

The Basics of Pipes and Bends on Ships



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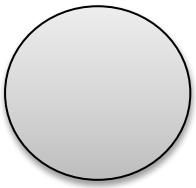
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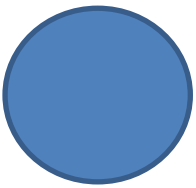
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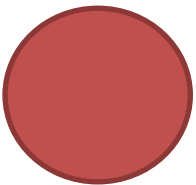
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— *Intermediate*

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— *Advanced*

Advanced content is for professionals who are, or want to be, experts on the subject.

About

This eBook is a compilation of series of articles written by Chief Engineer Mohit Sanguri on “Pipes and Bends on Ships”



Chief Engineer
Mohit Sanguri



About the Author

Chief Engineer Mohit Sanguri is a Marine Engineer (Class I Unlimited Power). He has 12 years of experience working on ships. He is currently working with Dynacom Tankers Ltd on their Bulk Carriers division and has served in the past in Wallems Ship Mgmt. on Car Carriers and PCTC's, MSC Ship Mgmt. on Containers, Univan Ship Mgmt on RoRos, Five Stars Shipping on Bulkers, and SNP Ship Mgmt. on General Cargo at various designations.

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CHAPTER 1:

Basics of Pipes

There are several important aspects of the duties of marine engineer on ships as he is someone who is in charge of all the operations and watch keeping of the engine room.



In case of new fabrication of a pipe line, repair work, or making dry dock specification, a marine engineer must have good knowledge of piping and fittings to be used in the engine room of the ship.

Pipes vs. Tubes – What is the Difference?

There is always a doubt among marine engineers about the difference between pipes and tubes. Several engineers consider them as synonyms and even think that they are interchangeable.

However, it is to note that there is a difference and it is based primarily on the rules of nomenclature of the pipes and the tubes.

In the following points we endeavour to clarify the issue:

- Pipe is rigid and resistant to bending whereas some tubes such as copper tubes and brass tubes can be flexible. However, in structural projects tubes are rigid.
- Pipes are classified by schedule and nominal diameter. For example, a 250mm nominal diameter and schedule 80 pipe.
- Tubes are classified by outside diameter and thickness. For example, 10mm copper tube 2 mm thickness.



The Basics of Pipes and Bends on Ships

- In pipes, all the fittings can be matched by nominal size and schedule. For example a schedule 40 one inch pipe will have fittings specified by the same name. These pipe fittings would not fit a 1" tube.
- Pipe is always round or cylindrical. Tubes may be square, rectangular and cylindrical.
- Pipes generally start from ½ inch to very large sizes. However, tubes are generally of smaller diameter only. We use a 10 inch pipe but not 10 inch tube.
- Tubes are used in applications where the outside diameter must be precise, like in cooler tubes, heat exchanger tubes, boiler tubes etc.
- Pipes are generally used to carry fluids and must contain them. They also have pressure rating and hence are scheduled.
- In tubes the thickness increases in standard steps like 1 mm thick, 2 mm thick etc. In pipes however the thickness depends on the schedule of the pipe and there is no fixed step.



The Basics of Pipes and Bends on Ships

- Pipe joining is more time consuming . For e.g. welding, threading, flanges with bolts etc. The tubes joining are faster using flaring, brazing, couplings etc.
- Tube dimensions are actual dimensions. Whereas the pipe dimensions are only nominal. That means that a 1” tube will have actually OD as 1”. The pipes on the other hand are named nominally, which means only for name. The 1” schedule 40 Nominal size pipe has an ID of 1.049”, OD of 1.32” and a wall thickness of 0.133”.
- Tube fittings are compression fittings such as ferrule and union nut, flared fittings, biting fittings, mechanical grip type fittings. The pipe fittings on the other hand are pipe to pipe butt welding, threaded pipe fitting connectors, flange to flange bolted fittings etc.

