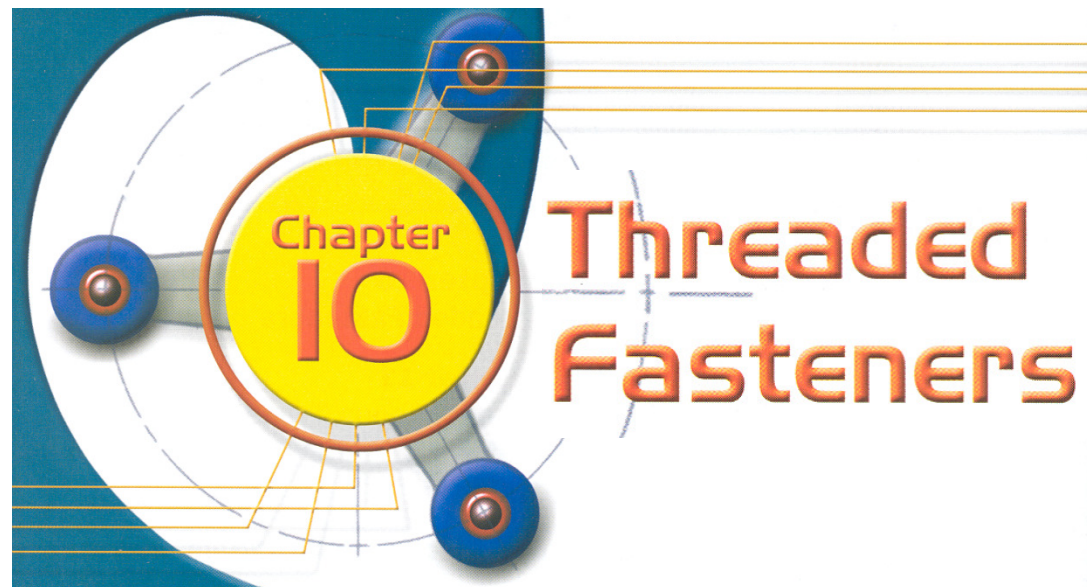


MECH 313 Engineering Drawing & Design

Lecture 12



Common Threaded Fasteners

Fastener Configuration

Head Styles

- Head styles are defined based on the type of driving equipment used (screw driver, spanner, wrench), type of load and the appearance desired
- The head styles shown here are identified with Cap Screws or Machine Screws

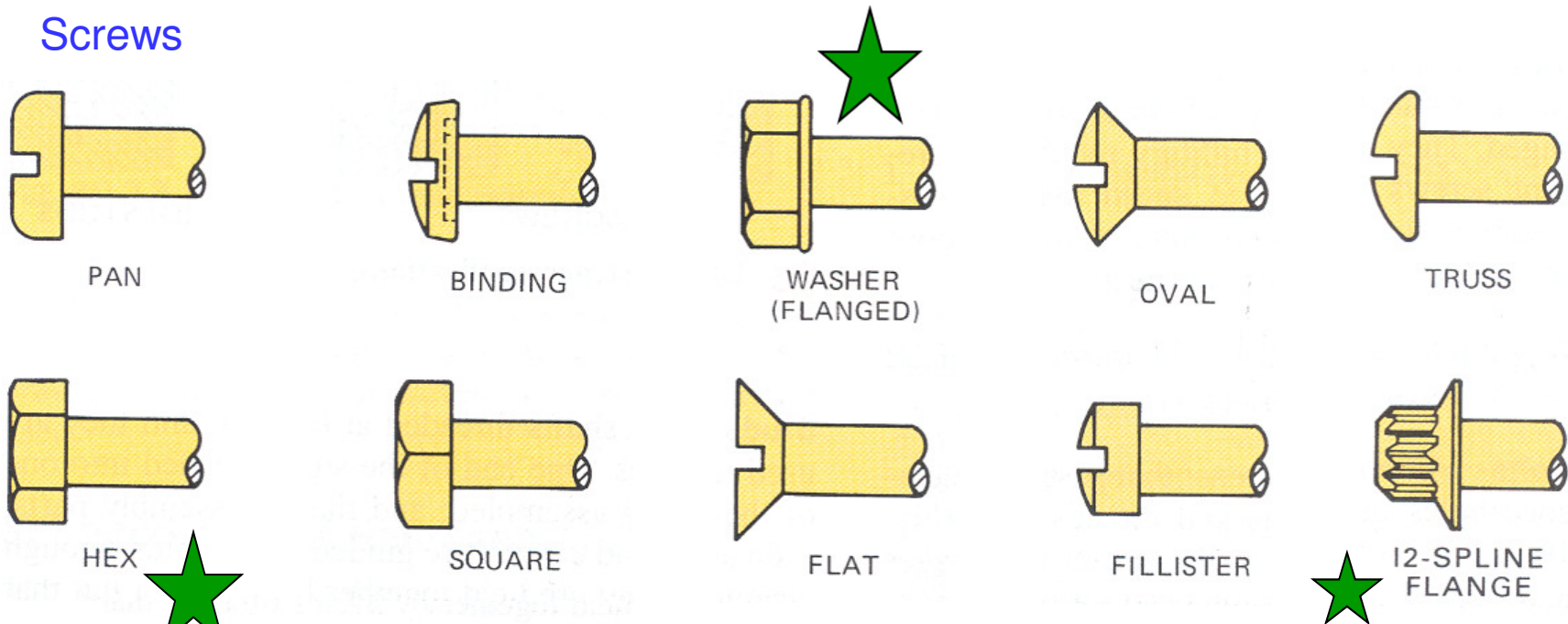


Fig. 10-3-3

Common head styles.

