Manufacturing Tooling
4. Work Holding Principles

Nageswara Rao Posinasetti

Work Holding

- Work holder includes all devices that hold, grip, or chuck a work piece to perform a manufacturing operation.

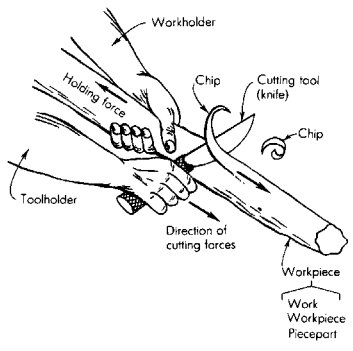


Figure 4-1. Principles of workholders.

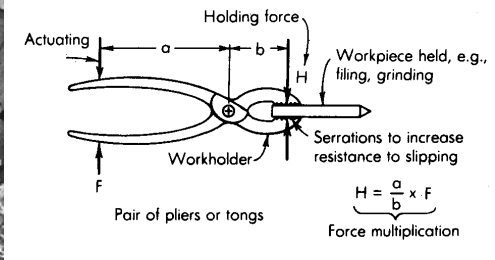


Figure 4-2. **Multiplication of holding force.**

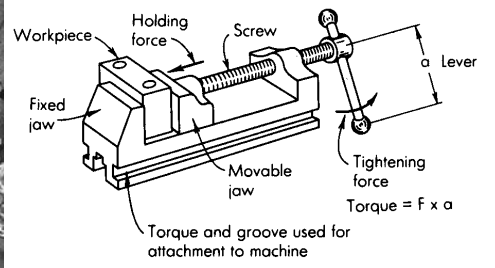


Figure 4-3. **Elementary workholder (vise).**

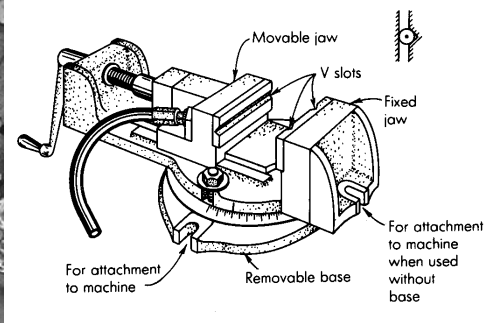


Figure 4-4. **Vise with hydraulic clamping.**

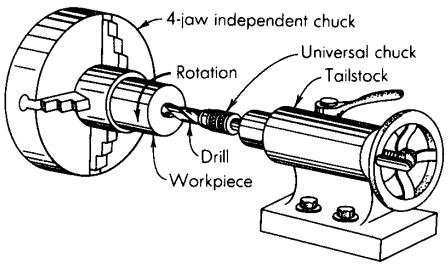


Figure 4-5. **Holding (chucking) a round workpiece.**

Purpose & Function of Work Holder

- Location
- Clamping
- Support
- Cutting forces
- Safety

General Considerations

- Physical characteristics of the workpiece
  - Degree of precision
  - Strength and stiffness of workpiece
  - Production requirements
  - Safety requirements
- Standard work holders

Locating Principles

- Work piece surfaces
  - Flat surfaces
  - Cylindrical surfaces
  - Irregular surfaces
- Types of location

Plane Location

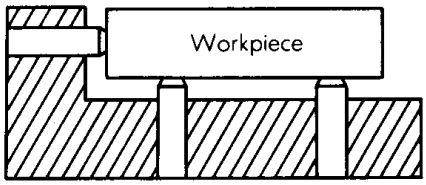


Figure 4-6. **Plane location.**

Concentric Location

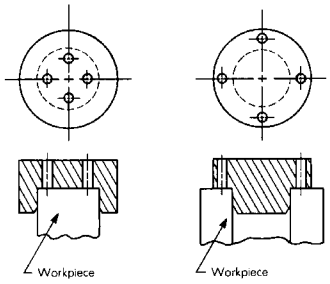


Figure 4-7. **Concentric location.**

Radial Location

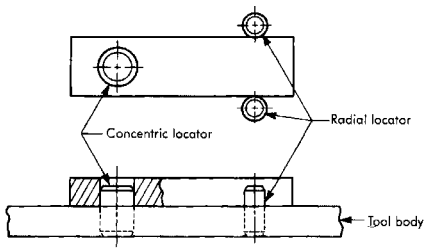


Figure 4-8. Radial location.