Nominal Bore 10 inch (DN 250 mm), Outside Diameter 273.0 mm

Schedule	Sch. 5	Sch. 10	Sch. 20	Sch. 30	Sch. 40	Sch. 60	Sch. 80
Wall thickness (mm)	3.4	4.2	6.4	7.8	9.3	12.7	15.1
Internal Diameter (mm)	266.2	264.6	260.2	257.4	254.4	247.6	242.8
Schedule	Sch. 100	Sch. 120	Sch. 140	Sch. 160	XXS		
Wall thickness (mm)	18.2	21.4	25.4	28.6	25.4		
Internal Diameter (mm)	236.6	230.2	222.2	215.8	222.3		



What is Nominal Diameter?

The dictionary meaning of nominal is, “existing in name only”. For example a 250 A nominal size pipe has an ID of 242.8 mm and OD of 273 mm and as per schedule 80. But instead of saying 242.8 mm IDF pipe with wall thickness of 15.1 mm, we say 250A, SH80. It is easier to speak and remember.

Nominal diameter is the approximate inner diameter of the pipe. It is a rounded figure easier to use and remember. By prescribing the nominal size of the pipe, all different fittings can be selected based on the same nominal diameter, without physically checking the dimensions and compatibility of each component.

Nominal diameter is not the internal diameter but is similar to it. With reference to the above example the nominal bore of the pipe is 250 mm, but the ID varies from 266.2 mm to 222.3 mm depending on schedule of the pipe.

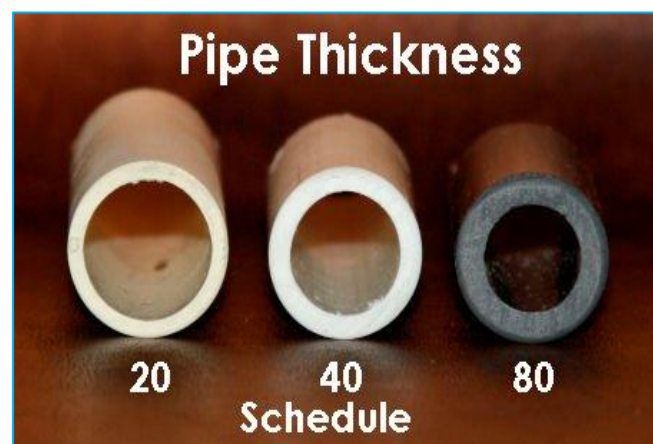
“Nominal diameter is more of a label than a size.”

Schedule of Pipes: What does it mean?

In marine field we generally use schedule 40 for light duty and schedule 80 for heavy duty. There are however many other schedules which have been incorporated due to improvement in metallurgy and requirements due to increased pressure demands.

Basically the schedule of a pipe refers to its pressure rating. The higher the schedule the higher pressure it can contain. The schedules are normally 5S, 10S, 10, 20, 30, 40S, 40, 60, 80 100, 120, 140 and 160. As the schedule increases the wall thickness increases and the ID deceases.

“**The higher the schedule number, the thicker is the pipe.**”



CHAPTER 2:

Bend & Elbow

Bends and elbows are important parts of any piping system as they allow the integration of flexibility of design by change in the flow direction of the media to be carried inside

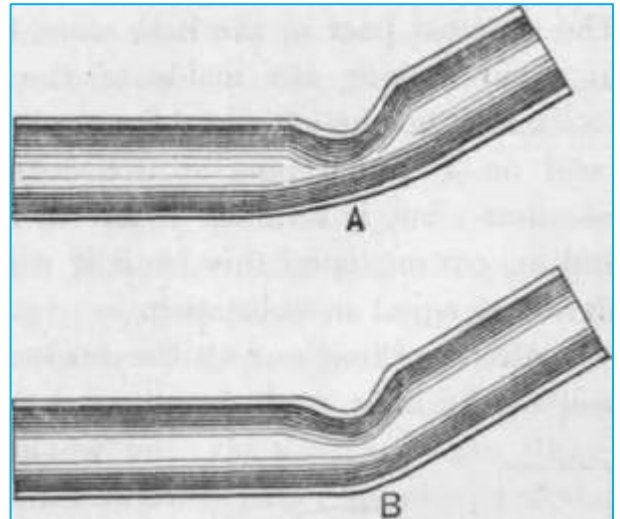


The details of these important components are discussed in this chapter



Bend or Elbow

There is always a doubt about the terms bends and elbows on ships.



