# Piping Training Course

# OVERVIEW OF PROCESS PLANT PIPING SYSTEM

## *Piping components: summary*

- Definition
- Piping component
- Piping drawing
- Design
- Pipe work
- Codes & Standards

# Definition

*Definition:*

- *piping:*

  assemblies of piping components used…[for] fluid flows. Piping also includes pipe supporting elements, but does not include support structures…or equipment…

- *piping system:*

  interconnected piping subject to the same design conditions

*Definition:*

- ***piping components:***

  mechanical elements suitable for joining or assembly into pressure tight fluid-containing piping systems include

# Piping component

*Piping components:*

- *piping components includes:*
  - ✓ Pipe & tube
  - ✓ Fittings (e.g. elbows, reducers, branch, connections, flanges, etc.)
  - ✓ gaskets, bolting
  - ✓ valves
  - ✓ Pipe support
  - ✓ Special items such as expansion joints…

# Pipe & Tube


## Piping components: Pipe & tube manufacturing

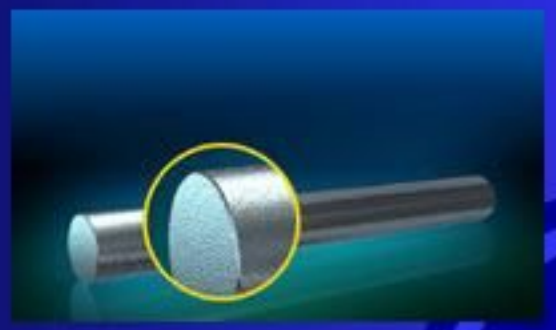
- **Seamless** Show

- **Welded:**
  - *Longitudinal seam*
    - Single seam
    - Double seam (NPS ≥ 36”)
  - *Helical (spiral) seam* Show
    - NPS ≥ 4 ½”
    - 0.8 OD ≤ Skelp width ≤ 3.0 OD
    - Submerged arc welding

- Welding process:
  - Without filler metal
    - Electric welding — Show
    - Continuous welding — Show
  - With filler metal
    - Sub-merged arc welding
    - Gas metal arc welding

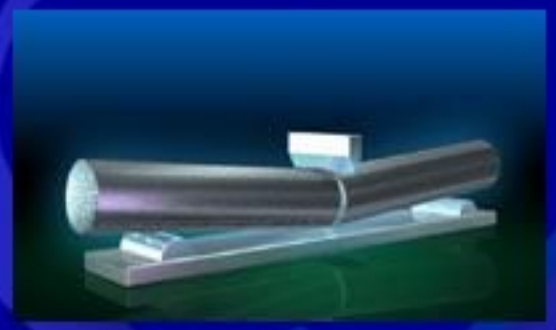
# Piping components: Pipe & tube manufacturing : Seamless pipe

1



Billet preparing
visual control

2



Billet chopping

3

Billet heating
in annular furnace

4

Rough tube
piercing

5

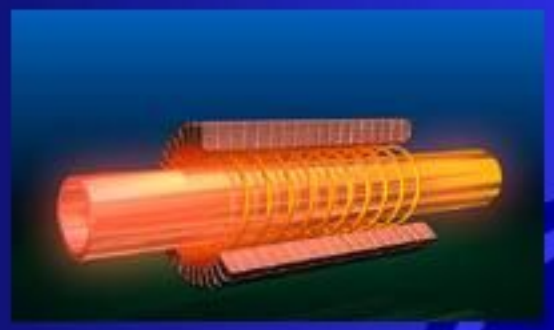
Tube rolling in
continuous mandrel mill

6

Mandrel removing

# Piping components: Pipe & tube manufacturing : Seamless pipe

7



Tube heating in cell induction furnace

8

Sizing and reduction

9

Stalk ends cutting, tubes cutting with flying shears

10

Tubes cooling

11

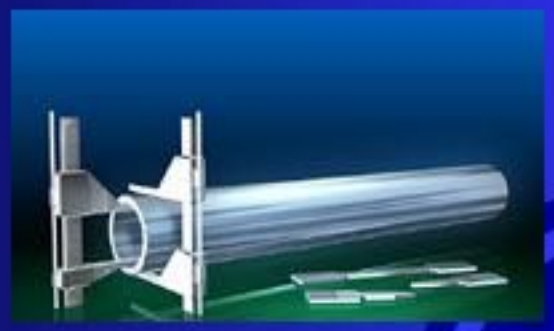
Tubes leveling

12

Tubes cutting in ready sizes, tubes facing

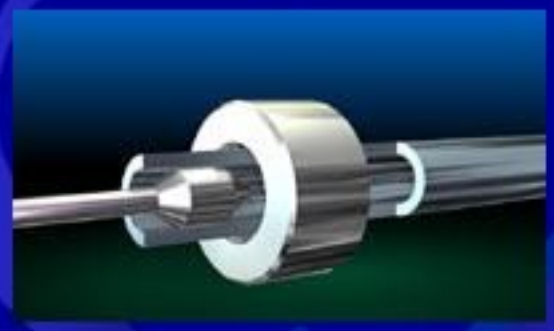
# Piping components: Pipe & tube manufacturing : Seamless pipe

13



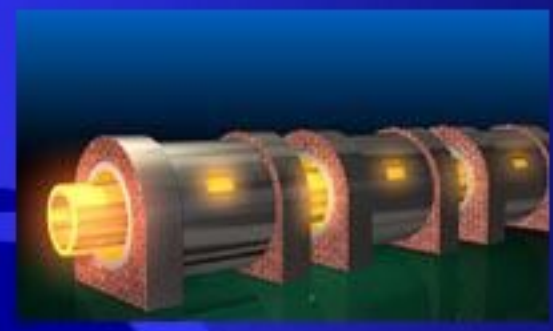
Geometry measuring, mechanical tests, chemical composition control

14



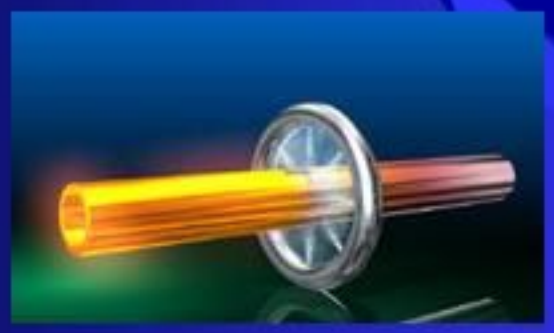
Tube ends sizing (by OD and ID)

15



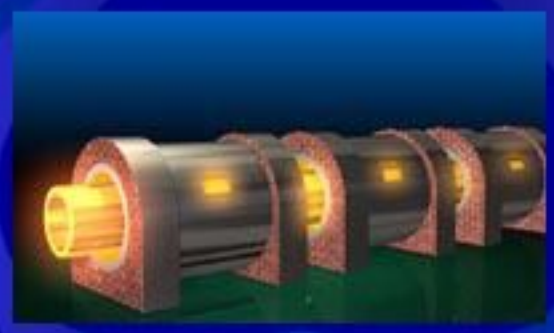
Heating for quenching

16



Quenching in sprayer

17



Tempering

18

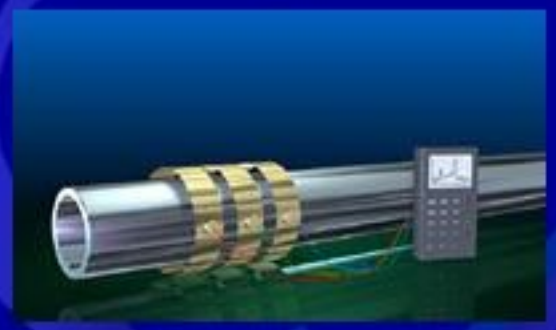
Tubes cooling

# Piping components: Pipe & tube manufacturing : Seamless pipe

19

Tubes etching

20

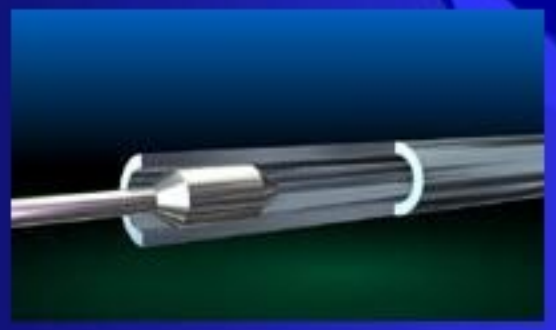


Ultrasonic or electromagnetic test

21

Hydraulic test

22



Sweeping-up (if required) , visual control

23

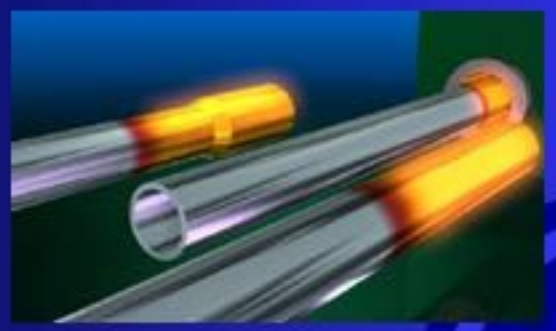
Preservative coating

25

Weighing, marking, packing, storing

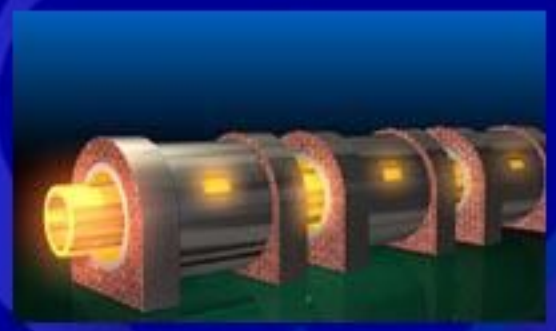
# Piping components: Pipe & tube manufacturing : Seamless pipe (threaded)

