

JIGS AND FIXTURES

Introduction

The successful running of any mass production depends upon the inter-changeability to facilitate easy assembly and reduction of unit cost. Mass production methods demand a fast and easy method of positioning work for accurate operations on it.

JIGS

It is a work holding device that holds, supports and locates the work piece and guides the cutting tool for a specific operation. Jigs are usually fitted with hardened steel bushings for guiding or other cutting tools. A jig is a type of tool used to control the location and/or motion of another tool. A jig's primary purpose is to provide repeatability, accuracy, and inter-changeability in the manufacturing of products. A device that does both functions (holding the work and guiding a tool) is called a jig.

FIXTURES

It is a work holding device that holds, supports and locates the work piece for a specific operation but does not guide the cutting tool. It provides only a reference surface or a device, What makes a fixture unique is that each one is built to fit a particular part or shape. The main purpose of a fixture is to locate and in some cases hold a work piece during either a machining operation or some other industrial process. A jig differs from a fixture in that it guides the tool to its correct position in addition to locating and supporting the work piece.

DIFFERENCE BETWEEN JIGS & FIXTURE

1. jigs are work holding device that holds, supports and locates the work piece and guides the cutting tool for a specific operation but. fixtures are also work holding device that holds, supports and locates the work piece for specific operation , does not guide the cutting tool.
2. Jigs are not clamped to the drill press but Fixtures should be securely clamped to table unless large diameters to be drilled.
3. The jigs are special tools particularly in drilling, reaming, tapping and boring but Fixtures are specific tools used particularly in milling machine, shapers and operation. slotting machine and operation.
4. Gauge blocks are not necessary with jig but Gauge blocks may be provided for effective handling in case of fixture.
5. Jigs are Lighter in construction but fixtures are Heavier in construction.

ADVANTAGES OF JIGS & FIXTURE:-

PRODUCTIVITY: -Jigs and fixtures increases the productivity by eliminating the individual marking, positioning and frequent checking. The operation time is also reduced due to increase in speed, feed and depth of cut, because of high clamping rigidity.

INTERCHANGEABILITY AND QUALITY:- Jigs and fixtures facilitate the production of articles in large quantities with high degree of accuracy, uniform quality and inter-changeability at a competitive cost .

SKILL REDUCTION:- There is no need for skill-full setting of work on tool. Jigs and fixtures makes possible to employ unskilled or semi skilled machine operator to make savings in labour cost.

COST REDUCTION:-Higher production, reduction in scrap, easy assembly and savings in labour cost results in ultimate reduction in unit cost.

Fundamental principles of Jigs and Fixtures design

LOCATING POINTS:- Good facilities should be provided for locating the work. The article to be machined must be easily inserted and quickly taken out from the jig so that no time is wasted in placing the work piece in position to perform operations. The position of work piece should be accurate with respect to tool guiding in the jig or setting elements in fixture.

Full PROOF: -The design of jigs and fixtures should be such that it would not permit the work piece or the tool to inserted in any position other than the correct one.

REDUCTION OF IDLE TIME:- Design of Jigs and Fixtures should be such that the process, loading, clamping and unloading time of the work piece takes minimum as far as possible.

WEIGHT OF JIGS AND FIXTURES:- It should be easy to handle, smaller in size and low cost in regard to amount of material used without sacrificing rigidity and stiffness.

JIGS PROVIDED WITH FEET:- Jigs sometimes are provided with feet so that it can be placed on the table of the machine.

MATERIALS FOR JIGS AND FIXTURES:- Usually made of hardened materials to avoid frequent damage and to resist wear. Example-MS, Cast iron, Die steel, CS, HSS.

CLAMPING DEVICE:- It should be as simple as possible without sacrificing effectiveness. The strength of clamp should be such that not only to hold the work piece firmly in place but also to take the strain of the cutting tool without springing when designing the jigs and fixtures.