Common Threaded Fasteners

Drive Configurations

- The figure shows different drive designs on fastener heads

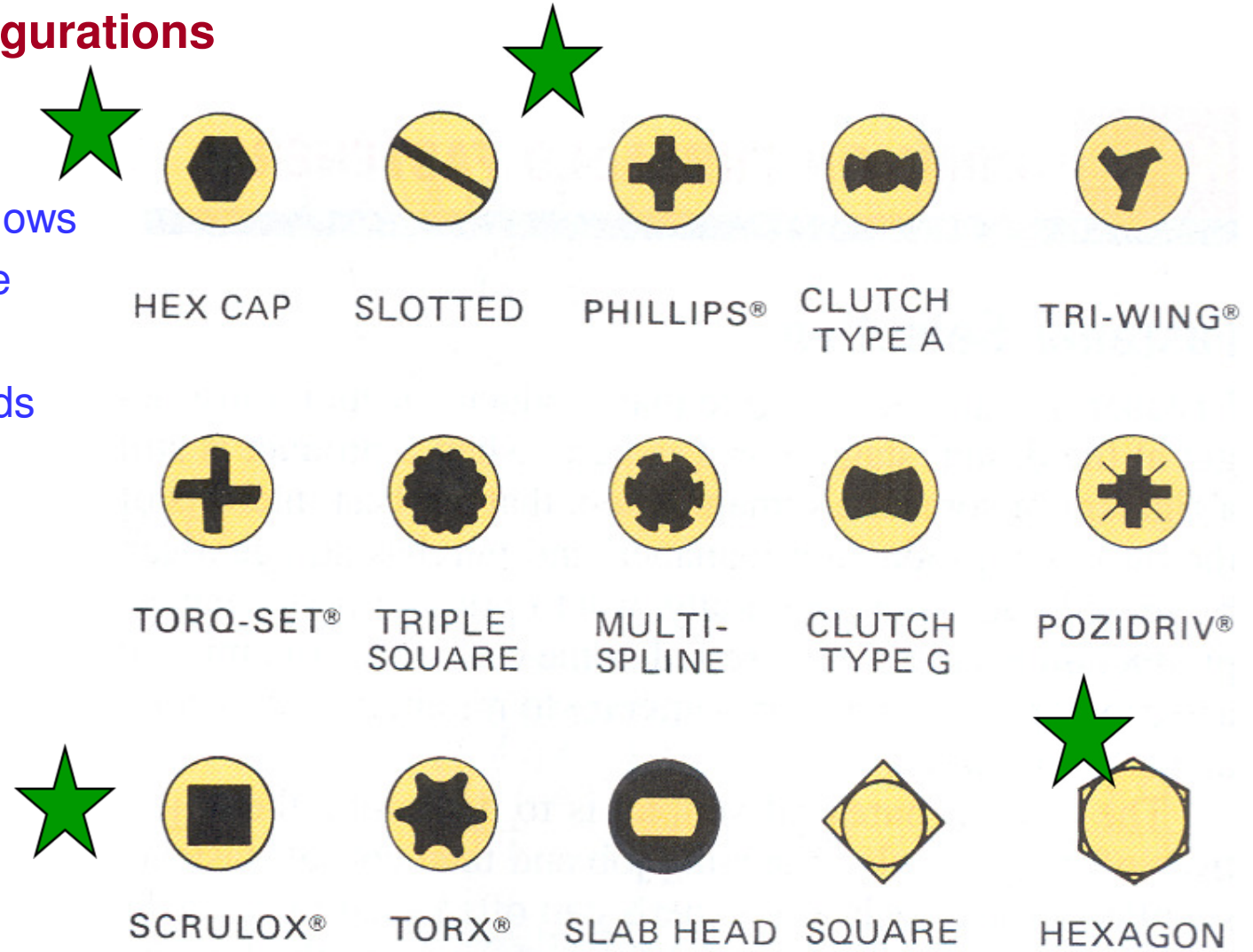


Fig. 10-3-4

Drive configurations.

Common Threaded Fasteners

Point Styles

- The point of a fastener is the configuration of the end of the shank of a headed or headless fastener. Standard point styles are shown in Fig. 10-3-6.
- **Cup** - Used when cutting in action of the point is not objectionable (most widely used)
- **Flat** - Used when frequent resetting of a part is required particularly suited for use against hardened steel shafts
- **Cone** - Used for permanent location; spotted in a hole half of its length
- **Oval** - Used when frequent adjustment of assembled parts necessary
- **Half Dog** - Used for permanent location of part with respect to the other part

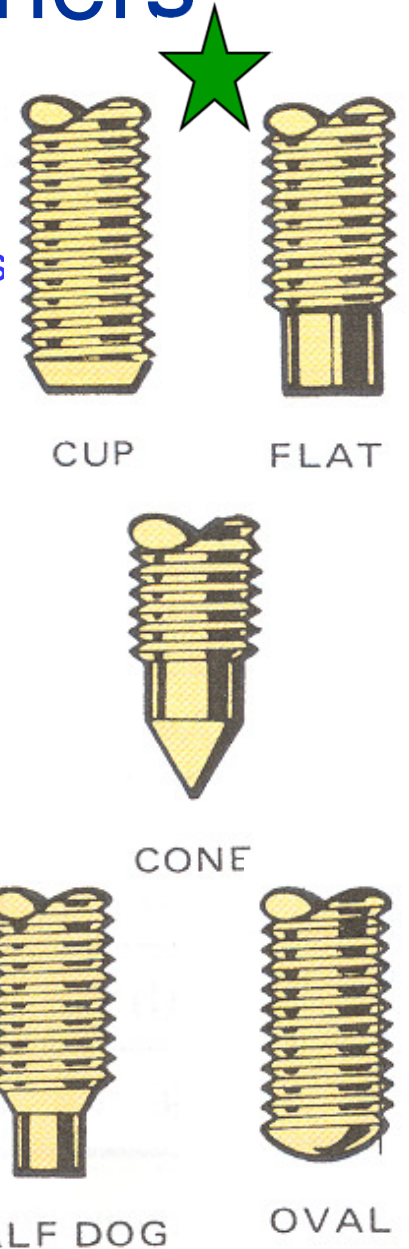


Fig. 10-3-6

Point styles.

