PIPE SUPPORTS

- A pipe support is a device designed to carry the weight of the pipe, any in-line equipment and the material in the pipe over a defined span.
- Pipe supports used in high or low temperature applications may contain insulation materials.
- The overall design configuration of a pipe support assembly is dependent on the loading and operating conditions.
PIPE SUPPORTS

• Supports:
  – Absorb system weight
  – Reduce:
    • Longitudinal pipe stress
    • Pipe sag
    • End point reaction loads
RERAINTNOLS

- Restraints
  - Control, limit, redirect thermal movement
    - Reduce thermal stress
    - Reduce loads on equipment connections
  - Absorb imposed loads
    - Wind
    - Earthquake
    - Water hammer
    - Flow induced-vibration
Support and Restraint Selection Factors:

- Weight load
- Available attachment clearance
- Availability of structural steel
- Direction of loads and/or movement
- Design temperature
- Vertical thermal movement at supports
PIPE SUPPORTS

• The **PRIMARY PIPE SUPPORTS** systems are those supports that are a part of the infrastructure and fall under the prime responsibility of the structural department.
  
  Ex: Pipe Sleepers, Pipe Racks

• The **SECONDARY PIPE SUPPORT** systems are more a part of the piping systems and as such fall under the prime responsibility of the piping department.
  
  Ex: Anchors, Guides, Shoes
Location:

• In order to set the location of the primary pipe support systems the total plant layout must be established.

• This means that all the various disciplines must have a very good idea what equipment is required and it's size.

• The "Plot Plan" must be reviewed by all the key people on the project and then approved by the client.
Configuration:

- This is the selection of "fit-for-purpose."
- Each main run, minor run and branch run must be looked at to determine its configuration.
  - Will it be an overhead rack or a sleeper way?
  - Will each be single deck (layer) or multiple deck?
  - Will the support be a single column ("T") support or multi-column support?
  - How many columns?
Configuration:

- A second part of the configuration issue effects pipe racks in the process units themselves. This is the question of whether or not the pipe rack will support equipment such as Air Coolers (Fin Fans).
- Another part of configuration is the issue of intersections. Poor planning on this issue can cause problems later with the piping.
**PRIMARY PIPE SUPPORTS**

**Height:**

- For low sleepers.
  - The sleepers are concrete with an imbedded steel plate on the top. For sleepers, they need to be off the ground to allow for maintenance and drainage also to prevent corrosion.
- For elevated multi-level racks
  - For elevated racks you must plan the height and the separation of the whole system together.
  - A key element in the determination of separation is the line sizes to be carried on the racks.
Width:

- This requires a detailed study of the total piping systems for the whole plant based on pipe rack routing.
- A study called "Transposition" to be done to identify all the rack piping from the largest to the smallest.
- A percentage was added as an error factor and then the clients "future" reserve was added. This then constituted the minimum rack width.
- The final width would be set after all racks were "sized" and then some might be rounded up in width for consistence based on the materials of construction/fabrication method.
This issue can be addressed after the transposition has been completed.

With the pipe size information (largest, smallest and average pipe size) the number and spacing of the pipe support bents can be set.

A cost trade off is evaluated and made between more pipe supports spaced closer together or fewer pipe supports and some sort of intermediate support system.
Materials of construction/fabrication method:

- Pipe racks can be bare steel, steel with concrete encasement (fireproofing), reinforced concrete or a combination.
- The steel can be steel structural shapes or pipe shape.
- The concrete fireproofing can be cast in place onto (or around) the steel columns and beams or it can be pre-cast onto the columns and beams prior to installation.
- The reinforced concrete pipe supports can also be cast in place or pre-cast then field erected.
- The space requirement dimensions for a reinforced concrete column or beam is about twice that of bare steel.
PIPE SUPPORTS

- PIPING SUPPORT
  - SUPPORTS FROM CIVIL/STRUCTURE
    - PRIMARY PIPE SUPPORTS
      - PIPE RACKS
      - PIPE SLEEPERS
  - SUPPORTS FROM VESSELS
    - SECONDARY PIPE SUPPORTS
      - ANCHORS
      - GUIDES
      - SUPPORTS
      - DUMMY
      - TRUNNION
      - CANTILEVER
      - L-TYPE
      - GOAL POST
      - TRAPEZE
PRIMARY PIPE SUPPORTS – Pipe Sleepers
PRIMARY PIPE SUPPORTS – Pipe Sleepers
PRIMARY PIPE SUPPORTS – Pipe Sleepers
PRIMARY PIPE SUPPORTS – Pipe Sleepers
Structural steel pipe racks typically support pipes, power cables and instrument cable trays in petrochemical, chemical and power plants.

Occasionally, pipe racks may also support mechanical equipment, vessels and valve access platforms.

Main pipe racks generally transfer material between equipment and storage or utility areas.

Storage racks found in warehouses are not pipe racks, even if they store lengths of pipe.