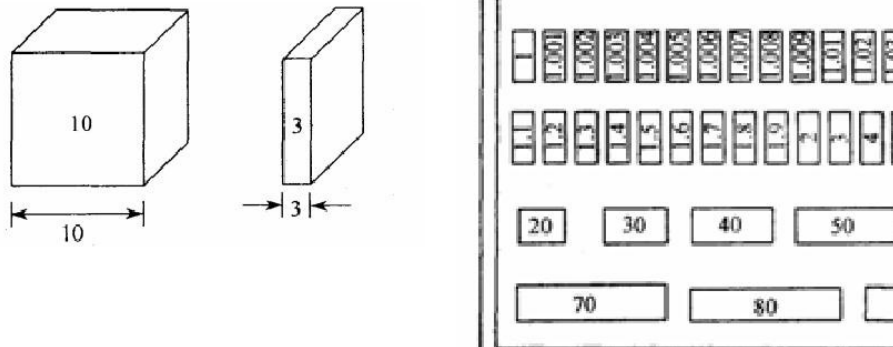
Essential features of Jigs and Fixtures

- Reduction of idle time – Should enable easy clamping and unloading such that idle time is minimum
- Cleanliness of machining process – Design must be such that not much time is wasted in cleaning of scarfs, burrs, chips etc.
- Replaceable part or standardization – The locating and supporting surfaces as far as possible should be replaceable, should be standardized so that their interchangeable manufacture is possible
 - Provision for coolant – Provision should be there so that the tool is cooled and the swarfs and chips are washed away
- Hardened surfaces – All locating and supporting surfaces should be hardened materials as far as conditions permit so that they are not quickly worn out and accuracy is retained for a long time
- Inserts and pads – Should always be riveted to those faces of the clamps which will come in contact with finished surfaces of the work piece so that they are not spoilt
- Fool-proofing – Pins and other devices of simple nature incorporated in such a position that they will always spoil the cutting tool until the latter are in correct position.
- Economic soundness – Equipment should be economically sound, cost of design and manufacture should be in proportion to the quantity and price of producer.
- Easy manipulation – It should be as light in weight as possible and easy to handle so that workman is not subjected to fatigue, should be provided with adequate lift aids.
- Initial location – Should be ensured that work piece is not located on more than 3 points in anyone plane test to avoid rocking, spring loading should be done

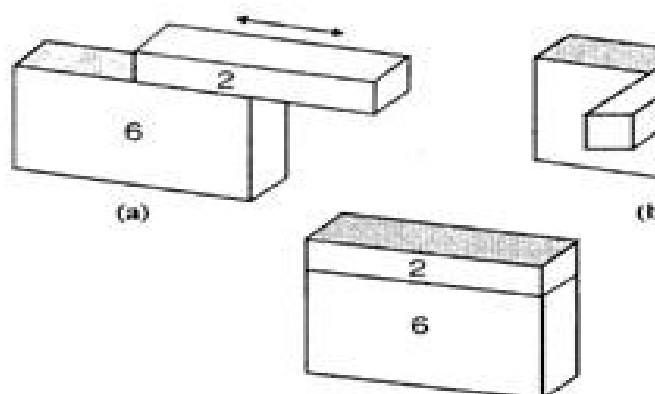
- Position of clamps – Clamping should occur directly above the points supporting the work piece to avoid distortion and springing.
- Clearance – Sufficient amount of clearance should be provided around the work so that operator's hands can easily enter the body for placing the work piece and any variations of work can be accommodated
- Ejecting devices – Proper ejecting devices should be incorporated in the body to push the work piece out after operation
- Rigidity and stability – It should remain perfectly rigid and stable during operation. Provision should be made for proper positioning and rigidly holding the jigs and fixtures.
- Safety – The design should assure perfect safety of the operator.

SLIP GAUGES

These may be used as reference standards for transferring the dimension of the unit of length from the primary standard to gauge blocks of lower accuracy and for the verification and graduation of measuring apparatus. These are high carbon steel hardened, ground and lapped rectangular blocks, having cross sectional area of 30 mm. 10mm. Their opposite faces are flat, parallel and are accurately the stated distance apart. The opposite faces are of such a high degree of surface finish, that when the blocks are pressed together with a slight twist by hand, they will wring together. They will remain firmly attached to each other. They are supplied in sets of 112 pieces down to 32 pieces. Due to properties of slip gauges, they are built up by, wringing into combination which gives size, varying by steps of 0.01 mm and the overall accuracy is of the order of 0.00025mm. Slip gauges with three basic forms are commonly found, these are rectangular, square with center hole, and square without center hole



Wringing or Sliding is nothing but combining the faces of slip gauges one over the other. Due to adhesion property of slip gauges, they will stick together. This is because of very high degree of surface finish of the measuring faces.



