DRILL JIGS DESIGN

Video link for jigs and fixture
https://www.youtube.com/watch?v=CA3GnfImGmw
Uses of jigs

• Drill jigs are generally used for drilling, tapping, and reaming, but also may be used for countersinking, counterboring, chamfering, and spot facing.

• Boring jigs, on the other hand, are used mostly for boring holes to a precise, predetermined size.

• The basic design of both classes of jigs is essentially the same. The only major difference is that boring jigs are normally fitted with a pilot bushing or bearing to support the outer end of the boring bar during the machining operation.
TYPES OF DRILL JIGS

1. Leaf jig
2. Plate jig
3. Box type jig
4. Tumble jig
5. Template jig
6. Indexing jig
7. Universal jig/pump jig
8. vise
Leaf/latch jigs

• Leaf jig have a leaf or hinged cover which is swung open to load or unload the jig. After the w/p has been located inside the jig, the leaf is firmly closed and locked.

• Drill bushing may be located in the leaf and reamer bushing in the base of the jig

• Advantages
  • w/p with irregular counter can easily and quickly be loaded and unloaded.
  • Holes may be drilled in more than one surface for a single loading of the jig

• Disadvantages/limitations
  • Chips may accumulate inside the jig
  • Inaccurate holes may be drilled when bushes play in the hinged

Corrective measures for bush play
Fix the bushed in the leaf firmly

Video link
https://www.youtube.com/watch?v=5m5HqEy_Jqs
Leaf jig

- Locking screw
- Hinge
- Leaf (hinged plate)
- Bushing
- Slot
- Quarter-turn screw
- Fixed stop
- Side-locating stop
- Bearing surface
- Chip clearance
- End-locating stop
- Jig feet
- Drill bushings
- Reamer bushings
- Workpiece
TEMPLATE JIGS

- It is the form of jig consisting of a suitable material having holes for correct location.
- Template drill jigs are not actually true jigs because they do not incorporate a clamping device. However, they can be used on a wide variety of parts and are among the simplest and least expensive drill jigs to build. Template drill jigs are simply plates containing holes or bushings to guide a drill. They are placed directly on a feature of the part to permit drilling holes at a desired location. When this is impractical, they are located on the part by measurement or sight lines scribed on the template.

Video link
https://www.youtube.com/watch?v=C4y7wpX3rhY
https://www.youtube.com/watch?v=fyuUf5K0lsY&t=24s
CIRCULAR PLATE TEMPLATE JIGS
FLAT-PLATE TEMPLATE DRILL JIGS
NESTING TEMPLATE DRILL JIGS

[Diagram of nesting template drill jigs with sections A-A a. and b.]
PLATE JIGS

- It is the modified form of the template jig with a provision for locating and clamping of w/p
- They have built-in clamps to hold the work.
- They use a flat plate containing bushing as their main structural member.
- All the details are attached and referenced to this plate.
- May or may not have legs.
PLATE JIGS

• Easy part loading and unloading, chip removal by providing clearance between plate and the workpiece.

• Also called open jig.

• Slip bushings for operations other than drilling.

• Thin parts stacked for drilling several parts at one time.

• These jigs are sometimes made with legs to raise the jig off the table for large work. This style is called a table jig.

• The feet provide square resting surface to the jig.

• The diameter of the jig feet should be bigger than the slot of machining table to prevent the feet from falling into the slots.
Plate jig examples
PLATE JIG

Diagram showing a plate jig with labeled parts:
- Drill bushings
- Leg
- Workpiece
- Gage plate
- Locating and retaining stud
- U washer
- Nut
- A
- B
• **Drill bushings**
  
  Precision tools that guide cutting tools such as drill and reamers into precise locations in a workpiece.
Operations Common to a Drill Jig

DRILL  REAM  TAP  CHAMFER COUNTERBORE COUNTERSINK

REVERSE COUNTERSINK  REVERSE SPOTFACE
SANDWICH JIGS

- A form of plate jig with a back plate
- The w.p is clamped like a sandwich b/w the base plate and the jig plate.
- This type of jig is ideal for thin or soft parts that could bend or wrap in another style of jig.
- Here, the use of bushings is determined by the number of parts to be made and diameter of the hole.
Sandwich jig example
PUMP or UNIVERSAL JIGS
• They are similar version of sandwich jig.
• Produced commercially as basic units and are adapted to specific jobs by tool makers.
• The lever activated plate makes this tool very fast to load and unload.
• Rigid, low weight, ample chip clearance and ease of operation.
• Handle connected to a cam or rack to clamp workpiece.
• It is also known as universal jig used for any given part by adding the necessary locators and bushes.
PUMP or UNIVERSAL JIGS

• The guide pillars attached to the jig plate have rack gear teeth on one side.
• Purpose of gear meshing by rotating the handle is to raise or lower the rack pillar with the jig plate.
• Pump jigs are suitable for drilling only a single hole on a fixed spindle drilling machine.
• One pump can be used for number of workpieces by providing detachable jig plate and base plate for different workpieces.
PUMP JIG/UNIVERSAL JIG
BOX JIGS

• Surround the part totally.
• Shape resembles a box.
• In the figure, for loading, the cam rod is taken out of the jig and the w.p placed in position inside the jig.
• The cam rod is then replaced and rotated to its locking position.
• This holds the work-piece firmly so that the drilling operation can be performed.
• Such jigs are generally used for components having irregular shapes or that cannot be held by common methods.
BOX JIGS

- Number of holes can be drilled economically with box jig.
- One side is open for loading and unloading the work-piece and provided bushing arrangements.
- The box jig can permits drilling of holes in three sides of the work-piece and saves times and increase production.
Box jig examples
CHANNEL JIGS

