

THREADED PIPING



Gustavo Cinca

Carbon Steel Threaded Piping
Calculation of Man Hours with Examples

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Author's Site <http://calculatemanhours.com>

Editorial: Gustavo Miguel Cinca.

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Introduction

This publication describes the different types of carbon steel threaded joints utilized in industry and domestic installations.

The first part of the book details the thread profiles commonly used in pipes, the different kinds of normalized fittings, and the manual and electric tools employed on construction site to execute the threading.

Subsequently, the performance tables used by the author during his career are reproduced.

In these tables are recorded the labor hours required to execute each of the threading tasks with manually operated tools.

Finally, two application examples are presented where assembly times are calculated.

Threaded joints are probably the oldest method of joining pipes and are usually employed in piping installations equal to or less than 2".

Piping threads are executed by carving a helix-shaped groove at the end of a pipe or fitting, these allow two threads to mate.

For the male part of a threaded joint, the thread appears on the outside diameter; if the part is female, the thread appears on the inside diameter.

Turning the end of the male part into a female part produces the joint.

Usually, the male end of the thread is on the pipe and the female end is the fitting.

One exception to this, for instance, is the male female elbow.

Since the male and female pipe threads must be successfully aligned to form a connection, factories must manufacture the threads following the adequate standards for this to happen.

The most common threaded joints are regulated by ASME for the American NPT thread and by BSP with its Whitworth pipe thread.

There are different types of threaded fittings available in the market that make the installation of threaded piping very versatile, simplifying joints, changes of direction, the variation of size in the line, etc.

Each of these types of fittings is manufactured in different materials, such as forged steel, malleable steel, gray cast steel, ductile steel, stainless steel, steel alloys, copper alloys, aluminum alloys, and plastics.

The technical specifications of the client or engineering are the ones that ultimately define the accessory to be used for each project.

Throughout the following chapters, the characteristics of carbon steel threaded piping, forged, malleable, or cast fittings and their assembly times are described.

Types of threaded unions

Types of pipe threads

The threads of the pipes are used to make not only a mechanical union but also a watertight union that prevents the entry or exit of fluids.

We can divide pipe threads into two types:

-Sealing threads: These are threads where the watertight joint is achieved through the interlocking of two threads.

For this joint, a tapered male thread is always used. The female thread can be parallel or tapered, and it usually be assured the hermetic with a sealer.

-Clamping thread: In this case both the male and female threads are parallel, here the watertightness is achieved by compressing a soft material (O-ring, gasket, or washer) against the shoulder of the female.

Here, the threads serve only to give clamping force.

The main pipe thread systems with triangular fillets are:

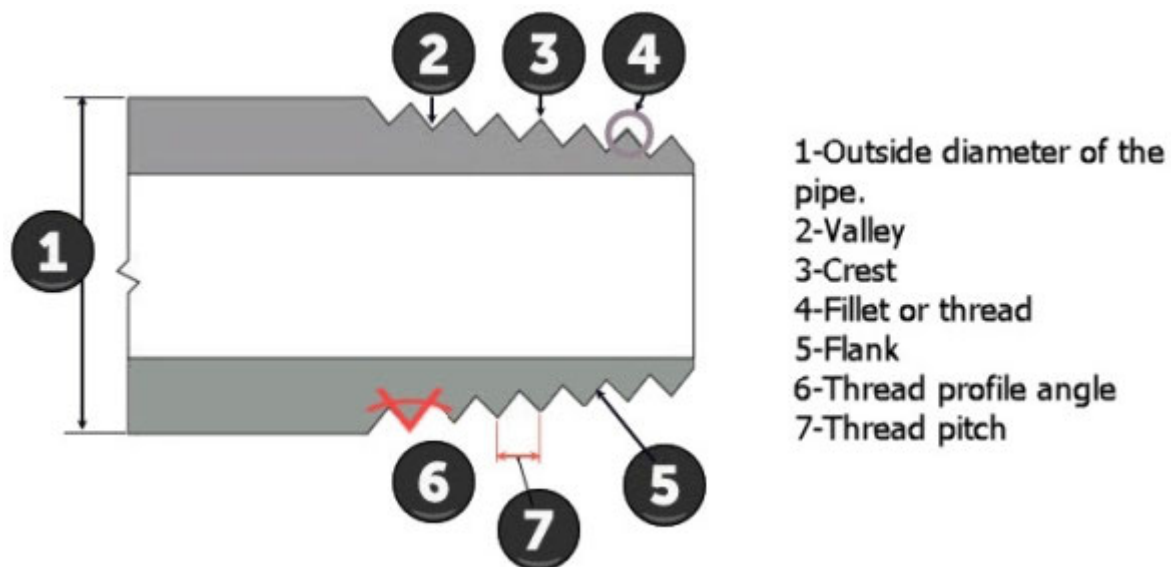
-The British standard BSP and its variants BSP tapered thread designated as BSPT, also known as ISO 7-1 and BSP parallel thread BSPP, known as ISO 228-1, widely used in Europe.

-The American tapered thread for NPT pipes and its variants, American cylindrical thread for NPS pipes, American dry seal tapered thread for NPTF pipes, American dry seal cylindrical thread for NPSF pipes, etc.

These types of threads are widely used in the United States and Canada.

In both standards, there are threads designed for clamping and others to achieve the union's sealing.

Profile of a tapered pipe thread



1-The outside diameter of the pipe.

2-Valley or internal part of the thread.

3-Crest or external part of the thread.

4-Fillet or prismatic surface (in this case triangular) in the shape of a helix constitutive of the thread.

5-Flank or side of the thread.

6-Thread profile angle or angle of the profile of a thread measured in degrees in an axial plane.

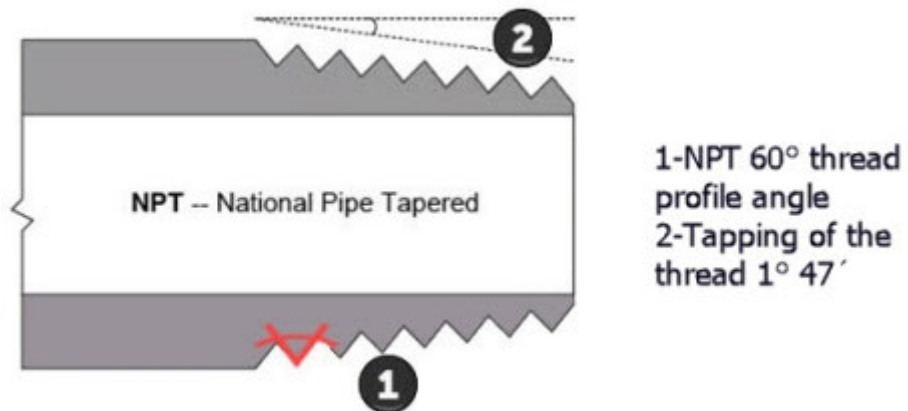
7-Thread pitch (P) or the distance between two consecutive ridges, representing the length a screw advances in a 360° turn.

Advance (a) or distance a fillet travels in the axis's direction when it makes a full turn. For a single thread, the advance (a) is equal to the pitch (P).

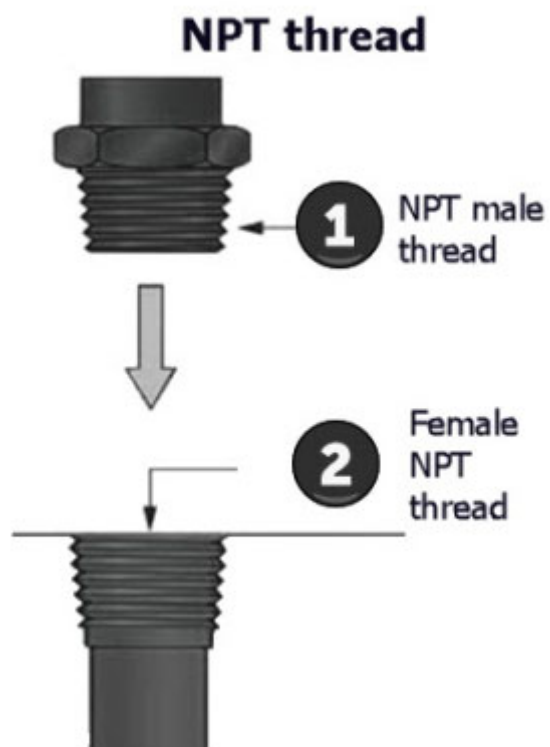
National Pipe Taper or NPT thread

In the United States, the most common standard tapered thread for general purpose pipe is the NPT, or National Pipe Taper design. The thread profile has a 60° angle, and the taper is $1^\circ 47'$. Here the crests and valleys are truncated.

We see the thread profile in the following figure:



We show the union assembly or engagement in the following illustration:



View of the union



1-View of the union, here the threads of the male and female parts are tapered.

The National Pipe Taper (NPT) thread, having truncated crests and valleys, has two possible helical leak paths, one along the larger diameter and the other along the smaller diameter. Thread sealant solves this problem.