Classification of Slip Gauges

Slip gauges are classified into various types according to their use as follows:

- 1) Grade 2
- 2) Grade 1
- 3) Grade 0
- 4) Grade 00
- 5) Calibration grade.

1) Grade 2:

It is a workshop grade slip gauges used for setting tools, cutters and checking dimensions roughly.

2) Grade 1:

The grade I is used for precise work in tool rooms.

3) Grade 0:

It is used as inspection grade of slip gauges mainly by inspection department.

4) Grade 00:

Grade 00 mainly used in high precision works in the form of error detection in instruments.

5) Calibration grade:

The actual size of the slip gauge is calibrated on a chart supplied by the manufactures.

Manufacture of Slip Gauges

The following additional operations are carried out to obtain the necessary qualities in slip gauges during manufacture.

- i. First the approximate size of slip gauges is done by preliminary operations.
- ii. The blocks are hardened and wear resistant by a special heat treatment process.
- iii. To stabilize the whole life of blocks, seasoning process is done.
- iv. The approximate required dimension is done by a final grinding process.
- v. To get the exact size of slip gauges, lapping operation is done.
- vi. Comparison is made with grand master sets.

Slip Gauges accessories

The application slip gauges can be increased by providing accessories to the slip gauges. The various accessories are

- Measuring jaw
- Scriber and Centre point.
- Holder and base

1. Measuring jaw:

It is available in two designs specially made for internal and external features.

2. Scriber and Centre point:

It is mainly formed for marking purpose.

3. Holder and base:

Holder is nothing but a holding device used to hold combination of slip gauges. Base is designed for mounting the holder rigidly on its top surface.

LIMIT GAUGES

- A limit gauge is not a measuring gauge. Just they are used as inspecting gauges.
- The limit gauges are used in inspection by methods of attributes.

This gives the information about the products which may be either within the prescribed limit

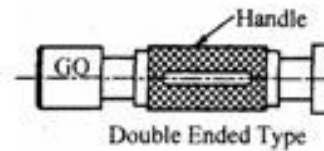
- or not.
- By using limit gauges report, the control charts of P and C charts are drawn to control invariance of the products.
- This procedure is mostly performed by the quality control department of each and every industry.
- Limit gauge are mainly used for checking for cylindrical holes of identical components with a large numbers in mass production.

Purpose of using limit gauges

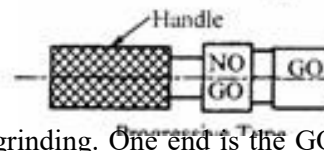
- Components are manufactured as per the specified tolerance limits, upper limit and lower limit. The dimension of each component should be within this upper and lower limit.
- If the dimensions are outside these limits, the components will be rejected.
- If we use any measuring instruments to check these dimensions, the process will consume more time. Still we are not interested in knowing the amount of error in dimensions.
- It is just enough whether the size of the component is within the prescribed limits or not. For this purpose, we can make use of gauges known as limit gauges.

The common types are as follows:

- 1) Plug gauges.
- 2) Ring gauges.
- 3) Snap gauges.



PLUG GAUGES



- The ends are hardened and accurately finished by grinding. One end is the GO end and the other end is NOGO end.
- Usually, the GO end will be equal to the lower limit size of the hole and the NOGO end will be equal to the upper limit size of the hole.
- If the size of the hole is within the limits, the GO end should go inside the hole and NOGO end should not go.
- If the GO end does not go, the hole is under size and also if NOGO end goes, the hole is **over size**. Hence, the components are rejected in both the cases.

1. Double ended plug gauges

In this type, the GO end and NOGO end are arranged on both the ends of the plug. This type has the advantage of easy handling.

2. Progressive type of plug gauges

In this type both the GO end and NOGO end are arranged in the same side of the plug. We can use the plug gauge ends progressively one after the other while checking the hole. It saves time. Generally, the GO end is made larger than the NOGO end in plug gauges.