The smallest size of pipe run on a pipe rack 2”
• Pipe rack consist:
  – Bent:
    • Connected shape frame
  – Stanchion (Column):
    • The vertical member of bents are termed stanchion

• Pipe rack arrangement:
  – Single deck
  – Double deck, ...
PRIMARY PIPE SUPPORTS – Pipe Rack
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PRIMARY PIPE SUPPORTS – Pipe Rack

Type of Support ????

Pipe Guide
The most economic beam section desired for the pipe rack.

If more room is needed, make double or triple pipe rack.
Categorize pipe rack, for example if using double deck, place utility service piping on the upper level of the pipe rack.
SECONDARY PIPE SUPPORTS – Wear Pad

Wear Pad (Load Distribution Pads):

- This is simply a 120 degree section of pipe and length will vary according to NPS
- The Pad is cut from the same material as the subject line.
- The Pad is opened up a little to fit the pipe O. D. and then welded to the pipe at the required location.
SECONDARY PIPE SUPPORTS – Wear Pad
SECONDARY PIPE SUPPORTS – Shoe
SECONDARY PIPE SUPPORTS – Shoe

• This device is mainly required to raise a hot insulated off the structural support surface.
• The reason for this is to prevent damage to the insulation as the pipe expands as it heats up and shrinks as it cools down.
• For pipe sizes 3" thru 10" a simple inverted "T" shoe with a flat bottom plate and one (single) vertical plate should be used.
• For pipe sizes 12" thru 18" a shoe with a flat bottom plate and two (double) vertical plates should be used.
• For pipe sizes 20" and larger consideration should be given to the addition of a Load Distribution pad (wear pad) where thin wall pipe may exist.
SECONDARY PIPE SUPPORTS – Shoe
SECONDARY PIPE SUPPORTS — Shoe

FIELD PIPING ENGINEERING

www.seabirdgroups.com
SECONDARY PIPE SUPPORTS — Shoe

- Other type of shoes
SECONDARY PIPE SUPPORTS – **Saddle**

For better stress distribution in the pipe wall, saddle used on large line and used for lines that twist over when moving.
SECONDARY PIPE SUPPORTS – Saddle

Saddle

Shoe
SECONDARY PIPE SUPPORTS – **Guides**

Guide

Guide

Vertical Guide

Guide
SECONDARY PIPE SUPPORTS – Guides

- Guides are predominantly in elevated pipe racks or sleepers to keep the pipes in their assigned berth.
- Guides are most often short lengths of properly sized steel angle welded to the pipe support on each side of each pipe.
- For the installations of guides care must be taken by installers to leave a small gap between the pipe and the angle to avoid binding. Because of the close spacing of the pipes in a rack guides are attached to alternate pipe bents in staggered fashion.
- Pipe guides can be used in conjunction with other pipe supports to achieve more than one degree of freedom.
SECONDARY PIPE SUPPORTS – Guides

Restrained in Horizontal
Restrained in Horizontal & Vertical
SECONDARY PIPE SUPPORTS – Base Guide

Figure P9: Base Guide

- Pipe O.D.
- Elastomeric Cushion
- 30°
- B.O.P.
- T.O.S.

1 5/8"

3/8" lateral & vertical gaps

A'

B'

E'

C'

D'
SECONDARY PIPE SUPPORTS – Base Guide

- For this item angle iron strips are installed on two opposite sides (depending on desired movement) to control the direction.
SECONDARY PIPE SUPPORTS – Anchors

Anchor

Anchor

Partial Anchor
SECONDARY PIPE SUPPORTS – Pipe Anchors

- A pipe anchor is a rigid support that restricts movement in all three orthogonal directions and all three rotational directions.
- This usually is a welded stanchion that is welded or bolted to steel or concrete.
SECONDARY PIPE SUPPORTS – Dummy Legs
SECONDARY PIPE SUPPORTS – Dummy Legs

• This is simply a piece of pipe extended from an elbow to provide support when a pipe line enters or leaves a pipe rack short of a support and is left improperly support.
• A stub or length of pipe sized to carry the load is welded to the elbow and extended beyond the support.
• The length and the wall schedule of the pipe extension are a rather complex formula based on the parent line size and the total load.
SECONDARY PIPE SUPPORTS – Dummy Legs
SECONDARY PIPE SUPPORTS – Gussets

Close up; fully welded collar and support gussett
SECONDARY PIPE SUPPORTS – Gussets

• Simple piece of angle steel welded or clamped to a header pipe and to a (small) branch to prevent breakage due to vibration or other action.
• Recommended locations and services are:
  o Suction and discharge piping of reciprocating compressors and pumps
  o Lines in mixed phase flow subject to slug flow or surge
  o Lines in hydrogen service
  o Lines in toxic service (category "X" or "M")
  o Branches in piping low to grade (or platforms) that may be used as a step by operators
SECONDARY PIPE SUPPORTS – Hanger
SECONDARY PIPE SUPPORTS – Hanger