20 21



Tube end upset

22



Thermal treatment

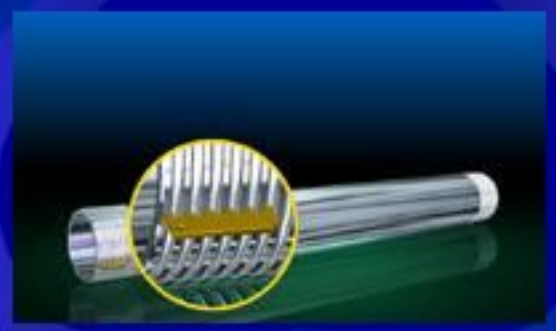
23

Leveling

24

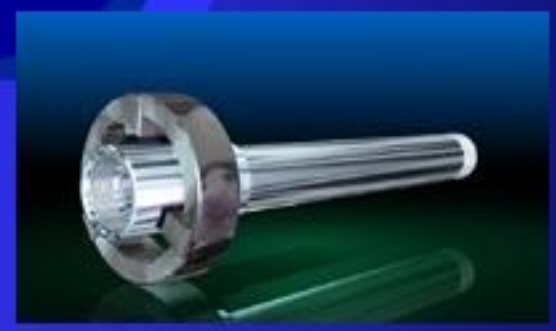
Sweeping-up and grading by length

25



Threading, thread quality monitoring

26



Couplings screwing-on

# *Piping components: Pipe & tube manufacturing : Seamless pipe (threaded)*

27

Hydraulic test

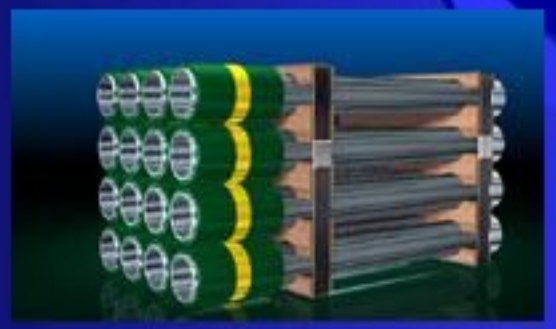
28

Tubes inspection, rings and nipple screwing-on, marking

29

Painting (if required))