HALF DOG

OVAL

Common Threaded Fasteners

Properties and Classes of Fasteners

- Inch Fasteners - Size of the fastener and the material with which it is made provides the strength of fasteners
- The mechanical requirement and the identification patterns are shown in the table


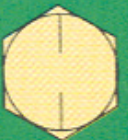
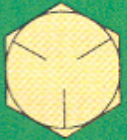

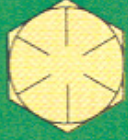
| HEAD DESIGNATION |  |  |  |  |  |
|-------------------------------|---|--|---|---|---|
| GRADE | GRADES 0, 1, 2 | GRADE 3 | GRADE 5 | GRADE 7 | GRADE 8 |
| MINIMUM TENSILE STRENGTH KIPS | 0—NO REQUIREMENTS 1—55 2—69 64 55 | 110 100 | 120 115 105 | 133 | 150 |

Fig. 10-3-7 Mechanical requirements for inch-size threaded fasteners.

Common Threaded Fasteners

Properties and Classes of Fasteners

- **Metric Fasteners** - For material and mechanical requirements they are classified under different property classes - designated by numerals
- Increasing numbers indicate increasing tensile strength and the designation numeral consisting 2 parts
- First of 2 digit or the first 2 of 3 digit numeral indicate one hundredth of the tensile strength in MPa
- The last numeral approximates the ratio of one tenth of the minimum yield strength to minimum tensile strength as a percentage

| Property Class (Equal to or Less Than) | Nominal Diameter | Minimum Tensile Strength MPa | Minimum Yield Strength MPa |
|--|------------------|------------------------------|----------------------------|
| 4.6 | M5 thru M36 | 400 | 240 |
| 4.8 | M1.6 thru M16 | 420 | 340 |
| 5.8 | M5 thru M24 | 520 | 420 |
| 8.8 | M16 thru M36 | 830 | 660 |
| 9.8 | M1.6 thru M16 | 900 | 720 |
| 10.9 | M5 thru M36 | 1040 | 940 |
| 12.9 | M1.6 thru M36 | 1220 | 1100 |

Fig. 10-3-8 Mechanical requirements for metric bolts, screws, and studs.

Common Threaded Fasteners

Drawing a Bolt and Nut

- Bolts and nuts are not normally drawn on detail drawings unless they are of a special size or have been modified.
- On some assemblies it may be necessary to show bolts and nuts (conventional practice is to show the nut and bolt heads across corner position in all the views)

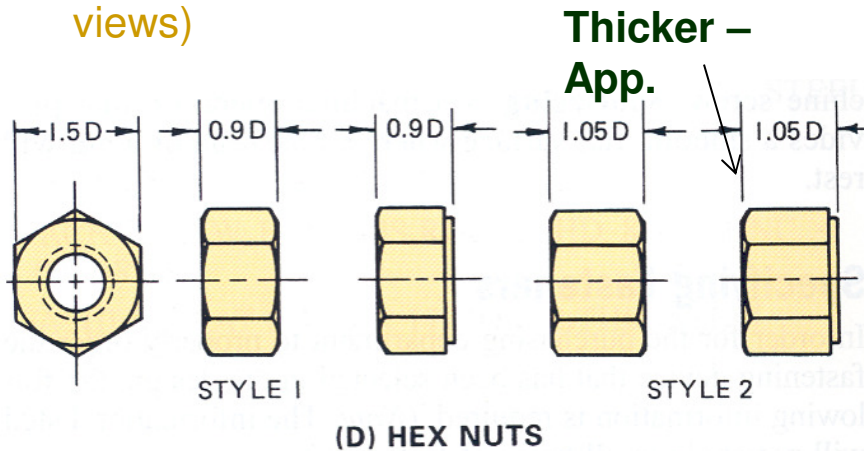
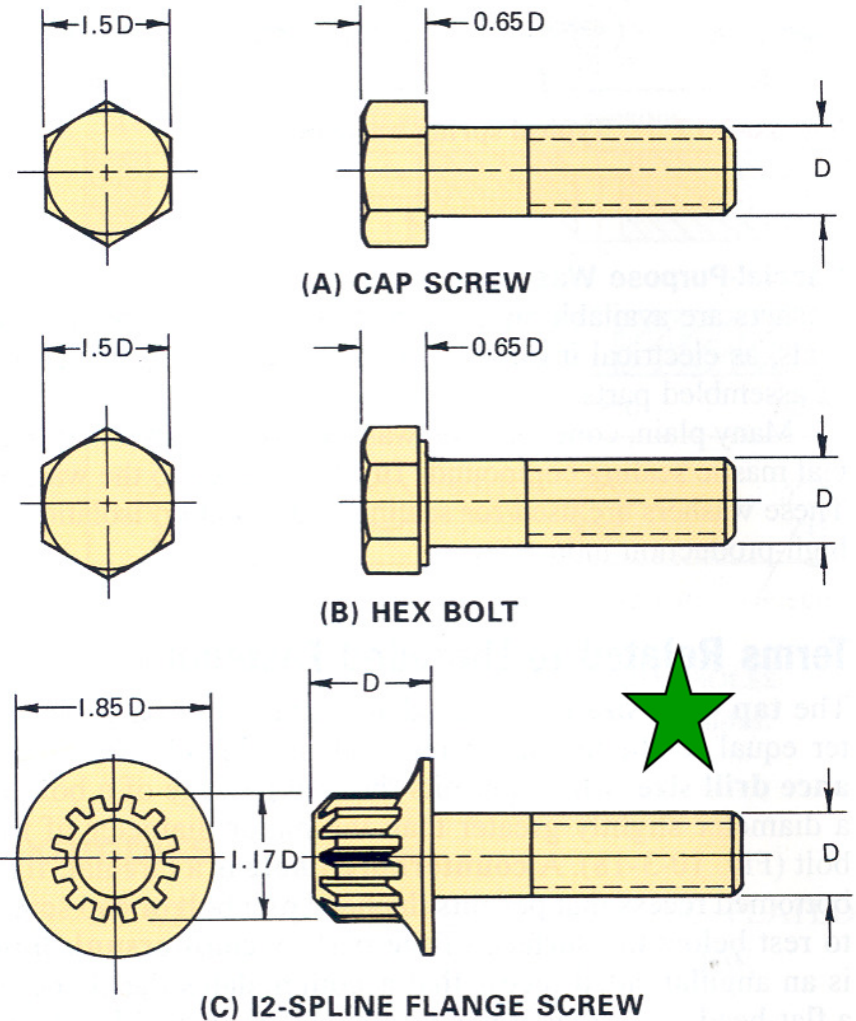