Types of sealants:

-*Teflon tape.*

The tape must be wound tightly around the male pipe threads following the direction of the thread advance so that the turning movement produced when the pipe is joined to the fitting follows the same direction as the tape winding.

The sealing tape makes it easier to insert the male into the female thread while filling minute gaps to prevent leakage.

Teflon tape also makes it easier to disassemble the joint, reducing thread wear and the tendency for threads to stick together.

But it has the disadvantage that under dynamic loads its lubricating effect favors loosening of the unions.

Special Teflon tapes (100% Teflon) that are not contaminated with oil or grease should be used on the threaded joints of oxygen and fuel gas lines.

-Thread sealants.

Thread sealants have the function of:

-Filling the spiral gap that forms between the female thread root and the male thread crest and vice versa.

-Lubricate the male part and the female part.

-Protect the surface of the metal so it does not corrode.

There are specific sealants that are used to seal tapered threads in each type of industry, such as chemical, oil & gas, power generation, etc.

Anaerobic sealants, which do not change size with curing, are recommended.

Thread sealing is achieved as the anaerobic adhesive cures, being confined in the absence of air, and between tight metal surfaces.

This technology is ideal for seals, which are considered dynamic for vibration, pressure changes or temperature changes.

The sealant used must be non-toxic, lead-free, and suitable for service in a wide temperature range.

NPT thread designation

An NPT thread in a 1/8" diameter pipe or fitting is designated as: 1/8-27 NPT, where 27 is the pitch value.

Most threaded pipe fittings are right-hand threads, but left hand (LH) thread options are available. If the thread pitch were counterclockwise, the thread designation on a 1/8" pipe or fitting would be 1/8-27 NPT LH.

NPTF-National Pipe Thread Fuel

The National Pipe Taper Fuel (NPTF) dry seal thread is designed to have a mismatch between the larger and smaller diameters so that they deform on final tightening to achieve an optimum mechanical seal.

For better sealing, a tapered male National Pipe Taper Fuel (NPTF) dry seal thread is coupled with a parallel female National Pipe Straight Fuel (NPSF) dry seal thread.

This combination achieves better sealed because of the reduced assembly force required and the concentration of the compressive force.

BSP-British Standard Pipe parallel (cylindrical) or "Gas" thread (G). DIN 3852-B

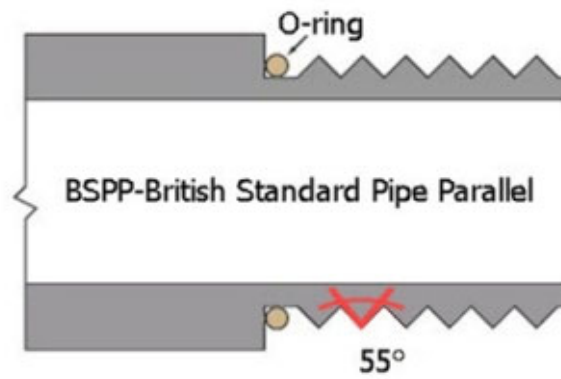
BSPP is a type of Whitworth thread, a name derived from the inventor of the same and whose origins date back to mid-nineteenth century England. The Whitworth thread is formed by a triangular fillet with an angle between flanks of 55° and with rounded crests and roots.

This thread became the most used for threaded pipe connection and turned into British standard, known as British Standard Pipe Thread or BSP Thread

Sealing is done by an O-ring that compresses and fits against the shoulder of the female.

BSPP threads are regulated by ISO 228-1: Pipe threads for joints without thread sealing.

We show the profile of the thread in the following figure.



BSPP Thread Designation

It is designated by the letter G, followed by the nominal pipe diameter in inches according to ISO 228-1. For example, G 2.

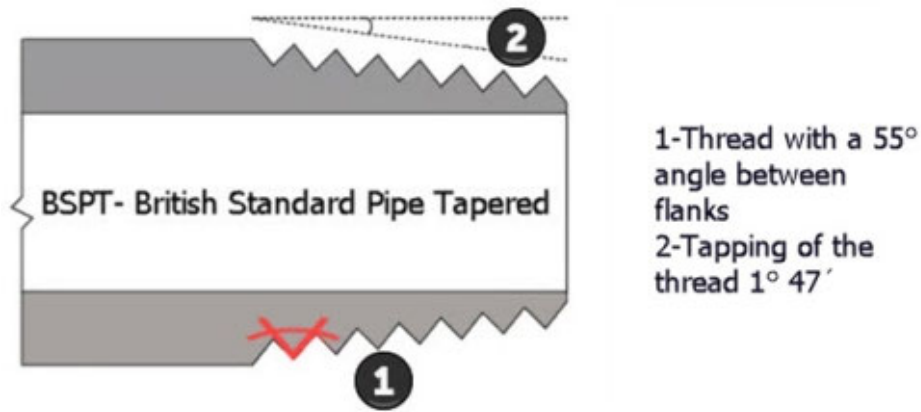
British Standard Pipe Tapered or ISO 7-1

Another tapered thread standard is the BSPT, or British Standard Pipe, according to ISO 7-1.

The BSPT threads have a 55° thread angle and with rounded ridges and valleys that in theory eliminate the helical leakage path.

But as the threads are not perfectly manufactured, leaks occur that also require the use of sealant for these threads.

We can see the profile of the thread in the following figure:



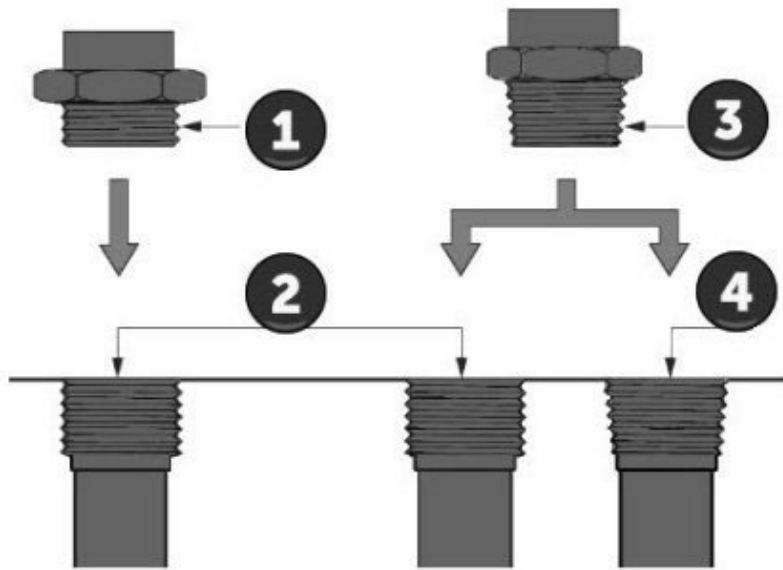
The tapered male be threaded against a female thread that can be tapered or parallel..

Using the female internal thread Rp parallel (BSPP) with the male external thread R tapered British Standard Pipe Taper (BSPT) to concentrate pressure on one point results in a dry seal.

The designation according to ISO 7-1 (EN 10226-1) is R for external thread (male) and Rp and Rc for internal threads (female), Rp being cylindrical and Rc being tapered.

We illustrate this in the following figure:

BSP



- 1-Parallel male thread
- 2-Parallel female thread
- 3-Tapered male thread
- 4-Tapered female thread

View of the unions



BSPT thread designation

Threads of this type are designated by the letter R, followed by the nominal pipe diameter in inches according to ISO 7-1.

For example, R 2.

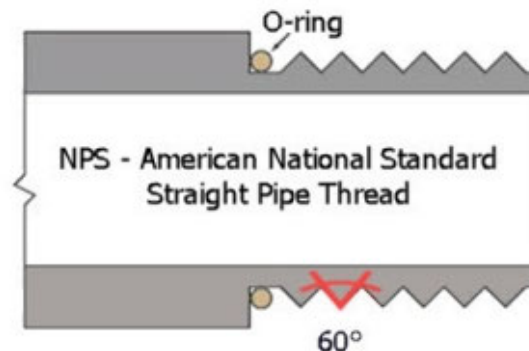
NPS - American National Standard Straight Pipe Thread.

An alternative to tapered threads in pipe joints is the use of parallel threads, like threads on machine screws and bolts.

Since the parallel threads of the male and female parts are incapable of forming an internal pressure-tight seal by themselves, the sealing action must be achieved otherwise.

This role is normally accomplished with an O-ring or gasket.

We show the profile of the thread in the following figure



Sealing is achieved by compressing the O-ring against the shoulder of the female.

The threads serve only to provide clamped (not to seal the fluid), much like the threads of a fastener.

Primary uses of threaded piping

Metal threaded pipes are used in non-critical applications and when the service fluid is at room temperature, usually in small diameters equal to or less than 2".

The employment of threaded joints is not permitted by ANSI B31.1 if severe erosion, crevice corrosion, shock or vibration, or service temperatures over 96° C are expected.

Coupling length in NPT threads.