They are frequently used as synonyms. The difference between them is as follows:

- Bend is a generic term for any offset or change of direction in the piping. It is a vague term that also includes elbows.
- An elbow is an engineering term and is classified as 90 deg or 45 deg, short or long radius.
- Elbows have industrial standards and have limitations to size, bend radius and angle. The angles are usually 45 deg or 90 degrees. All others offsets are classified as pipe bends.



The Basics of Pipes and Bends on Ships

- Bends are generally made or fabricated as per the need of the piping; however elbows are pre fabricated and standard, and are available off the shelf.
- Bends are never sharp corners but elbows are. Pipe bending techniques have constraint as to how much material thinning can be allowed to safely contain the pressure of the fluid to be contained. As elbows are pre fabricated, cast or butt welded, they can be sharp like right angles and return elbows which are 180 degrees.
- Elbow is a standard fitting but bends are custom fabricated.
- In bends as the pipe is bent and there is no welding involved, there is less pipe friction and flow is smoother. In elbows, the welding can create some friction.
- All elbows are bends but all bends are not elbows.
- Bend has a larger radius than elbows.



The Basics of Pipes and Bends on Ships

- Generally the most basic difference is the radius of curvature. Elbows generally have radius of curvature between one to twice the diameter of the pipe. Bends have a radius of curvature more than twice the diameter.

Short Radius and Long Radius

Elbows are again classified as long radius or short radius elbows. The difference between them of the length and curvature.

Following are some points to differentiate these two:

- Long radius elbows give less frictional resistance to the fluid than the short elbows.
- Long radius elbows create lesser pressure drop than short radius elbows.
- Short radius is less costly than long radius elbows.
- The short radius elbows are used where there is scarcity of space.



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A short radius elbow will be giving the piping a sharper turn than a long radius elbow.



In a long radius elbow the radius of curvature is 1.5 times the nominal diameter. In a standard elbow the radius of curvature is 1.0 times the nominal diameter of the pipe.

In addition to this classification the elbows of 45 degrees, 90 degrees and 180 degrees are called as a return elbow.



Miter bends

Another type of bend is a Miter bend. A Miter bend is a bend which is made by cutting pipe ends at an angle and joining the pipe ends. A true miter bend is a 90 degree bend made by cutting two pipes at 45 degrees and joining them by welding. Similarly three pipes cut at 22.5 degrees will give a 90 degree miter bend.



“**Mitered bends are simple to make and can be readily compensated to act acoustically.**”

CHAPTER 3:

Types of Elbow

Without elbows, it is impossible to think of a piping system on ship, especially in a limited place of installation. Elbows give flexibility for directing and building the piping system leading to saving of space and material.



Different types of elbows are used in the piping system of ships as per the space and design of installation.

➤ Female Elbow



A female elbow is a pipe fitting that is used to change the direction of the piping and has female threads on both sides, which allow for fixing pipes or fittings with male threads. They come in various angles like 45 degrees and 90 degrees.

➤ Male Elbow

A male elbow is a fitting with male threads on both sides and is used for changing the direction of the piping. They fix on to female threads of the fittings on both sides. They come in various angles like 45 degrees and 90 degrees.



➤ **Street Elbow**



A street elbow is different from the male and female elbows in the respect that it has a male thread on one side and a female thread on other side. The advantage of using the street elbow is that it can directly fix to the pipe without connecting a nipple. They come in various angles like 45 degrees and 90 degrees.