Fig. 10-3-12 Approximate head proportions for hex-head cap screws, bolts, and nuts.



Common Threaded Fasteners

Studs

- used in large quantities for needs of design functions and economy
- Double end studs are designated as type and name, nominal size, thread information, stud length, material, including grading and coating (if required)

▪ Example 3

- TYPE 2 DOUBLE-END STUD
- .500-13 UNC-2A x 4.00
- CADMIUM PLATED
- Continuous studs are designated as product name, nominal size, thread information, stud length, material, and finish – coating (if required)



(A) DOUBLE-END



(B) CONTINUOUS-THREAD

Fig. 10-3-13 Studs.

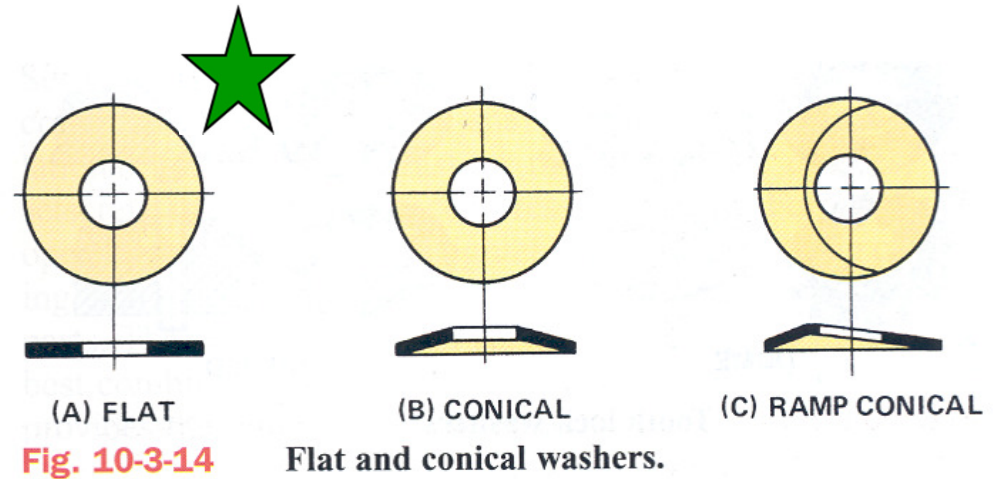
▪ Example 4

- TYPE 3 CONTINUOUS THREAD STUD
- M25 x 3 x 200,
- STEEL CLASS 8.8
- ZINC PHOSPATE & OIL

Common Threaded Fasteners

Washers

- Most common form of hardware performing different functions in fastened assemblies



- Mainly used give better bearing for nuts in oversize clearance holes, or distribute load over greater area; sometimes to provide a seal
- Classification of Washers**
- Washers are commonly the elements that are added to screw systems to keep them tight, but not all washers are locking types. Many washers serve other functions, such as surface protection, insulation, sealing, electrical connection, and spring-tension take-up devices.

Common Threaded Fasteners

Washers

Helical Spring Washers

- These washers are made of slightly trapezoidal wire formed into a helix of one coil so that the free height is approximately twice the thickness of the washer section