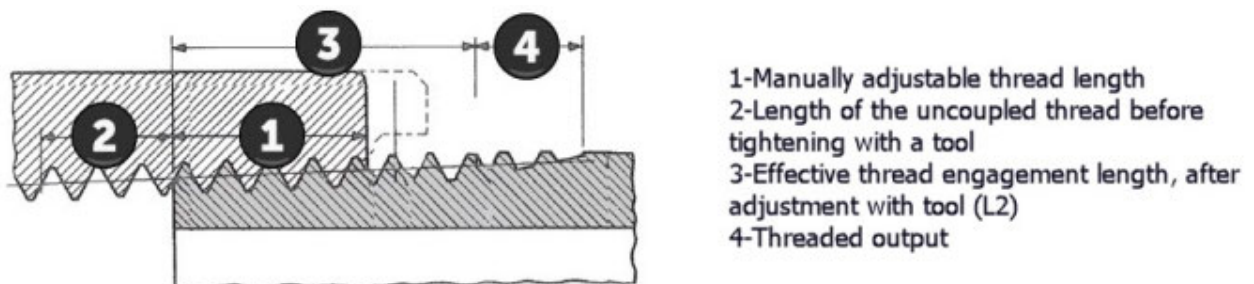
Because of the taper, a pipe is manually threaded into a fitting up to a certain length and then locked. The standard specifies at this distance like the length that the pipe thread can be screwed in manually.

The standards also specify another distance, which is the effective thread length.

We define the effective thread length as the thread length required to achieve the seal on thread with a conventional machining.

The following figure shows the thread engagement diagram.

The following figure shows the thread engagement diagram



Note:

- The distance "4" is known as the thread exit (the threads vanish until they reach the outer diameter of the pipe) and should remain visible after tightening with a tool.

- Over tightening will cause the threads in zone "4" not to be visible.

Over-tightening of the joint implies a high risk of leakage.

We can also get the effective thread engagement length analytically using the following equation:

$$L_2 = (0.8D + 6.8) / n$$

Where

D= external diameter of the pipe.

n=threads per inch.

For example, for NPS 1" pipe the outside diameter is 1.315" and n= 11.5 so $L_2 = (0.8 \times 1.315 + 6.8) / 11.5 = 0.6828"$.

For pipe installers, it is more practical to know how many turns are required for manual adjustment and how many for adjustment with a tool.

A simple rule of thumb for installing pipe with tapered threads, both metal and plastic, is to hand tighten until the threads are blocked and then tighten one or two more turns with a tool.

Pipe Threading Equipment

We can make an external or internal thread in two ways: by hand or by machine. The machines that are generally used are lathes or special machines for threading.

For hand threading of female threads, thread taps are used, and for making male threads a die set is used.

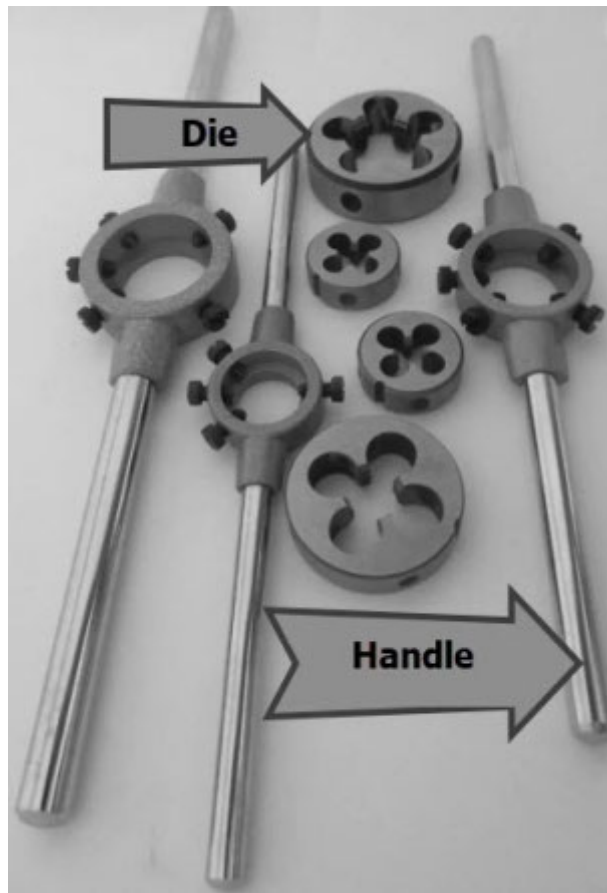
Threaded fittings supplied by the manufacturing industry offer all the female threads required for the threaded pipe systems, so the tools required for male or external threading are described in more detail here.

Manual external threading is an operation that comprises cutting a continuous helical groove in the outer surface of a pipe by machining using an implement called a die set that cuts the spiral that forms the pipe thread.

Manual die stock

The die stock in its simplest expression is a set composed of a steel threading die hollowed out in such a way that the blades protrude towards the center, plus support which receives the dies and which has two handles opposite in the central part, and that allows it to execute the force and rotation to execute the thread.

We use the die stock for both metal and plastic pipes. See figure:



This tool is the cheapest option, but also the least efficient threading method, as it requires significant physical effort as the diameter of the pipe increases.

Besides the die, we require a series of tools and accessories to carry out the threading of a pipe, including a stand or tripod with a screw or chain press to hold the pipe, a pipe cutter, a scar, threading oil, etc.

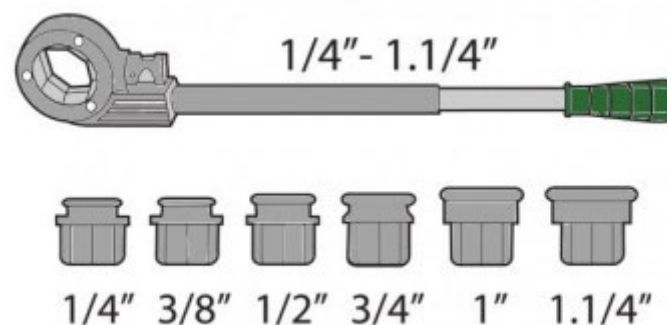
Manual ratchet threaders

The ratchet threader's use a manually operated cricket and different interchangeable die heads.

The ratchet of the threader machine has a single handle and the ratchet action allows it to be used in small spaces.

Its size and convenience allow pipe installers to cut a section of pipe already assembled and then execute its threading or also to rework a damaged thread in that pipe.

We show this type in the following figure:



Adjustable threading machines for different pipe diameters

Adjustable threading machines are those that using a mechanical system that can regulate the distances of the dies to achieve different thread diameters.

They allow, for example, threading pipes from 1 1/2" to 4" with a single tool, just by changing the dies.

The following figure shows an adjustable 4-arm threading machine



Steps to be followed to execute a thread with the manual ratchet threaders

1-First inspect the threader before use.

2-Change the dies and any other parts that show signs of damage or wear.

3-Hold the pipe on which the thread is to be made in a stable screw or chain pipe press. If you are threading a pipe that has already been installed, make sure it is firm and will not move. Cut the end of the pipe cleanly at a right angle using a pipe cutter.

4-Scarify the end of the pipe to remove any burrs that may have occurred during the cutting of the pipe.

5-Select the correct die head for the size and type of pipe to be threaded and the thread form you need.

Insert the die head into the ratchet.

Insert the back of the threader into the pipe and apply slight pressure to the front of the die head while simultaneously lowering the handle to start the threader, making sure the ratchet works.

6-When threading by hand, the operator should load his weight on the handle to make the leverage better. If possible, do not do all the work with your arms; use your weight.

7-As the workpiece is threaded forward, we recommend it to back up a little and then continue forward. In this way, you advance at a slower pace, but with a better result (cleaner thread and better finish). For example, once we make a 360° turn with the thread, we go back to 180°. Then we advance again at 360° and go back again to 180° and so on.

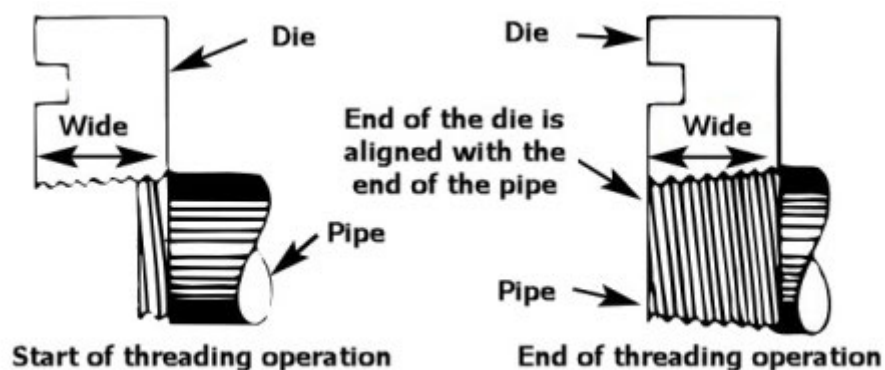


8- Apply a generous amount of cutting oil.

Using lubricating oil or a poor thread-cutting oil can lead to poor quality threads, defective joints, shorten the life of the dies and demand too much force on the handle.

9. Stop threading when the ends of the die are aligned with the end of the pipe. It is precisely at this point that we have reached the correct thread size to produce a correct joint.

Continuing beyond this point will cause a poor thread.



When the thread has been completed, reverse the die head by reversing the direction of the ratchet mechanism and placing the die head in the opposite direction.