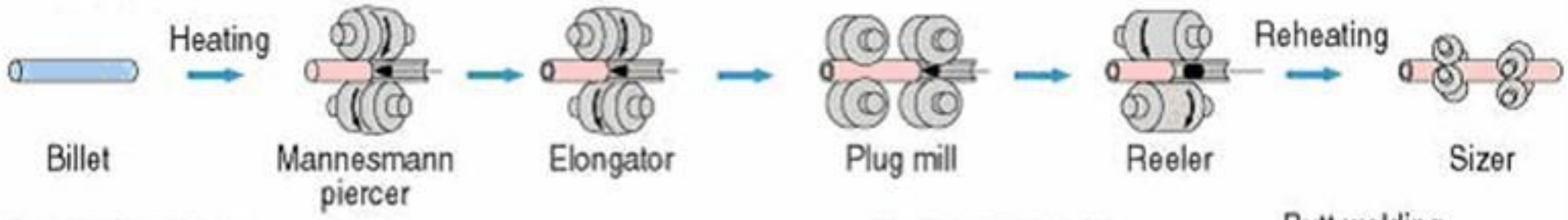
30



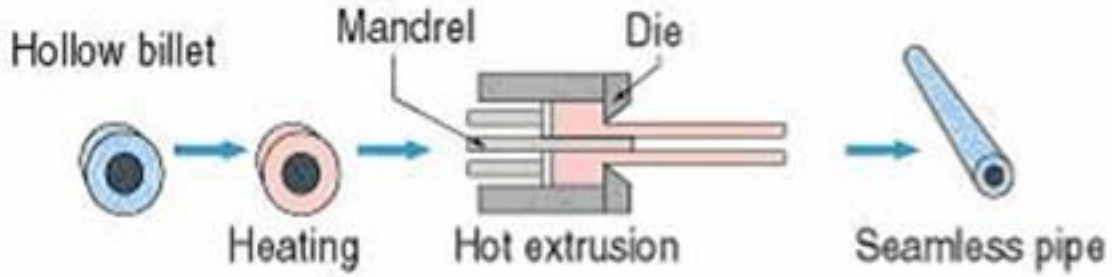
Packing, storing

# Piping components: Pipe & tube manufacturing : other pipe

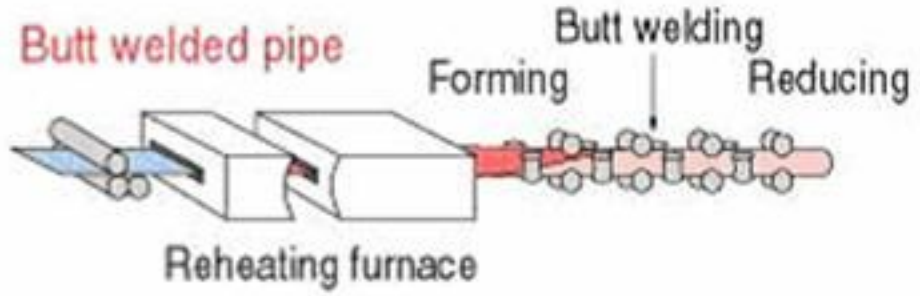
## Seamless pipe



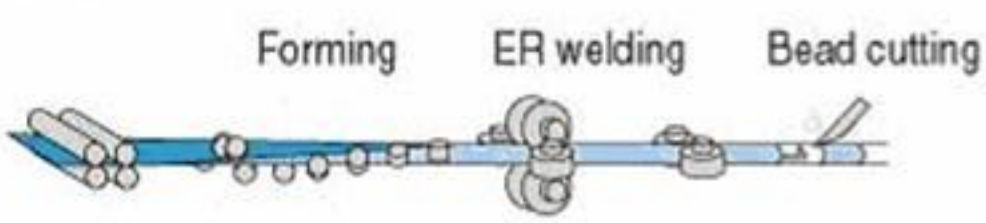

## Hot extruded pipe



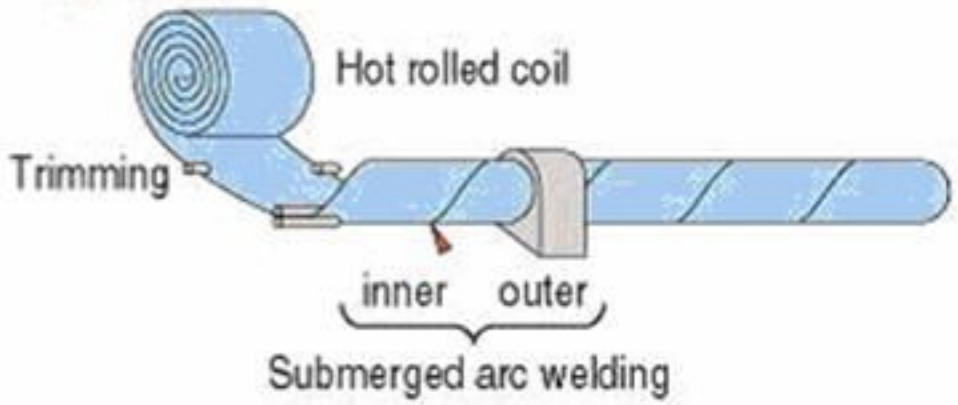

## Butt welded pipe



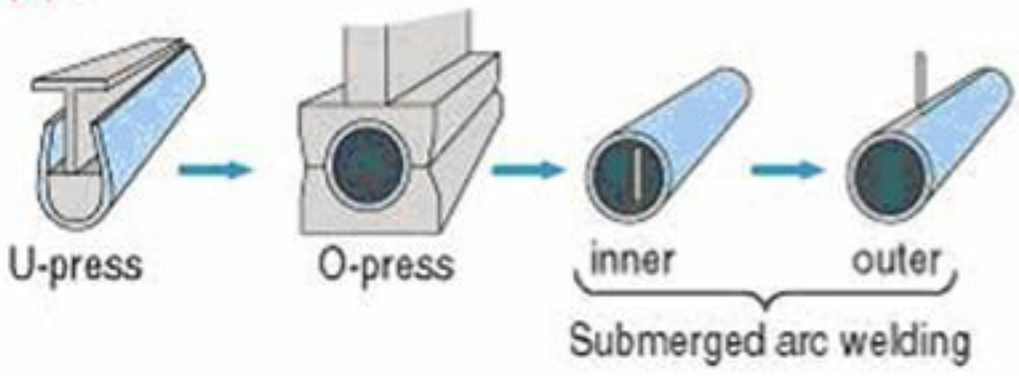

## ERW pipe




## Spiral pipe




## UO pipe



## Piping components: pipe & tube classification

- Pipe classification:
  - Iron pipe size (approximate internal dia.)
  - Manufacturers' weight: NPS +
    - STD
    - XS
    - XXS
  - Schedule number: NPS +
    - 5, 5s, 10, 10s, 20, 20s, 30, 40, 40s, 60, 80, 80s, 100, 120, 140, 160
    - SCH ≈ 1000 P/S
    - NPS ≤ 12, OD ≥ NPS
    - NPS ≥ 14, OD = NPS
    - NPS ≤ 10, SCH 40 = STD
    - NPS ≤ 8, SCH 80 = XS
    - Light wall = light gage = 5, 5s, 10, 10s
  - API designation
    - A25, A, B, X42, X46, X52, X60, X65, X70
    - X(AA), AA = Allowable stress
  - Pressure-Temperature Ratings
    - 150, 300, 400, 600, 900, 1500, 2500

Show

## Piping components: pipe & tube classification

- **Pipe:**
  - **NPS:**
    **1/8”, ¼”, 3/8”, ½”, ¾”, 1”, 1 ½”, 2”, 3”, 4”, 6”, 8”, 10”, 12”, 14”, 16”, 18”, 20”, 24”, 28”, 30”, 32”, 36”, 40”, 44”, 48” 52”, 56”, 60”**
  - **NPS 1 ¼”, 2 ½”, 3 ½”, 5” not used**
  - **Pipe is supplied in**
    - **Random length (17 to 25 ft)**
    - **Double random length (38 to 48 ft)**
  - **Pipe end:**
    - **BE (bevel end)**
    - **PE (plain end)**
    - **T& C (treaded and coupled, rating of coupling shall be specified**

## Piping components: pipe & tube classification

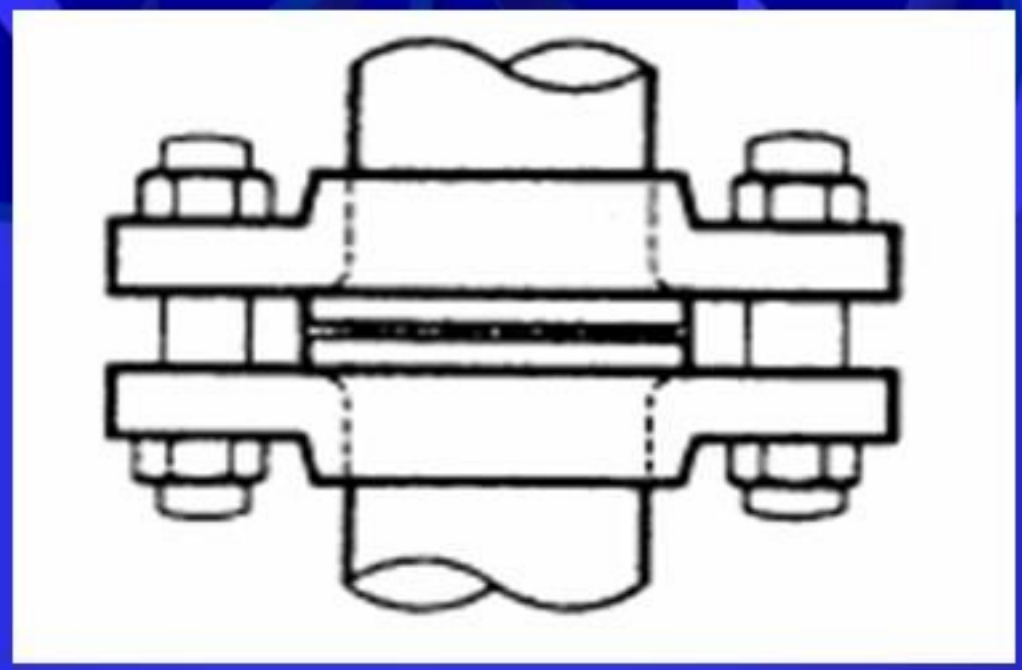
- **Tube:**
  - Specify by two of
    - Outside diameter
    - Inside diameter
    - Wall thickness:
      - Thousandths of inch
      - Gauge number
        - » American wire gauge
        - » Steel wire gauge
        - » Birmingham wire gauge
        - » …
  - When gauge numbers are given without reference to a system (BWG) is implied

## *Piping components: pipe standards*

- ASTM A53 – Steel Pipe
- ASTM A312 – Stainless Steel Pipe
- AWWA C151 – Ductile Iron Pipe
- API 5L – Line pipes
- ISO 11960, API 5CT – tubing

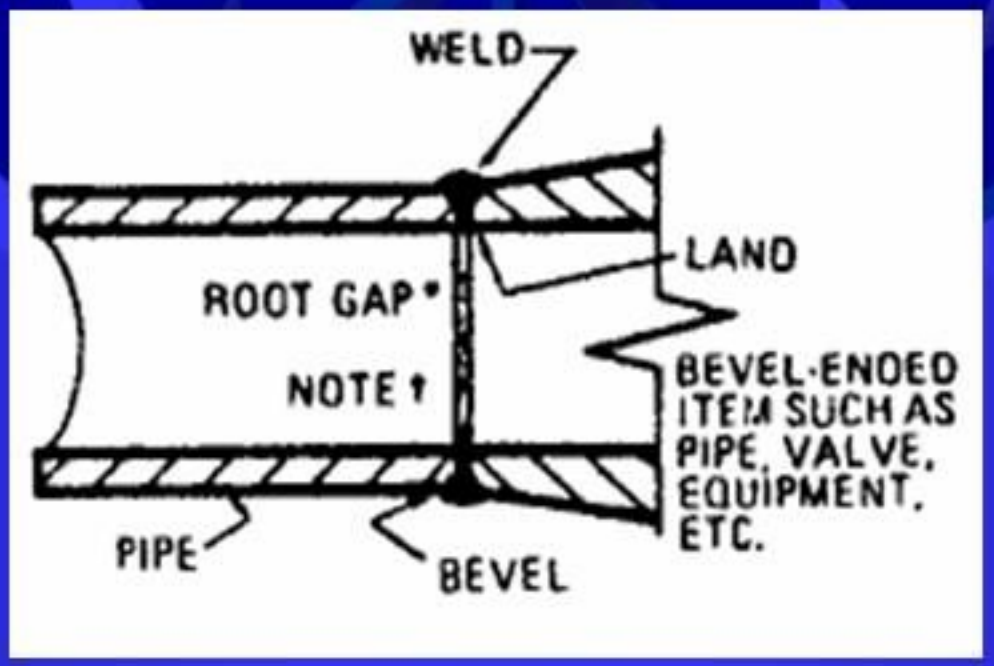
- ASTM A 53/A 53M Electric-weldedand seamless steel pipes, black or hot-dip galvanized
- ASTM A 106 Seamless carbon steel pipes for high temperature performance

- Method of joining pipe:
  - Butt weld
  - Socket weld
  - Threaded
  - Quick coupling
  - Flange
  - Special item