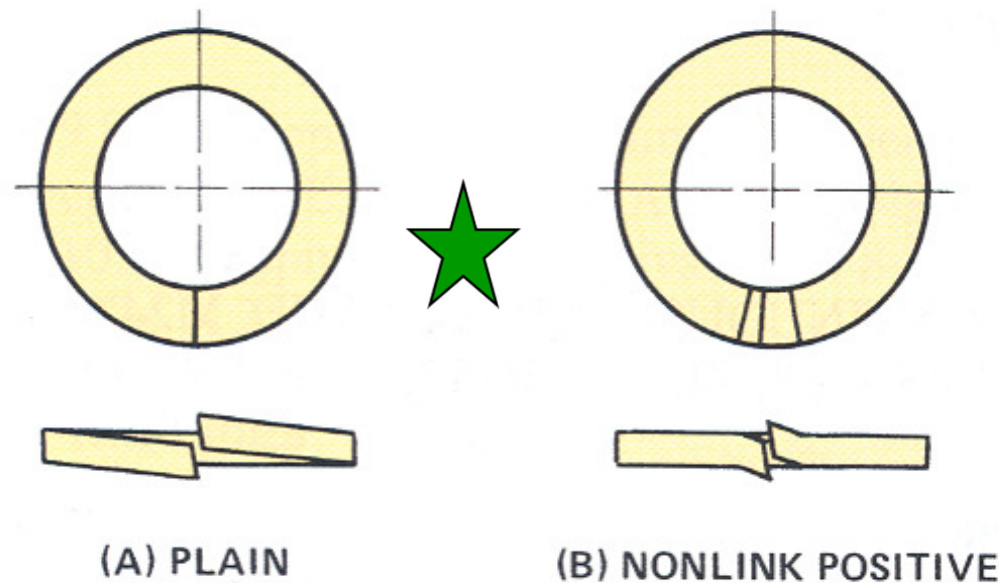


Fig. 10-3-15 Helical spring washers.

Common Threaded Fasteners

Terms Related to Threaded Fasteners

- Tap drill size – minor Φ of the thread
- Clearance drill size – Φ slightly $>$ thread major Φ
- Counterbored hole – permits head to rest below the part surface
- Countersunk hole – angular facing recess for heads
- Spotfacing – a machining operation providing smooth flat surface for head to rest

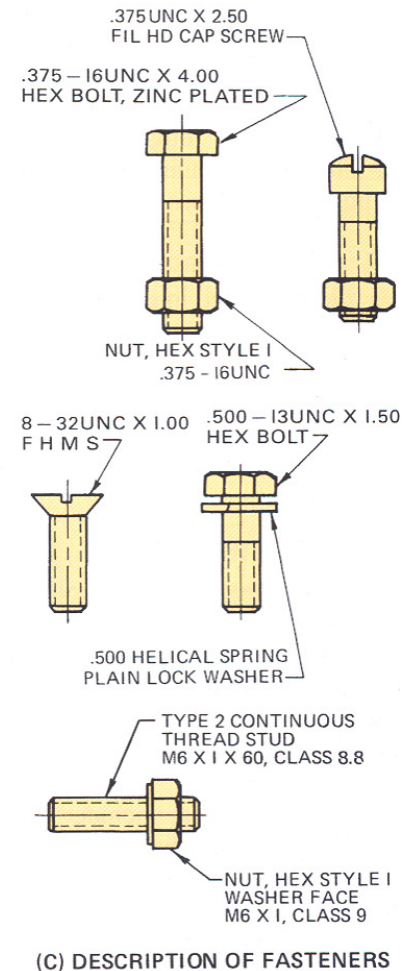
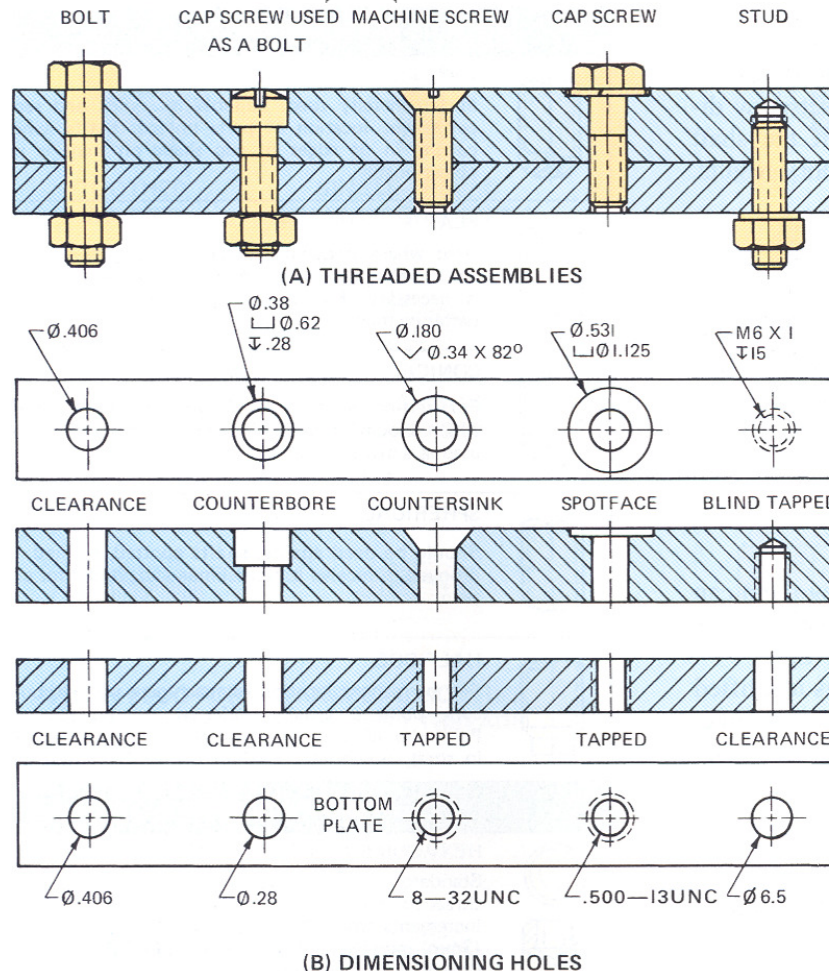