• It’s a type of box jig.
• The work-piece is mounted against the top and one side of the jig.
• It is clamped from the third side.
• Provides better stability and support for work-piece.
• This type is limited to work-pieces of simple symmetrical shapes.
• It mainly consist of the jig body, jig bush and screws and w.p is clamped inside the channel with the help of screw.
CHANNEL JIGS
INDEXING JIGS

- Many components require holes at stated angular positions.
- Used to drill a series of holes in a circle on the face of a work-piece under a single bushing.
- Brings the hole portion under the drill each time it is indexed.
- To do this a reference plate and a plunger is used.
- For this purpose multi head machine is used at regular intervals.
- The operation can also be performed on single spindle machine.
Indexing jigs examples

Video link
https://www.youtube.com/watch?v=X8VrcgtXLaQ
V-BLOCK JIGS

• Used to drilling radial **holes in cylindrical** or spherical workpiece.

• It mainly consist of the V-block clamping plate.

• The component is placed on the V-block and clamped rigidly by means of a clamping plate and bolt.
V-BLOCK JIGS

- These jigs may also be called *diameter jigs* by some toolmakers.
VISE JIGS

• Constructed by attaching special inserts to the jaws of a regular machine vise.

• Generally used for low volume and short production runs.

• It is generally used for drilling the shafts and consists of a pair of specially designed jaws, setting stops and support.
MULTISTATION JIGS

▪ Commonly used on multi-spindle machines.
▪ Facilitates more than one workpieces at a time.
▪ For example one part being drilled, another can be reamed and third counter-bored.
▪ The final station is used for unloading the finished part and loading fresh part.
▪ It is the complex and specialized type of the jig that cannot be further classified and skilled worker is required to operate.

Video link
https://www.youtube.com/watch?v=9OouzVx8f1k
GENERAL CONSIDERATIONS IN THE DESIGN OF DRILL JIGS

• Jig must be strong enough to **withstand all forces applied to it**.

• It must also resist deflections that may be the result of **excessive tightening** of clamps that hold the w.p in place.

• The work must also be supported so that it does not bend under drilling pressure.

• **Cast iron** is generally used because it absorb shocks and compressive forces.
GENERAL CONSIDERATIONS IN THE DESIGN OF DRILL JIGS

- The type of machine in which operation is performed needs careful considerations.

- The layout of the jig must provide adequate hand clearance for *easily loading and unloading* and process for loading and unloading must be quick.

- **Errors arise in components** due to wear, dirt, chips burns and wear resistance surfaces should be small and easily replaceable.

- Bushes are provided on a jig for guiding drills, reamers and borings, for the desired positioning.
GENERAL CONSIDERATIONS IN THE DESIGN OF DRILL JIGS

- To increase tool life and keep the components cool, a coolant is provided in cutting edge in sufficient quantity.

- Design considerations require easy ejection of the component from jig (particularly for heavy ones) to save the operation time and increase the productivity, pneumatic devices are very suitable for easy and quick ejection.

- Foolproffing must be done.
GENERAL CONSIDERATIONS IN THE DESIGN OF DRILL JIGS

Chip Control:

• Types of chips: segmental and continuous.

• The **segmental chip** is preferred.

• Continuous chip can be controlled by drill bit, grinding of chip breaker, oscillating or intermittent feed to the drill.

• Space between the work and bottom of drill bushings to allow chips to pass b/w the work and busing plate. This works well with segmental chip. But the continuous chips may tangle b/w w/p and bushing and difficult to remove. The compromised distance is (1d to 1.5d)

• Three ways of chip removal: coolant, manually with brush or hook, compressed air
Chip Control:
Cont.. Chip Control

- For angular entry of the drill, clearance b/w workpiece and bush plate should be approx. zero.
- Complicated clamping should be avoided.
- Handle of clamping should be fastened to the jig by a small chain or cable.
- Corner relief must be given to avoid build up of small chips in the corners.
- Small chips may also stick to the contact surfaces therefore, the contact surfaces should be minimized.
GENERAL CONSIDERATIONS IN THE DESIGN OF DRILL JIGS

Jig feet and legs:

• A drill jig should stand on four feet (Or legs) rather than a flat surface.

• Jig feet may be built into the jig body or purchased as standard parts.

• They are usually placed on the extremities of the jig.

• Feet should be ground so that they are all in one plane after they are mounted on the jig base.

• When jig is bolted to machine table, usually provides with four feet instead of a flat bottom, squaring provides easily chip removal and sustainability.
Types of Standard Jig Feet:

- Rest button
- Hexagonal rest button
- Cap-screw rest button
- Flat jig feet
- Jig leg
GENERAL CONSIDERATIONS IN THE DESIGN OF DRILL JIGS

Miscellaneous considerations:
• **Sharp corners** should be eliminated.
• Provisions should be made for the coolant to get to the drill.
• Holes or passages for escape of the coolant.
• Gripping surfaces should be knurled.
• The jig should be large enough to hold it against the torque of the drilling machine.
• It must be easy to handle.
METHODS OF CONSTRUCTION

• Generally jigs are constructed by holding the components together mechanically.
• This is referred to as *built-up* construction.
• Adv.: All parts can be completely machined before assembly and worn parts can be easily replaced.
• Minor adjustments can be made during assembly.
• Jigs of this type are held together by socket-head cap screws and dowels.
• Screw serve to hold the components together while the dowels serve to hold the parts in alignment.
METHODS OF CONSTRUCTION

• Welded construction is also used in building a drill jig.
• Drill jigs are sometimes constructed by a combination of welding and mechanical assembly.
• The main body may be of welded construction with the smaller components attached by screws and dowels.
• The main body of a drill jig may also be cast.