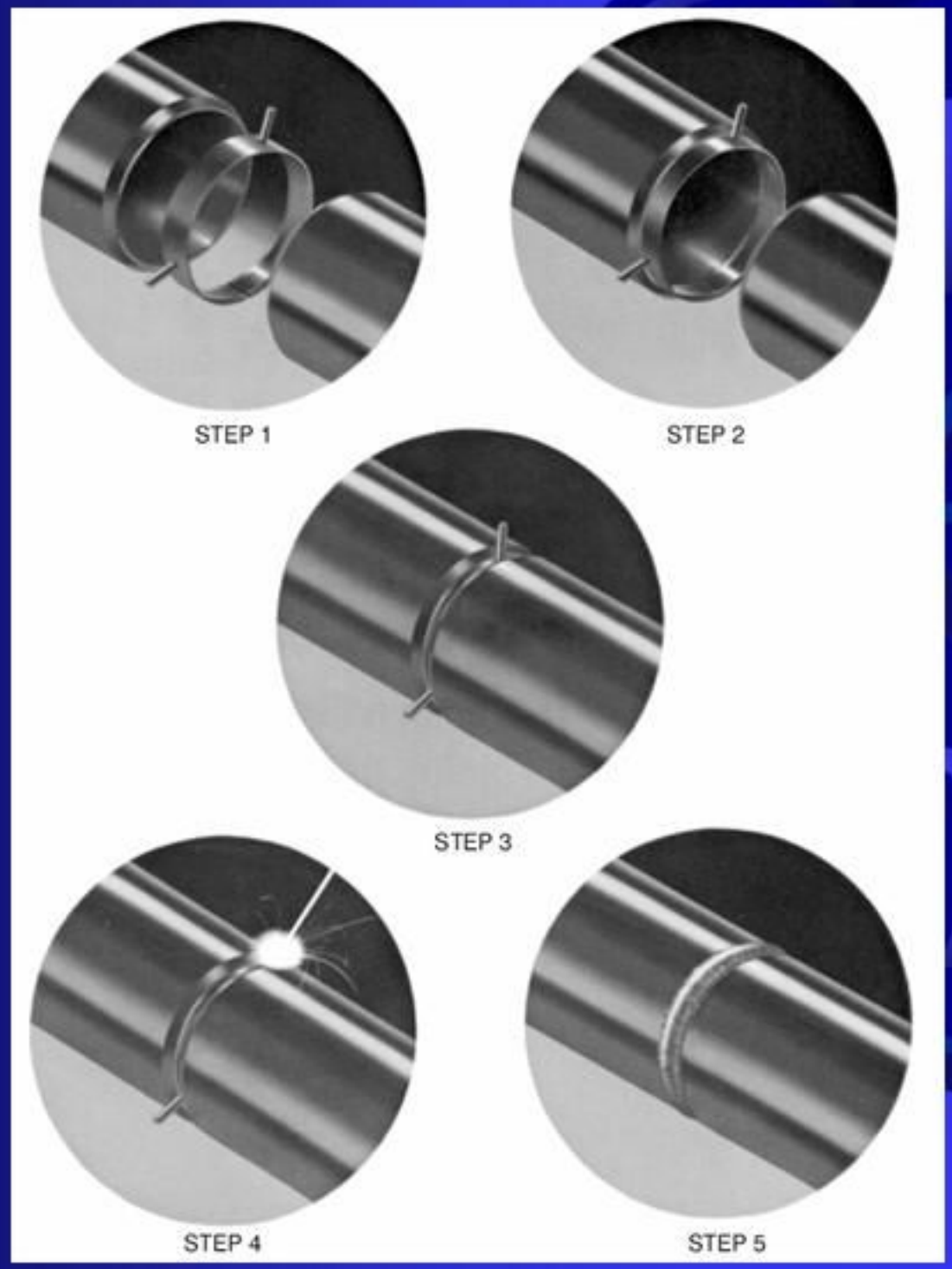


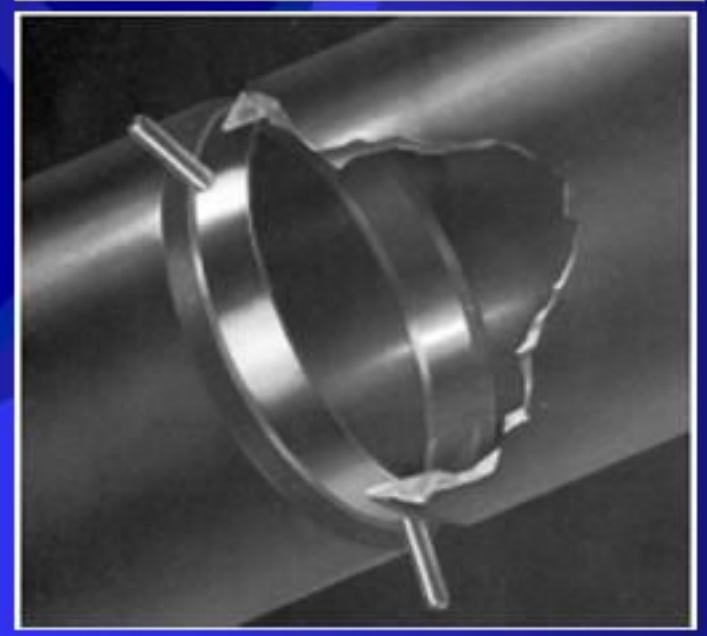
## *Piping components: Fitting (butt-weld)*

- ASME B16.9
- Used in most piping systems *NPS* ≥ 2”
- Use generally not restricted
- Difficult in small sizes, especially for thin wall

