Chapter 12

Working Drawing



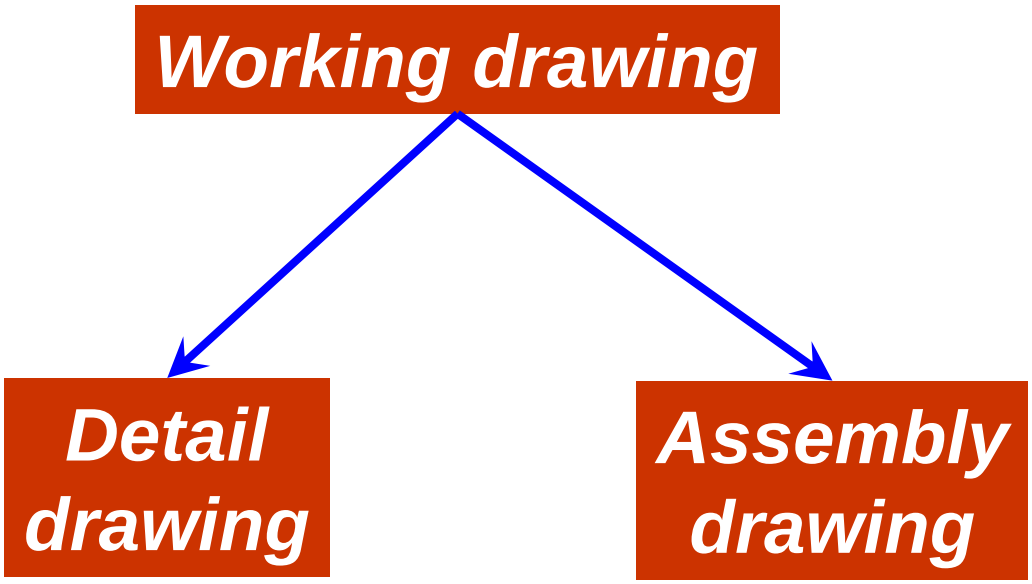
TOPICS

- Introduction
- Detail drawing
- Assembly drawing
- Assembly section
- Dimensioning

Introduction

DEFINITION

- ***Working drawing*** is a set of drawing used during the work of making a product.



DEFINITION

- ***Detail drawing*** is a ***multiview representation*** of a single part with ***dimensions and notes***.

- ***Assembly drawing*** is a drawing of various parts of a machine or structure assembled in their relative working positions.

PURPOSE

- ***Detail drawing*** conveys the ***information*** and ***instructions*** for manufacturing the part.

- ***Assembly drawing*** conveys

  1. completed shape of the product.
  2. overall dimensions.
  3. relative position of each part.
  4. functional relationship among various components.

Detail Drawing

INFORMATION IN DETAIL DRAWING

1. General information → Title block

2. Part' s information

2.1 Shape description → Object's views

2.2 Size description → Object's views

2.3 Specifications → Notes

GENERAL INFORMATION

- Name of company
- Title of drawing (usually part's name)
- Drawing sheet number
- Name of drafter, checker
- Relevant dates of action

  (drawn, checked, approved etc.)
- Revision table
- Unit
- Scale
- Method of projection

PART' S INFORMATION

Shape	❖ **Orthographic drawing** ❖ Pictorial drawing
Size	❖ **Dimensions** and Tolerances
Specifications	❖ **Part number, name, number required** ❖ **Type of material used** ❖ **General notes** ❖ Heat treatment ❖ Surface finish ❖ General tolerances

RECOMMENDED PRACTICE

- Draw **one part** to **one sheet** of paper**.**

- If not the case,

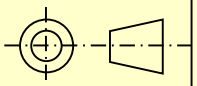
  - apply ***enough spacing*** between parts.
  - draw all parts using the ***same scale***.

    Otherwise, the scale should be clearly note under each part's drawing**.**

- Standard parts such as ***bolt***, ***nut***, ***pin***, ***bearing*** do not require detail drawings.

PLACING AN INFORMATION

(This course)



Completed dimension orthographic drawing

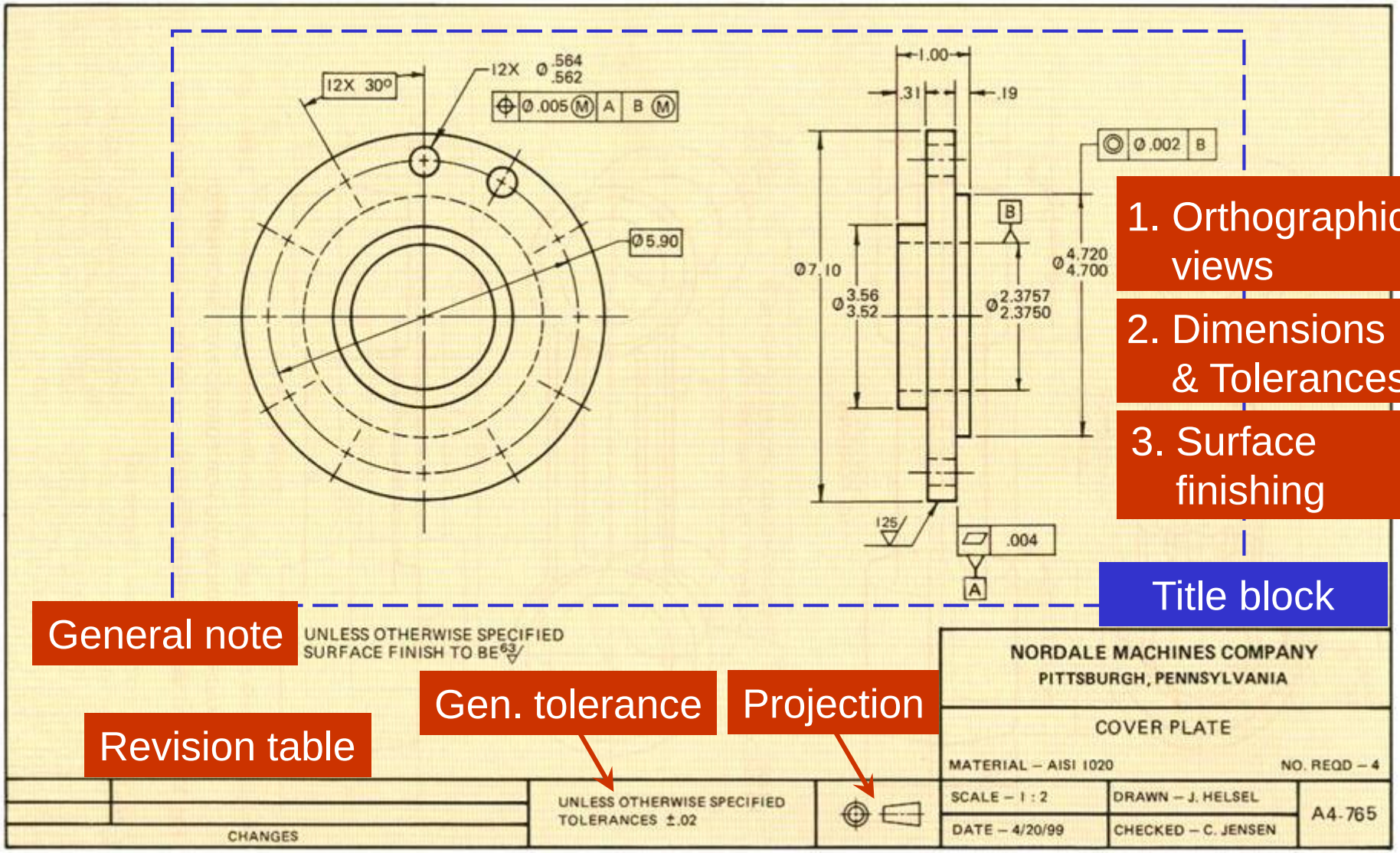
Part No., Part name, material, Number required

Notes

Unit, fillets & rounds sizes etc.

Title block

EXAMPLE : Interpreting detail drawing



Assembly Drawing

TYPES OF ASSEMBLY DRAWING

1. Exploded assembly drawings

The parts are separately display, but they are aligned according to their assembly positions and sequences.

2. General assembly drawings.

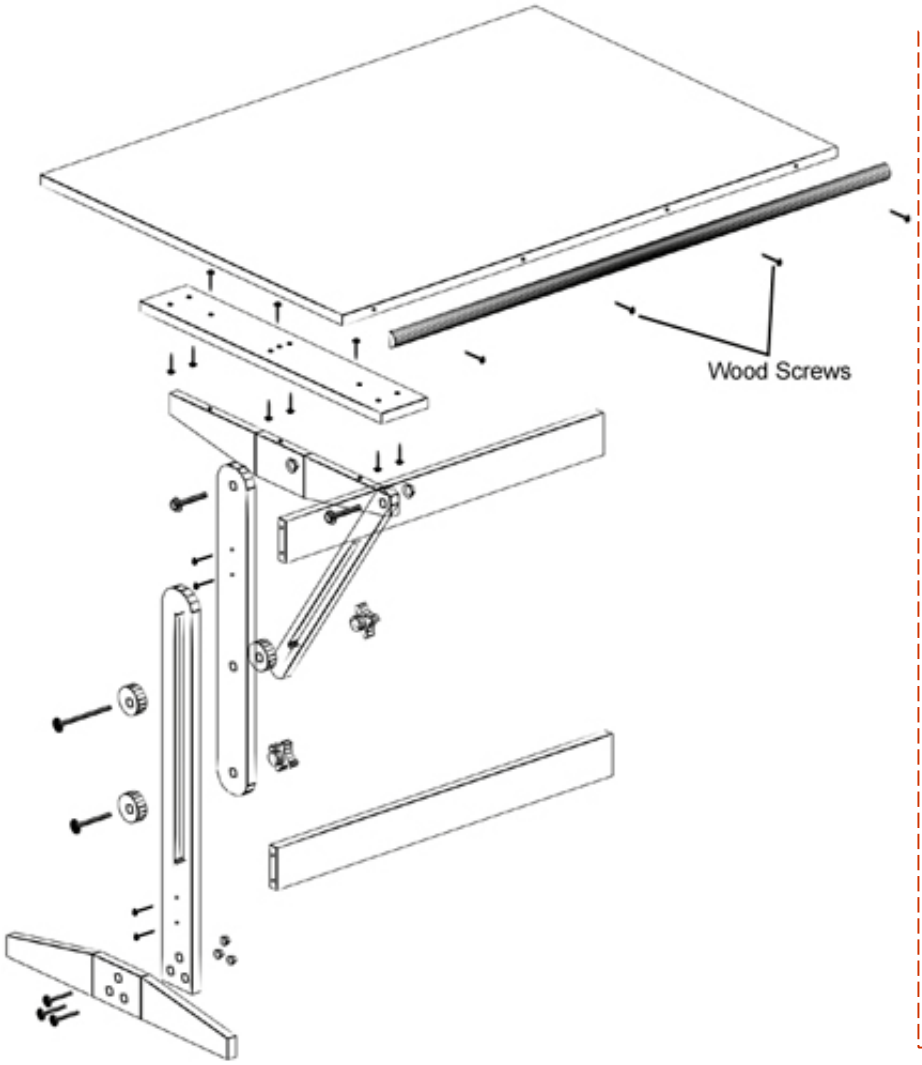
All parts are drawn in their working position.

3. Detail assembly drawings

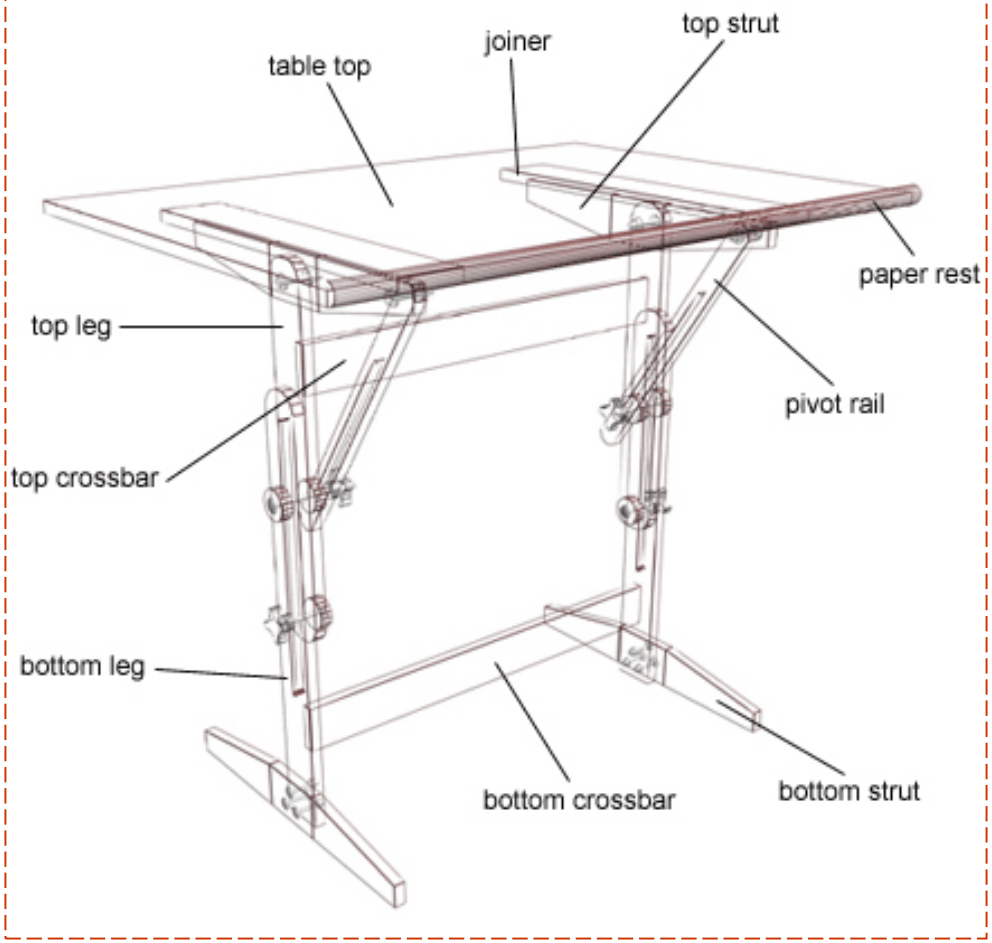
All parts are drawn in their working position with a completed dimensions.