Fig 10-3-18 Specifying Threaded Fasteners and Holes

Common Threaded Fasteners

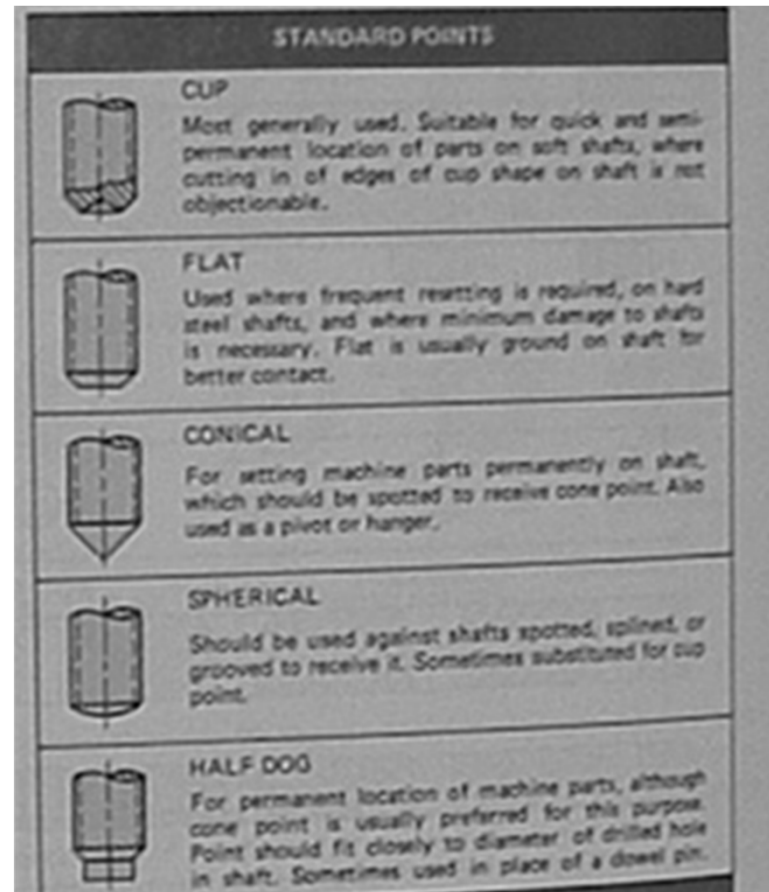
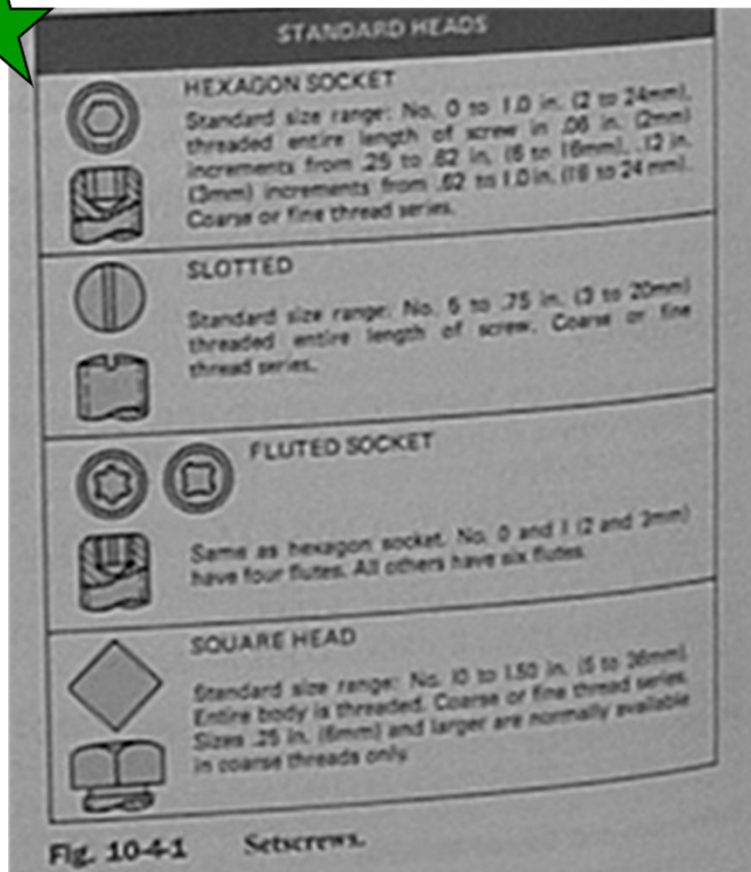
Specifying Fasteners

- In order for the purchasing department to properly order the fastening device that has been selected in the design, the following information is required. (Note: The information listed will not apply to all types of fasteners.)

1. Type of fastener
 - **Examples**
2. Thread specifications
 - .375-16 UNC-2A x 4.00 HEX BOLT, ZINC PLATED
3. Fastener length
 - M10 x 1.5 x 50, 9.8 12-SPLINE FLANGE SCREW, CADMIUM PLATED
4. Material
 - TYPE 2 DOUBLE-END STUD, M10 x 1.5 x 100, STEEL CLASS 9.8, CADMIUM PLATED
5. Head style
 - NUT, HEX, STYLE 1, .500 UNC STEEL
6. Type of driving recess
 - MACH SCREW, PHILLIPS ROUND HD, 8-32 UNC x 1.00, BRASS
7. Point type (setscrews only)
8. Property class
 - WASHER, FLAT 8.4 ID x 17 OD x 2 THK, STEEL
9. Finish
 - HELICAL SPRING

Special Fasteners **Setscrews**

- Used as semi permanent fasteners – produces strong clamping action and prevents movement of assembled parts
- Selection of setscrew is to find the right form, size, point and head style that will provide the required holding power



Special Fasteners

Locknuts

- Are nuts with means for gripping fastener to prevent rotation
- Same dimensions and mechanical requirements as a nut but with added feature for locking
- They are divided into 3 types, free spinning, prevailing torque and other