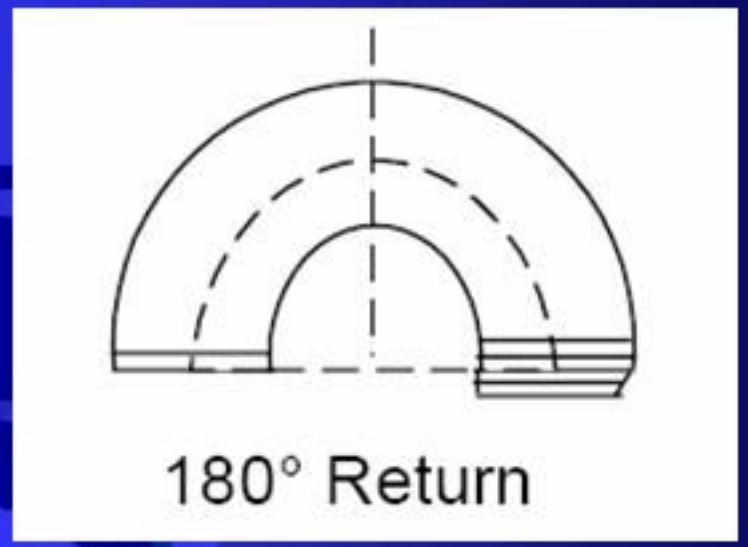


# Backing ring



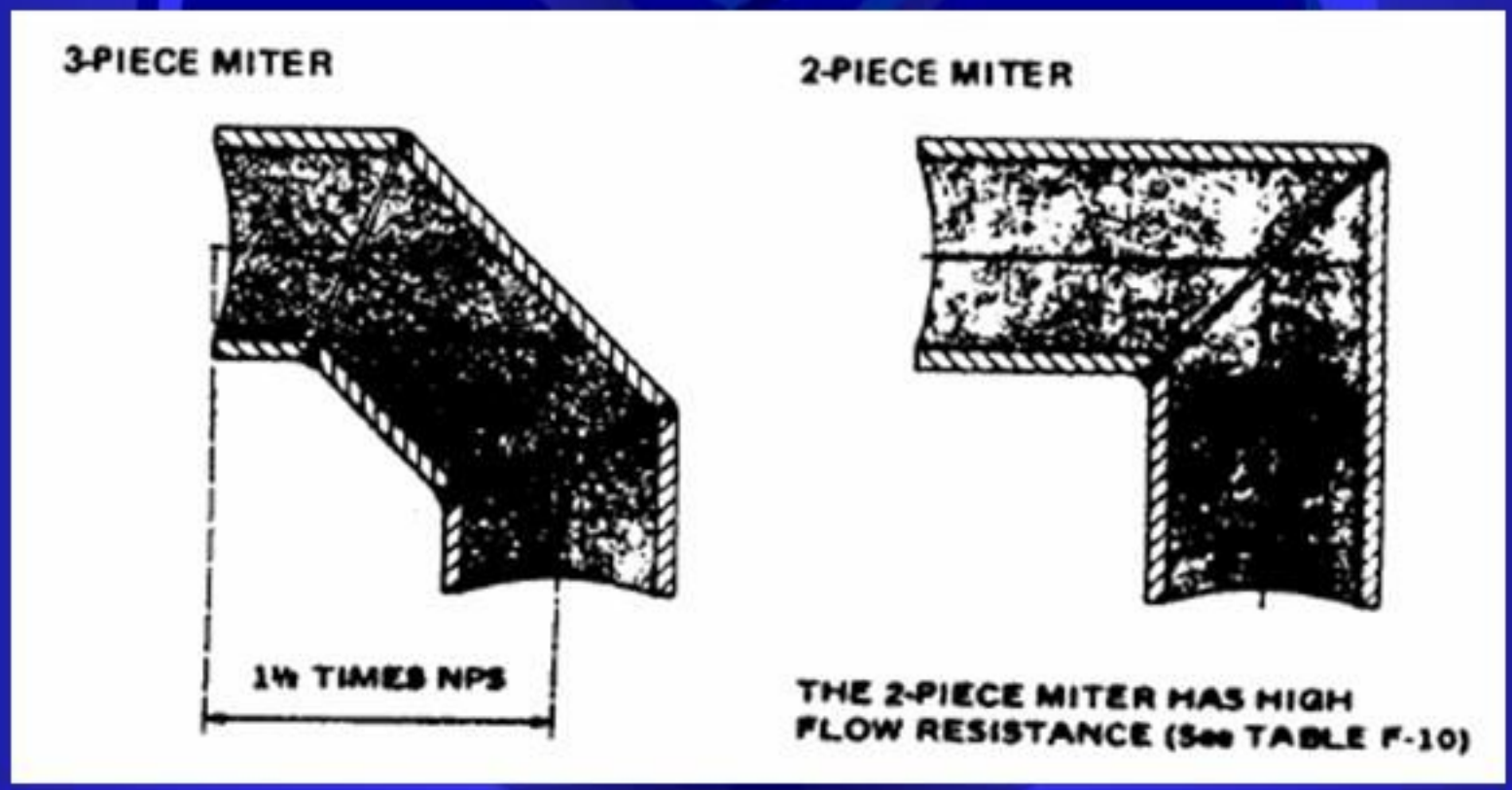



- Return:
  - Curvature = 1 ½ NPS
  - Uses in:
    - Vent on tanks



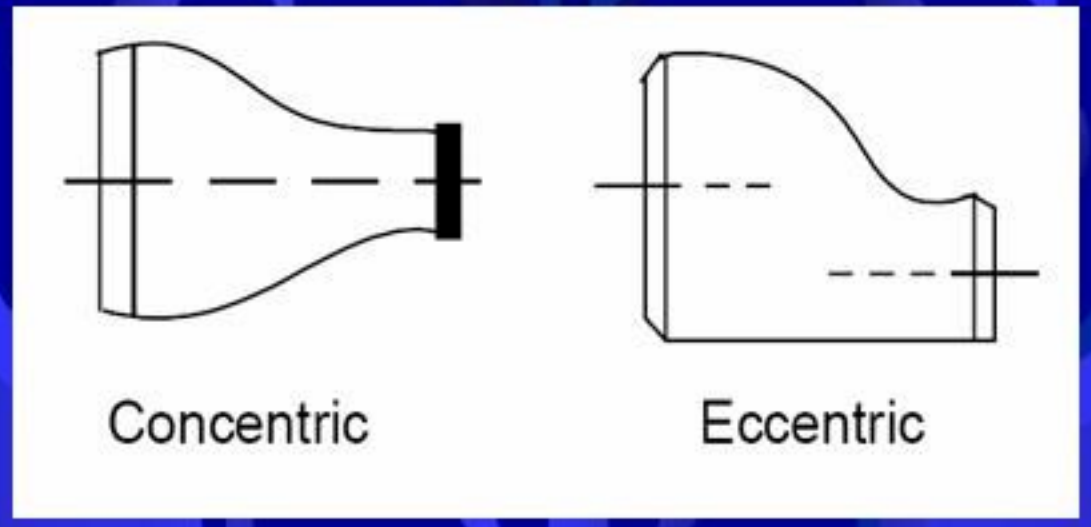

- Bend:
  - Curvature = 4 - 6 NPS
  - Made from seamless and ERW straight pipe
  - Two methods used to making bend
    - Hot
    - Cold

- Miter
  - 2 piece (pressure drop ≈ 4-6 LR elbow)
  - 3 piece (pressure drop ≈ 2 LR elbow)
  - Low pressure line, NPS > 10” & pressure drop not important
  - 90

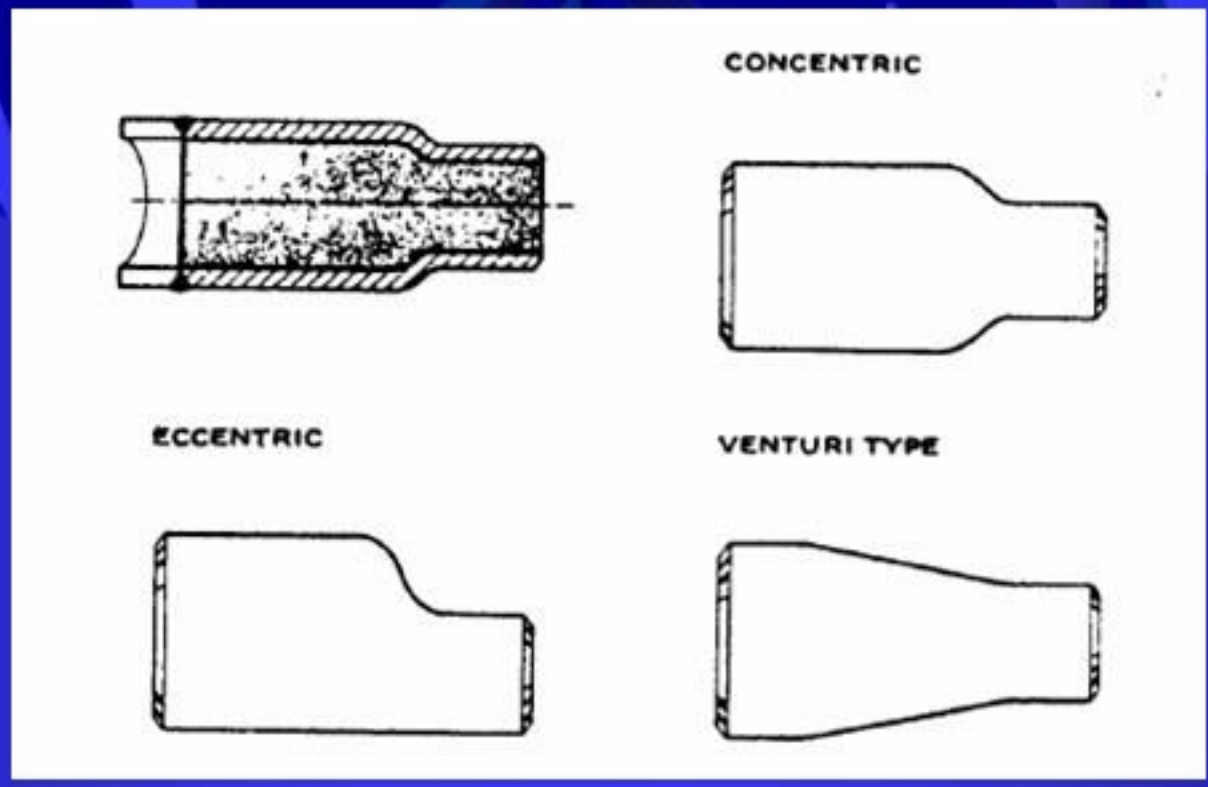


## *Piping components: Fitting (butt-weld)*

- Reducer
  - Eccentric
    - Suction & discharge of pump
    - support
  - concentric



- Sewage :
  - connect butt-welded piping to smaller socket-weld or screwed
  - Abrupt change of line size in butt-weld Type:
    - Eccentric
    - Concentric
    - Venturi: Allows smoother flow

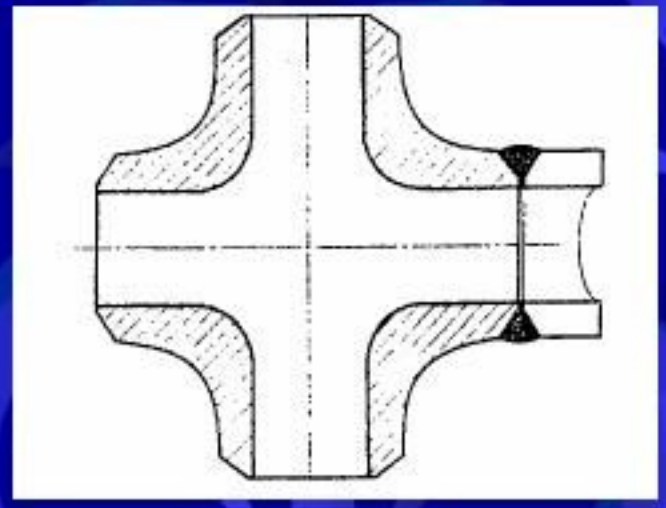


- Tee
  - Straight (branch to the same size as the run)
  - Reducing
    - Branch smaller than the run
  - Bullhead tee have branch larger than run & seldom used and made to special order