When you have nearly removed the dies from the thread, keep the threader securely fastened and under control so as not to damage the thread.

Clean up any oil spills or splashes on the ground. At the end of each job, especially clean the pipe threader dies after each used to remove adhering oil and metal particles that could cause poor quality threads on the next work, then store them in a clean, dry place so they are not damaged.

Hand-held power drives

This type of machine has an excellent performance and is widely used in the market for pipes and conduits.

There are electric tapping machines of different sizes with a handle that is held by the hands while the end piece rotates to make the thread. These threading machines are suitable for confined spaces.

The reverse rotation, once the threading is completed, is selected with a reversible switch.

The figure shows the machine in position:



Electric foot threading machine

This type of machine can thread a wide range of pipes, including black pipes, galvanized pipes, stainless steel pipes, plastic pipes, resin pipes, steel rods, etc.

The motor rotates the pipe for cutting, threading, and reaming

These units typically operate at 36 RPM for 1/4" to 2" pipe and 12 RPM for 2 1/2" to 4" pipe.

With constant and adequate lubrication of the dies and the workpiece, it allows the cutting of conical or straight BSPT/BSPP or NPT/NPS threads.

Motor control for reverse/stop/advance, is achieved with an integral heavy-duty rotary foot switch that allows the pipefitter to have both hands free for the workpiece.

This equipment allows us to produce finished products in a short time.



Threading oils

Threading oils are used to cool and lubricate the cutting die and the workpiece.

Using threading oils assists the threading process because:

- It keeps the die and the workpiece at a stable temperature (this is critical when working with tight tolerances) and therefore improves the quality of the thread.
- Maximizes the life of the cutting dies by lubricating the working edge.
- Reduce threading torque and speed up metal removal.
- Prevents rusting of threading dies and machined threads.

Oils should be selected according to the pipe service to be installed and the pipe material to be threaded.

Taps

The threads of the accessories are executed by the manufacturer according to the reference standard.

Assembly specifications in industrial plants do not allow maintenance or reworking of female threads with taps.

Taps are widely used in electrical assemblies, e.g. in explosion-proof installations to execute the female threads into the aluminum boxes.

Basic tapping.

-The operation of executing female threads can be done manually or by machine.

-We use hand tapping for very specific jobs and for making threads that do not need too much precision, while machine tapping is used for mass production or when more precise threads are required.

-To make a female thread, first, a smooth hole must be drilled with a drill, and then the hole must be machined with the appropriate taps.

-The set of taps is selected according to the type and diameter of the standard thread to be executed.

-Once the set of taps to be used has been chosen, the recommended drill is searched for in the tables.

-For tenacious materials, we execute the hand tapping process using three taps in succession. The first tap is used to start and guide the thread. The next one executes a medium thread, and the last one finishes and calibrates the thread.

The figure shows a set of taps



correct selection of the lubricant is critical in the threading operation.

-The vast majority of taps are constructed of HCS high carbon steel (hand tapping only) or HSS (High-Speed Steel) which have high levels of hardness and very good wear resistance.

-When working with machines, we use reference tables where the workpiece and its mechanical properties are correlated with the cutting speeds and the type of lubricant recommended.

Threaded accessories

Threaded forged steel accessories

The table below lists the various types of forged accessories, and the standards or references covering them.

FORGED STEEL THREADED FITTINGS	REFERENCE
45 degree elbow, 90 degree elbow, tee, cross with H-H ends, M-H threaded elbows, coupling, half coupling, cap, square and hex head plug, hex head reduction bushing and reduction coupling.	ASME B16.11
Class 3000 And 6000 Pipe Unions, Socket Welding and Threaded (Carbon Steel, Alloy Steel, Stainless Steels, And Nickel Alloys)	MSS SP-83
Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Buttwelding Ends	MSS SP-97
Reduction nipples and special plugs	MSS SP-95
Pipe nipples threaded	ASME A773

NOTE:

-BSI through BS 3799:1974 establishes the specification of steel piping.

This specification matching with ASME B16.11, ASTM A 234, and ASTM A 403 for threaded fittings and socket welds for the petroleum industry.

The relevant characteristics of forged threaded fittings are:

-ASME B16.11-2016 - Forged steel accessories, socket welding and threaded.

Scope:

ASME B16.11 covers forged steel fittings, including socket welding and threaded type of carbon steel, alloy steel, and stainless-steel materials.

This chapter addresses only the salient features of forged carbon steel threaded fittings with both internal and external threads that meet ASME B1.20.1, titled "Pipe Threads, General Purpose, Inches.

The numerical value or pressure class 2000, 3000, or 6000, mentioned in the standard, is an indicator of the permissible static pressure, expressed in pounds or psi, that the accessory can resist at room temperature.

This applies, except for AISI 304, to all materials included in Table I of ASTM A34 for temperatures below 40°C.

ASME B16.11 allows the 2000 series besides the 3000 and 6000 series only for 90° and 45° elbows, tees, and crosses with female-female ends. All other threaded forged fittings follow the pressure classification class 3000 and 6000.

Designation of the threaded accessories.

Type of fitting + "threaded" + "forged steel" + ASME B16.11 + Ø
(DN or NPS) + Series + Material.

Example: Forged steel threaded fitting, NPS 1", Series 3000, Material
ASTM A105.

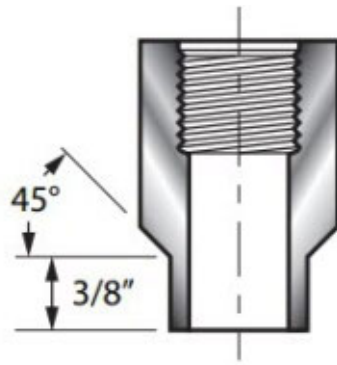
Overall dimensions of forged steel threaded fittings:

The standard establishes dimensional tables of the following
elements:

A) 45° and 90° elbow, normal tee and cross. Material: All grades.
Ends: female-female. Sizes from 1/8" to 4". Pressure class 2000,
3000 or 6000.



B) Couplings, half couplings, boss, screw caps, and couplets.
Material: All grades. Ends: female-female, female-bisel, female-flat.
Sizes from 1/8" to 4", except couplets with sizes from 1/4" to 4".
Series 3000 and 6000.



Couplet
Dimensions: ASME
B16.11
Sizes: 1/4" to 4"
Materials: All grades

C) Male/female Ends: male-female. Sizes from 1/8" to 2". Series 3000 and 6000. Threads according to ASME B1.20.1- (NPT)



Male/female elbow
Dimensions: ASME
B16.11
Sizes: 1/8" to 2"

D) Hexagonal, or round head cap and reduction bushings. Material: All grades. Ends: Male for plugs and male female for bushings. Sizes from 1/8" to 4", except for 1/4" to 4" bushings. Series: not identified by series but can be used up to class 6000.



Reduction bushing
Sizes from 1/4" to 4"
Dimensions: ASME
B16.11
Material: All grades

Tolerances: Accessories must meet the dimensional tolerances listed in Table 4 of ASME B16.11.

The fitting should be geometrically inspected to verify:

- a) Concentricity of holes
- b) Shaft matching (thread alignment), stated in paragraphs 7.1.1 and 7.1.2. of ASME B16.11

Tests:

Point 8.1 of ASME B16.11 states that no testing is required.

But paragraph 2.2 of the standard states that the fittings shall be capable of withstanding the hydrostatic pressure test required by the applicable code for a seamless pipe of equivalent material to the forged fitting.

Correlation between the pressure class of fittings and the SCH, or wall designation of the pipe on which we mount them:

Class 2000: SCH 80, or wall designation XS.

Class 3000: SCH 160.

Class 6000: wall designation XXS (double extra strong)

The pipe used can be thinner or thicker than the one stated in the earlier paragraph. When the pipe is thinner, its resistance should

govern the range. When a thicker pipe is used, it is the resistance of the fitting that decides the line pressure limit.

Marking of accessories

Each accessory shall contain permanent neck or shoulder markings. Cylindrical fittings must be marked on their outside diameter, the mark cannot be erased or affected by threading.

This standard does not demand the marking of caps and reductions.

The marking must include, but not be limited to:

- Logo or name of the manufacturer.
- Material identification.
- Reference to the applicable standard.
- Series (the three zeros may be replaced by an M)
- Size (NPS)

Omission of Marking:

When the size and shape of the accessory does not allow all the information to be marked, priority will be given to marking the manufacturer's logo, and the material.

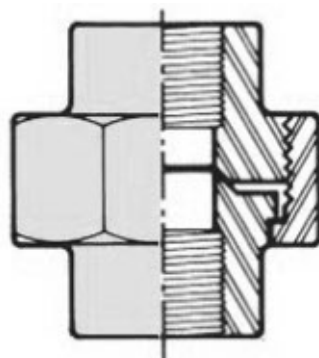
Forged accessories not included in ASME B16.11.

The following forged threaded fittings are not included in ASME B16.11 and are covered by the specifications listed below:

- MSS SP-83 double threaded fitting
- MSS SP-97 threaded bypass fittings
- Special caps (sausages) MSS SP-95
- Steel welded and seamless nipples ASME A773.