1. EXPLODED ASSEMBLY

Pictorial representation

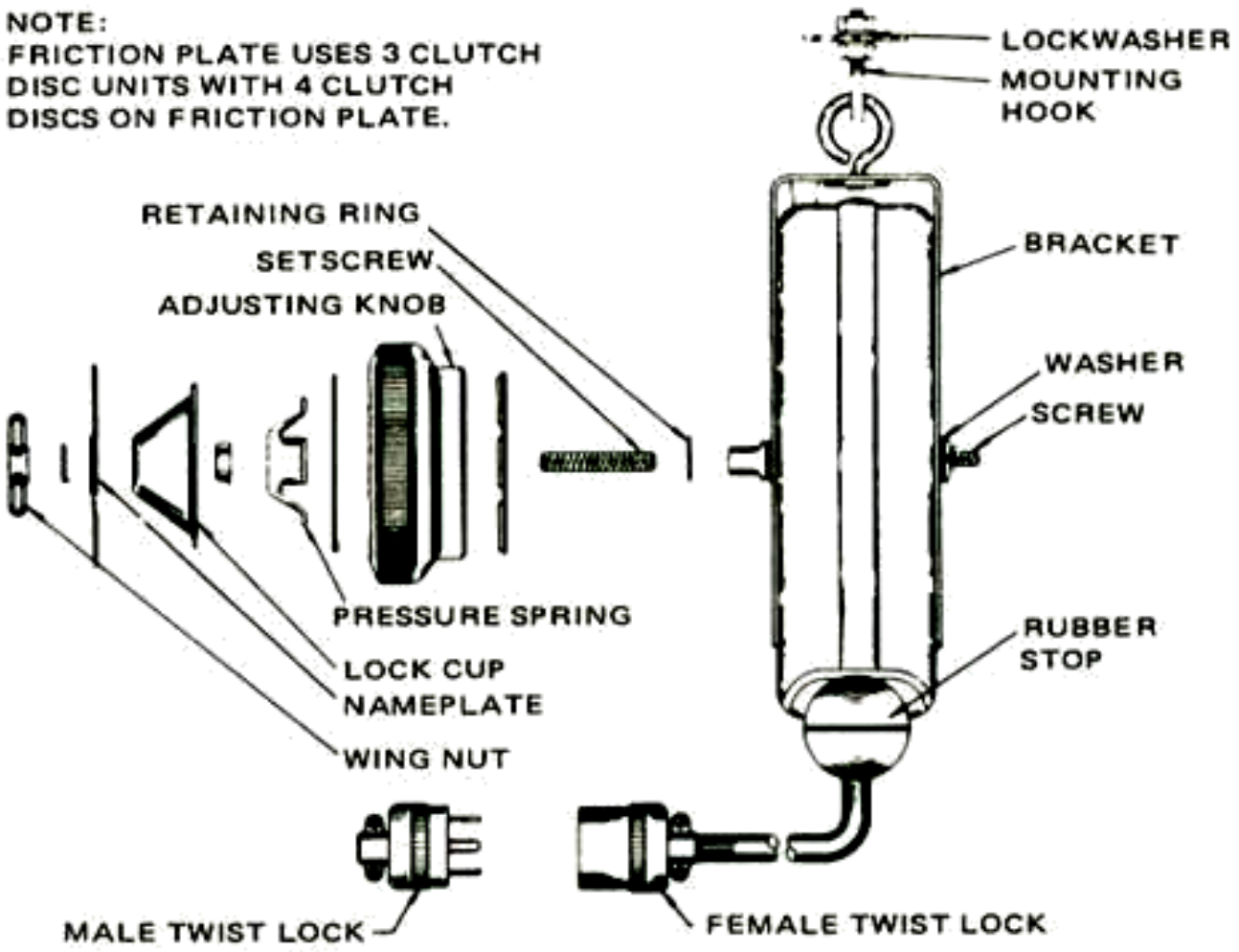


Finished product



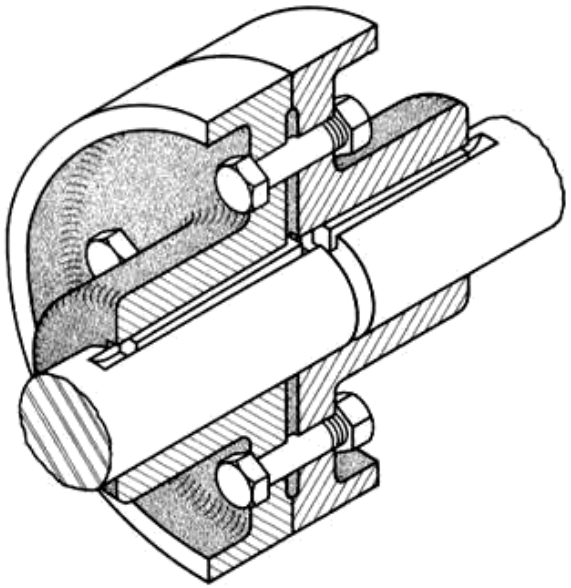
1. EXPLODED ASSEMBLY

Orthographic representation

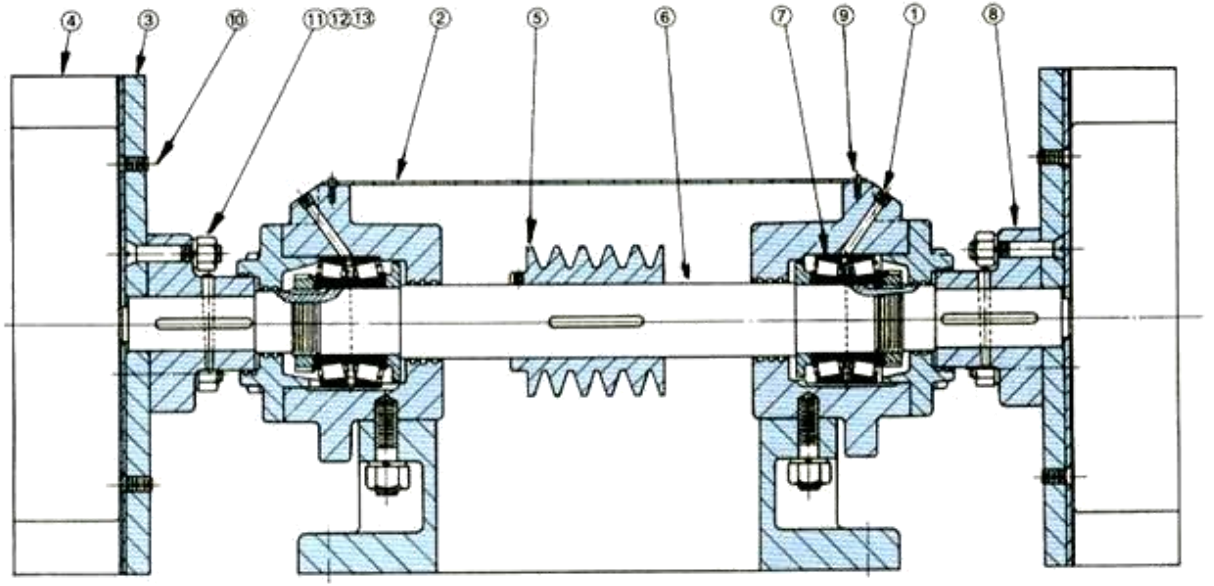


2. GENERAL ASSEMBLY

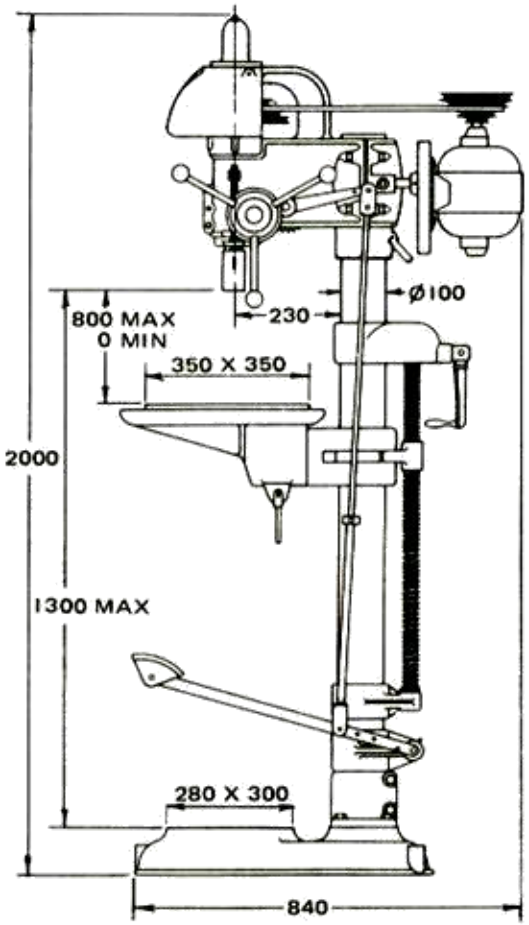
Pictorial



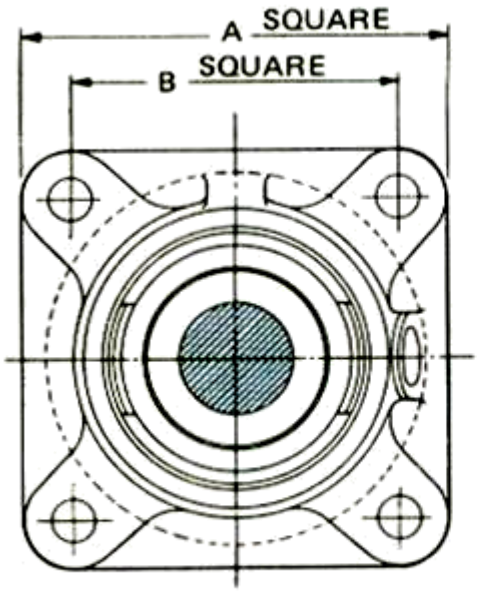
Orthographic

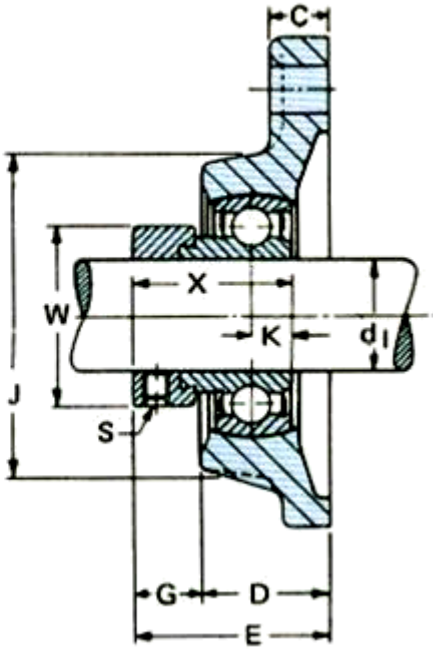


2. GENERAL ASSEMBLY



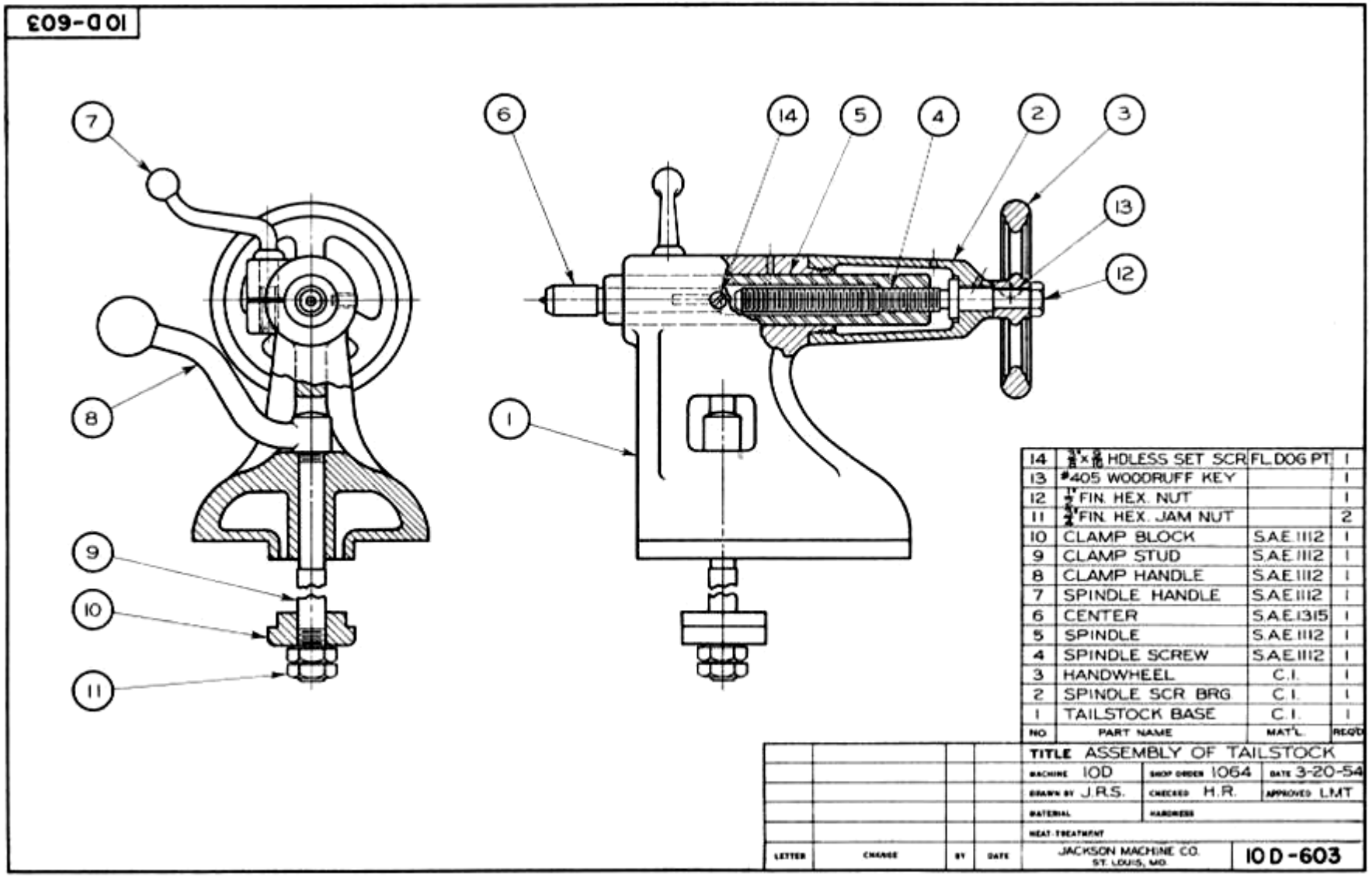
Only dimensions relate to machine's operation are given.





Only dimensions relate to machine's operation are given in tabulated form (not shown).