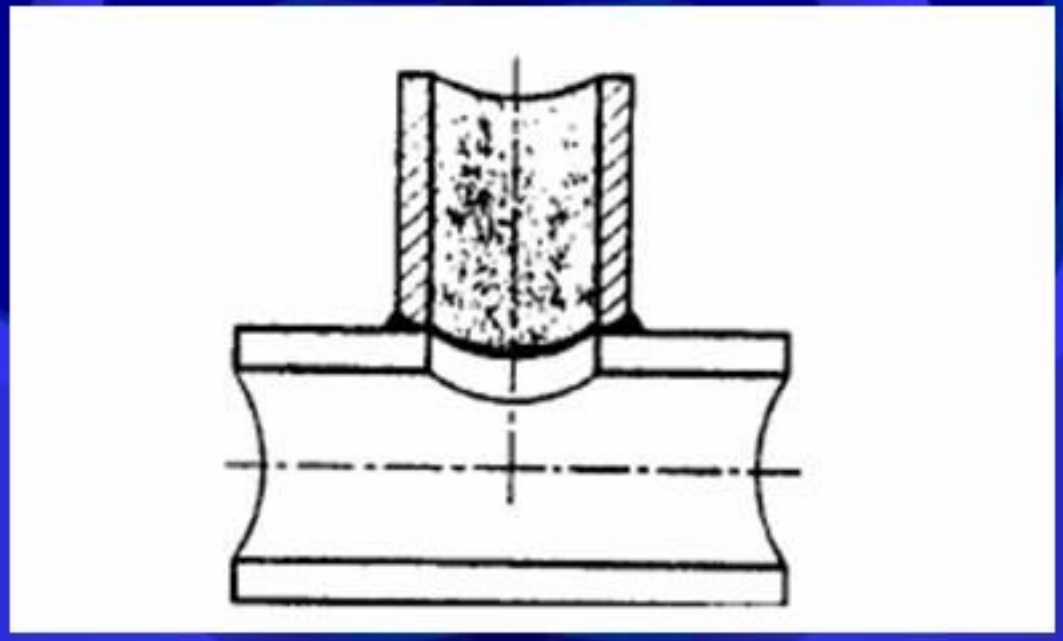
**Specifying Size of Butt-Welding Reducing Tee**

| How to specify TEE | Run Inlet | Run Outlet | Branch | Example |
|---|---|---|---|---|
| Reducing on Branch | 6” | 6” | 4” | Red Tee 6 x 6 x 4” |

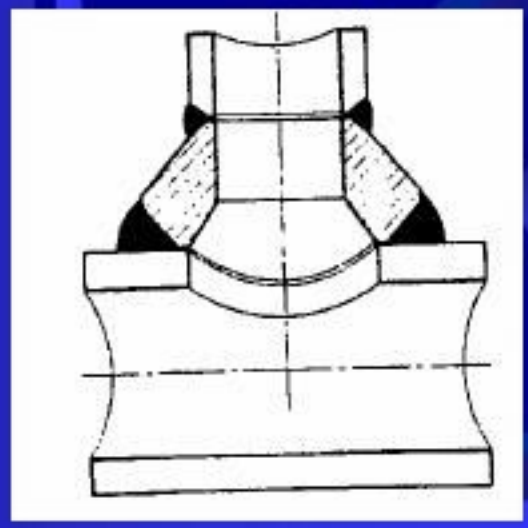
- Cross
  - Straight (branch to the same size as the run)
  - Reducing (rarely used)



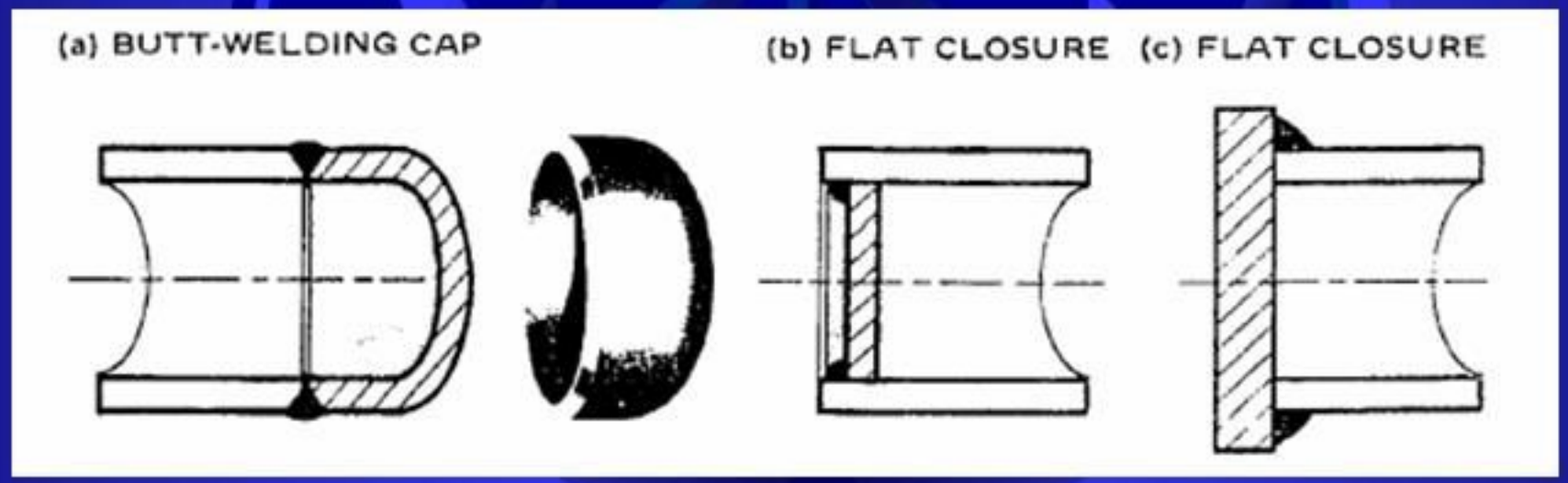
- Stub-in
  - Welded directly in the side of the main pipe run
  - Least expensive
  - NPS ≥ 2”
  - Cab be reinforced



- Weldolet
  - Make a closer manifold that Tee
  - Full size
  - Reducing
  - Flat
    - Are available for connecting to pipe caps and pressure vessel