➤ **Reducing Street Elbow**

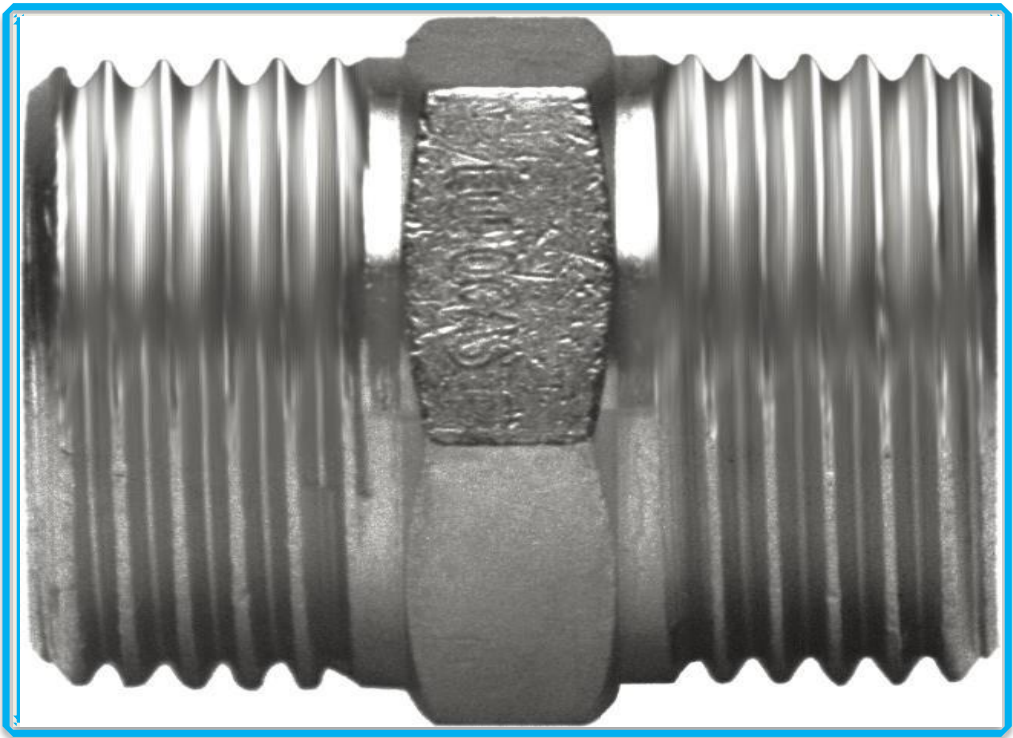
A reducing street elbow is a pipe fitting that has male thread on one side and unequal female threads on other side. They are used for altering the direction of flow as well as joining pipes of two different sizes. They come in various angles like 45 degrees and 90 degrees.



CHAPTER 4:

Types of Nipple

A nipple is basically a pipe with male threads on each side to facilitate joining two pipes or fittings with similar female threads.



It is made by cutting threads on both sides of a pipe by die or a suitable process. The nipples may be short or long.

➤ Hexagonal Reducer Nipple



A hexagonal reducer nipple is a hexagonal shaped nipple with two different sizes of threads on each side.

The purpose of the hexagonal reducer nipple is to connect the pipes of two different sizes together

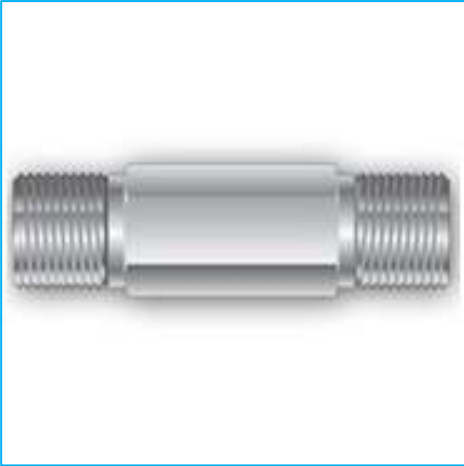
➤ Hexagonal Nipple

A hexagonal nipple is a pipe connector with male threads on both sides and a hexagonal nut in between for easy installation and screwing.

Both sides are to be screwed in pipe or fitting having reciprocating female threads.



➤ Hexagonal Long Nipple



A hexagonal long nipple is used where the distance between the pipe and the fittings is to be joined.

They are otherwise similar to the hexagonal nipples apart from the length.

➤ Long Pipe Nipple

A long pipe nipple is similar to a standard nipple but longer in length

It is used when there is more distance between the fittings or when a fitting like a valve is to be put at a distance.