MSS SP-83-2018. Class 3000 and 6000 pipe unions, socket welding and threaded (carbon steel, alloy steel, stainless steels, and nickel alloys).

This standard practice sets the minimum requirements for essential dimensions, finishes, tolerances, testing, marking, material, and performance for A 105 forged carbon steel and alloy steel, stainless steel, and nickel alloys.



Forged steel union.
MSS SP-83

Marked

-The name or mark of the manufacturer.

-Identification of the grade of material.

The materials of the nut and ends must be the same (except where the ends are F304L or F316L, in this case, it is accepted that the nut is F304 or F316 respectively)

-Batch of material or casting number for traceability.

-Service designation: 3000, 6000 or 3M, 6M (M to designate units of 1000)

-Nominal pipe size.

MSS SP-97-2019 includes essential dimensions, finish, tolerances, testing, marking, material, and minimum strength requirements for 90° and 45° integrally reinforced forged branch outlet fittings of butt welding, socket welding, and threaded types

Unless specified otherwise by the manufacturer, conventional integrally reinforced forged branch outlet fittings are intended for the following header by branch combinations: STD × STD, XS × XS, SCH. 160 × SCH 160, XXS × XXS, XS × 3000, SCH 160 × 6000, and XXS × 9000.

When the run and branch pipes are of differing or mixed schedules, then the selection of the branch connection shall be determined by contacting the manufacturer.

Such selections shall be agreed upon by purchaser and manufacturer at the time of order and may involve supplemental marking requirements determined by other standards (e.g., material grade determination and other factors)

Mixed schedule branch outlet fittings are unique to the design of each system, and thus outside the scope of this Standard Practice.

Mathematical analysis may establish the adequacy of the design for light, intermediate, and heavy as contained in the applicable pressure vessel or piping codes, or by finite element analysis.

Fittings manufactured to this Standard Practice, are designed to make a fully reinforced branch connection under applicable piping code requirements, when attached, at an opening in a run pipe using a full penetration weld.

Fittings, otherwise conforming to this Standard Practice, may be made to special dimensions, size, shape, tolerances, or other dimensional requirements of other wrought material by agreement between the manufacturer and the purchaser.



Thredolet has the basic configuration of the weldolet with the threaded end branch connection in classes 3000 and 6000.

ASME A773 03, Welded and seamless carbon steel nipples.

Covers short and long, fully threaded nipples. Material: SCH 40, SCH 80, SCH 160, and XXS pipes. Ends: male-male, male-bevel, or male-flat.

Sizes from 1/8" to 6" for SCH 40 and SCH 80 nipples and from 1/2" to 6" for SCH 160 and XXS nipples.

MSS SP-95-2018

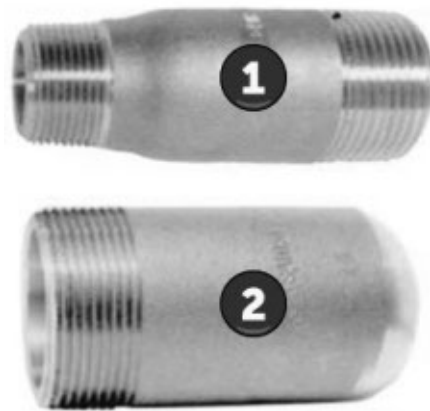
It covers the dimensions, finish, tolerances, marking and material of carbon steel and alloy steel:

-NPS 1/8 to NPS 12 reduction nipples

-Male plugs (hollow or solid), NPS 1/8 to NPS 12.

These fittings are made with threaded, beveled, square cut, grooved ends, or any combination of these.

It includes both concentric and eccentric reduction nipples.



MSS SP-95
 1-Concentric reduction nipple with threaded ends.
 2-Male plug with both threaded ends.

Partial

Under the agreement between the manufacturer and the buyer, accessories of special dimensions and accessories made of non-standard materials may be designed and manufactured.

Malleable iron threaded fittings.

The table below lists the malleable threaded fittings and the standards that define them.

MALLEABLE IRON THREADED FITTINGS	ASME
90° and 45° elbows, tees and crosses with H.H. ends, normal and with reduction. 90° and 45° elbows and tees with normal M-H ends Y-branches at 45° normal. Normal and reduced couplings. Caps. Threaded curves with 180° return.	ASME B16.3
Male threaded plugs, reduction bushings and counter nuts with pipe thread.	ASME B16.14
Malleable iron unions: Classes 150, 250 and 300.	ASME B16.39

NOTE:

ISO 49 or BS EN 10242, title: "Malleable cast iron threaded pipe fittings", covers specifications for threaded fittings for the transmission of general-purpose fluids and gases according to ISO 7-1, sizes 1/8" to 6".

-The designation according to ISO 7-1 (EN 10226-1) is R for external thread (male) and Rp and Rc for internal thread (female), Rp being cylindrical and Rc being tapered.

-Parallel threads are regulated by ISO 228-1: Parallel pipe threads for joints without sealing in the thread, with designation G (gas).

The relevant aspects of malleable threaded fittings, with both internal and external threads complying with ASME B1.20.1, are listed below:

ASME B16.3-2016. Malleable Iron Threaded Fittings: Classes 150 and 300.

Malleable iron has good resistance to impact, is ductile, and is highly machinable. Its major disadvantage is that it shrinks when cooled. This is because it loses volume as it cools.

We use the malleable iron fitting in light industrial applications, for example, plumbing applications.

Note:

Ductile iron shrinks much less than malleable iron.

This property makes ductile iron less prone than malleable iron to internal defects and weaknesses caused by the casting process.

Both types of irons are strong, and good for machining into new shapes. Ductile iron is used to make pipes.

The chemical and physical properties of castings should follow ASTM A197. The manufacturer must certify that they have produced the product in this way.



Y-branch at 45°.
Malleable iron threaded
accessory. ASME B16.3

This standard defines pressure-temperature grades, marking, material, dimensions and tolerances, type of thread and coatings.

Sizes class 150:

-45 and 90° elbows, tees, and normal crossings are manufactured from 1/8" to 6". Sizes of elbows, tees, and crosses with reduction are determined in the standard.

-Normal 45° threaded Y-branches range from 3/8" to 4".

-Normal and reduced couplings go from 1/8" to 4".

-The threaded caps go from 1/8" to 6".

-The threaded curves with 180° return from 1/2" to 4".

Sizes class 300:

-45 and 90° elbows, normal tees and crosses are manufactured from 1/4" to 3". The sizes of elbows and tees with reduction are determined in the standard.

-Normal couplings range from 1/4" to 3". The standard determines the sizes of the couplings with reduction.

-The threaded caps go from 1/4" to 3".

-Threaded curves with 180° return from 1" to 2".

Coating of malleable iron fittings

-Galvanized by hot immersion: According to ASTM A153. Coatings shall have a minimum thickness of 0.0034" (0.864 mm)

-Galvanized by electrodeposition of zinc, per ASTM B633, Type I, service condition 4. Zinc shall have a minimum thickness of 0,025 mm (0,001 in.)

Other special coatings upon request are epoxy, cataphoretic, hybrid, double galvanized, etc.

Marking:

Class 150 accessories.

Each Class 150 fitting shall be marked for identification with the manufacturer's name or mark.

Class 300 accessories.

Each Class 300 fitting shall be marked for identification with

-The name or mark of the manufacturer.

-Class 300.

-The letters "MI" to designate malleable iron.

-The size.

-Other markings permitted by the SMS SP-25.

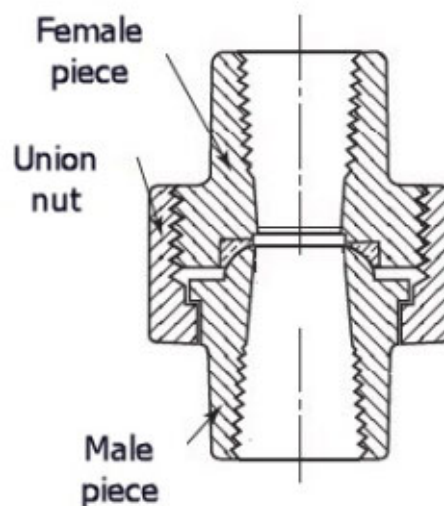
ASME B16.14-2018. Ferrous pipe plugs, bushings, and locknuts with pipe threads.

This Standard covers, pressure-temperature ratings, size, marking, materials, dimensions and tolerances, threading and pattern taper of ferrous pipe plugs, bushings, and locknuts with pipe threads.

ASME B16.39-2019. Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300.

This Standard cover threaded malleable iron unions, classes 150, 250, and 300. Sizes from 1/8" to 4.

This Standard includes requirements for design, pressure-temperature ratings, size, marking, materials, joints and seats, threads, hydrostatic strength, tensile strength, air pressure test, sampling, coatings, and dimensions.



The seat gasket type design can be a ball to a cone, ball to ball, or ball to socket with iron to iron metal or copper or copper alloy seat surfaces.

The accessory coating according to A 153 hot-dip galvanized.

Unions allow easy installation, removal, or replacement of pipe sections, valves, or piping vessels.