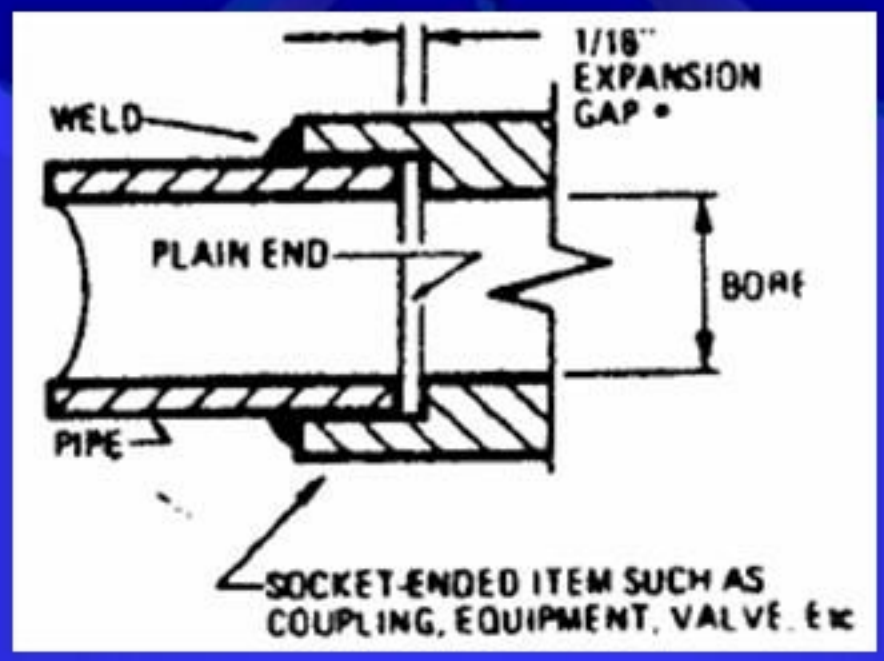


- Closure
  - Cap
  - Flat closure



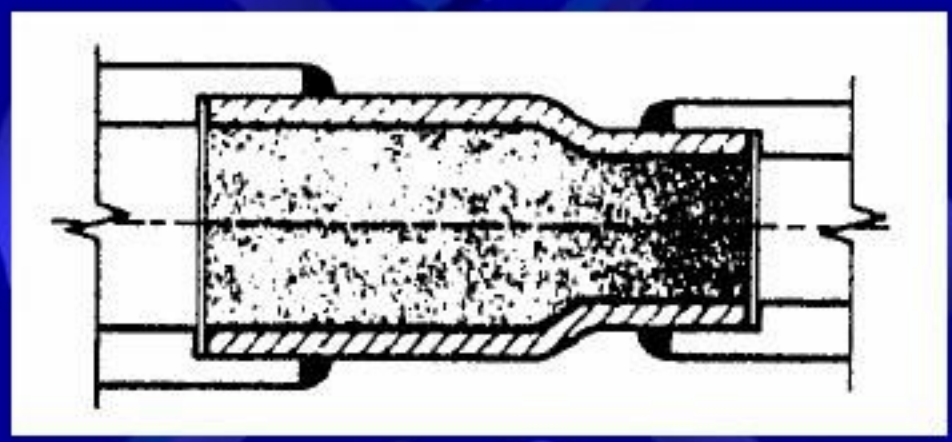
*Piping components: Fitting (socket)*

- Size frequently limited to *NPS≤ 1 ½" (ASME* B16.11)
- Not used in "severe cyclic conditions" and in services where corrosion is accelerated in crevices
- No weld metal can enter bore, easier alignment on small line than butt-weld
- Tack is unnecessary
- Have not any leakage

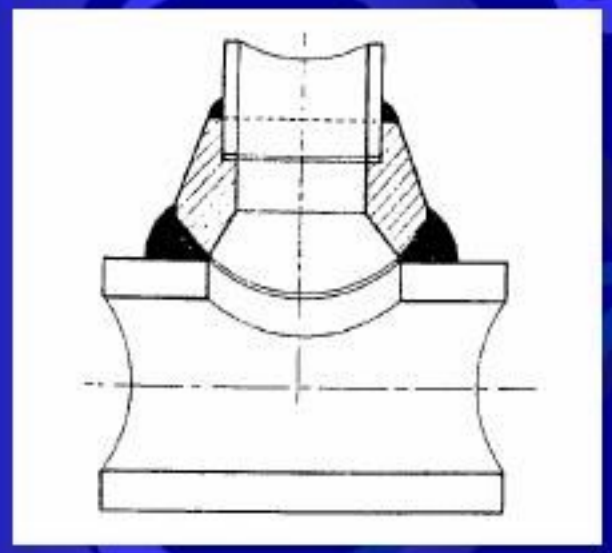


- Return:

- Sewage :
  - Abrupt change of line size in butt-weld

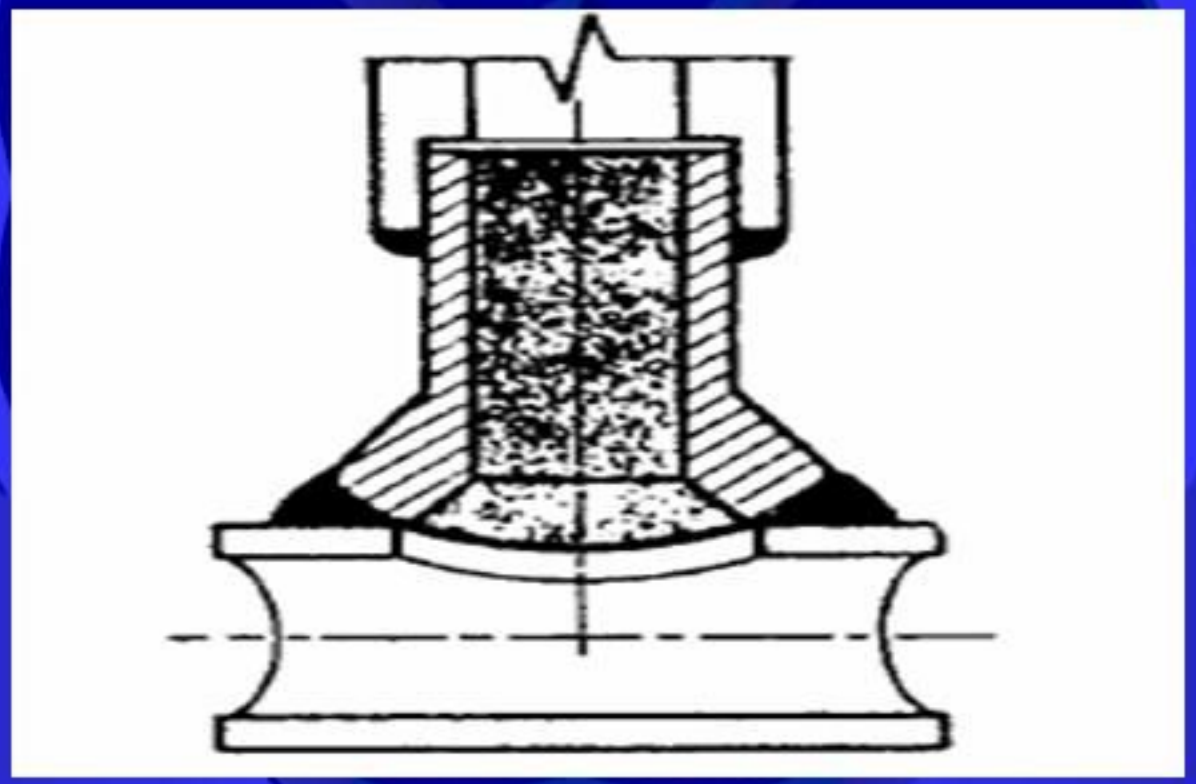


- Sockolet

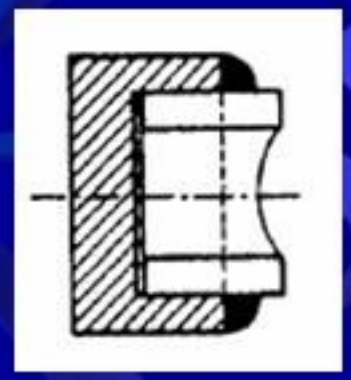


*Piping components: Fitting (socket)*

- Socket welding Elbolet
- Socket welding latrolet
- Nippolet

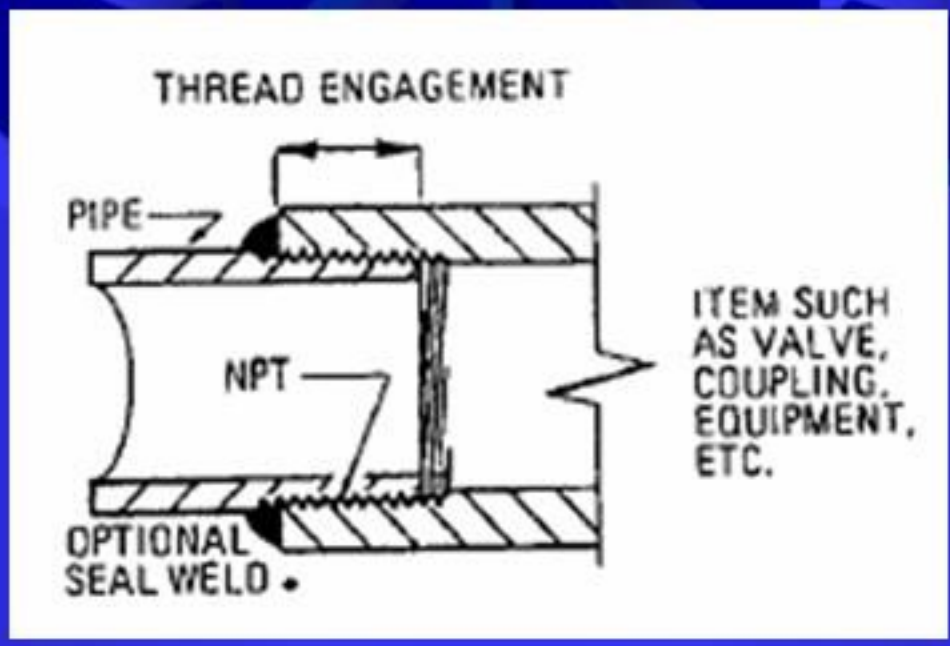


- Cap



*Piping components: Fitting (threaded = screwed)*

- **Common materials**
  - Gray iron (ASME B16.4)
  - Malleable iron (ASME B16.3)
  - Steel (ASME B16.11)
- ***Non-toxic, non-flammable,* Generally not used where leaks cannot be tolerated**
- ***NPS ≤ 1 ½" , pressure rating < 600, temperature < 625***

