand movements between the walls of a jig and workpiece.

4. Stability and Rigidity

- ❖ Jigs and fixtures should possess a high rigidity to withstand the cutting forces. At least four legs should be provided on the jigs for stability.
- ❖ The fixtures are rigidly fixed on the machine table.
Make the equipment as rigid as necessary for the operation.

5. Clearance for chips

Adequate space in the form of channel ways should be provided to enable the metal chips to be blown to clear easily.

6. Fool Proof Design

- ❖ Jigs aid fixtures should be fool proof besides being safe to use.
- ❖ The design of Jigs and fixture such that it is Impossible to use the workpiece and tool in any position other than the correct one.
- ❖ Locating plan a. provided for this purpose.

7. Provisions for Tool Guides

Provisions for tool guides in Jig bushing and cutter setting devices in fixture should be made.

8. Provisions for Indexing

Provisions for indexing the workpiece should be made wherever it is necessary. It enables the workpiece to divide into any number of equi-spaced faces.

9. Weight

- ❖ Jigs aid fixtures should be lighter in weight
- ❖ Jig weight should be kept below 15 kg since they are to be handled often.

10. Safety

- ❖ Jigs aid fixtures are designed for safety
- ❖ Handles and Levers should be large enough. All sharp edges should be removed or avoided.

11. Coolant Supply

Adequate arrangements must be made for the supply of coolant to the cutting edges for reducing the friction.

12. Economy

Jigs and fixture should reduce machining aid production costs by providing ease of manufacturing.

GENERAL FACTORS IN WORKHOLDER DESIGN AND SELECTION

Designing and selection of jigs and fixtures depend upon so many factors. These factors should be considered during designing and selection of work holding devices.

The factors to be considered during designing and selection of Jigs and fixtures are given below.

1. Physical characteristics of the workpiece (i.e., shape/form (geometry), size and mass).
2. Physical characteristics of the finished component.
3. Type and capacity of the machine, Its extent of automation.
4. Provision of locating devices in the machine.
5. Available clamping arrangements in the machine.
6. Available indexing devices, their accuracy.
7. Evaluation of variability in the performance results of the machine.
8. Rigidity of the machine tool under consideration.
9. Study of ejecting devices, safety devices, etc.
10. Required level of the accuracy in the work and quality to be produced.

Types of Jigs and Fixtures

Types of Jigs

Jigs can be classified broadly into two types based on manufacturing process involved as;

1. Drill jigs, and
2. Boring jigs

1. Drill Jig

Drill jigs are used for the following operations:

- ❖ Drilling
- ❖ Reaming
- ❖ Tapping
- ❖ Chamfering
- ❖ Spot facing
- ❖ Counter sinking. etc.

Different types of drilling jigs used are:

- ❖ Template jig
- ❖ Plate type jig
- ❖ Open type jig
- ❖ Swinging leaf type jig
- ❖ Box type jig
- ❖ Solid type jig
- ❖ Pot type jig
- ❖ Index jig
- ❖ Multi station jig
- ❖ Universal Jig

2. Boring Jigs

Boring jigs are used to bore holes that may be too large to drill or must be made on odd size.

Types of Fixtures

Fixtures are designed specifically for an operation and so these can be named on the base the operation to be carried out with their help. Fixtures are used to hold the workpiece properly to carry out the operations.

The different types of fixture based on the operation include:

- ❖ Turning fixture
- ❖ Milling fixture
- ❖ Fixture for grinding
- ❖ Fixture for broaching
- ❖ Fixture for boring/drilling
- ❖ Tapping fixture
- ❖ Fixture for welding
- ❖ Assembling fixture

Fixtures can also be classified based on their construction type as

- ❖ Plate fixtures
- ❖ Angle plate fixtures
- ❖ Vice-jaw fixtures
- ❖ Indexing fixtures

Standard Parts for Jigs and Fixtures

There are various standard parts being used in the design and construction of jigs and fixtures

Some of the standard parts include:

- ❖ Mechanical fasteners
- ❖ Locating and supporting devices
- ❖ Indexing pins
- ❖ Drill Bushes
- ❖ Hand Knobs and Handles