2. GENERAL ASSEMBLY



NO	PART NAME	MAT'L.	REQ'D
14	3/8 x 5/16 HDLESS SET SCR. FL. DOG PT.		1
13	#405 WOODRUFF KEY		1
12	1" FIN. HEX. NUT		1
11	3/4" FIN. HEX. JAM NUT		2
10	CLAMP BLOCK	S.A.E. 1112	1
9	CLAMP STUD	S.A.E. 1112	1
8	CLAMP HANDLE	S.A.E. 1112	1
7	SPINDLE HANDLE	S.A.E. 1112	1
6	CENTER	S.A.E. 1315	1
5	SPINDLE	S.A.E. 1112	1
4	SPINDLE SCREW	S.A.E. 1112	1
3	HANDWHEEL	C.I.	1
2	SPINDLE SCR. BRG.	C.I.	1
1	TAILSTOCK BASE	C.I.	1

TITLE ASSEMBLY OF TAILSTOCK

MACHINE 10D | SHOP ORDER 1064 | DATE 3-20-54

DRAWN BY J.R.S. | CHECKED H.R. | APPROVED L.M.T

MATERIAL | HARDNESS

HEAT TREATMENT

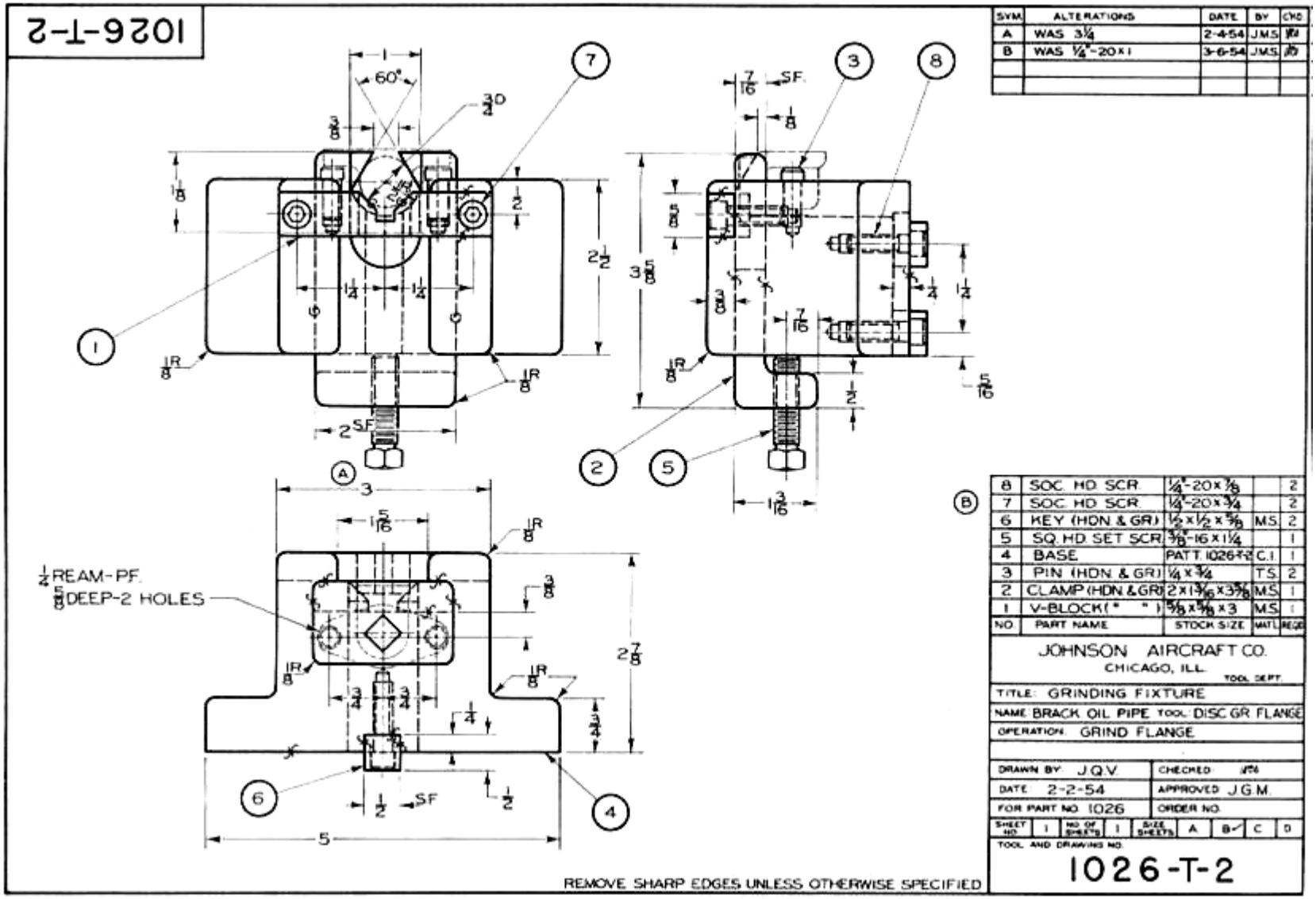
LETTER	CHANGE	BY	DATE

JACKSON MACHINE CO. ST. LOUIS, MO.

10D-603

3. DETAILED ASSEMBLY

(working-drawing assembly)



REQUIRED INFORMATION IN GENERAL ASSEMBLY DRAWING

1. All parts, drawn in their operating position.

2. Part list (or bill of materials, BOM)

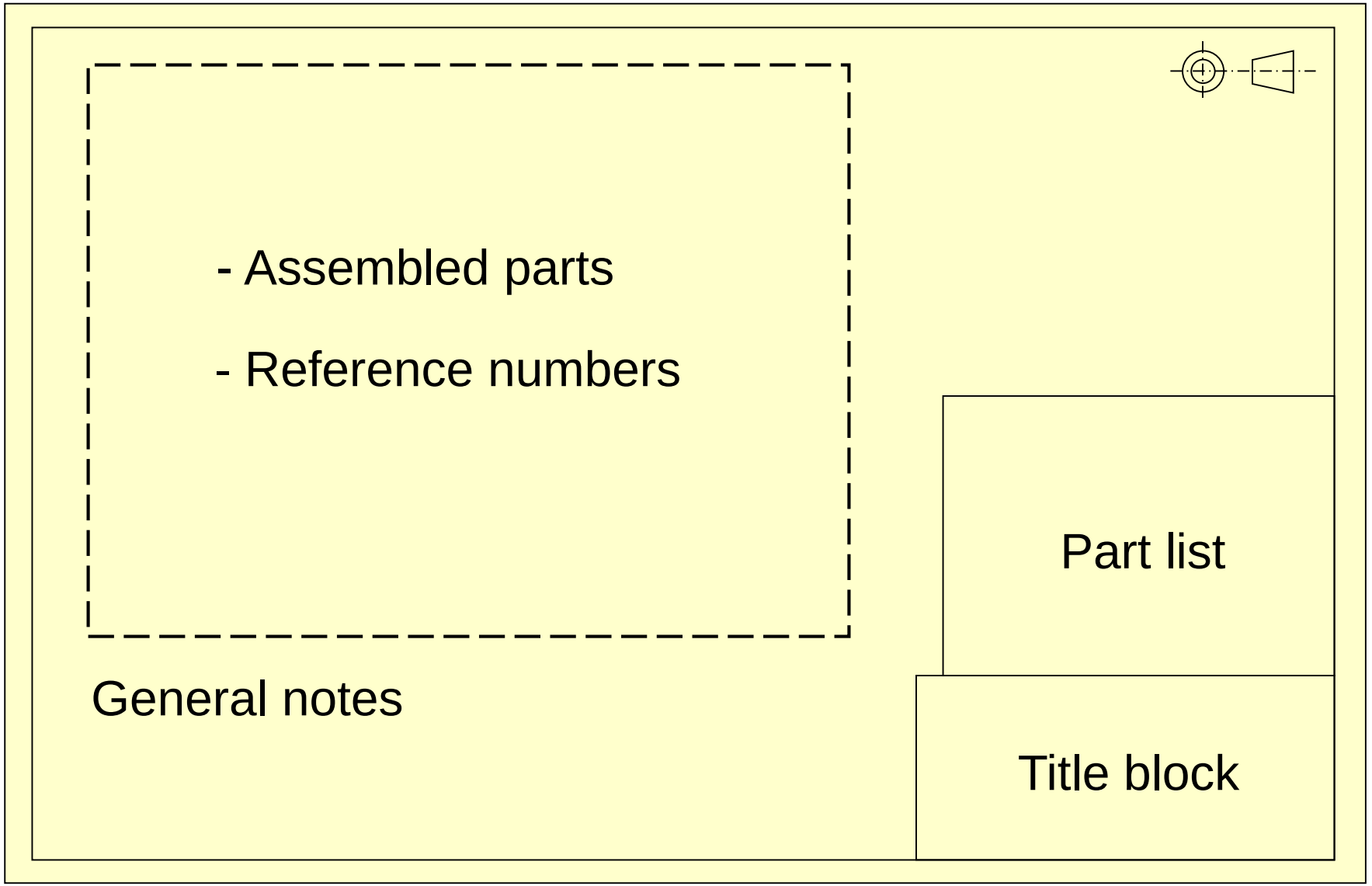
1. Item number
2. Descriptive name
3. Material, MATL.
4. Quantity required (per a unit of machine), QTY.

3. Leader lines with **balloons** around **part numbers.**

4. Machining and **assembly operations** and **critical dimensions** related to operation of the machine.

PLACING AN INFORMATION

(This course)



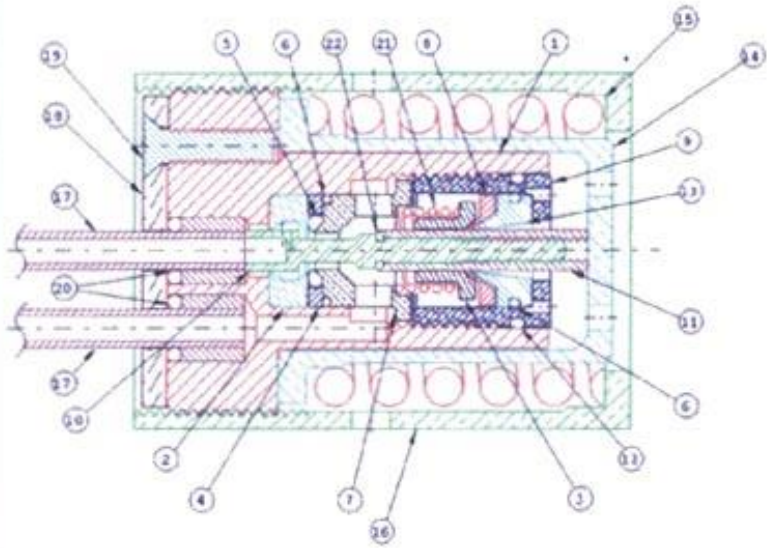
PART LIST (BOM) (This course)

- Locate above or beside the title block.

  Fill the table from the bottom.

NO.	PART NAME	REQD.	MATL. & NOTE
3	SET SCREW	1	Stainless Steel, M3 HEX SOCK CUP PT
2	SHAFT	1	Stainless Steel
1	SUPPORT	2	Cast Iron

EXAMPLE : Another allowable place for BOM



BILL OF MATERIAL

FIND NO.	PART NO.	DESCRIPTION/TITLE	NO. REQD	REMARKS
1	BE2001	BODY	1	
2	BE2002	SEPT SUPPORT	1	
3	BE2003	SEAL SUPPORT	1	
4	BE2004	SPACER RING	1	
5		O-RING .100 I.D. x .040 W	1	
6		O-RING .220 I.D. x .032 W	2	
7	BE2005	MANIFOLD	1	
8	BE2006	TEFLON SEAL	1	
9	BE2007	RETAINING NUT	1	
10	BE2008	POPPET STEM	1	
11	BE2009	POPPET SEALING SLEEVE	1	
12		O-RING .055 I.D. x .032 W	1	
13	BE2010	SEAL SUPPORT	1	
14	BE2011	CAGE 1	1	
15		SPRING	1	
16	BE2012	CAGE 2	1	
17	BE2013	PORT TUBE	2	
18	BE2014	CLAMPING DISC	1	
19		HOLD DOWN SCREW	3	
20		O-RING .087 I.D. x .039 W	2	
21		ENERGIZER SPRING	1	
22		O-RING	1	

STONE ENGINEERING COMPANY
A DIVISION OF THE BAAS CORPORATION
935 MADISON ST., SUITE 2C HUNTSVILLE, AL. 35801

DRAWN BY: TLR
DATE: 09/21/93
SCALE: 5:1
APP. BY:
TOLERANCES:
TITLE: HYDRAZINE REGULATOR ASSEMBLY
DRAWING NO. BE1001

STEPS TO CREATE ASSEMBLY DRAWING

1. ***Analyze*** geometry and dimensions of all parts in order to understand the *assembly steps* and overall shape of device or machine.
2. Select an appropriate view.
3. ***Choose major parts***, i.e. parts that have several parts assembled on.
4. Draw a view of ***major parts*** according to a selected viewing direction.

STEPS TO CREATE ASSEMBLY DRAWING

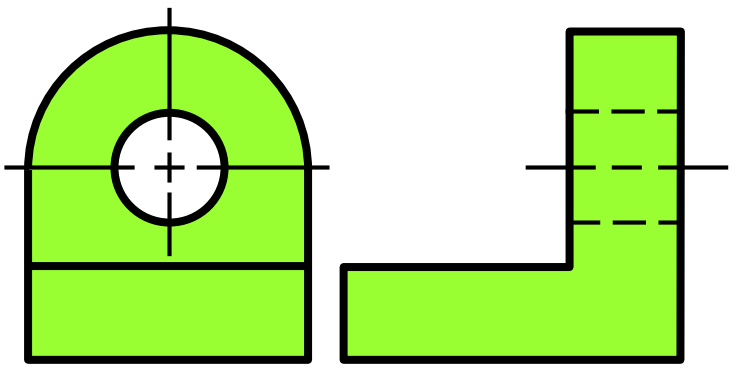
5. Add detail view of the remaining parts at their working positions.
6. Apply ***section technique*** where relative positions between adjacent parts are needed to clarify.
7. Add ***balloons***, ***notes*** and ***dimensions*** (if any).
8. Create BOM.

GENERAL PRACTICE

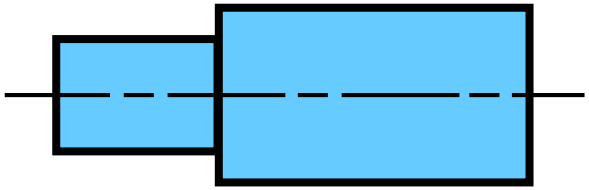
- The ***number of views*** can be one, two, three or more as needed, but it should be **minimum**.
- A good ***viewing direction*** is that represents all (or most) of the parts assembled in their working position.