Marking.

The unions must be marked on the nut with the manufacturer's mark and the nominal pressure class.

Additional markings allowed by SMS SP-25 can be added.

ASME B16.4-2016. Gray Iron Threaded Fittings: Classes 125 and 250.

This Standard for gray iron threaded fittings, Classes 125 and 250 covers: pressure-temperature ratings, size, and method of designating openings of reducing fittings, marking, material, dimensions, and tolerances, threading, and coatings.

Sizes class 125:

-45 and 90° elbows, tees, and normal crosses are manufactured from 1/4" to 12".

-90° elbows with reduction from 1/2" x 3/8" to 8" x 6".

-Tees with reduction up to 6" x 6" x 8".

-Crossings with reduction from 3/4" x 3/4" x 1/2" x 1/2"

to 8" x 8" x 4" x 4".

-Threaded caps 1/2" to 12", concentric couplings with a reduction from 1/2" to 8".

-Closed and open threaded curves with 180° return from 1/2" to 4".



Class 125 grey iron tee.
ASME B16.4

In class 250, the standard only covers 45° and 90° elbows, normal tees, and crosses from 1/4" to 12".

Material.

Castings must meet the requirements of ASTM A126, Class A, B, or C.

We primarily use cast iron fittings in the assembly of sanitary, drainage, and ventilation pipes.

Grey cast iron has a high vibration damping capacity and is resistant to corrosion. But it is brittle and can be problematic to machine, as it is difficult to produce a smooth surface and can reduce tool life.

Marking:

-Each Class 125 accessory shall be marked for identification with the manufacturer's name or mark.

-Each Class 250 accessory shall be marked for identification with:

-The name or mark of the manufacturer.

-The pressure class "250".

ASME B16.12 - Threaded Cast Iron Drain Fittings.

This standard comprises the set of accessories intended for use in gravity drainage systems for waste liquids at temperatures ranging from ambient to approximately 100°C (212°F).

The use of this Standard for pressurized waste handling systems is the responsibility of the user and is subject to the requirements of any applicable code.

The fittings have been designed to allow continuous drainage of the fluid, in order to solid matter not accumulate and block the pipe.

Man-hour estimate

In this chapter, the reader will find the tables of consumption of man-hours to execute threaded connections on site of work.

The records of these tables are indispensable for the calculation of the number of man-hours required for the execution of each task.

The tables reproduced are a duplicate of those used by the author in his work activity.

Measuring the consumption of man-hours or fraction of them that are necessary to do a task; requires first to delimit the conditions within which the task is accomplished.

This ensures that the measurement is repeatable. We define these conditions as standard conditions.

Standard Conditions

If a project is executed under standard conditions, the yields indicated in the Tables for the calculation of man-hours can be applied, without the need for corrections.

On the contrary, if the project is not executed under standard conditions, the results must be corrected.

A project is executed under standard conditions, when the following conditions are met:

- The site is isolated, and the execution of the work is independent of any plant in operation.

- The consumption of man-hours (Mhrs) per activity, stated in the tables, with threaded pipes, is that used by a typical crew composed of an assistant and an officer.

- We carry the tasks out in a moderate climate (i.e. with average temperatures between 5° C and 40° C) and with winds of less than 30 km/hour.

- The area where the work is executed is free of contamination.

- We carry the work out during the day.

- We do the work in a place whose soil condition is level and dry

- The maximum height of the work plane does not exceed 1.50 m above the ground.

- A minimum free height in roofed places of 2.60 m.

- Maximum transport distance from the storage or unloading area to the construction site of 300 m.

-Operators' entrance door is 200 m or less from the work area.

-We receive engineering, and supplies according to the project schedule.

-Trained field personnel are available.

-The Construction equipment and tools are available.

-The work site must be at an altitude above sea level that does not need additional effort from the workers.

Not include man-hours consumption per:

-Assembly and removal of scaffolding.

-Review work for design errors.

It do not include the consumption of man-hours for manufacturing accessories.

It do not include the consumption of man-hours for the insulation of pipes.

Table A of man-hours consumption (Mhrs) for threaded pipe laying

NPS	SCH 40		SCH 80		SCH 160	
	Kg/m	Mhrs	Kg/m	Mhrs	Kg/m	Mhrs
1/2"	1,27	0,25	1,62	0,30	1,94	0,35
3/4"	1,68	0,30	2,19	0,35	2,88	0,40
1"	2,50	0,35	3,25	0,40	4,25	0,45
1 1/2"	4,04	0,45	5,40	0,50	7,23	0,55
2"	5,44	0,50	7,47	0,60	11,08	0,70
2 1/2"	8,50	0,60	11,50	0,70	14,85	0,80
3"	11,28	0,70	15,25	0,85	21,31	1,20
4"	16,06	0,90	22,29	1,10	33,49	1,50
6"	28,23	1,30	42,51	1,60	67,41	2,10

Note:

Mhrs include:

-Handling and alignment of pipes.

-Union of pipes with couplings.

-Tightness tests.

The records in Table N° A do not include:

-Thread execution.

-Scaffolding.

-Painting.

-Supports, insulation, etc.

Man-hour consumption tables (Mhrs) for threaded pipe assembly.

The following tables record the man-hours required for the assembly of 2000, 3000, and 6000 series threaded pipes.

The hourly consumption required is valid for standard working conditions.

Table N°1-Mhrs for the assembly of threaded pipes series 2000

NPS	Flange		Elbow and others		Tee		Valves	
	Weight	Mhrs	Weight	Mhrs	Weight	Mhrs	Weight	Mhrs
1/4"		0.3		0.6		0.9		0.8
3/8"		0.4		0.8		1.2		1.0
1/2"		0.5		1.0		1.5		1.3
3/4"		0.6		1.2		1.8		1.5
1"		0.7		1.4		2.1		1.8
1 1/2"		0.9		1.8		2.7		2.6
2"		1.2		2.4		3.6		3.0
2 1/2"		1.5		3.0		4.5		3.8
3"		1.8		3.6		5.4		4.5
4"		2.5		5.0		7.5		6.0
6"		3.5		7.0		10.5		9.0

Note:

By "other" it means that it applies to unions and reductions.

Mhrs include:

-Handling, measuring, pipe cutting, thread making, and assembly for class 2000 fittings, SCH 80, or SCH 40 pipes.

The records in Table N° 1 do not include:

-Manufacturing and assembly of supports, painting, insulation, scaffolding, etc.

Table N°2-Mhrs for the assembly of threaded pipes series 3000

NPS	Flange		Elbows and others		Tee		Valves	
	Weight	Mhrs	Weight	Mhrs	Weight	Mhrs	Weight	Mhrs
1/4"		0.4		0.8		1.2		1.0
3/8"		0.5		1.0		1.5		1.3
1/2"		0.6		1.2		1.8		1.5
3/4"		0.7		1.4		2.1		1.7
1"		0.8		1.6		2.4		2.0
1 1/2"		1.0		2.0		3.0		2.7
2"		1.3		2.6		3.9		3.4
2 1/2"		1.6		3.2		4.8		4.0
3"		2.0		4.0		6.0		5.0
4"		2.7		5.4		8.1		7.0
6"		3.8		7.6		11.4		10.0

Note:

Mhrs include:

-Handling, measuring, pipe cutting, thread making, and assembly for class 3000 accessories or SCH 160 pipes.

The records in Table N° 2 not include:

-Manufacturing and assembly of supports, painting, insulation, scaffolding, etc.

Table N°3-Mhrs for the assembly of threaded pipes series 6000

NPS	Flange		Elbows and others		Tee		Valves	
	Weight	Mhrs	Weight	Mhrs	Weight	Mhrs	Weight	Mhrs
1/4"		0.5		1.0		1.5		1.2
3/8"		0.6		1.2		1.8		1.4
1/2"		0.7		1.4		2.1		1.6
3/4"		0.8		1.6		2.4		1.8
1"		0.9		1.8		2.7		2.2
1 1/2"		1.1		2.2		3.3		3.0
2"		1.4		2.8		4.2		3.7
2 1/2"		1.7		3.4		5.1		4.2
3"		2.2		4.4		6.6		5.2
4"		3.0		6.0		9.0		7.2
6"		4.0		8.0		12.0		10.5

Note:

Mhrs include:

-Handling, measuring, pipe cutting, threading, and assembly for class 6000 or SCH XXS fittings.

The records in Table N° 3, not include:

-Manufacturing and assembly of supports, painting, insulation, scaffolding, etc.

Inspection of threaded pipes

The inspection of threaded pipes covers the following activities:

Before assembly:

- Verification that the marking of the elements complies with the standard.
- Checking the integrity of the thread.
- Concentricity of holes and coincidence of shafts (thread alignment).

After assembly:

- Hydrostatic or pneumatic pressure test.

Piping pressure test

It should be noted that pressure tests on critical processes are performed following a strict engineering protocol using pressure and temperature recorders calibrated.

Although threaded piping are not part of the critical processes in a plant, a simple pressure test on a threaded piping of an

industrial or domestic facility can prevent major trouble.