- These items are a combination of clevises, steel shapes, bolts and compression washers.
- They are used to hold down the piping on the suction and discharge of reciprocating compressors and pumps.
- Normally this type of piping is low to the ground and supported on sleepers.
- The hold-down is a bridge assembly over the pipe and welded to the sleeper steel plate.
- The combination of clevises, steel shapes bolts and compression washers exert tension on the pipe to suppress vibration.
- Rigid hangers are normally used at locations where no vertical movement of the piping occurs.
SECONDARY PIPE SUPPORTS — **Hanger**

- **C - C -/+ (Maximum Adjustment)**
- **Rod Extension Piece**
- **Rear Bracket**
- **Pipe Extension Piece**

**FIG. E380**
SECONDARY PIPE SUPPORTS – Hanger

Pipe Hangers, Supports & Snubbers
SECONDARY PIPE SUPPORTS – Trunnions
SECONDARY PIPE SUPPORTS – Trunnions

• For this device will have stub pipes attached vertically to the pipe.
• One end of these stub pipes is shaped to fit the O.D. of the pipe and the other end is normally square cut.
• The shaped end of the stubs are welded to the pipe with a full penetration fillet weld.
• This full penetration refers to the wall thickness of only the stub pipes not the pipe.
SECONDARY PIPE SUPPORTS – Insulated
SECONDARY PIPE SUPPORTS – Insulated

• An insulated pipe support (also called pre-insulated pipe support) is a load-bearing member and minimizes energy dissipation.
• Insulated pipe supports can be designed for vertical, axial and/or lateral loading combinations in both low and high temperature applications.
• Adequately insulating the pipeline increases the efficiency of the piping system by not allowing the "cold" inside to escape to the environment.
SECONDARY PIPE SUPPORTS – **Insulated**
SECONDARY PIPE SUPPORTS – Trapeze
SECONDARY PIPE SUPPORTS – Trapeze
SECONDARY PIPE SUPPORTS

Goal Post
SECONDARY PIPE SUPPORTS – Trapeze

Illustration of a gas supply pipe supported by a hanger rod, roller, bolt roller to angle, and lock nut, with a reference to a Trapeze Bar.
SPRING PIPE SUPPORTS

• An engineered spring support upholds a specific load, including the weight of the pipe, commodity, flanges, valves, refractory, and insulation.

• Spring supports also allow the supported load to travel through a predetermined thermal deflection cycle from its installed condition to its operational condition.
SPRING PIPE SUPPORTS

Spring supports
SECONDARY PIPE SUPPORTS – Shock Absorber

- A shock absorber absorbs energy of sudden impulses or dissipate energy from the pipeline.
SECONDARY PIPE SUPPORTS – Bracket

Brackets
SECONDARY PIPE SUPPORTS

Bracket
SECONDARY PIPE SUPPORTS

Failure of Bracket Support
SECONDARY PIPE SUPPORTS – Rigid Support

- Shoe
- Saddle
- Base Adjustable Support
- Dummy Support
- Trunnion
SECONDARY PIPE SUPPORTS – **Flexible Support**

- **Load and Deflection Scale**

- **Small Change in Effective Lever Arm**

- **Typical Variable-Load Spring Support**

- **Large Change in Effective Lever Arm**

- **Relatively Constant Load**

- **Typical Constant-Load Spring Support Mechanism**
ANCHOR VS GUIDE

- **Anchor**
  - Full fixation
  - Permits very limited (if any) translation or rotation

- **Guide**
  - Permits movement along pipe axis
  - Prevents lateral movement
  - May permit pipe rotation
PIPING ARRANGEMENT

Piping can be arranged...

• On pipe racks
• Near grade on sleeper
• In trench
• Near steelwork or equipment
PIPING & SUPPORT ARRANGEMENT

Piping Arrangement in trench
Don’t install pipe on stanchion, this will prevent adding another deck.

Consider sufficient space beside pipe rack. 10 ft minimum.
Arrangement of pipe on support:
- Usually 2” < NPS < 12” mounted on pipe rack and larger pipes are mounted on sleeper
- Mounted large diameter pipe near stanchion for uniform distribution of load
PIPING & SUPPORT ARRANGEMENT

- Use bracket or outrigger for
  - Installation of electrical and instrument tray
  - Pipes with slope

Alternate position if clearances are adequate, & there is no interference
– Group requiring expansion loop at one side of the pipe rack

– Design hanger for 2 ½” and larger pipe
For line smaller than 2” and non-critical arrange supports in the field

Pocketing of liquid due to sagging can be eliminated by sloping the line

As a rule of thumb, spans for insulated lines should be reduced by approximately 30% from those for uninsulated pipes
– Support piping from overhead, in preference to underneath

– Install flange, with 12” minimum clearance from supporting steel

>12”
PIPING & SUPPORT ARRANGEMENT

– Keep weld joints at least 3” from supporting steel or other obstruction
PIPE SUPPORT DRAWING
# PIPE SUPPORT DOCUMENT

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PIPE SUPPORT DRAWING

SP-P1-400
ELEVATION FACING NORTH
1 PC REQ'D (NTS)