EXAMPLE : Selection of a necessary view

Given

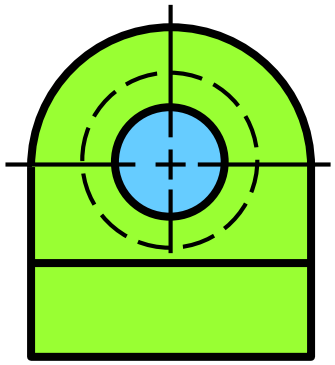


Part A

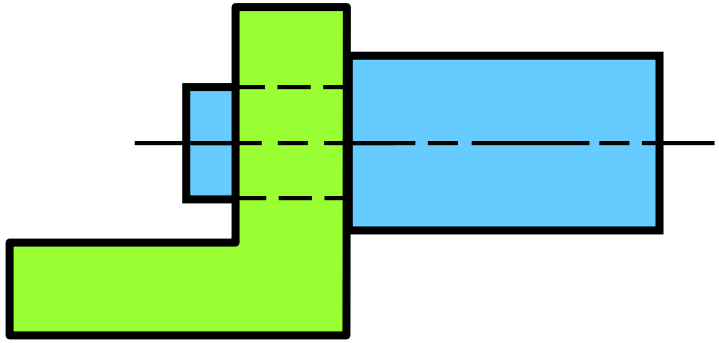


Part B

Student A



Student B

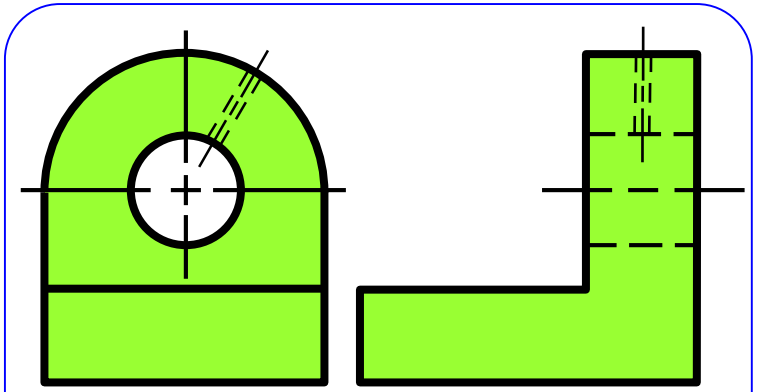


Which is an appropriate view for assembly drawing ?

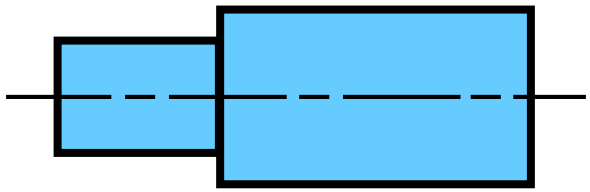
GENERAL PRACTICE

- ***Hidden lines*** usually **omit** unless they are absolutely necessary to illustrate some important feature that the reader might otherwise miss.

EXAMPLE : Hidden lines omit ***or not*** ?

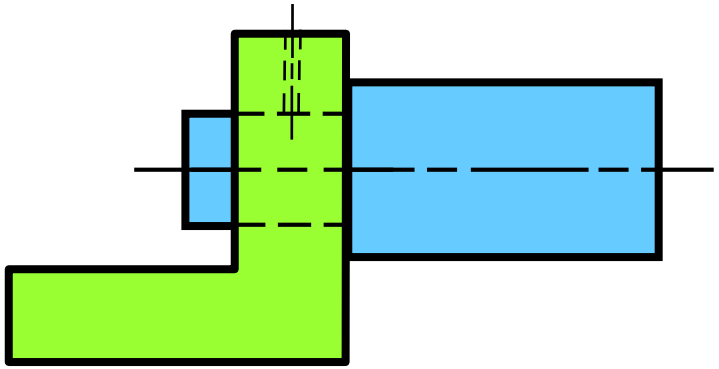


Part A

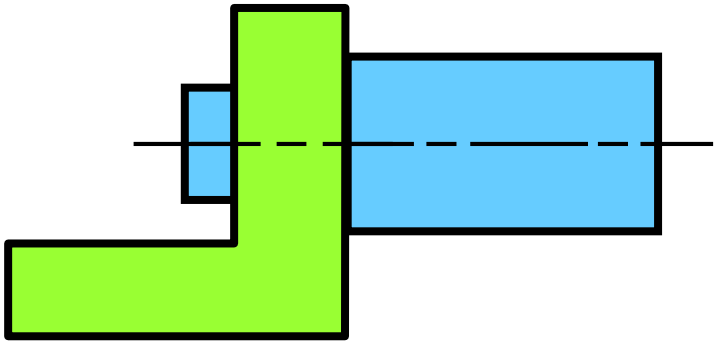


Part B

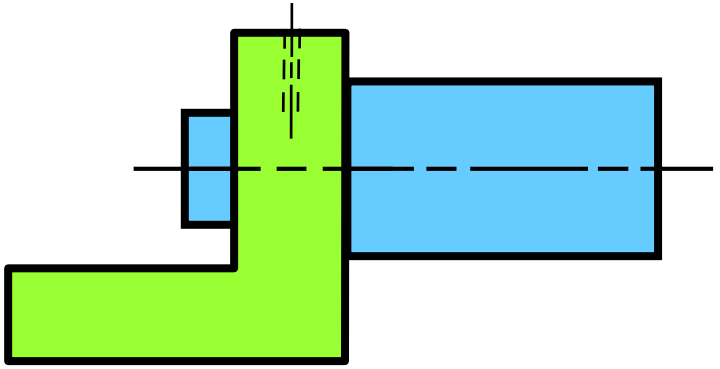
A



B



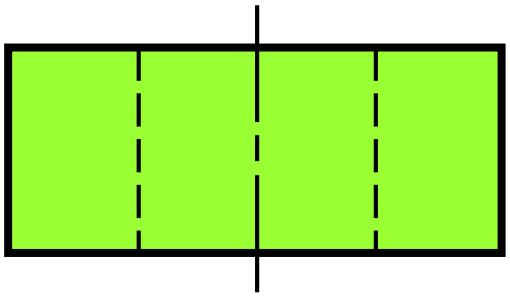
C



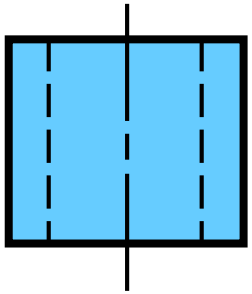
Good

Poor

EXAMPLE : Hidden lines omit ***or not*** ?

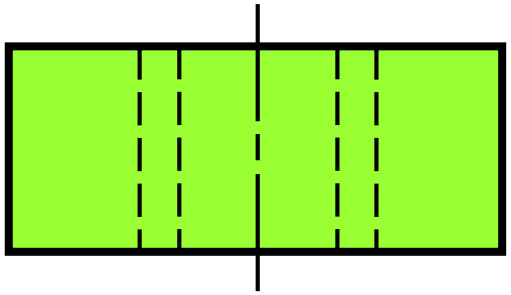


Part A

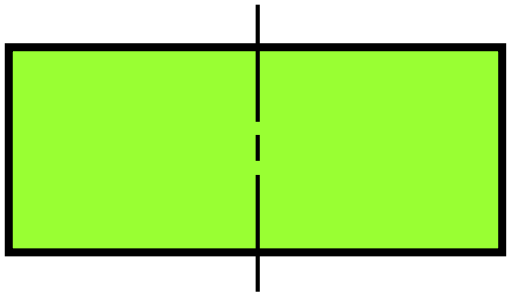


Part B

A



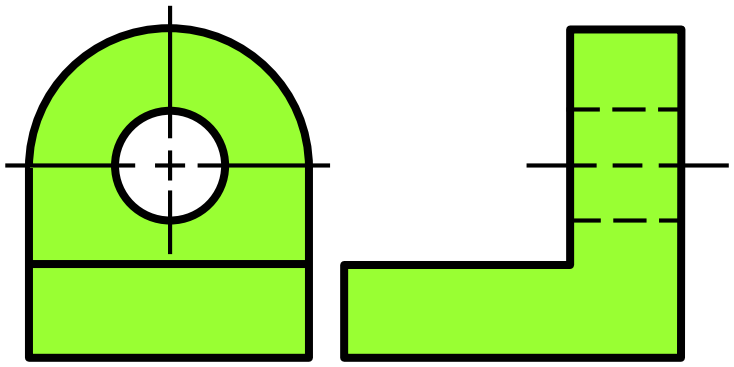
B



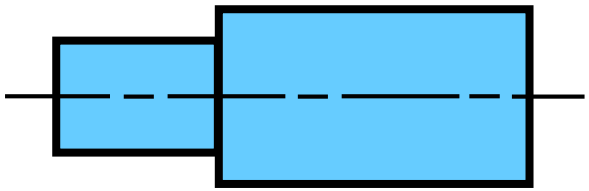
Good

Poor

EXAMPLE : Hidden lines omit ***or not*** ?

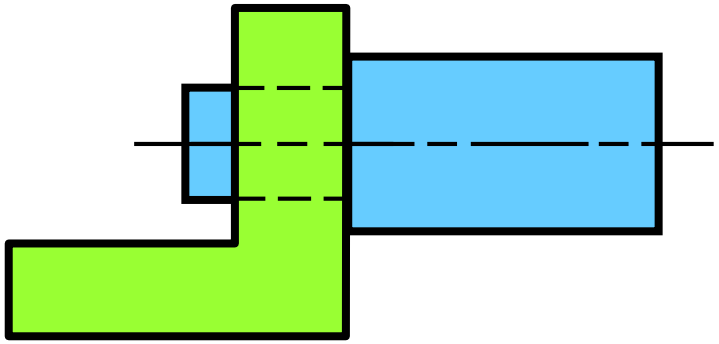


Part A

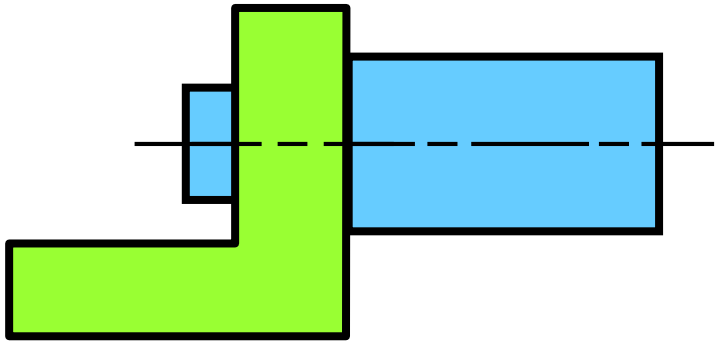


Part B

A



B

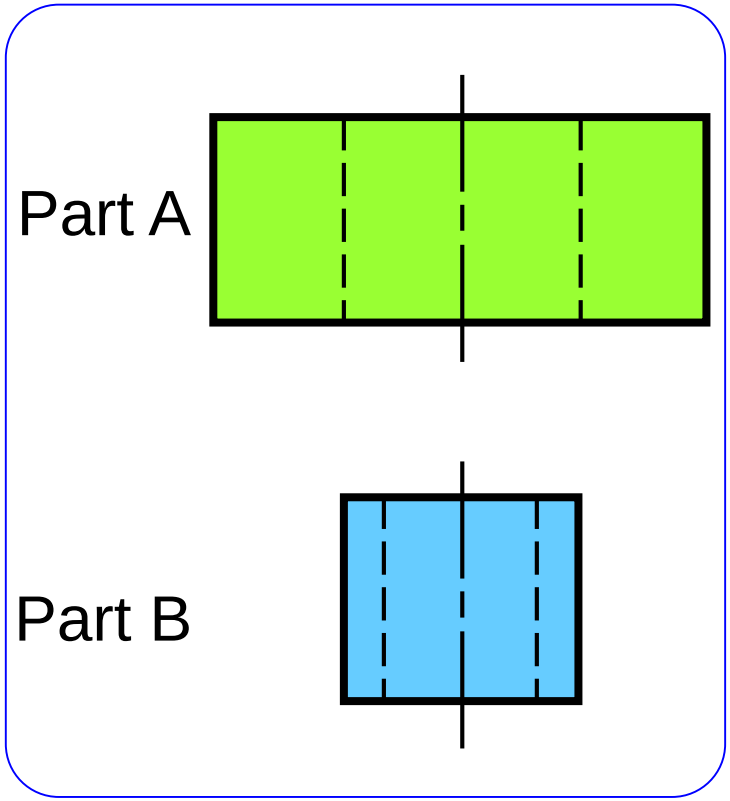


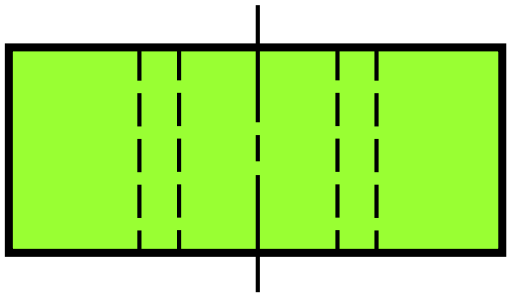
Good

Poor

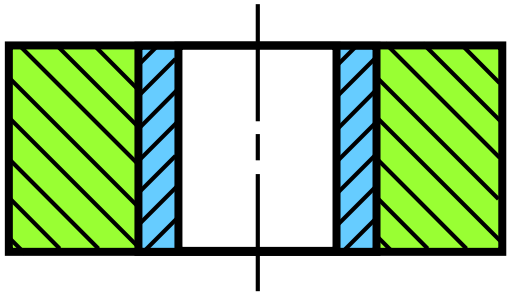
GENERAL PRACTICE

- ***Section technique*** is usually need to clarify mating of the parts.
- Use ***different*** section line styles for adjacent parts.





Correct



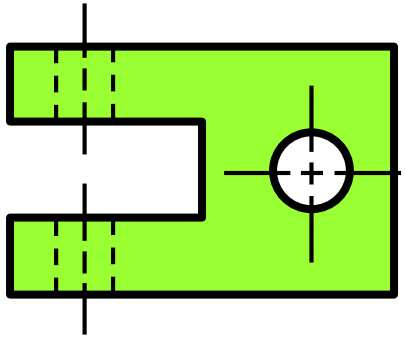
Better

Color *OFF* *ON*

SECTION LINE PRACTICE

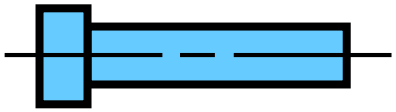
- ***Do not*** draw section lines on sectional view of standard parts.
  - Threaded fastener
  - Washer
  - (longitudinal cut of) Solid shaft, Pin, Key

EXAMPLE 1 : Assembly steps

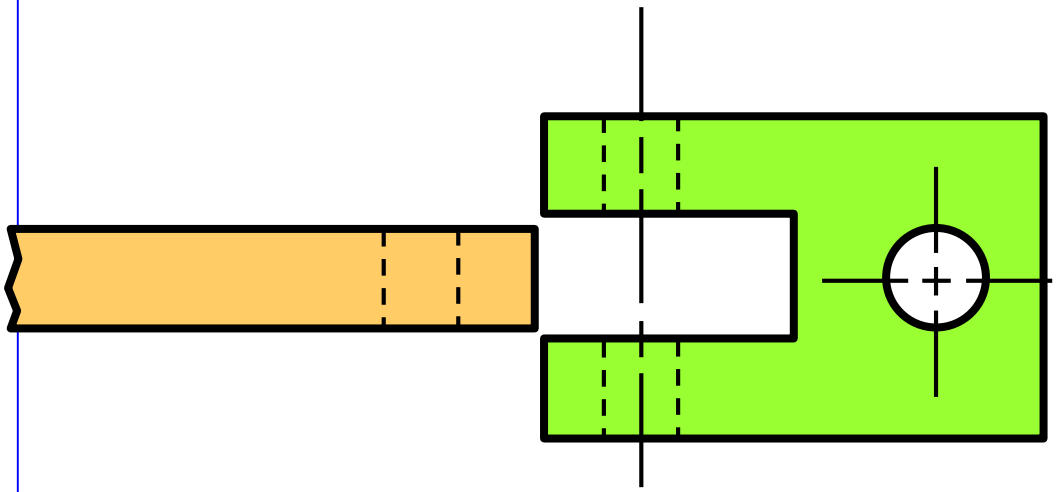


① CLEVIS, Steel, 1 REQD.

