

MODERN MACHINING AND FORMING METHODS

(ELECTIVE - III) Instruction

4 Periods per week

Duration of University Examination 3 Hours

University Examination 75 Marks Sessional

25 Marks

Unit-V

Stretch Forming: Introduction, types of stretch forming: stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming. Stretch forming equipment and accessories, accuracy and surface finish, process variables and limitations.

Tube spinning: Introduction, methods of tube spinning, Backward spinning, Forward spinning, machines and tools used. Machine variables, speeds and feeds, effect of tube spinning on work metal properties and applications.

Hydrostatic Forming: Process principle, description and applications.

Water Hammer Forming (WHF): Schematic diagram of the process, principle of operation, process variables, work materials, process limitations and applications.

Suggested Reading:

1. P.C. Pandey and H.S. Shah, Modern Machining Process, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980.
2. A. Bhattacharya, New Technology, The Institution of Engineers (India), 1984.
3. Davies and Austin, Developments in High Speed Metal Forming, The Machinery Publishing Co. Ltd., 1985.
4. Production Technology, HMT.

Stretch Forming: Introduction, types of stretch forming: stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming. Stretch forming equipment and accessories, accuracy and surface finish, process variables and limitations.

Basic introduction

Stretch forming is a metal forming process in which a piece of sheet metal is stretched and bent simultaneously over a die in order to form large contoured parts.

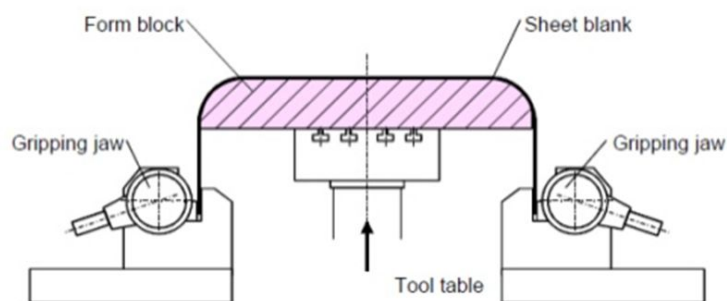
- It is performed on a stretch press,
 - a piece of sheet metal is securely gripped along its edges by gripping jaws.
 - Each gripping jaw is pulled by pneumatic or hydraulic force to stretch the sheet.
 - The tooling used in this process is a stretch form block, called a form die, which is a solid contoured piece against which the sheet metal will be pressed.
 - The most common stretch presses are oriented vertically, in which the form die rests on a press table that can be raised into the sheet by a hydraulic ram.
- As the form die is driven into the sheet, which is gripped tightly at its edges, the tensile forces increase and the sheet plastically deforms into a new shape.
- Horizontal stretch presses mount the form die sideways on a stationary press table, while the gripping jaws pull the sheet horizontally around the form die.

Types:

Simple stretch forming

- Forming block moves & gripping jaws are stationary.
- Large area of contact - Frictional forces prevent deformation.
- Only tensile load is involved in overall expansion.
- Applications: Wing parts of aeroplanes from trapezoidal blanks.