Combined Location

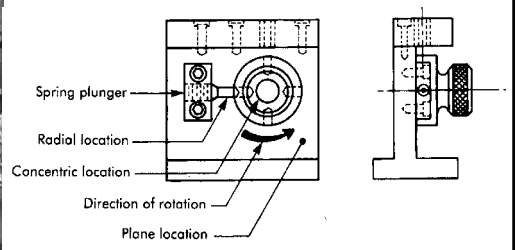


Figure 4-9. Plane, concentric, and radial location.

Degrees of Freedom

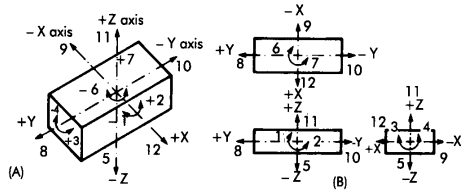


Figure 4-10. Six degrees of freedom and 12 directions.

3-2-1 Method of Location

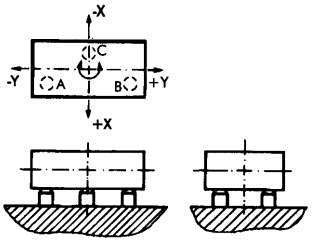
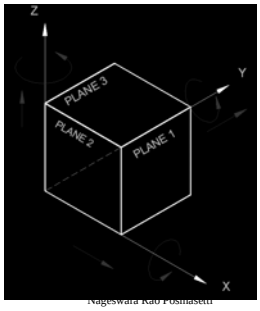
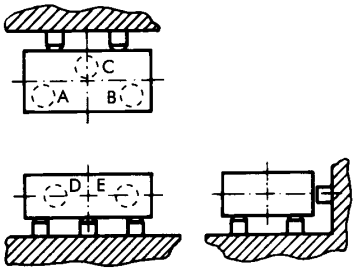


Figure 4-11. Three pins arrest three directional movements.

3-2-1 Method of Location





4-12. Five pins arrest eight directional movements.

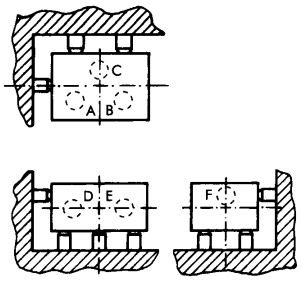


Figure 4-13. Six pins arrest nine directional movements.

Concentric Location

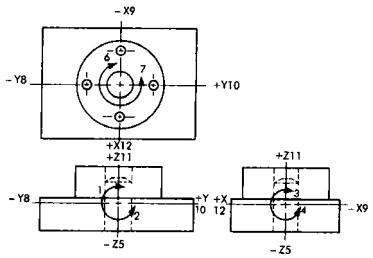


Figure 4-14. Base and center pin restrict nine directional movements.

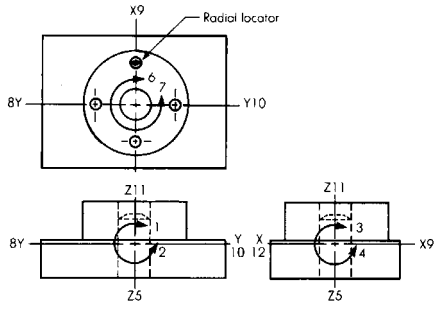


Figure 4-15. Base, center pin, and radial locator restrict 11 directional movements. Clamping will restrict Z11 if required.

Basic Locating Rules

- Position and Number of Locators
- Redundant Locators
- Locational tolerances
- Fool proofing

When more than one locator is placed on a surface, they should be distributed as far apart as possible on the surface

- When more than one locator is placed on a surface (plane), they should be distributed as far apart as possible on the surface.
- This would help in placing the workpiece on locators without much skill.
- Also the clamping forces would not be able to shift the workpiece from such locators.
- A blank with irregular surface (such as sand casting) would be better located on such distributed locators.

When more than one locator is placed on a surface, they should be distributed as far apart as possible on the surface

- Machining forces would not be able to disturb the equilibrium of the workpiece in the fixture with properly distributed locators.
- Wear of any locator contributes less to the inaccuracy of location if the locators are placed far apart.