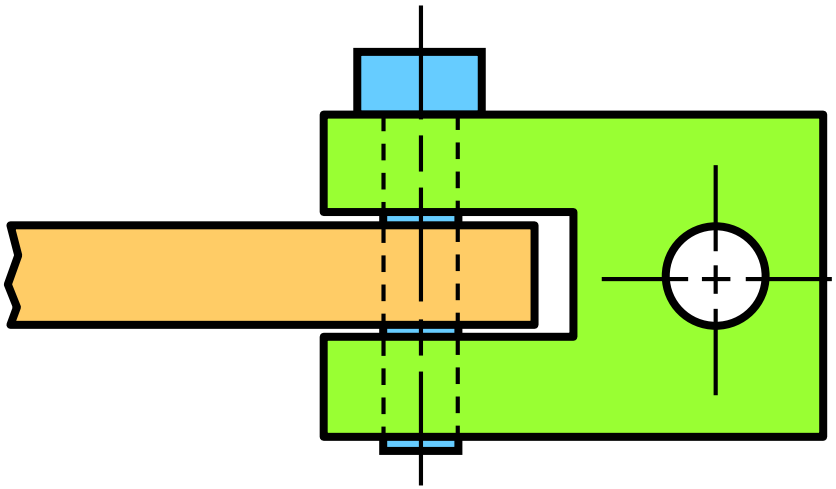
② ARM, Steel, 1 REQD.



③ PIN, Steel, 1 REQD.

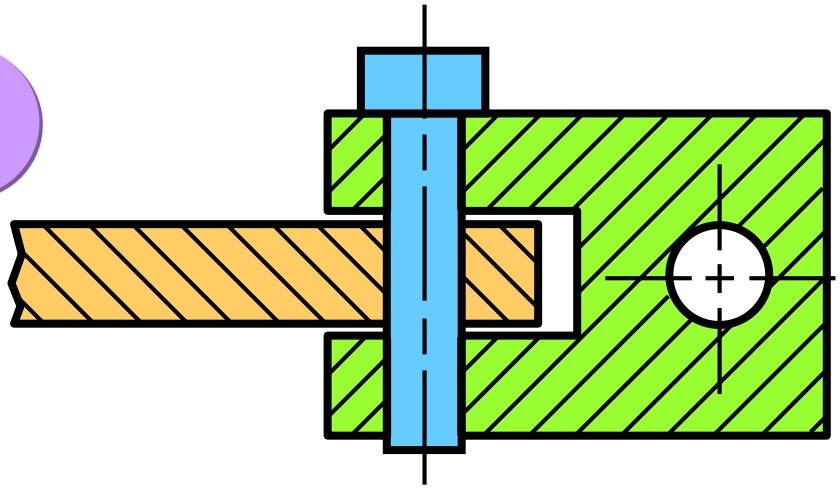


EXAMPLE : Section line practice

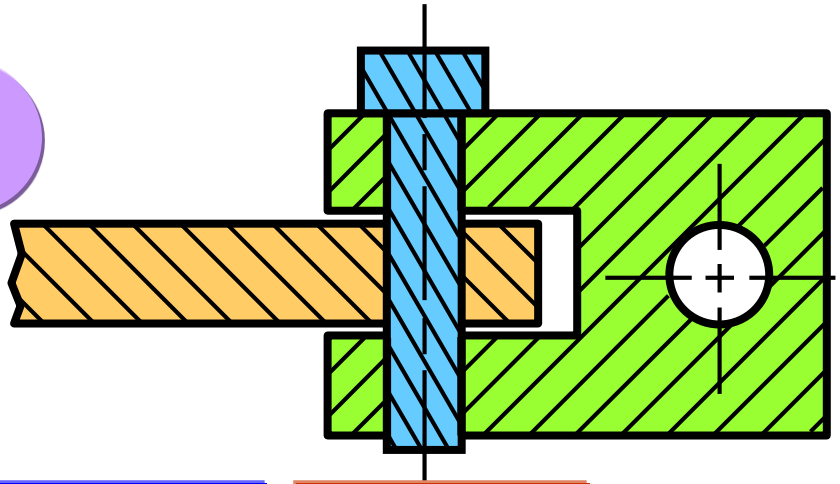


Which is an appropriate full section view of this assembly ?

A



B



Good

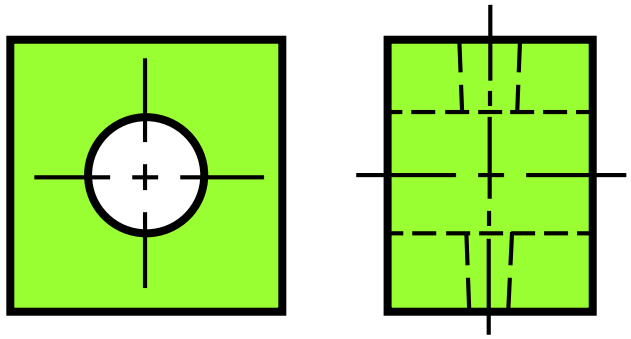
Poor

Color

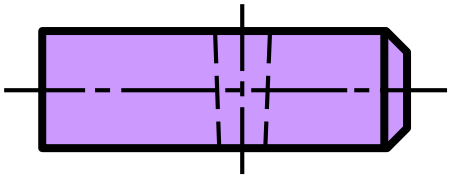
OFF

ON

EXAMPLE 2 : Assembly steps

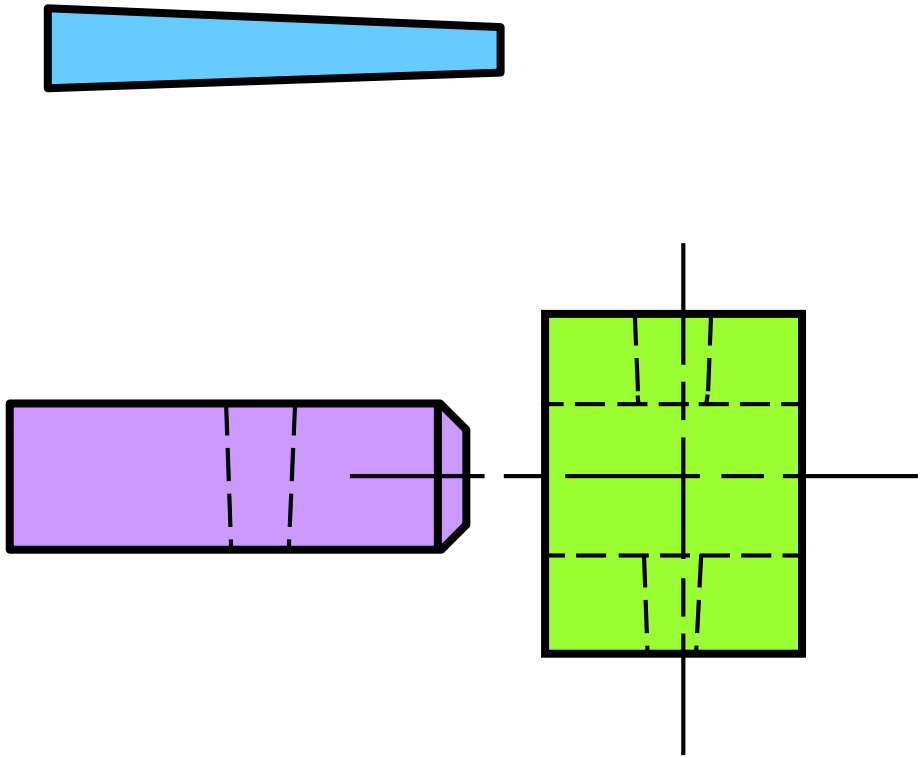


① SUPPORT, Steel, 1 REQD.

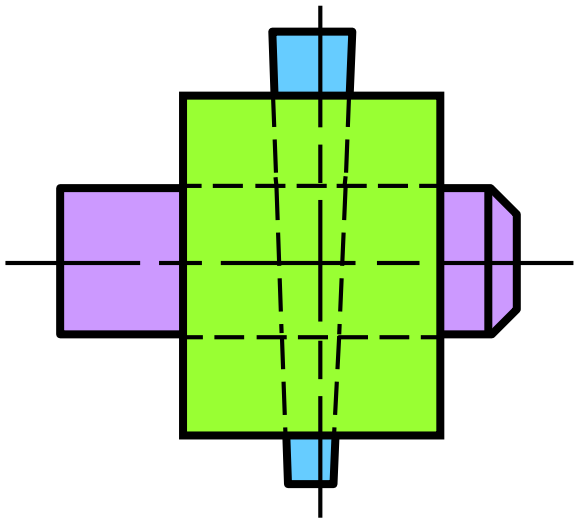


② SHAFT, Steel, 1 REQD.

③ TAPER PIN, Steel, 1 REQD.

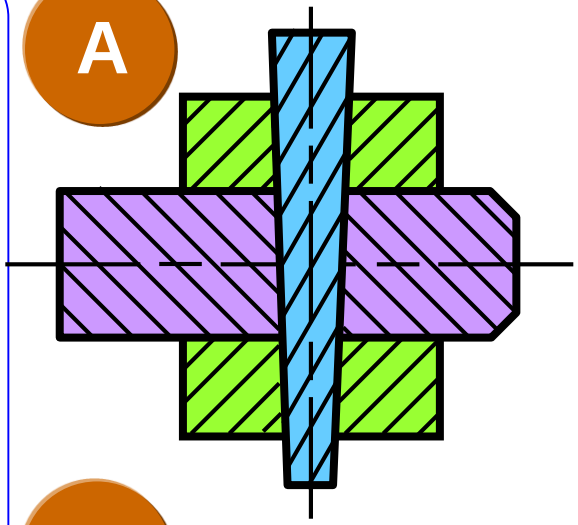


EXAMPLE : Section line practice

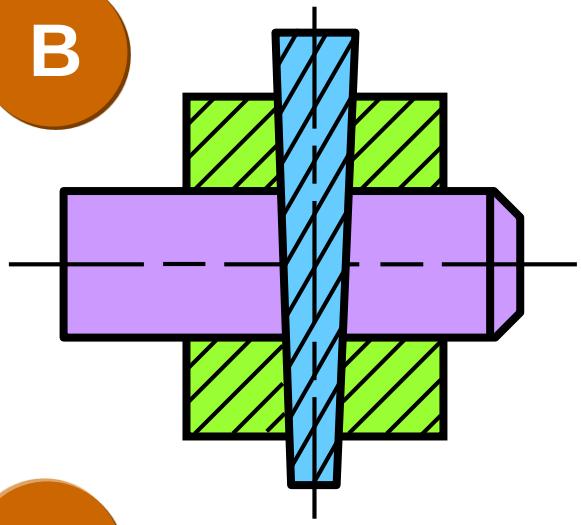


Which is an appropriate full section view of this assembly ?

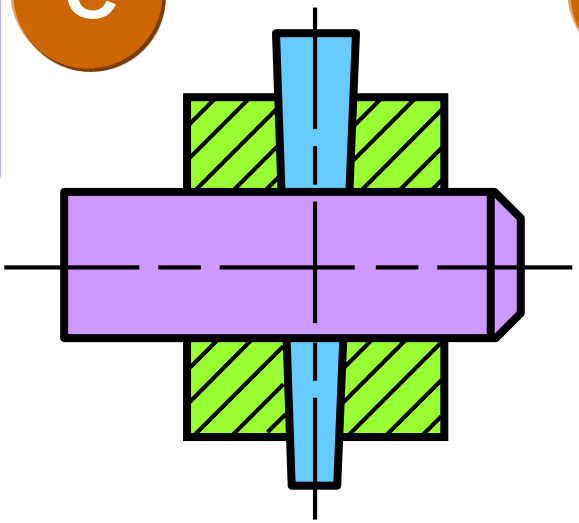
A



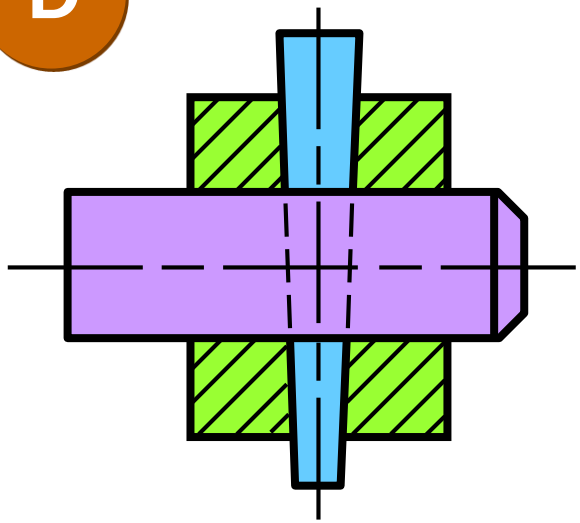
B



C



D

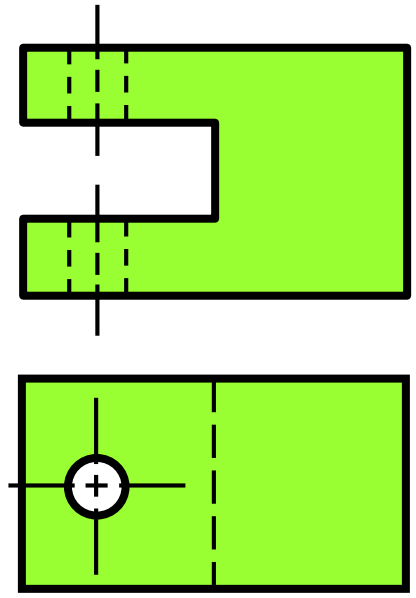


Good

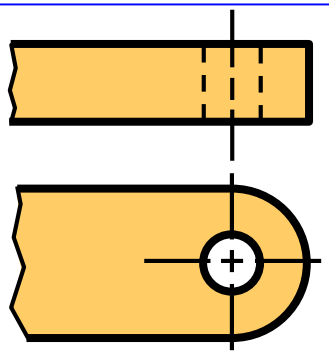
Poor

Color *OFF* *ON*

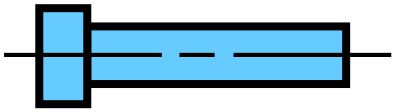
EXAMPLE 3 : Assembly steps



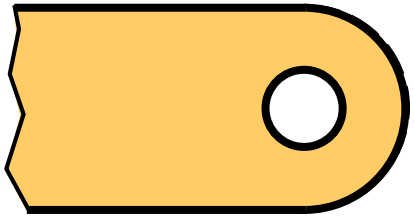
① CLEVIS, Steel, 1 REQD.