➤ **Close Nipple**



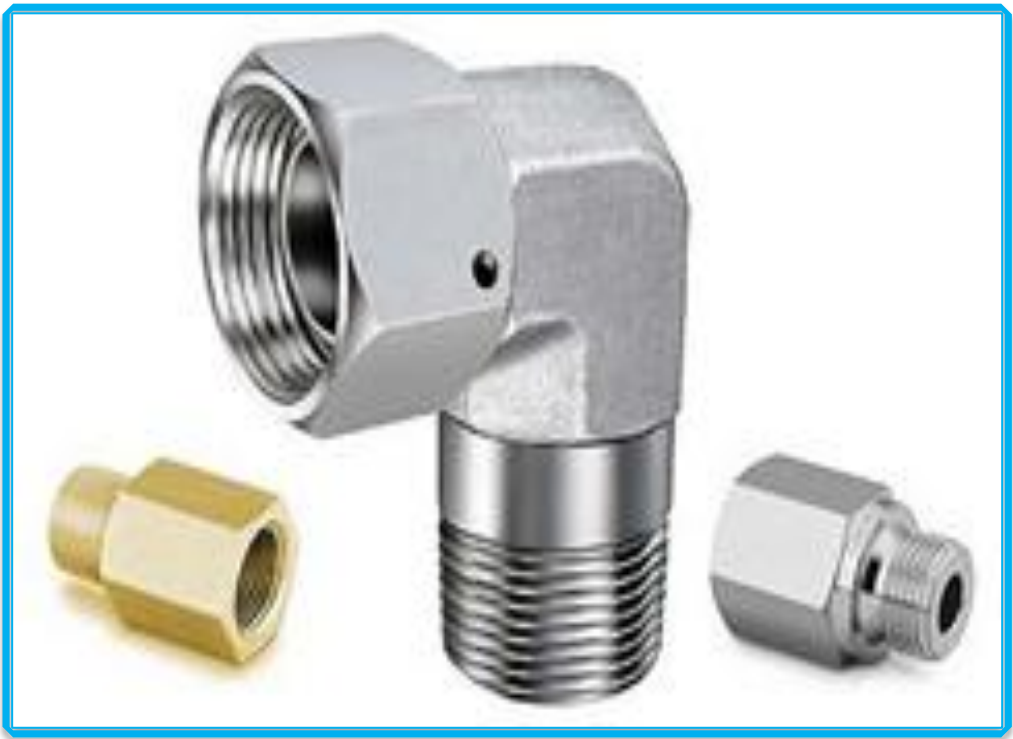
A close nipple is completely threaded and there is no unthreaded area.

This means that there is no hexagonal nut of plain pipe for putting the wrench. These can be damaged by using wrenches. Therefore, a special tool called nipple wrench, which holds the nipple from inside, is used for fitting.

CHAPTER 5:

Types of Adapters

Pipe adapters are fittings that have to adapt to changes and are therefore used for joining different types of pipes such as a pipe to a hose. Adapters are used to extend or terminate the piping. They are also used to connect dissimilar pipes.



There are male to female adapters, parallel to taper thread adapters, and pipe to hose adapters etc. Pipe adapters have a male or female thread on one side and an opposite gender thread on the other side.

➤ Gauge Adapter

A gauge adapter is used for fitting pressure gauges and instrumentation fittings. They are used for the fitting of pressure measuring instrument such as pressure gauges, gauge cocks, shut off valves etc. The different types of gauge adapters are male – female adapters, female – female adapters, male – male adapters, self sealing nipples, LH-RH unions, union nut with nipple, compression fitting with ferrule, swivel adapters etc.



➤ Reducing Adapter

A reducing adapter is used for joining a pipe to a hose or tube as well as to help in flow control.

In doing so it controls the pressure acting on the hose at the end. It is used in applications where a copper tube is joined to the main steam pipe for trace heating. These are the main types of pipe fittings. However, there are many more types. In the next article we shall continue discussing about various pipe fittings.