- While selecting the surface for the largest locators, consideration should be given to the largest area of the workpiece.
- The two locators should be placed on the surface with the next largest area and the single locator on the surface with the least surface area.

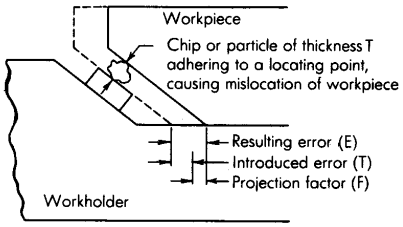


Figure 4-16. **Magnification and projection of error.**

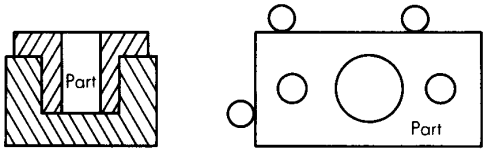


Figure 4-17. **Redundant locators.**

Redundant Locator

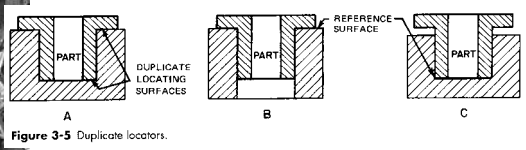


Figure 3-5 Duplicate locators.

To prevent incorrect loading

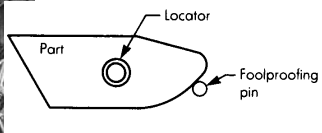


Figure 4-18. **Foolproofing.**

To prevent incorrect loading

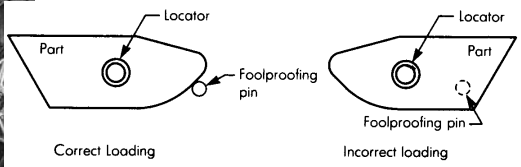


Figure 4-18. **Foolproofing.**

To prevent incorrect loading

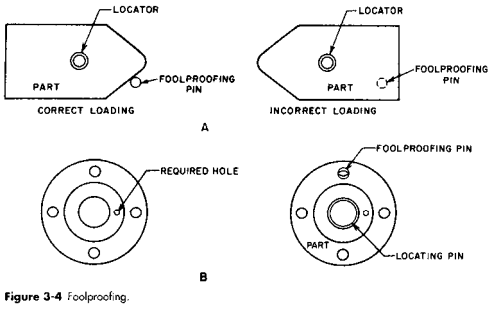


Figure 3-4 Foolproofing.

Basic types of Locators

- External locators
  - Fixed
  - Adjustable
    - Threaded locators
    - Spring pressure locators
    - Equalizing locators
- Integral locators
- Assembled locators

Integral locators

Figure 4-19. Integral locators.

Assembled locators

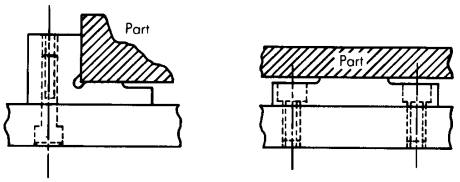


Figure 4-20. Assembled locators.

Basic types of Locators

- Locating pins
- V-locators
- Locating nests
- Adjustable locators

Locating pins

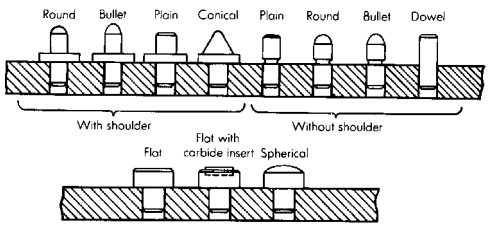
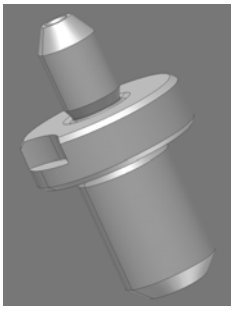


Figure 4-21. Locating pins.