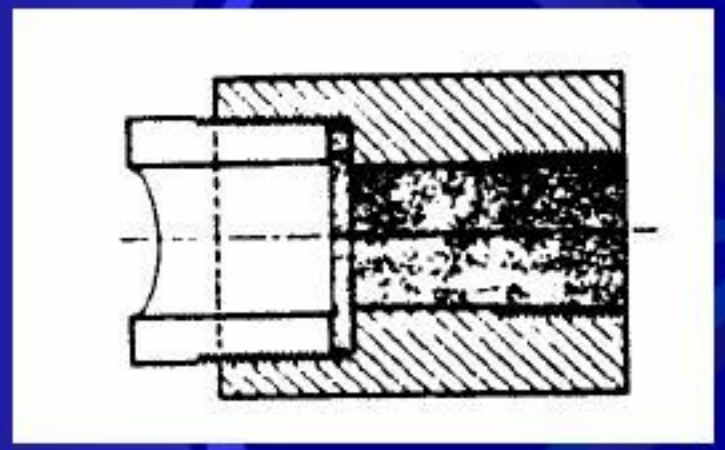


*Piping components: Fitting (thread)*

- Elbow (90, 45)
- Reducing elbow

## *Piping components: Fitting (thread)*

- Reducer
- Reducer insert



## Tee

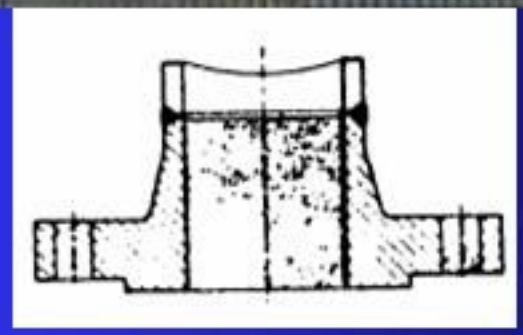
**Specifying Size of Butt-Welding Reducing Tee**

| How to specify TEE | Run Inlet | Run Outlet | Branch | Example |
|---|---|---|---|---|
| Reducing on Branch | 6” | 6” | 4” | Red Tee 6 x 6 x 4” |

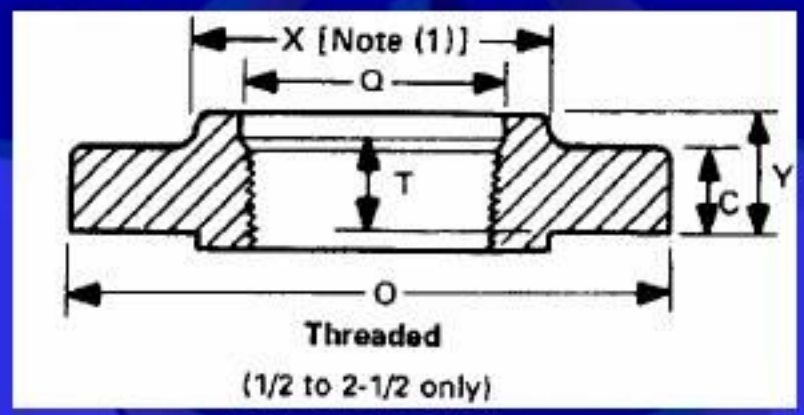
- Closure
  - Cap
  - plug

- Welding neck flange
  - Regular
  - Long (used for vessel & equipment nozzle, rarely for pipe
- Suitable where
  - Extreme temperature
  - Shear
  - Impact and vibration

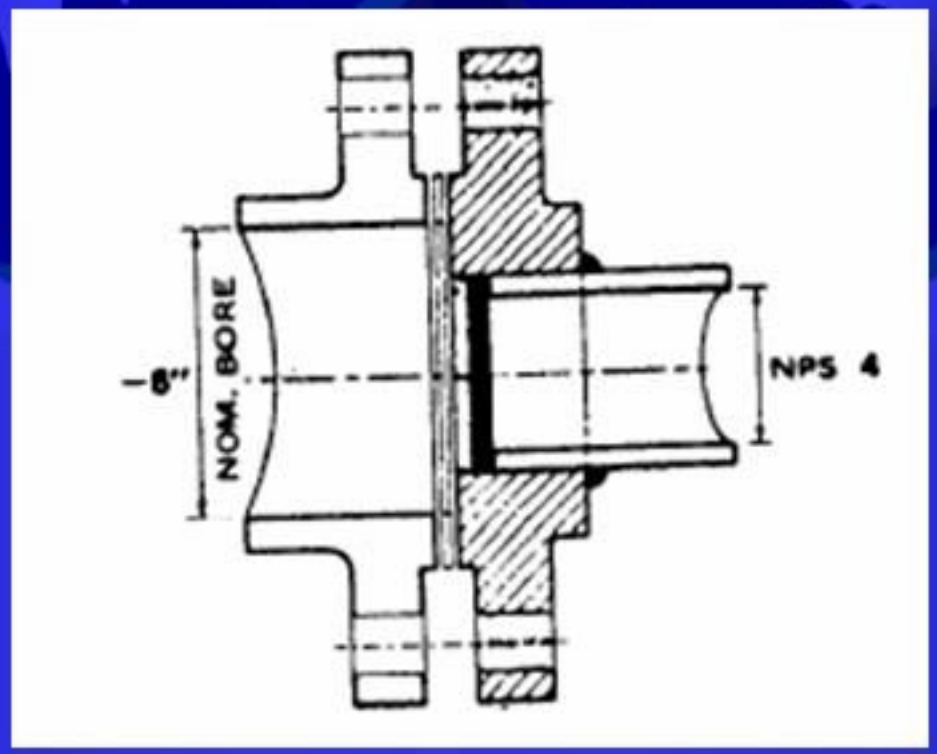
Stress apply

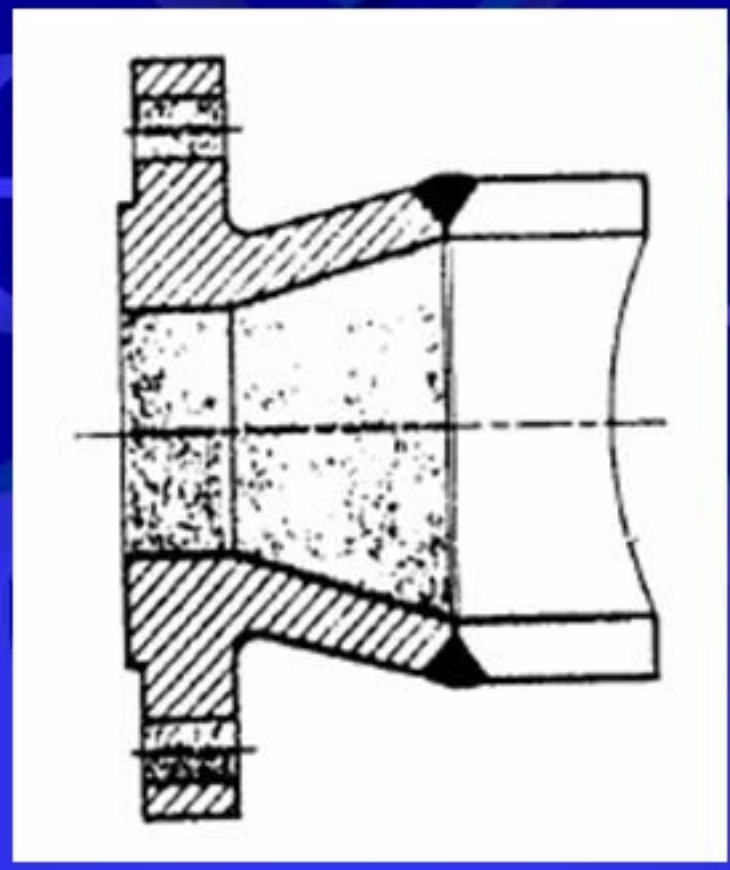
- Threaded flange

- Reducing flange
  - Specify by size of smaller pipe and outside diameter of flange to be mate
    - Ex/ RED FLG 4” × 11”
  - Should not be used if abrupt transition would create undesirable turbulence as at pump



- Expander flange
  - Reducer + welding neck flange
  - Increase pipe size to first or second large size



- Lap joint (van stone) flange
  - If stub and flange are of the same material they will be more expensive than a welding neck flange
  - Economical for different material of stub and flange