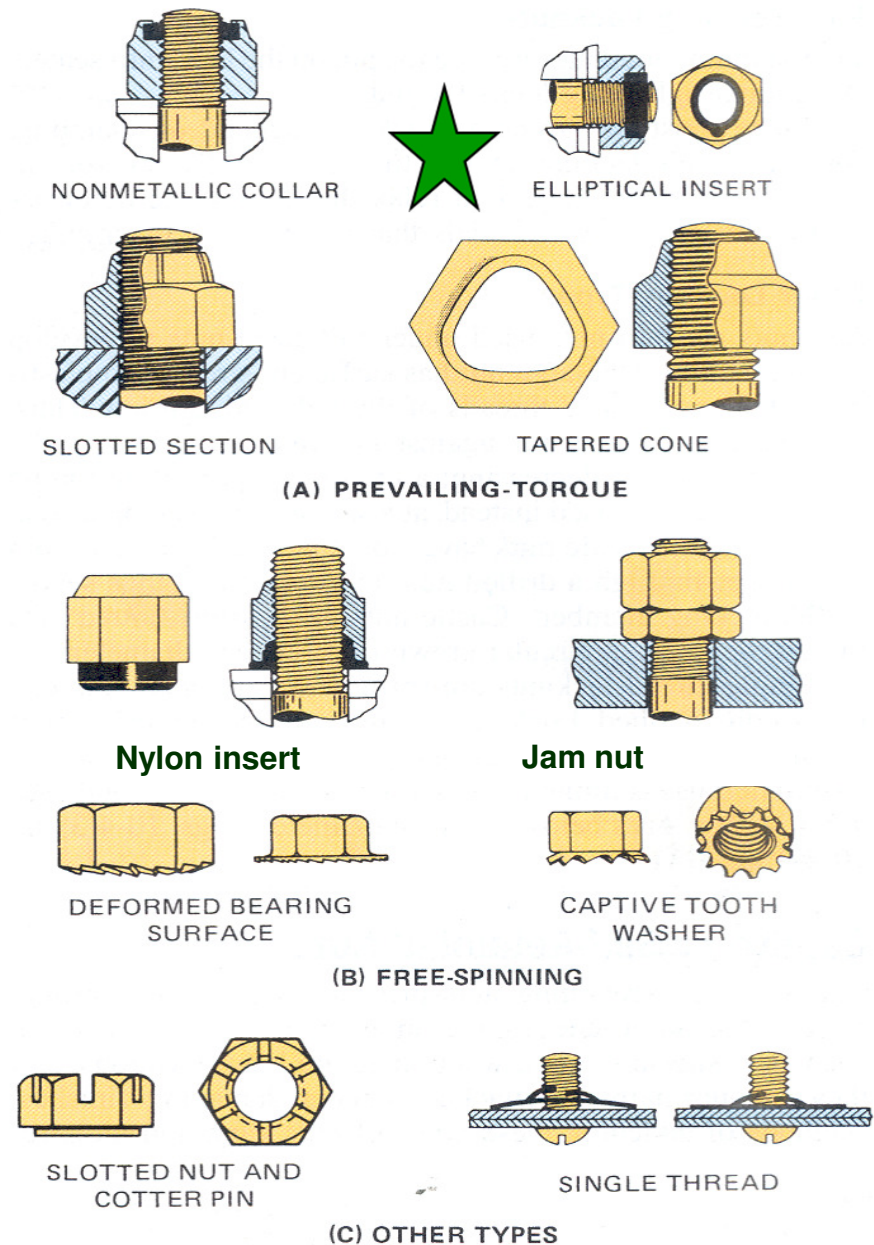
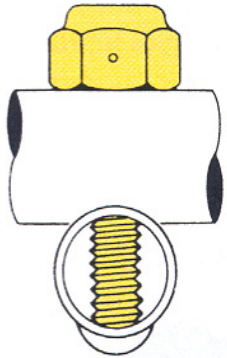


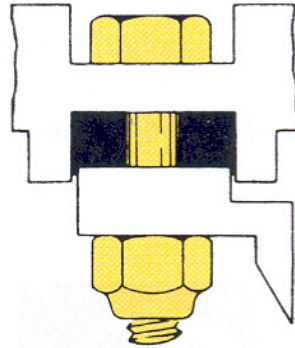
Fig. 10-4-3 Locknuts.