Locator 0.5 in (Jergens)



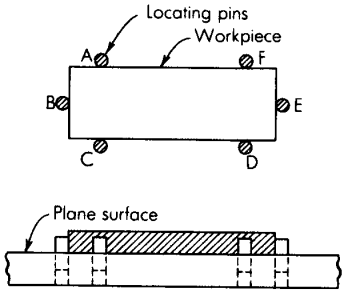


Figure 4-22. **Simple workholder made of plane surface and pins.**

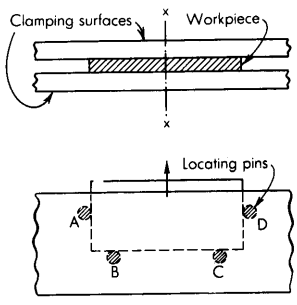


Figure 4-23. **Vertical locating with pins.**

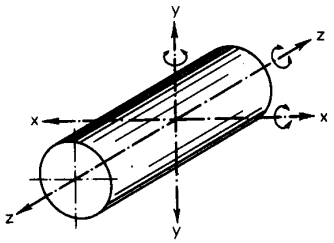


Figure 4-24. Six degrees of freedom and 12 directions of a cylindrical workpiece.

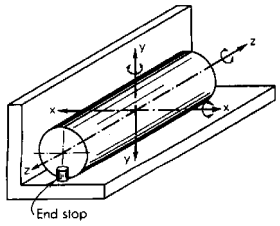


Figure 4-25. Seven directional movements arrested by V locator with stop pin.

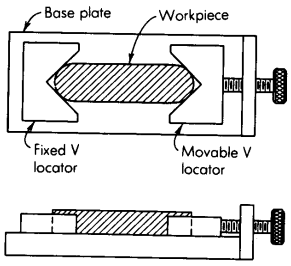
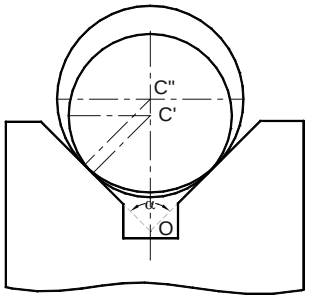
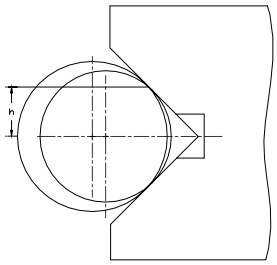


Figure 4-26. Workholder with multiple V locators.

V-locator error?



V-locator error?



Adjustable Locators

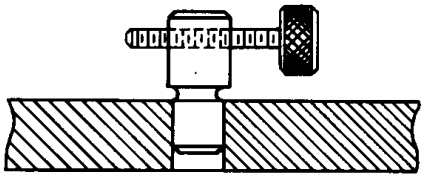


Figure 4-33. Threaded adjustable locator.

Support surfaces

- Select a surface where there is maximum likelihood for the part to deflect under the action of clamping and cutting forces.
- Support areas selected should not disturb the location of the workpiece in any manner nor displace the locators while providing the support.
- Support areas selected should not interfere with the loading and unloading of the component into the work holding fixture.

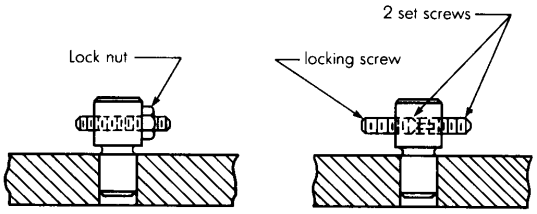


Figure 4-34. Adjustable locators with locknut or screw.

Adjustable Supports

- Adjustable locators positioned beneath the workpiece
  - Threaded
  - Spring
  - Equalizers

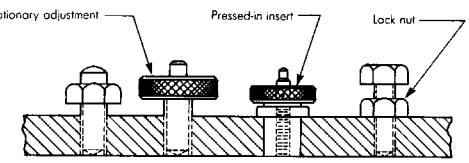


Figure 4-35. Threaded type adjustable supports.

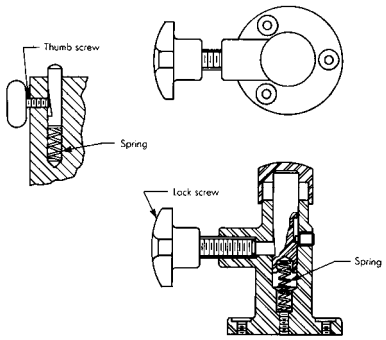


Figure 4-36. Spring type adjustable supports.

