JIGS

A Jig is a fixture with an additional feature of tool guidance.
WHAT?    WHERE?    HOW?

- jig bush
- drill
- clamping screw
- jig bracket
- supporting pins
- base
- adjustable locating pin
- machine table
Introduction

• Mass production aims at high productivities to reduce unit cost and inter-changeability to facilitate easy assembly.
• Jigs are useful in mass production.
• They provide a means of manufacturing interchangeable parts since they establish a relationship, with predetermined tolerances, between work and tool.
• Eliminate set up time for each piece and thus reduce cost.

Basic requirements of a good drill jig are
1. Quick and accurate location of the work piece.
2. Easy loading and unloading of the work piece and prevention from of loading.
3. Prevention of bending or movement of work piece during drilling.
4. Ample chip clearance to facilitate fast removal and cleaning.
5. Light weight to minimize operator fatigue due to repeated handling.
Figure 2.1 Jig

- Drill
- Bush
- Work
- Locating pins
DRILL BUSHES

• These are used to guide drills, reamers and other cutting tools to the workpiece.

• Bushes are made of water hardening carbon steel with 0.85 to 1% carbon and 0.50 to 0.9% of manganese and hardened to RC60 to 64 to minimize wear due to contact with hard rotating tools.

• Jig bushings are used in drilling and boring jigs. Their use permits giving up the reduction of drill run off and hole expansion.

• The diametric accuracy of holes in drilling is 50% higher on the average compared to that of holes drilled conventionally.
GENERAL NOTES ON DRILL BUSHES

- Bushing are mainly used to guide drill, reamers and other machining tool in the proper positioning on the workpiece. Drill bushes need to
- Prevent the bending moment of the drill
- Helps better accuracy minimize the time for drilling.
- It protects the drill jig plate.
- To reduce the wandering of long drill.
- The concentricity of the drill bushes is 0.01.
- The length of bushing should be approx. twice the diameter of the bush hole.
- The diameter should be very close to the dia of the drill but not be tight as it will cause drag in bushing.
- General rule for clearance between 0.013 to0.026 mm. High clearance causes chipped drill margin and inaccuracy.
MATERIALS FOR DRILL BUSHES

• Made of good quality case hardened steel or tool steel.

• Can also be made of mild steel carburised to give sufficient case depth.

• Common material for drill bushing is: Water hardening steels with 0.85 to 1.0% C, 0.5 to 0.9% Mn and hardened to 60 to 64 Rc.
TYPES OF DRILL BUSHES

1. Press fit bushes
   a) Headless or plain bush
   b) Headed or flanged bush
   c) Headed or collared press fir bush
2. Renewable bushes
   a) Fixed bushes
   b) Slip bushes
3. Linear bushes
4. Threaded bushes
5. Screw or clamping bush
SPECIAL BUSHES

1. Oil grove bushes
   a) Type 1 – oil with hole: P-type, H type, slip fit type
   b) Type 2 – with oil hole and external groove
   c) Type 3 – without oil feed

1. Template bushes
OTHER TYPES

• Circuit board drill bushes
• Chip breaker bushes
• Direct coolant bushes
The factors to be considered while designing for jig - bushing,

- The bushes, used to guide and properly locate drills, reamers etc. are generally made of carbon or alloy steel and made wear resistive by hardening to RC 60 and above. Often bushes are also made from grey cast iron for antifriction and protection of the tools.

- The hardened jig bushes are finished outside by grinding and inside by grinding and lapping if high precision is insisted.

- The bush’s length should be sufficient (≥ twice drill diameter) and its diameter should be slightly larger than the drill diameter.

- Design and construction should enable easy and quick proper fitting and removal or replacement of the bushes.

- Bushes should not come out from its seat along with the drill during its return.
Press Fit Bushing

• Pressed by interference fit in the bush plates (jig plates)
• Used in batch production where bushes outlast life of jig
• Employed where the centre distances of holes are too close to permit the fitting of liners and renewable bushes.
• 1. Headless OR Plain Bush
  2. Headed OR Flanged bush
  3. Headed Collard OR Press fit bush
• Headed bushes are preferable
  ➢ Collar provides positive slop
  ➢ Chance of getting loose and move axially is less.
A. Headless or Plain Bush

B. Headed or Flanged Bush

C. Headed Collared Press Fit Bush

Figure 2.2 Press Fit Bush

Precision running fit with drill F7

Chamfer or radius
Renewable Bushes

- Used for continuous OR for large batch production (Used in linear bushings)
- Inside diameter is subjected to severe wear due to continuous contact with cutting tools.
- Employed where the bushing will wear out before jig does
- 2 types  1. Fixed  2. Slip
- Must be prevented from rotating and moving axially (By provision of a flat on the collar)
Figure 2.3 Fixed Renewable Bush
Slip Bushes

• When a hole requires two operations such as drilling and reaming
• Necessary to use two different guide bushes for the different tools.
• Are interchangeable in a given size of liner.
• Used when the component is still in the jig for reaming operation there by providing more accuracy.
• Knurled in its head for easy removal.
Liner Bushes

- Known as ‘master bushings’ are permanently fixed into the jig body.
- Liner bushings are available in head OR headless types and are pressed into the jig plate.
- They are hardened and so they provide only a little chance of affecting the accuracy of the tool by changing the bushings.
Threaded Bushes

• Used for clamping the work piece are threaded on the outside
• The screwing of the bush into the jig body holds the bush in place & makes bush adjustable.
• Adjusted to suite the length of component.
• But its very difficult to maintain accuracy
• This is overcome by making the thread loose and guiding the bushing by a ground cylindrical portion.
Figure 2.6 Threaded Bushes
Screw or clamping Bushes

• Used where work piece also clamped.
• When light work piece to be drilled.
• They have external threads
• Rapid wear of thread, so not preferred for accurate work.
Figure 2.7 Screw or Clamping Bushes
SPECIAL BUSHES

Figure 2.8 Special Bush
• Used for special operations such as bottom of a bush requires shaping to suit the profile of the component to prevent deflection of tool

• Minimize weight by use of thinner sections, many drill jigs are built up from steel plates from sections.

• It has the advantage of economy of time since it avoids time necessary to make casting pattern
**Figure 2.9 Special Bushies**

- **Drill Bush for curved surface**
- **Drill Bush for inclined surface**
- **Two holes close together**
Special Drill Bushes

• Some of the special drill bushing are template bushing, groove bushing, knurled and generated bushing.

• Some other type of special bushing are:
1. Drill holes in inclined surface
2. Long bush is used if hole being drilled is in recess. To reduce drill friction, bush can be counter-bored.
3. Two bushing with flat can be used, if it becomes impossible to provide drill bushes in jig plate
4. Bushing with 2 holes can be used.
1. Oil grooved bushes:
   - Permit positive and complete lubrication of the bushing for continuous high speed drilling operations
   - Give complete drill with lubrication and cooling
   - Used when drilling hardened steel and used as bearing.
   - Different Types:
     a) With oil hole: P type, H type, slip fit type
     b) With oil hole and external groove
     c) Without oil feed
COOLANT
2. Template bushes:

Used for installation in thin jig plates. Bushing is pressed into the hole, and a lock ring is installed on the opposite side.