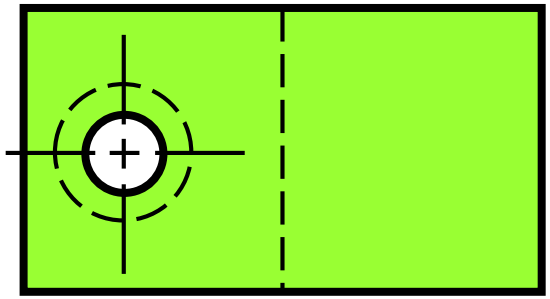


② ARM, Steel, 1 REQD.

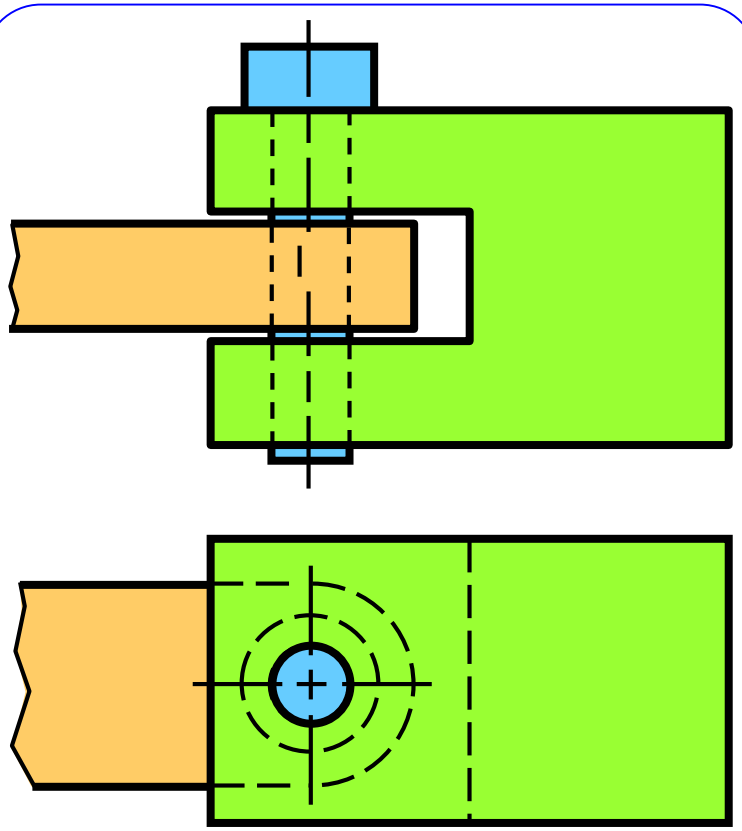


③ PIN, Steel, 1 REQD.

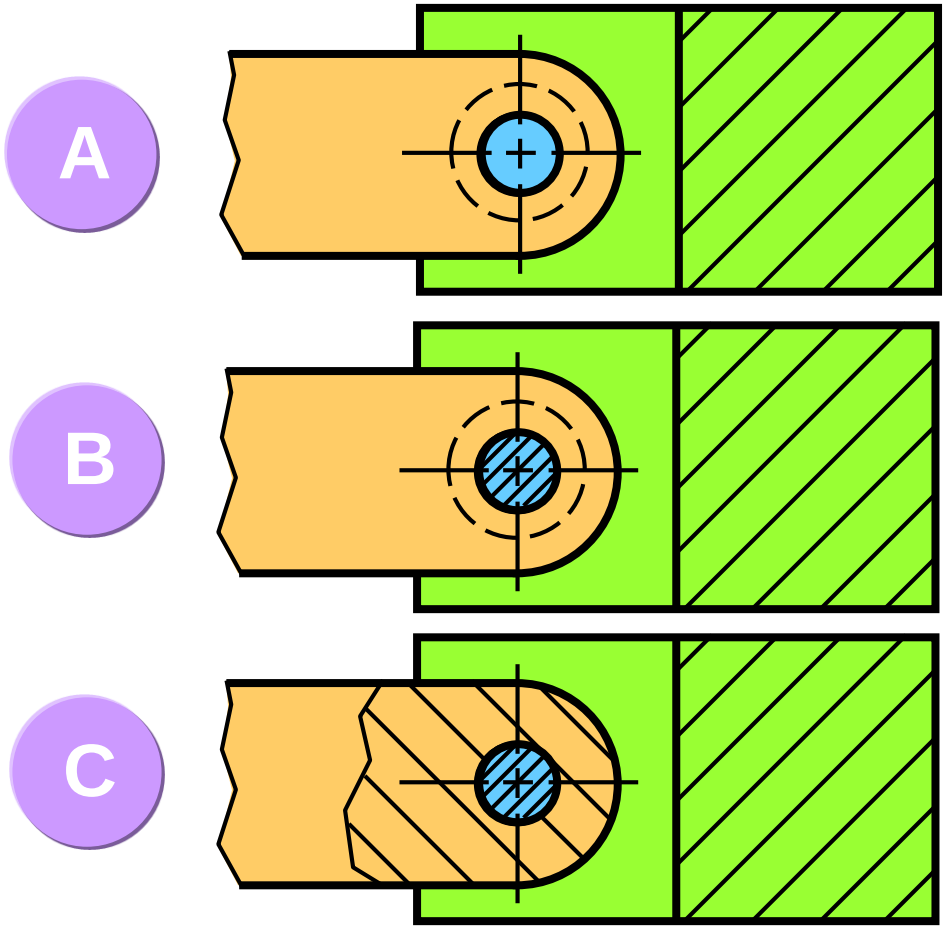




EXAMPLE : Section line practice



Which is an appropriate section view of the joint ?

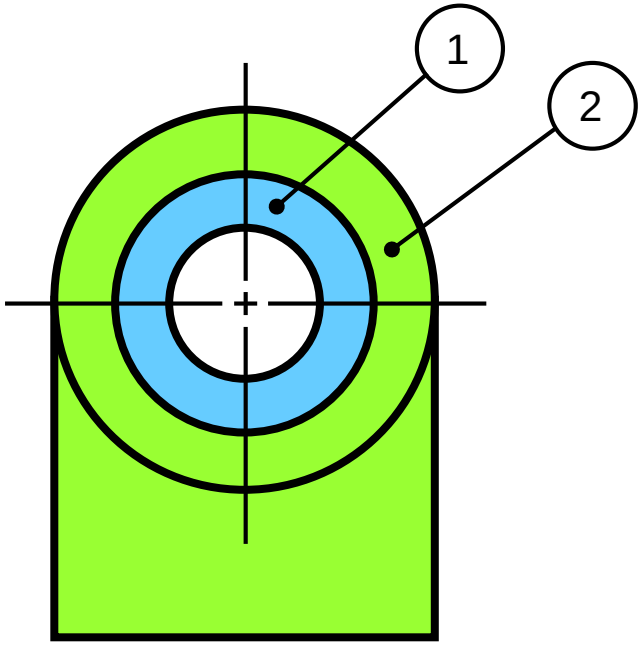


Good Poor

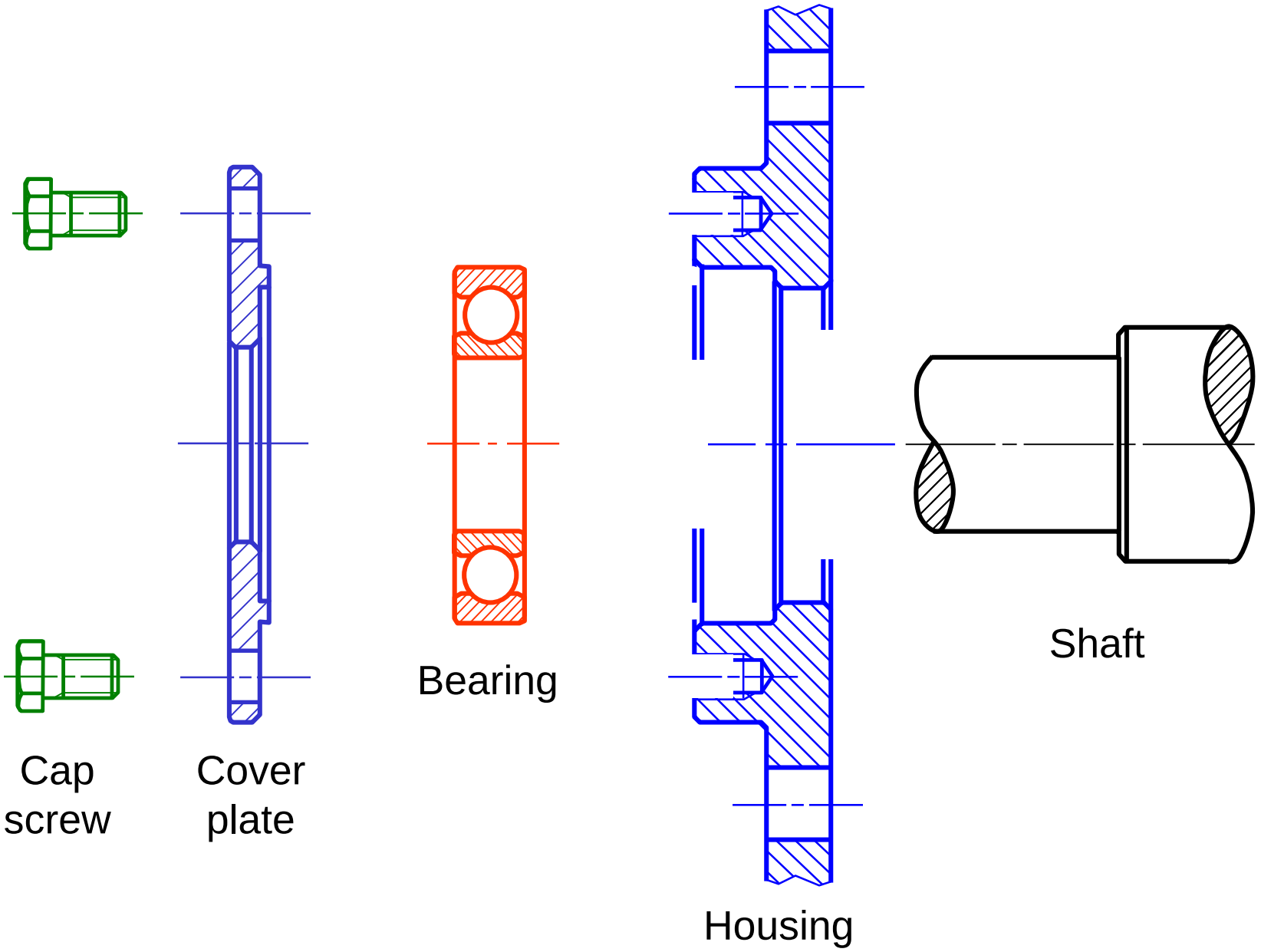
Color OFF ON

LEADER LINE PRACTICE

- Drawn from the inside of the part to the balloon and placed a filled circle at the beginning of a line.
- Drawn in the ***oblique*** direction.



EXAMPLE



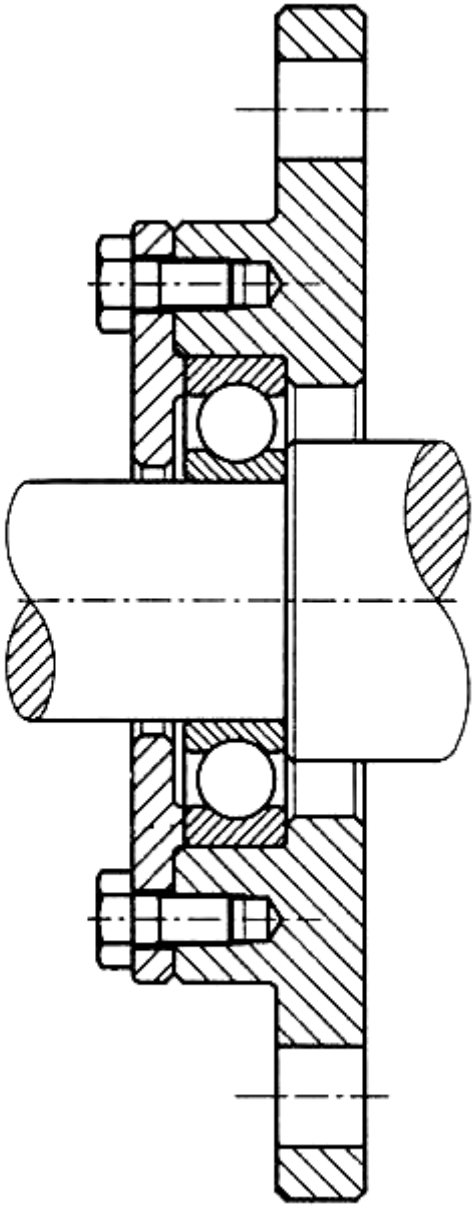
INTERPRETING ASSEMBLY DRAWING

1. Assemble steps.

2. Function of each part in machine.

3. Design concept.

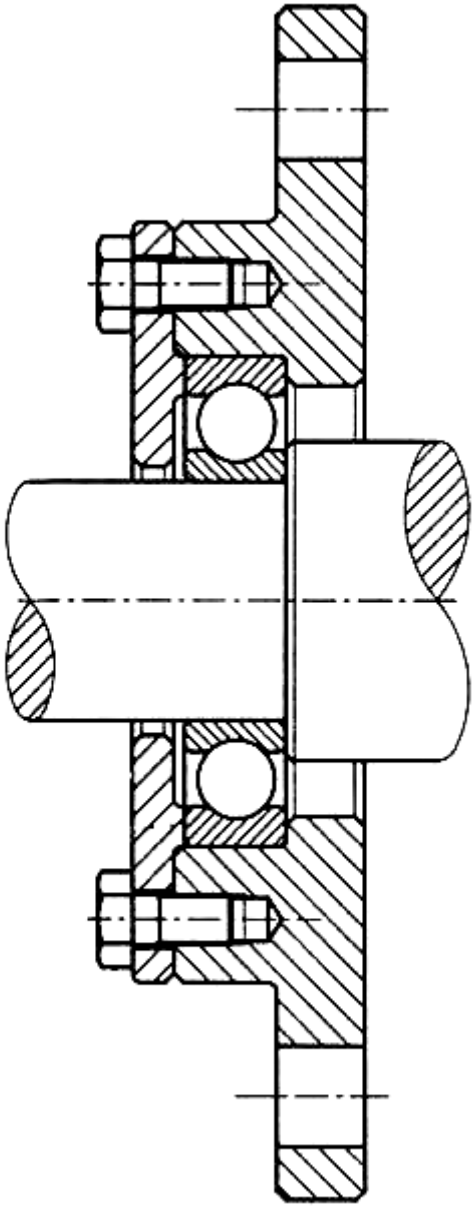
EXAMPLE 1 : *Shaft support on a machine housing*



Assemble steps

1. Install bearing to the shaft.
2. Install the bearing-shaft unit to the housing.
3. Install the cover plate.
4. Tighten the screw.