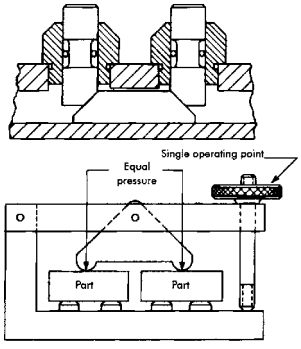


Figure 4-37. Equalizing type adjustable supports.

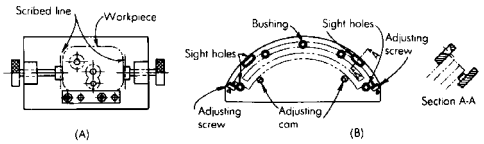


Figure 4-38. Sight locators: (*a*) by scribed lines; and (*b*) by sighting holes.

Internal Locators

- Use holes or bored diameters

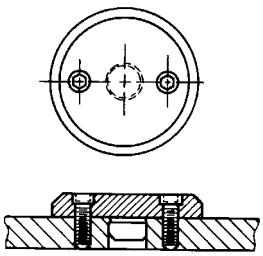


Figure 4-39. Machined internal locator.

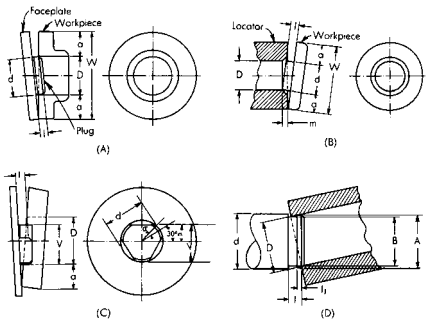


Figure 4-40. Nonsticking locator design.

Pin locators

- Plain
- Shouldered
- Undersized (0.0005 to 0.002")
  - Prevent jamming

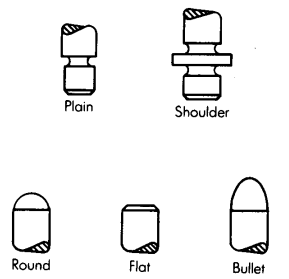


Figure 4-41. Commercial pin locators.

Figure 4-42. Relieved locators.

Diamond Pin

- Radial location

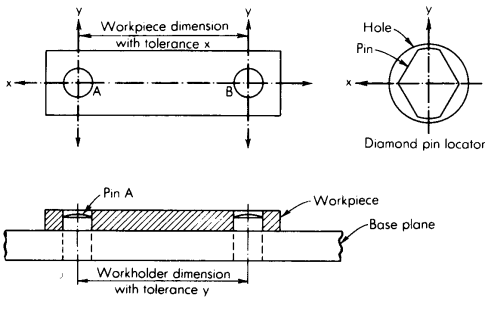


Figure 4-43. Radial location with internal pins or plugs.

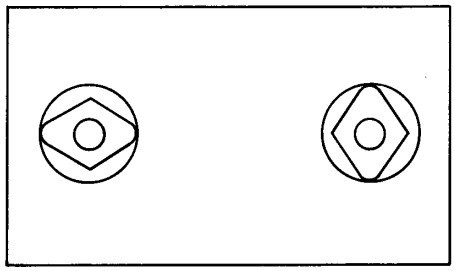


Figure 4-44. Locating completely with diamond pins.

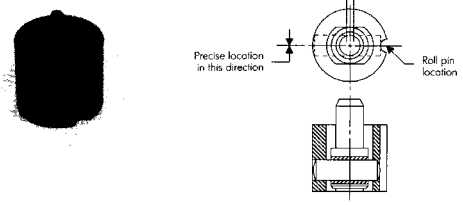


Figure 4-45. Floating locating pin. (*Courtesy, Carr Lane Manufacturing Co.*)

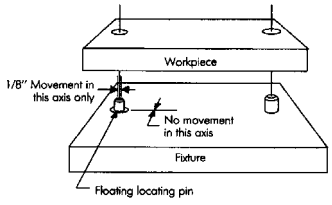


Figure 4-46. Floating locating pin used in combination with round locating pins. (*Courtesy, Carr Lane Manufacturing Co.*)