TAPER PLUG GAUGE

Taper plug gauges are used to check tapered holes. It has two check lines. One is a GO line and another is a NOGO line. During the checking of work, NOGO line remains outside the hole and GO line remains inside the hole.

They are various types taper plug gauges are available as shown in fig. Such as

- 1) Taper plug gauge — plain
- 2) Taper plug gauge — tapered.
- 3) Taper ring gauge plain
- 4) Taper ring gauge — tapered.

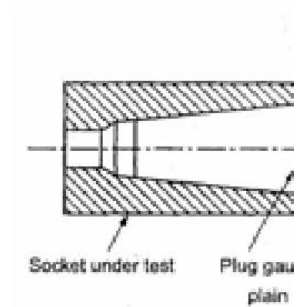
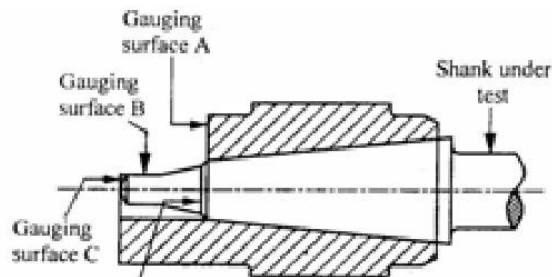
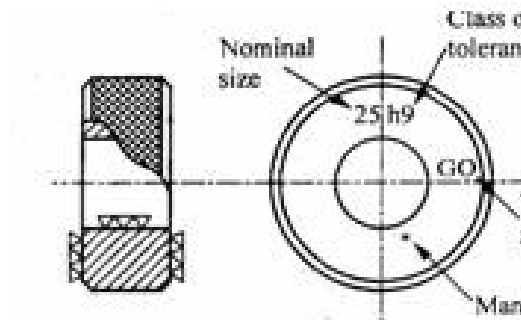


Fig 2.10

RING GAUGES

- Ring gauges are mainly used for checking the diameter of shafts having a central hole. The hole is accurately finished by grinding and lapping after taking hardening process.
- The periphery of the ring is knurled to give more grips while handling the gauges. We have to make two ring gauges separately to check the shaft such as GO ring gauge and NOGO ring gauge.
- But the hole of GO ring gauge is made to the upper limit size of the shaft and NOGO for the lower limit.
- While checking the shaft, the GO ring gauge will pass through the shaft and NOGO will not pass.
- To identify the NOGO ring gauges easily, a red mark or a small groove cut on its periphery.



SNAP GAUGE

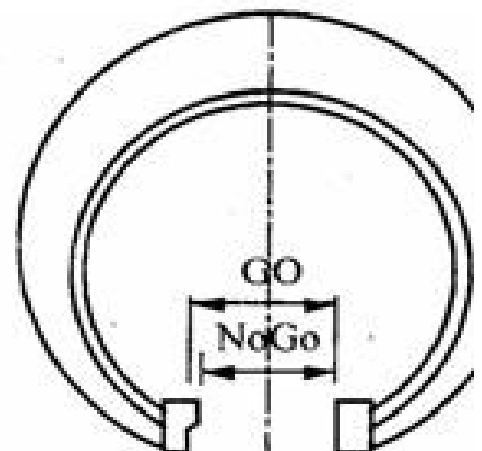
Snap gauges are used for checking external dimensions. They are also called as gap gauges. The different types of snap gauges are:

1. Double Ended Snap Gauge

This gauge is having two ends in the form of anvils. Here also, the GO anvil is made to lower limit and NOGO anvil is made to upper limit of the shaft. It is also known as solid snap gauges

2. Progressive Snap Gauge

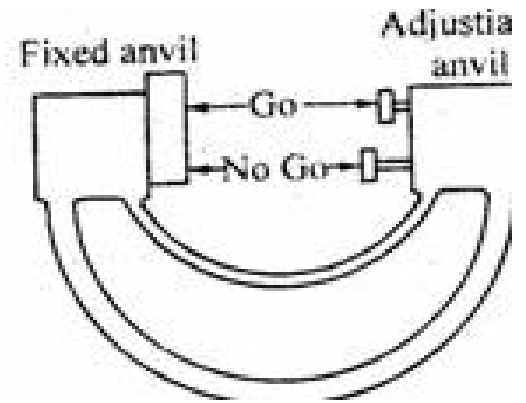
This type of snap gauge is also called caliper gauge. It is mainly used for checking large diameters up to 100mm. Both GO and NOGO anvils at the same end. The GO anvil should be at the front



and NOGO anvil at the rear. So, the diameter of the shaft is checked progressively by these two ends. This type of gauge is made of horse shoe shaped frame with I section to reduce the weight of the snap gauges.