For such a situation, we show relevant aspects of pressure tests applicable to threaded pipes in industrial plants and domestic installations.

Most of the pressure tests on pipes are hydrostatic. If we execute the tests with pneumatic pressure, we must take extreme precautions to prevent a line bursting.

Water, like all fluids, is virtually incompressible and only a small amount of energy needs to be introduced to increase its pressure significantly.

Air, like all gases, is compressible, and therefore much more energy has to be incorporated to raise its pressure.

If a component or joint fails under that test pressure, the gas or compressed air escapes, releasing an enormous amount of energy and creating a dangerous situation for personnel and facilities.

However, in certain types of works where water losses cause costly property damage, it is advisable to first carry out a low-pressure pneumatic leak test, by sections or in the whole line, to verify the tightness of the joints with soapy water and then carry out the hydrostatic test.

Hydrostatic test

We test piping systems at 1.5 times their design pressure unless otherwise stated in the technical specifications.

When the test pressure is reached, we must keep it stable for a minimum time, e.g. 1 hour.

The usual test fluid for hydrostatic testing is clean potable water (unless otherwise specified) at room temperature and must not contain any substances which are harmful to the material or the process.

Normally, the testing procedure is carried out according to these stages:

- Preliminary filling a with water at low pressure of the pipe system, e.g. 1 bar
- Purge of all air in the pipe system from its highest point, while holding this pressure at 1 Bar.

Note:

After venting, we should maintain the pressure for a period to check the system for leaks.

If leaks are detected during this step, or at any other time, the pressure should be relieved, and the leaks eliminated.

-We then increase the pressure in stages until we reach the maximum test pressure.

At each stage, we maintain the pressure until it is stabilized and checked for leaks before adding more pressure.

The test pressure is influenced by the ambient temperature which, if it changes during the test, causes the system to expand or contract; e.g. cooling of the test liquid will cause it to contract and the pressure in the system will drop with no leakage.

Once the test is completed, the vents are opened and the test liquid drained, and the tested pipe is then insulated until we put it into service.

Pneumatic test

The test fluid for pneumatic tests is usually clean, dry air, and in other cases, nitrogen, natural gas, etc. is used.

The test pressure is applied progressively in stages to inspect the joints for leaks with soapy water and to allow the system to equalize stresses before further increasing the pressure. The pressure increases to move from one test stage to another are set out in the technical specifications.

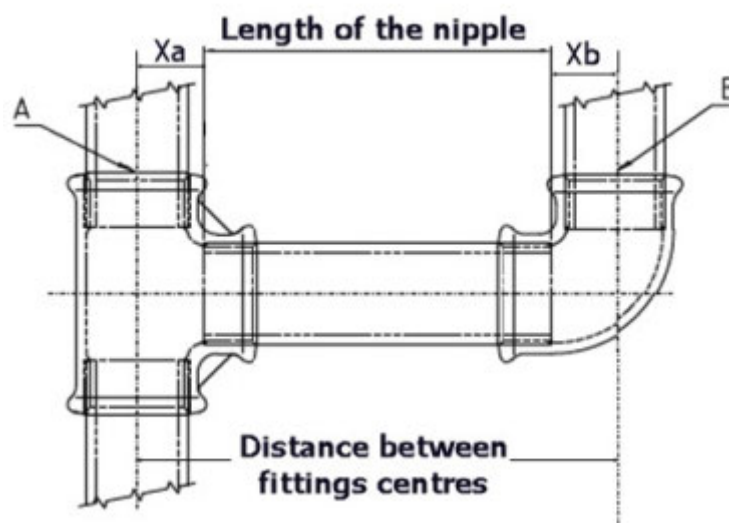
Once the test pressure has been reached, we must keep it stable for a certain period to get the consent of the client.

The system is then relieved slowly to avoid a sudden outflow of gaseous fluid that would affect the mechanical integrity of the pipe and produce an unbearable noise level.

Case Study: How to determine the length of a nipple to be cut and threaded

We will calculate the length of a nipple that joins two threaded fittings class 3000 of NPS 2", whose axes are at 1m distance.

It represents this in the following figure:



As shown in the figure the length of the nipple is equal to:

$$\text{Nipple length} = \text{Distance between centers} - (Xa + Xb)$$

Where X_a and X_b are got from the difference between the distances from the center of the fitting to the face of the fitting less the coupling length of the threads.

We get the coupling lengths of the threads from ASME B1.20.1 and are as shown in the following table.

Length of coupling												
NPS	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Coupling length mm	6,7	10,2	10,4	13,6	13,9	17,3	18	18,4	19,2	28,9	30,5	33

Where X_a = Distance from the center of the tee to the face of the fitting - the thread engagement length according to the table, i.e.:

$$64 - 19.2 = 44.8 \text{ mm.}$$

Where X_b = Distance from the center of the elbow to the face of the fitting - the thread engagement length according to the table, i.e.:

$$64 - 19.2 = 44.8 \text{ mm.}$$

$$\text{So } X_a + X_b = 44,8 + 44,8 = 89,60 \text{ mm.}$$

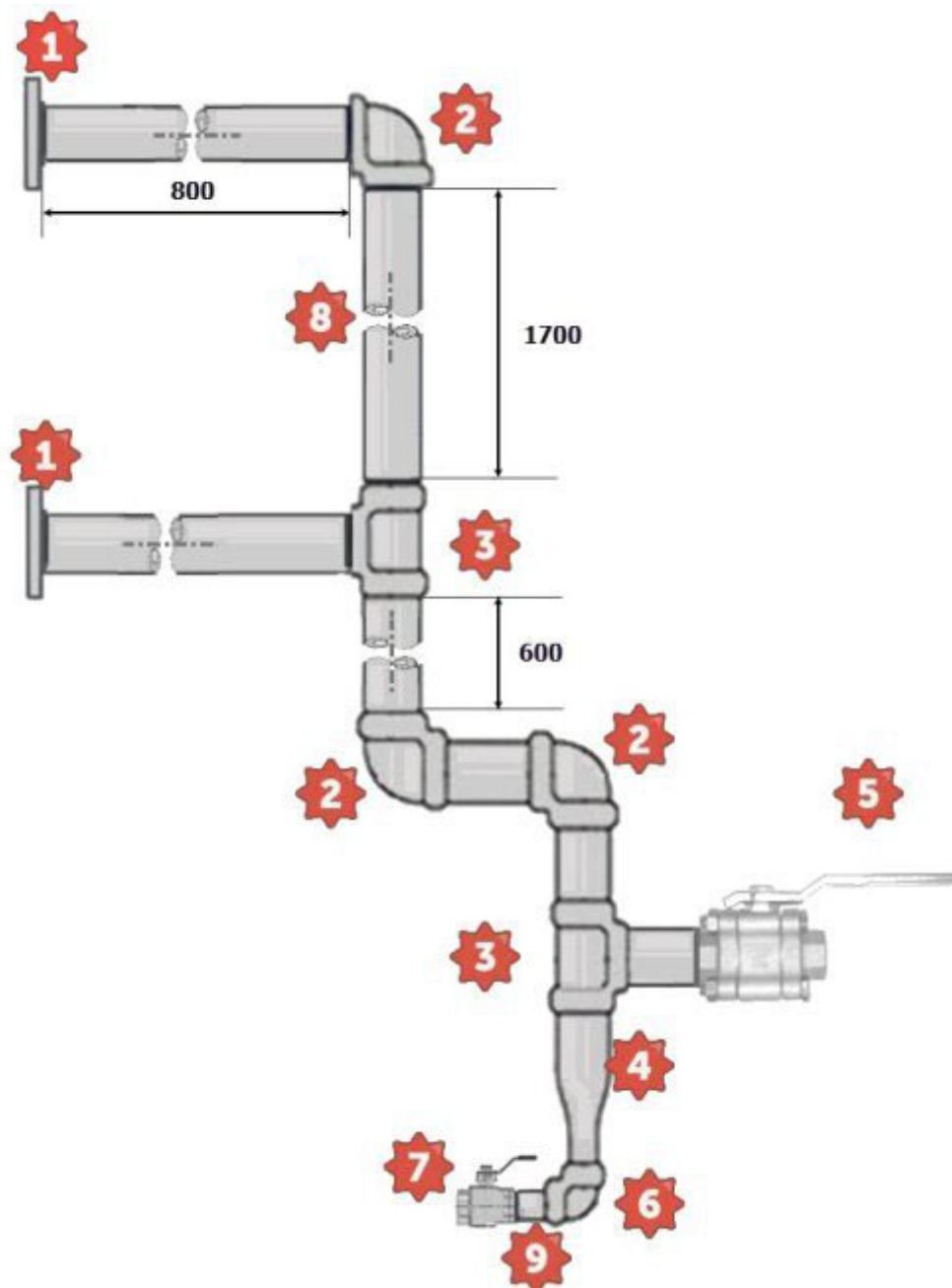
Then the length of the nipple to be cut is:

$$1000 - 89.60 = 910.40 \text{ mm.}$$

Example of application No. 1

Application example No. 1

Sketch of the piping where we will estimate the Mhrs.



Note:

- The service fluid is industrial air.