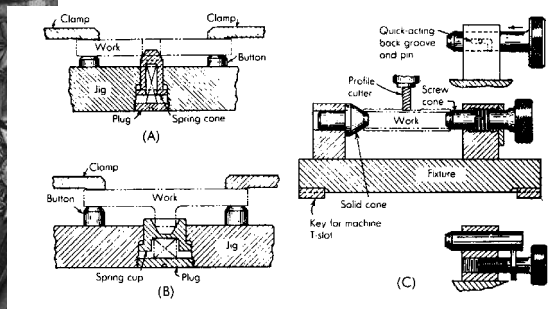


Figure 4-47. Conical locators.

Chip and Burr Problems

- Make locators easy to clean
  - Small and hard
  - Open jigs
- Make them self cleaning
  - Edge relief around locators
  - wipers
- Protect them

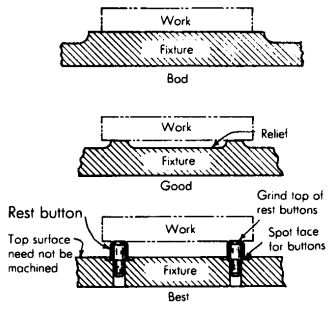
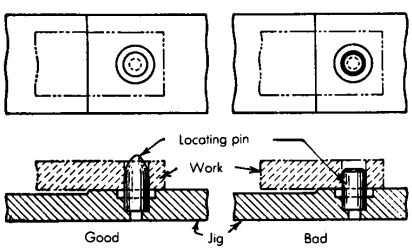
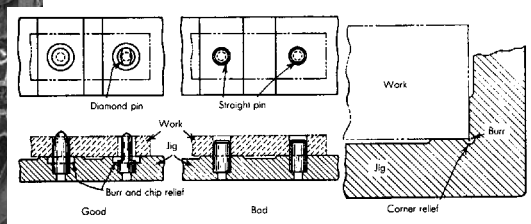


Figure 4-55. Raised workpiece supports.





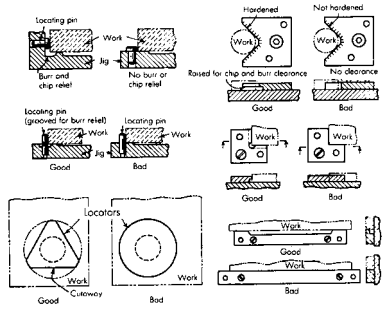
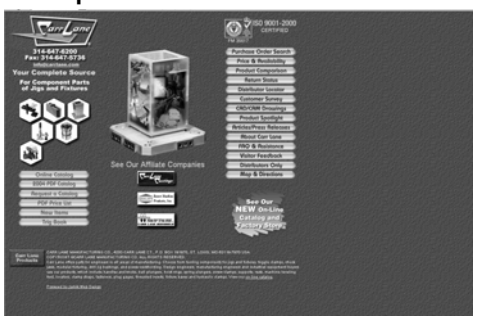


Figure 4-56. Examples of proper chip clearance around locating pins and blocks.

http://www.carrlane.com/



http://www.carrlane.com/

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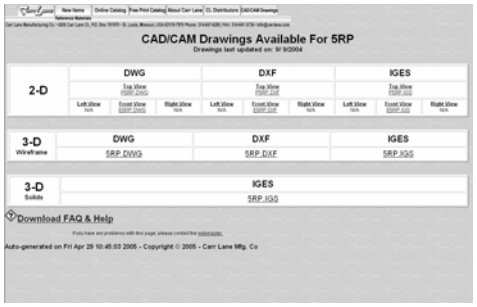

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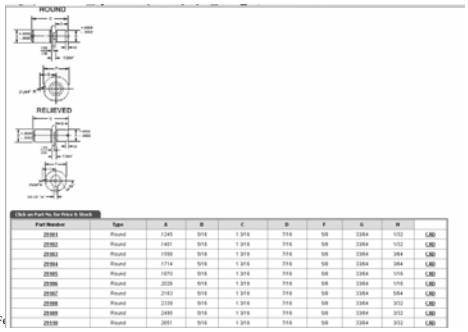

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