Simple Stretch Forming

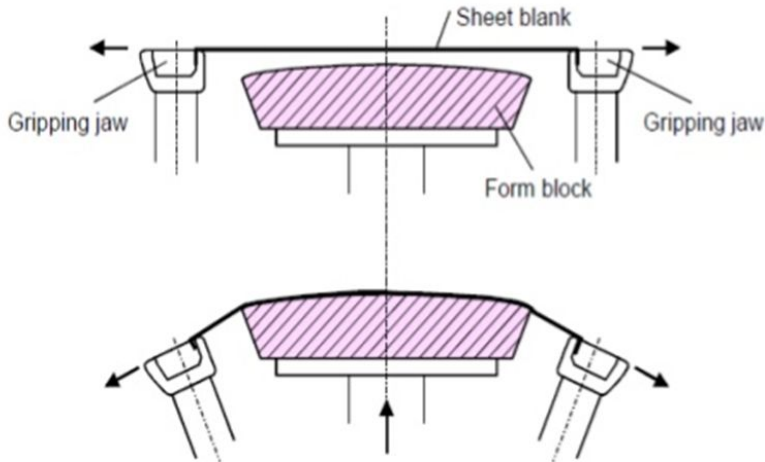


Tangential stretch forming

- Both form block & jaws are movable.
- Plastic pre-strain is applied on sheet to prior to forming.
 - Uniform plastic deformation occurs in entire cross section of sheet.
- 2 steps
 - Sheet gripped between 2 jaws & pulled away to obtain uniform plastic strain.

- Form block is moved to sheet.
 - Grip jaws tilt & orient.
 - Blank drops

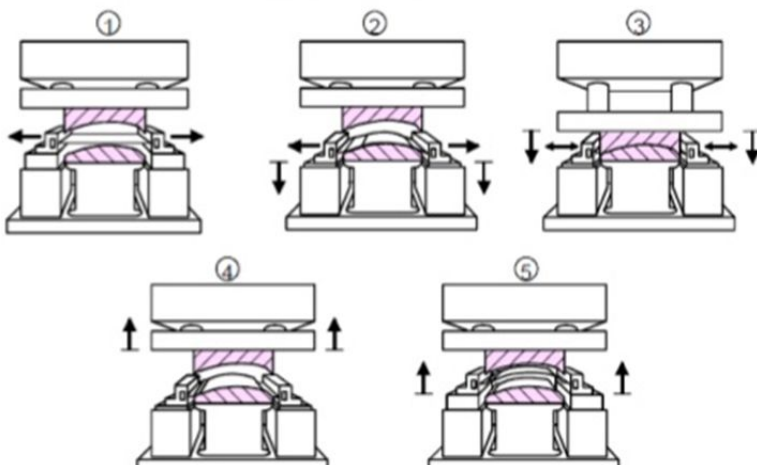
Tangential Stretch Forming



Cyril-Bath Process: Operating steps

1. Clamping & pre-straining the sheet blank.
2. Drawing the sheet blank over the form block.
3. Application of counter pressure.
4. Moving back the counter pressure equipment.
5. Opening the gripping jaws & removing the sheet shape.

The Cyril-Bath Process



Working principle

- The sheet is gripped securely along edges by a set of jaws.

- It is stretched under tensile load by Pneumatic / Hydraulic force.
- It is pressed on a forming block to deform into final shape.
- Deformation takes place in plastic range.

Equipment

Stretch press: Consists of holding jaws mounted on carriage.

Hydraulic press: Provides stretching force on carriage for pre stress.

Gripping jaws: Hold the edges of sheet to be formed.

Form Block: Acts like a +ve die with the final forming shape.

Process description

Process variations

Process parameters

Performance characteristics

Advantages

Advantages on workpiece:

- Large parts can be manufactured.
- Lower tooling costs than regular drawing tools
 - due to less run
- Residual stresses are low.
- Residual stresses are Homogenous.
- Greatly reduced spring back action.
- Increased hardness (by about 2%).
- Can be used on forming of sheets, bars & rolled or extruded sections.
- Final product is in normalised metallurgical state after forming & heat treatment processes.

Advantages on the press & tool

- Easy & fast tool changeover
- Finished product matches the tool shape.
- Low cost forming.
 - No of tools are just 1/3rd of the conventional.

Disadvantages

- Middle region of the sheet are not formed sufficiently.
- Strain distribution in sheet c/s is not uniform.
- Results in spring back action & loss in dimensional accuracy.
- Insufficient work hardening.
- Parts with sharp edges cannot be formed.

- Sheets with non uniform thickness cannot be formed.
- High maintenance cost of hydraulic cylinders.

Applications

- Forming large parts in small quantities.
- Aircraft & automotive parts.