➤ **Hose Adapter**

A hose adapter is used where a hose is connected to a pipe. It may be the termination of the piping like a garden hose at the end or a high rating hydraulic hose used to give flexibility and movability to the system

CHAPTER 6:

Types of Tee

Pipe adapters are fittings that have to adapt to changes and are therefore used for joining different types of pipes such as a pipe to a hose. Adapters are used to extend or terminate the piping. They are also used to connect dissimilar pipes.



There are male to female adapters, parallel to taper thread adapters, pipe to hose adapters etc. Pipe adapters have a male or female thread on one side and an opposite gender thread on the other side.

➤ Female Tee



A female tee is a pipe fitting that joins one pipe to another pipe in a perpendicular direction. The female tee has female threads on all ends and pipes or fittings with male threads fit into it.

➤ Male Tee

A male tee is a pipe fitting that joins two perpendicular pipes together or makes a “tee”. It is similar to a female tee but has male threads on all ends and joins to fittings with female threads.



➤ **Street Tee**



A street tee is a pipe fitting which joins one pipe to another, perpendicular to it. In addition it has male threads on one end and female threads on other two.

➤ **Reducing Tee**

A reducing tee has two openings of same size and one of different size. These are also used to join two pipes perpendicular to each other as well as to obtain flow control.



➤ **Cross Tee**

A cross tee is a pipe fitting that joins four pipes at 90 degrees each. There is either one inlet or three outlets or vice versa.



CHAPTER 6:

Miscellaneous Fittings

➤ Reducing Coupling

A reducer coupling is a coupling with two different sizes of threads on each side.

They can also be plain reducer coupling and hexagonal reducer coupling. They are used to connect two different sizes of pipes or fittings and sometimes also for flow control.



➤ Reducing Bushing

A reducing bushing is a pipe fitting with both male and female threads that joins two pipes of different diameters.

➤ Pipe Cap

A pipe cap is a fitting that seals the end of the pipe. It is like a plug but it has female threads and screws on the male threads on the end of a pipe or adapter



➤ Pipe Plug

A pipe plug is a fitting to close or seal the end of a pipe. A plug has male threads and screws on to the female threads on a fitting.



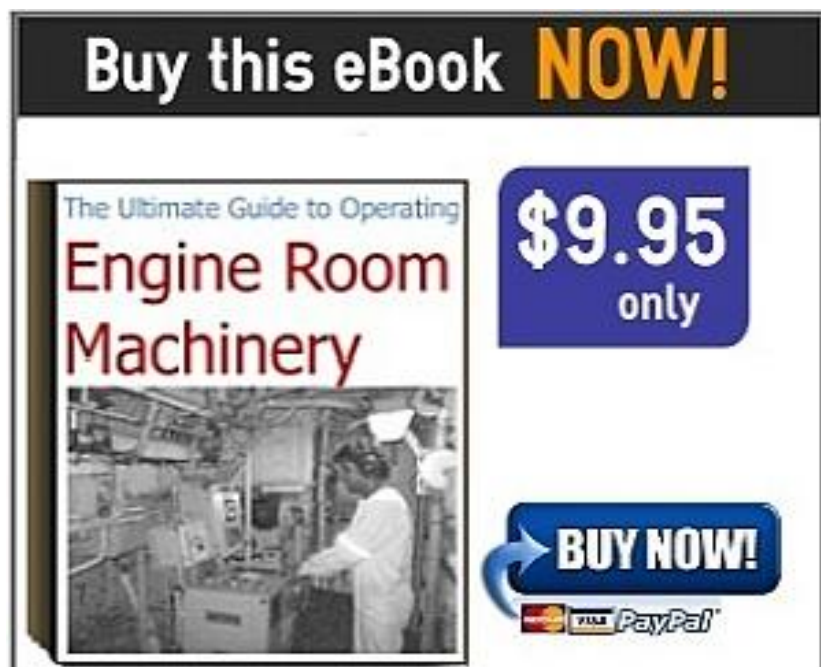
This eBook provides the basics of pipes and bends used on ships.

Kindly note that this is an “introductory” level essential guide for seafarers and is not meant for professionals looking for intermediately and advanced knowledge of the subject.

For additional information on pipes and bends used on ships, please feel free to contact Marine Insight at info@marineinsight.com.

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