EXAMPLE 1 : *Shaft support on a machine housing*



Functions of main parts

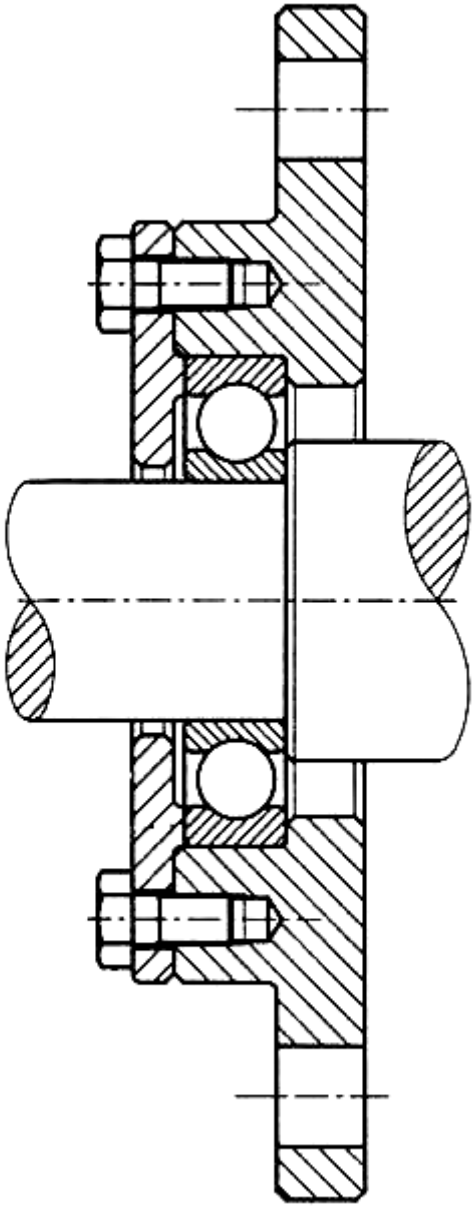
1. Bearing :

Support the rotating shaft.

2. Cover :

- Control an axial movement.
- Prevent the bearing unit from rotation.

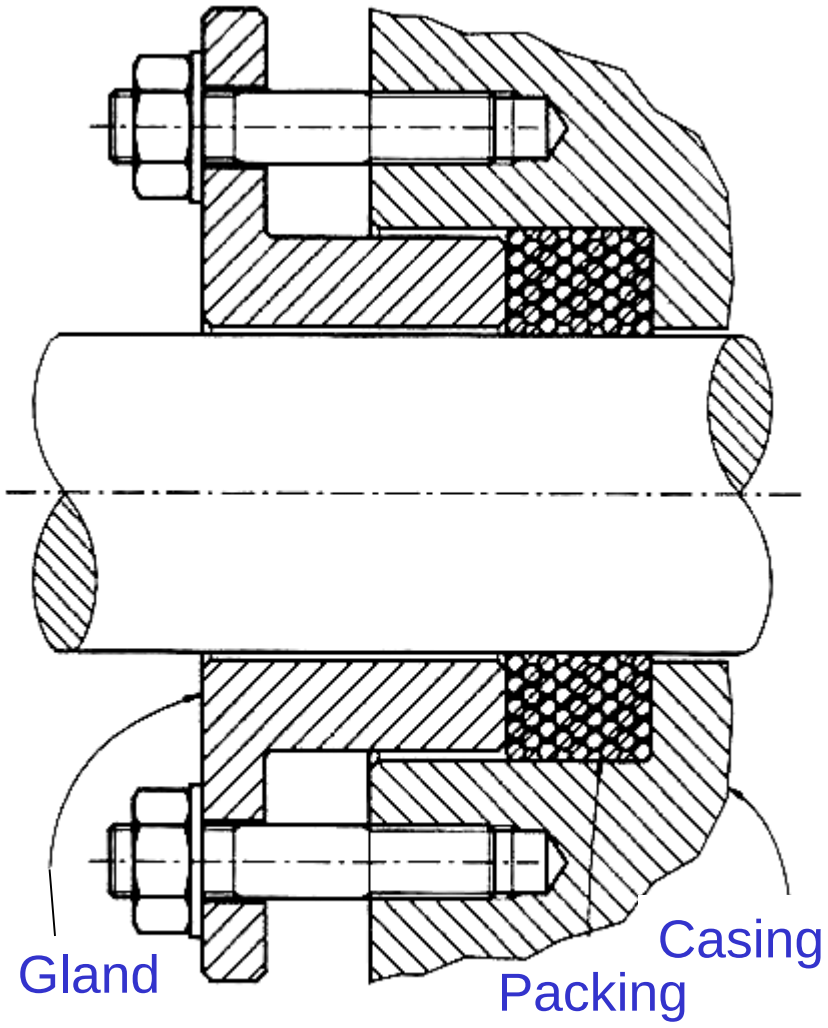
EXAMPLE 1 : *Shaft support on a machine housing*



Design concept

Avoid direct contact between rotating shaft and housing as well as cover plate by using a bearing and clearance holes.

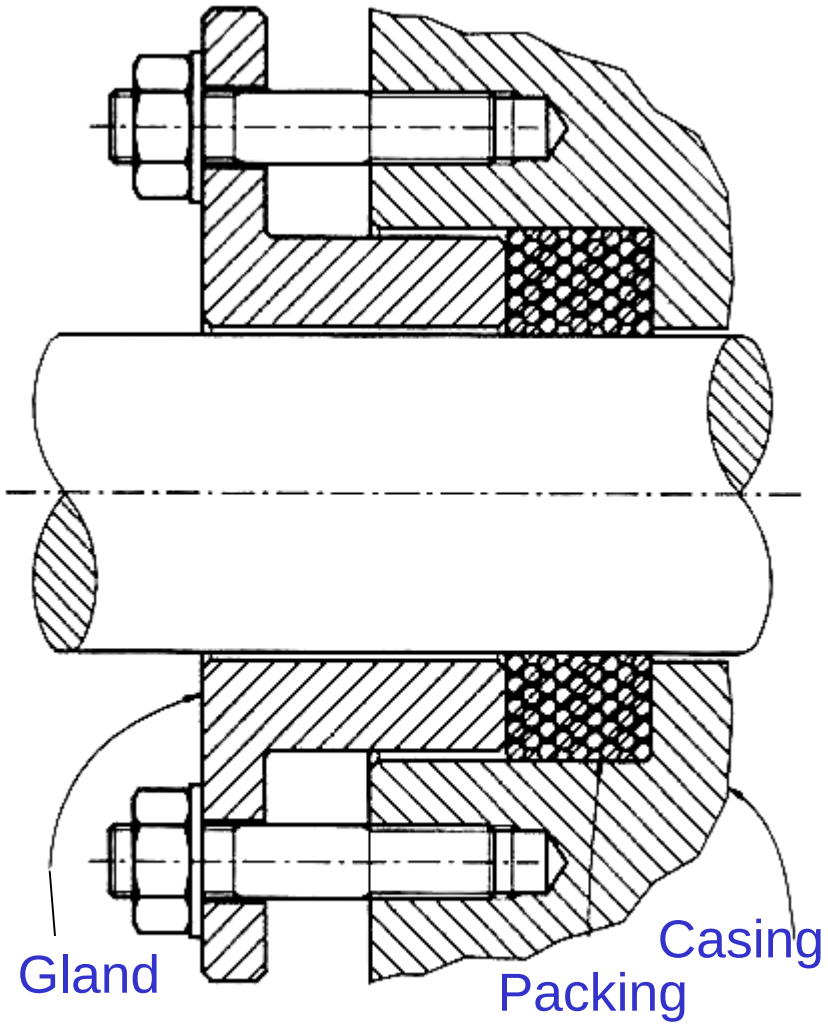
EXAMPLE 2 : Leakage prevention unit



Assemble steps

1. Wrap a packing to the shaft.
2. Install studs to the casing.
3. Install the gland ring where its holes align with stud.
4. Place the washer and tightening the nut.

EXAMPLE 2 : Leakage prevention unit



Function

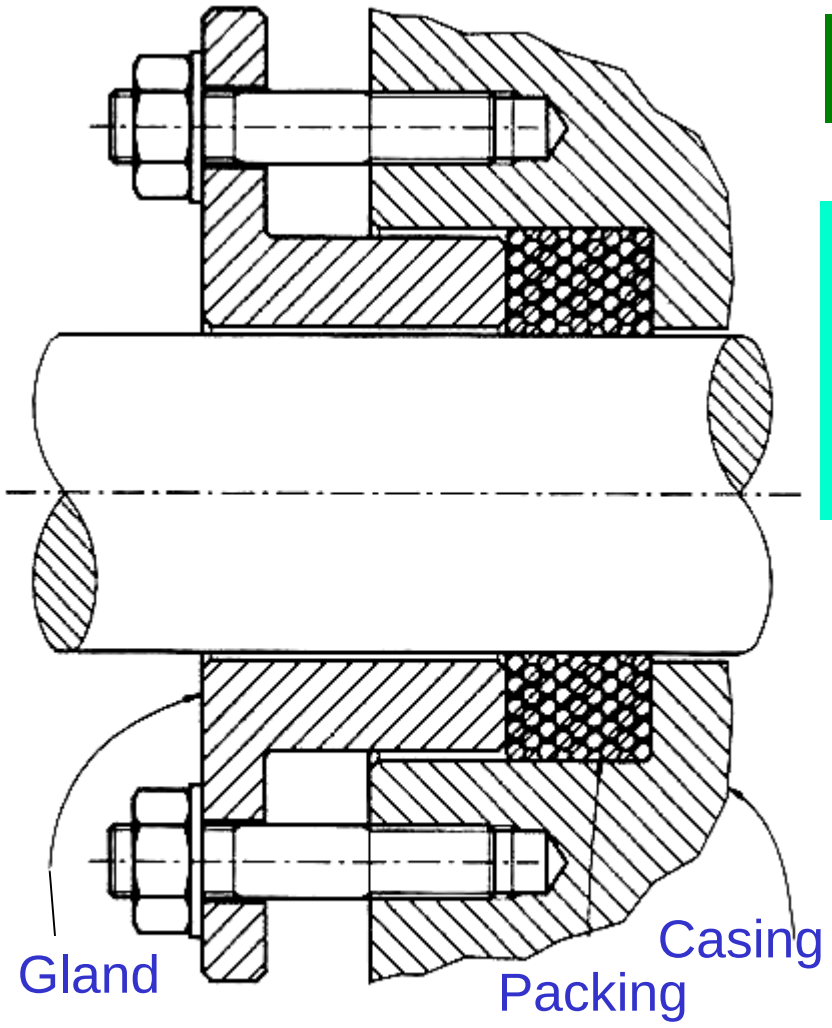
1. Packing :

- Preventing the leakage of a fluid inside the casing.

2. Gland :

- Press the packing to make it radial expand and press the shaft surface.

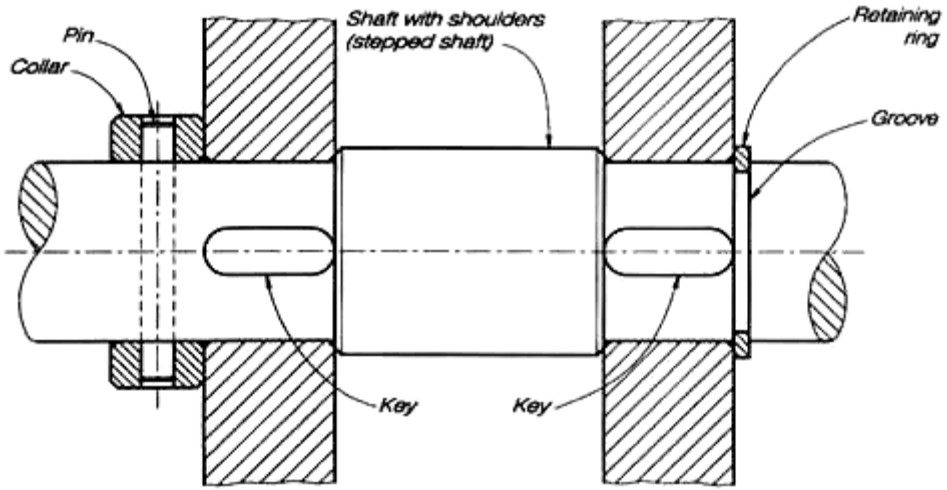
EXAMPLE 2 : Leakage prevention unit



Design concept

Avoid direct contact between rotating shaft and casing as well as gland ring’s hole.

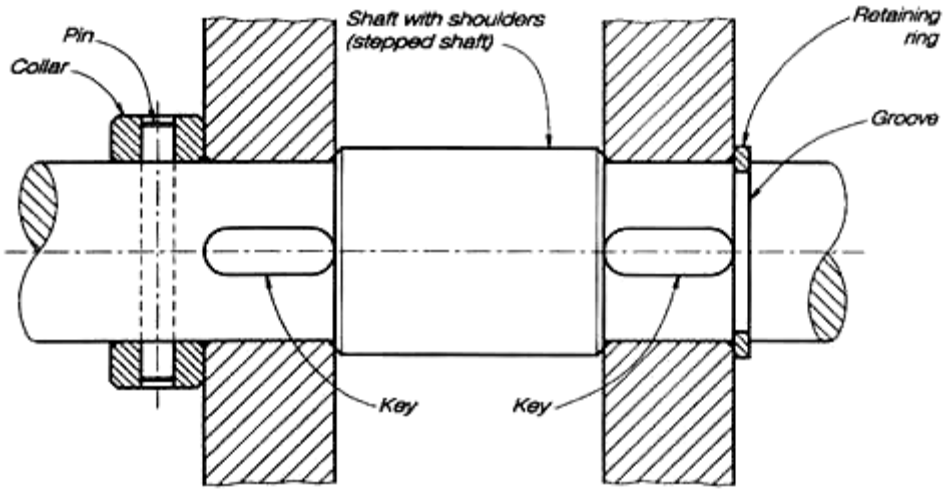
EXAMPLE 3 : Fixing parts on a shaft.



Assemble steps

1. Place the keys on the key seats.
2. Insert the parts to the shaft until their surfaces lean against the shoulder.
3. Insert collar and then pin or retaining ring into the groove.

EXAMPLE 3 : Fixing parts on a shaft.