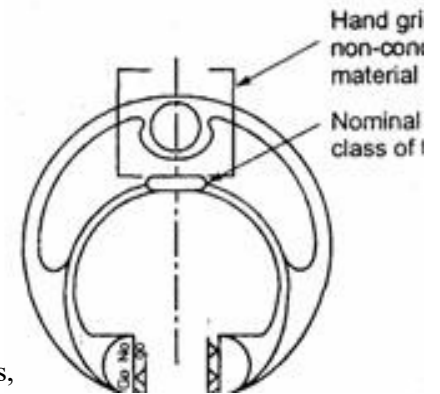
3. Adjustable Snap Gauge

Adjustable snap gauges are used for checking large size shafts made with horseshoe shaped frame of I section. It has one fixed anvil and two small adjustable anvils. The distance between the two anvils is adjusted by adjusting the adjustable anvils by means of setscrews. This adjustment can be made with the help of slip gauges for specified limits of size.



4. Combined Limit Gauges

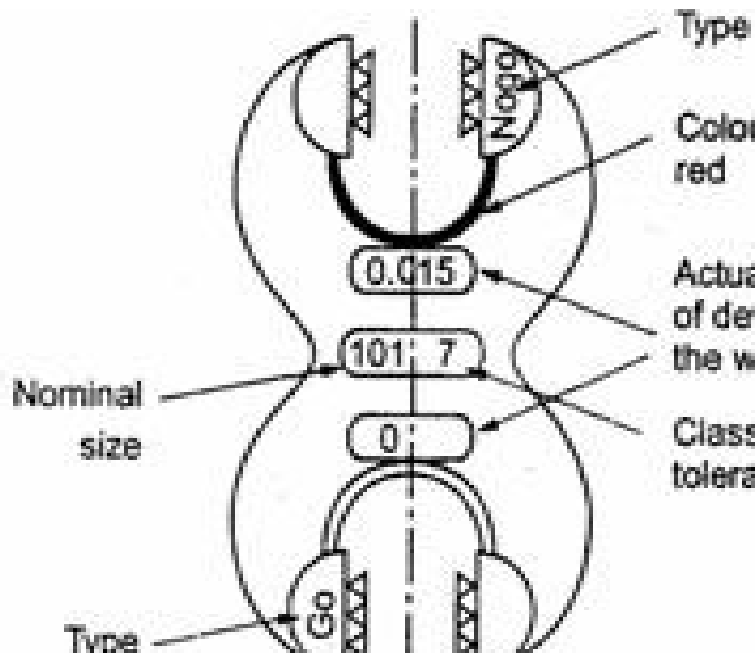
A spherical projection is provided with GO and NOGO dimension marked in a single gauge. While using GO gauge the handle is parallel to axes of the hole and normal to axes for NOGO gauge.



5. Position Gauge

It is designed for checking the position of features in relation to another surface.

Other types of gauges are also available such as contour gauges, receiver gauges, profile gauges etc.



TAYLOR' S PRINCIPLE

It states that GO gauge should check all related dimensions. Simultaneously NO GO gauge should check only one dimension at a time.

Maximum metal condition

It refers to the condition of hole or shaft when maximum material is left on i.e. high limit of shaft and low limit of hole.

Minimum metal condition

If refers to the condition of hole or shaft when minimum material is left on such as low limit of shaft and high limit of hole.

Applications of Limit Gauges

1. Thread gauges
2. Form gauges
3. Screw pitch gauges
4. Radius and fillet gauges
5. Feeler gauges
6. Plate gauge and Wire gauge