Special Fasteners

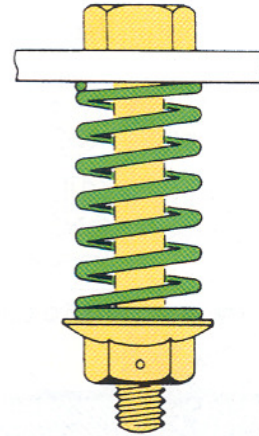
Locknut Applications



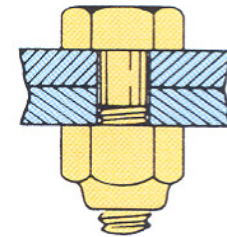
USE OF LOCKNUT FOR TUBULAR FASTENING



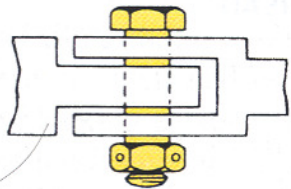
FOR RUBBER-INSULATED AND CUSHION MOUNTINGS WHERE THE NUT MUST REMAIN STATIONARY



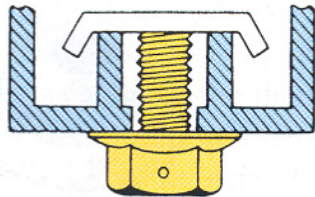
USE OF LOCKNUT ON A SPRING CLAMP



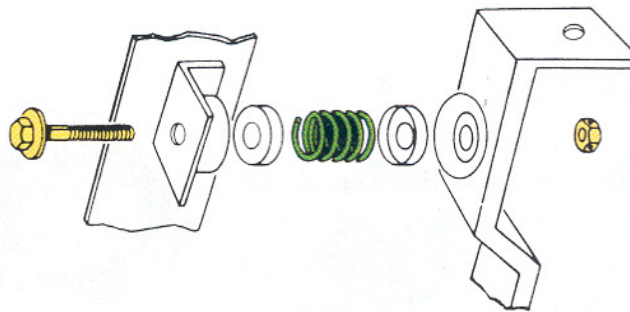
USE OF LOCKNUT WHERE ASSEMBLY IS SUBJECTED TO VIBRATORY OR CYCLIC MOTIONS THAT COULD CAUSE LOOSENING



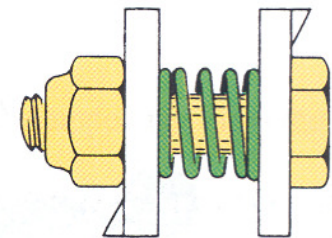
USE OF LOCKNUT ON A BOLTED CONNECTION THAT REQUIRES PRE-DETERMINED PLAY



FOR AN EXTRUDED PART ASSEMBLY



FOR HOLDING A MOTOR MOUNTING SECURELY IN POSITION



FOR SPRING-MOUNTED CONNECTIONS WHERE THE NUT MUST REMAIN STATIONARY OR IS SUBJECT TO ADJUSTMENT

Fig. 10-4-5 Typical locknut applications.

Special Fasteners

Captive or Self-Retaining Nuts

- Captive or self-retaining nuts provide a permanent, strong, multiple-thread fastener for use on thin materials. They are especially good when there are blind locations, and they can normally be attached without damaging finishes. Methods of attaching these types of nuts vary, and tools required for assembly are generally uncomplicated and inexpensive. The self-retained nuts are grouped according to four means of attachment
- Plate or anchor nuts: These nuts have mounting lugs that can be riveted, welded, or screwed to the part.
- Caged nuts: A spring-steel cage retains a standard nut. The cage snaps into a hole or clips over an edge to hold the nut in position



Fasteners for wood, light metal etc.

Self Tapping Screws

- Cut or form their own mating threads on the drilled hole
- One piece fastener, fast assembly and can be used where access is limited to one side
- As the mating thread fits exactly with the self tapping screw, no clearance is required
- This keeps the screws tight
- They are case hardened and can be driven tightly and have a relatively high torsional strength
- Self drilling tapping holes have their own sharp point which eliminates need for drilling or punching, but require power screw driver to drive

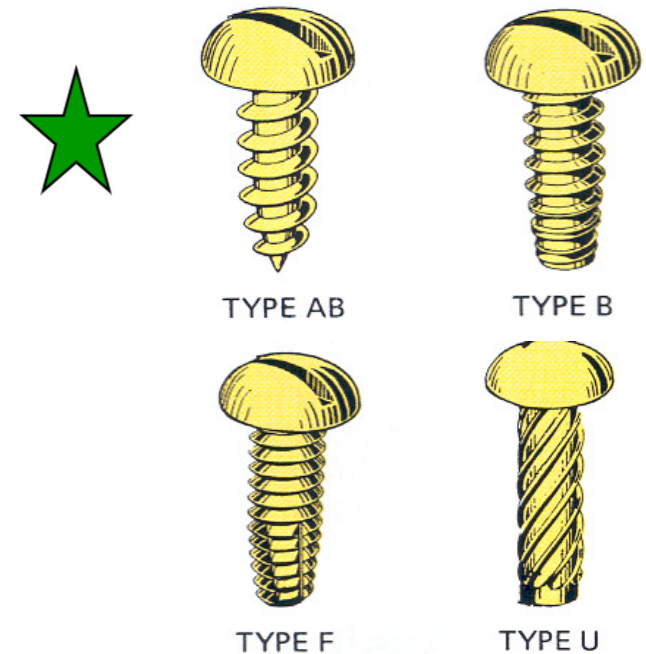


Fig. 10-5-1 Self-tapping screws.

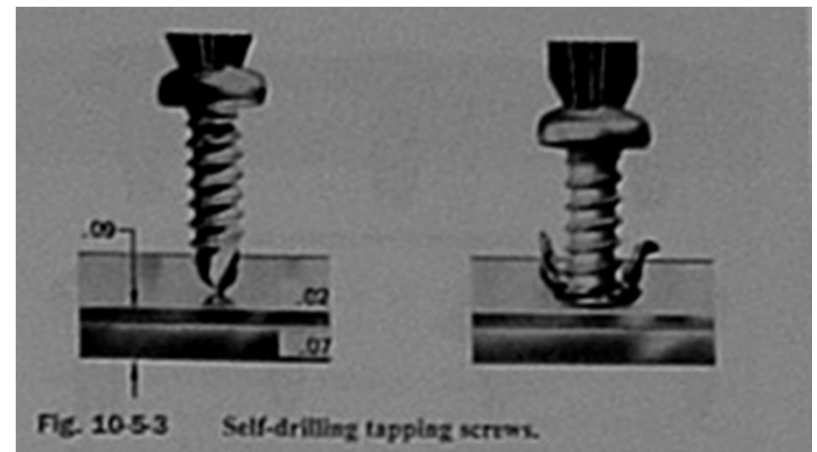


Fig. 10-5-3 Self-drilling tapping screws.