Function

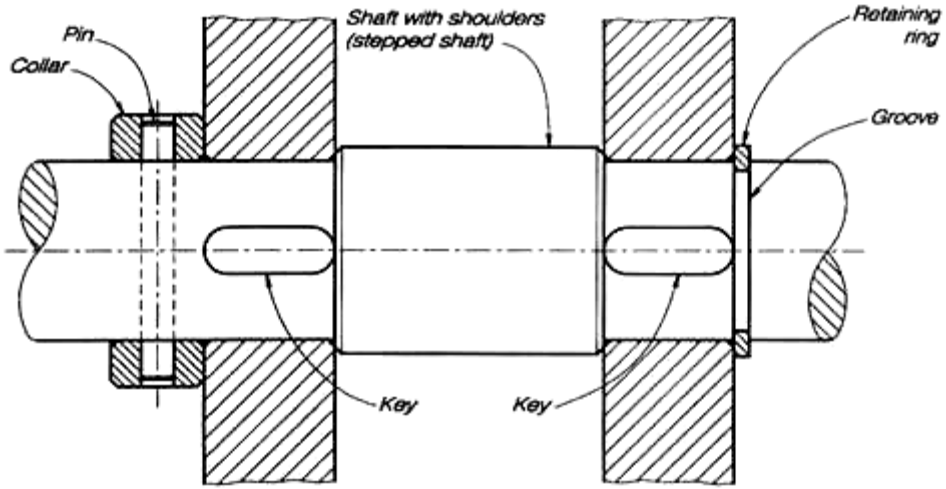
1. Key :

- Preventing rotational movement of parts.

2. Pin and ***retaining ring*** :

- Prevent axial movement of parts on the shaft.

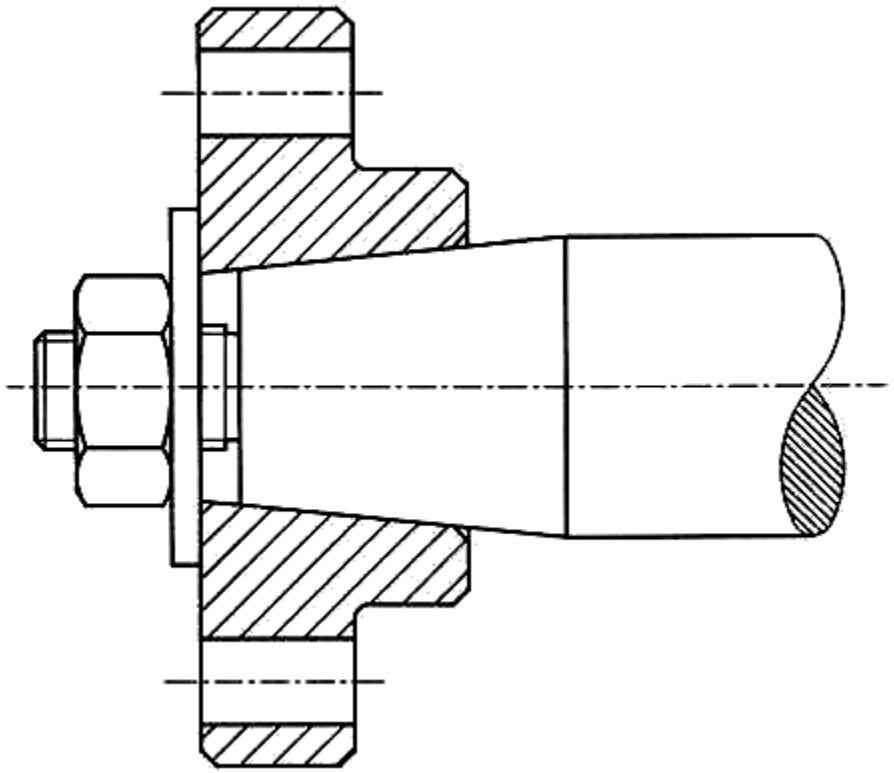
EXAMPLE : Fixing parts on a shaft.



Design concept

Retaining ring can resist lower axial force than collar & pin unit.

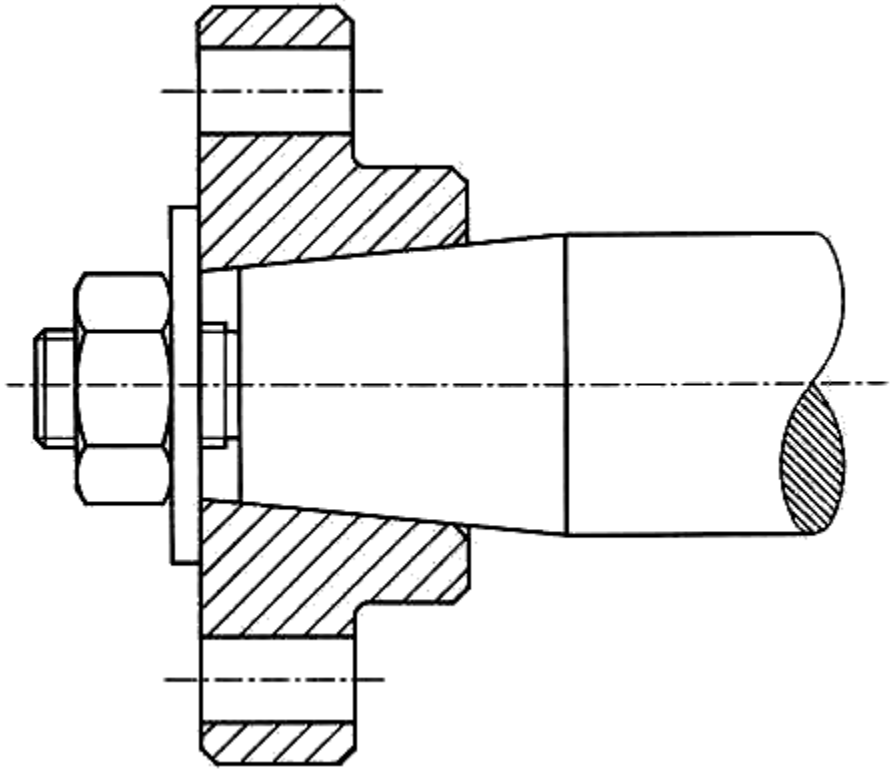
EXAMPLE : P*arts with tapered holes on tapered shaft.*



Assemble steps

1. Insert the part on the tapered end of the shaft.
2. Insert the washer (non-standard).
3. Tightening the nut.

EXAMPLE : P*arts with tapered holes on tapered shaft.*

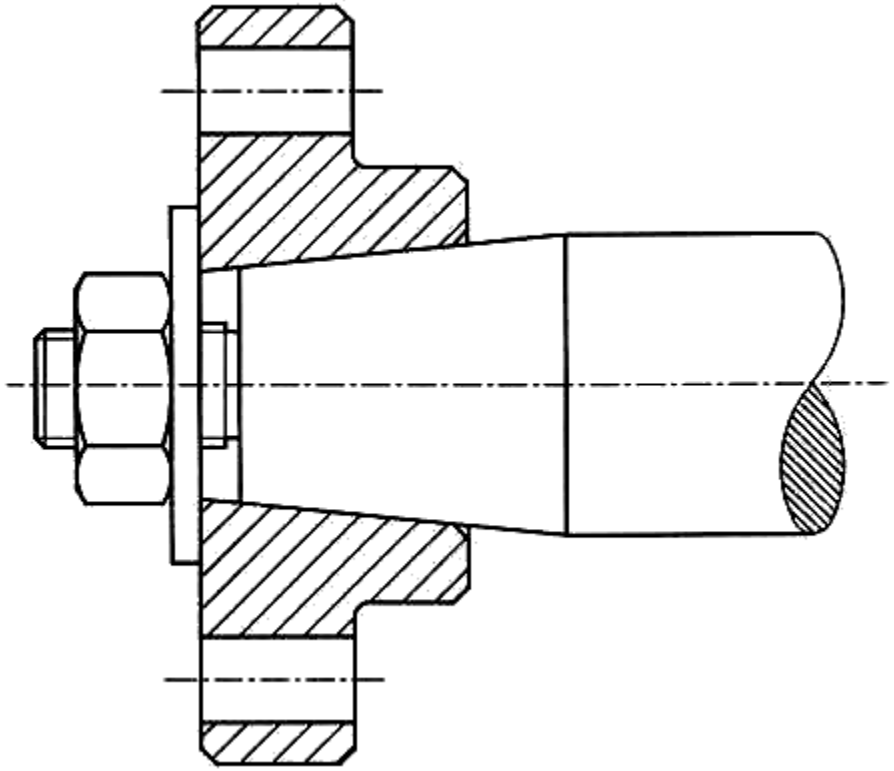


Function

1. Washer :

- Improve the distribution the tightening force on the part.

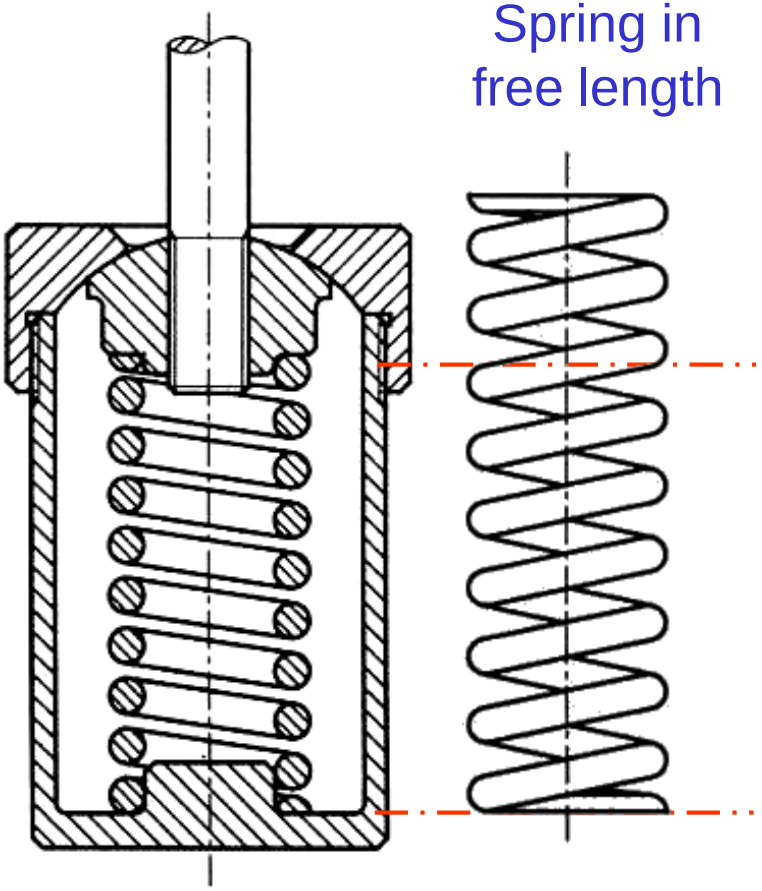
EXAMPLE : P*arts with tapered holes on tapered shaft.*



Design concept

Length of the tapered portion and depth of the tapered hole require a calculation.

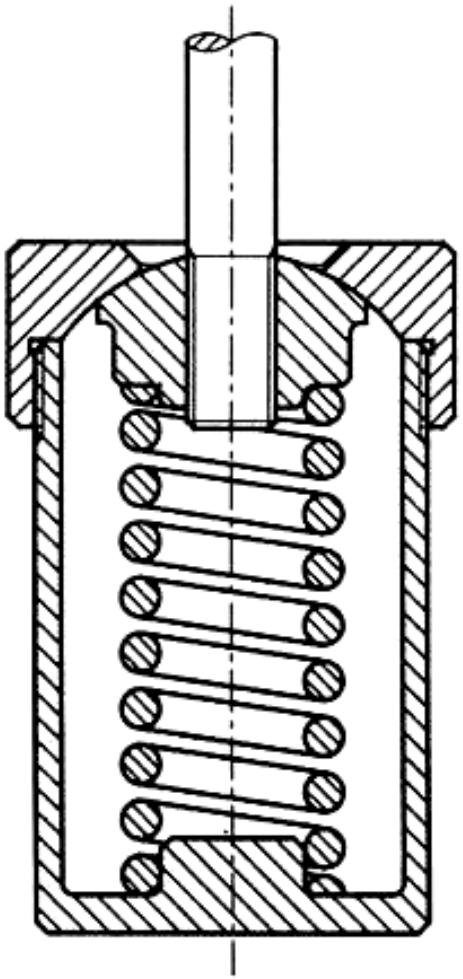
EXAMPLE : *Parts having preloaded spring*



Assemble steps

1. Insert the spring into the casing.
2. Tighten the rod to the spring loader.
3. Close the cap and tighten.

EXAMPLE : *Parts having preloaded spring*

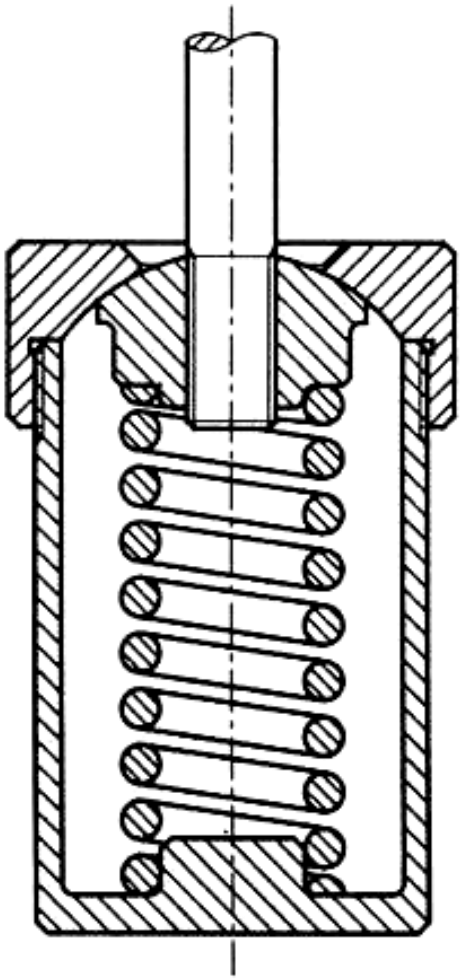


Function

1. Spring plunger :

- Transmit a force from rod to spring.
- Keep the spring in a position.

EXAMPLE : *Parts having preloaded spring*



Design concept

Spring plunger has a spherical surface contacts to the cap; therefore, the rod can align itself to original position.

Mating of Parts

POINTS TO CONSIDER

1. Surface finishing

2. Tolerance

   - Size

   - Geometry

SURFACE FINISHING

- Surface finishing means the quality of a surface. It relates to the level of roughness of a surface.

Purpose

1. To control the accuracy in positioning and tightness between mating parts.
2. To reduce the friction, especially for the part moves relative to other parts.

TOLERANCE

- Tolerance is the total amount dimension may vary.

  It is defined as the difference between the upper and lower limits.

Purpose

1. To control an ***interchangeability*** of parts.
2. To ensures the mating part will have a desired fit.