- The NPS of the largest diameter pipe is 1", we then reduce this with a reducing nipple to 3/4".

- The use of double connections depends on the assembly sequence or the indications on the project drawings.

- ASME allows the length of the threaded coupling between nipple and flange to be greater than that specified for nipple fittings.

Next, we will calculate the number of hours needed to assemble the threaded pipe section of the sketch which is made up of class 2000 forged fittings and SCH 80 pipe with hot-dip galvanized coating.

Chart 1. List of materials of the section

Item	Materials	Quantity
1	Threaded flanges NPS 1"	2
2	Elbows 90° H-H NPS 1"	3
3	Normal threaded tee NPS 1"	2
4	Concentric reduction nipple 1" x 3/4"	1
5	Threaded gate valve NPS 1"	1
6	Elbows 90° H-H NPS 3/4"	1
7	Threaded gate valve NPS 3/4"	1
8	1" NPS pipe nipples of different lengths	7
9	3/4" NPS pipe nipple	1

Steps for executing this estimate.

1-Estimation of the weight of the supports to be used.

First, we calculate the weight of the piping section.

Chart II. Weight of the piping.

Item	Materials	Quantity	Weight per unit	Weight of item
1	Threaded flanges NPS 1"	2	0,90	1,80
2	Elbows 90° H-H NPS 1"	3	0,46	1,38
3	Normal threaded tee NPS 1"	2	0,62	1,24
4	Concentric reduction nipple 1" x 3/4"	1	0,40	0,40
5	Threaded gate valve NPS 1"	1	4,20	4,20
6	Elbows 90° H-H NPS 3/4"	1	0,35	0,35
7	Threaded gate valve NPS 3/4"	1	2,20	2,20
8	1" NPS pipe nipples of different lengths. Length = 4.10 m	7	3,25 kg/m	13,33
9	3/4" NPS pipe nipple. Length = 0,50 m	1	2,19 kg/m	0,11
Total weight				25,01

The total weight of the section is 25.01 kg.

Note: The weights of the valves are approximate, in each specific case you should consult the supplier.

2-Calculation of the man-hours for prefabrication and assembly of supports.

For this, we use the total weight of the section calculated in the earlier step which is equal to 25.01 kg and we divide it by the unit weight of the 1" pipe (3.25 kg/m) to find the equivalent length in meters of 1" NPS pipe for this section of piping:

$$25,01/3,25 = 7,70 \text{ m}$$

(7.70 m is the length of a dummy pipe that weighs the same as the piping in the example), with this data and applying the following table we estimate the number of man-hours for prefabrication and assembly of supports.

Chart III Mhrs consumption to make the supports

NPS	Weight off the pipe per meter in kg		Distance between supports in meters	Kg of supports per meter of pipe		Prefabrication Mhr per meter of pipe. Mhr/m		Assembly of the support in Mhr per meter of pipe. Mhr/m	
	STD	SCH 80		STD	SCH 80	STD	SCH 80	STD	SCH 80
1 1"	2,5 2	3,25	2,14	0,5 3	0,65	0,5 4	0,65	0,1 5	0,13
1 1/2"	4,04	5,40	2,75	0,75	1,00	0,60	0,80	0,14	0,15
2"	5,44	7,47	3,05	1,00	1,35	0,65	0,90	0,17	0,22
2 1/2"	8,50	11,50	3,35	1,25	1,70	0,71	1,00	0,19	0,26
3"	11,25	15,25	5,65	1,50	2,00	0,75	1,10	0,22	0,29
4"	16,03	22,29	4,30	2,00	2,70	0,90	1,20	0,27	0,36
6"	28,23	42,51	5,20	3,00	4,70	1,20	1,80	0,37	0,60

Mhrs calculation for making the supports.

The Mhrs for the execution of the supports is the sum of the hours of prefabrication plus the hours of assembly, that is:

$$0.65 + 0.13 = 0.78 \text{ Mhrs/m.}$$

Multiplying by the number of meters we have:

$$0.78 * 7.70 = 6 \text{ Mhrs}$$

3-Mhrs for threading and assembly of the section on site

Using the labor yields stated in the tables in the earlier chapter, we get the man-hours required for this task; we show this in the following table.

Chart IV. Man-hours required for assembly.

Item	Materials	Quantity	Mhrs	Total Mhrs	Reference
1	Threaded flanges NPS 1"	2	0,70	1,40	Table N°1
2	Elbows 90° H-H NPS 1"	3	1,40	4,20	Table N°1
3	Normal threaded tee NPS 1"	2	2,10	4,20	Table N°1
4	Concentric reduction nipple 1" x 3/4"	1	0,40	0,40	Table N°1
5	Threaded gate valve NPS 1"	1	0,90	0,90	Table N°1
6	Elbows 90° H-H NPS 3/4"	1	1,20	1,20	Table N°1
7	Threaded gate valve NPS 3/4"	1	0,75	0,75	Table N°1
8	1" NPS pipe nipples of different lengths	7	0,35	2,45	Table N°1
9	3/4" NPS pipe nipple	1	0,30	0,30	Table N°1
Total Mhrs				15,80	

Total man-hours for assembly are 15.80 Mhrs.

Total Mhrs to execute the work in standard conditions:

$$\text{The total is } 6 + 15.80 = 21.80 \text{ Mhrs}$$

Corrections to apply to Mhrs of TABLE

Note: The analysis below may seem excessive, but the author's idea is to give a complete panorama of the possible corrections to apply to total standard hours.

The reader should select which factors influence his or her project.

We must correct the hours estimated by tables to adjust them to each specific project.

We call these corrections correction by variables, correction by location, correction by type of material to use (a specific topic that we analyze in other manuals), and correction by prefabrication or supply of spools.

a. Correction by variables or correction by the influence of variables that affect the estimation executed with the table.

For this example, we plan hypotheses on the degree of influence of the variables affecting this project, so that if the resulting value differs from the unit, that factor must adjust the table value.

We emphasize that the listed variables are not the only ones and it is the responsibility of the estimator or budgeters to define them for each budget.

We now analyze the listed variables.

1. Deviations for the consumption of hours calculated with the tables, according to the experience of the installer in the execution and supervision of similar

Has your company executed projects of this type? how often? what is the experience of your supervision for this project? do you have

qualified personnel available for this project?

Answer: it is a usual task of knowledge of the installer so there is no deviation (do not vary the Mhrs).

2. Deviations for the consumption of hours calculated with the tables, according to the quality of the information available to elaborate the offer.

Is the quality of the preliminary engineering to quote sufficient? was a visit to site work carried out with experienced personnel who reviewed during the visit all the aspects that will influence the performance of the personnel and the construction equipment?

Answer: this is a simple task with optimal information quality so there is no diversion (Mhrs do not vary).

3. Deviations from the consumption of hours calculated with the tables, according to the degree of labor and union demands.

What is the working schedule, will work be done at night too? Does the project have a very demanding schedule? Evaluate the local union and consider, for example, how many people from the union's labor pool should be employed by agreement and how this affects project performance.

Answer: The task is of little importance and therefore no corrections of Mhrs linked to the greater or lesser demand of a work program and/or the influence of the union are made. The local union does not intervene in small works. There is no detour.

4. Deviation for the consumption of hours calculated with the tables, depending on the soil of the site and the ease of access to the site.

What is the condition of the site? is it low and muddy, and difficult to drain, or is it high and dry? will your personnel have to travel a long distance to reach the site? are the access roads passable?

Answer: this is a place covered with stable concrete soil and easy access. there is no detour (Mhrs do not vary).

5. Deviation for the consumption of hours calculated with the tables, for the incidence of climatic factors.

What is the historical climatic condition in the project area? We can check them. What are future weather forecasts? Will there be a lot of rain, wind, or snow? What differences we expect in the climate regarding where your people usually work?

Answer: the place of work is ideal because it is an enclosed place; there is no loss of performance because of climatic factors. We do not consider them detours (Mhrs do not vary).

6. Deviation for the consumption of hours calculated with the tables, according to the height of the working plane.

Here, the tasks are performed at floor level, so the standard value of the table applies. There is no deviation (Mhrs do not vary).

Conclusion: After analyzing these 6 variables, we detect no deviations concerning the consumption of hours for an assembly in standard conditions.

We do not change the consumption of hours got from the tables for this example.

b. Correction by location or correction to be applied according to whether it is a work within an operating plant or a new work in an isolated site.

When we execute the work within a plant in operation, we link the importance of the correction to the characteristics of the plant in operation.

For this case, we apply no corrections

c. Correction by materials, when the materials of our work are different, the yields change. We will analyze this specific topic in other manuals.

Here, the elements of the section are of similar quality to those used for the recording of the yields of tables, so the total hours do not change.

Conclusion:

The total of hours to execute the work is 21,80 Mhrs.

Note:

In minor works the expenses for mobilization of work, demobilization, management of purchase of materials and indirect costs have a lot of weight.

Example of application No. 2

In this example we are going to calculate the number of hours necessary for the assembly of a section of pipe of a water installation, whose sketch, we show in the next figure.

The NPS of the main pipe is 2" with a 3/4" diameter branch, the fittings are made of class 150 malleable cast iron.

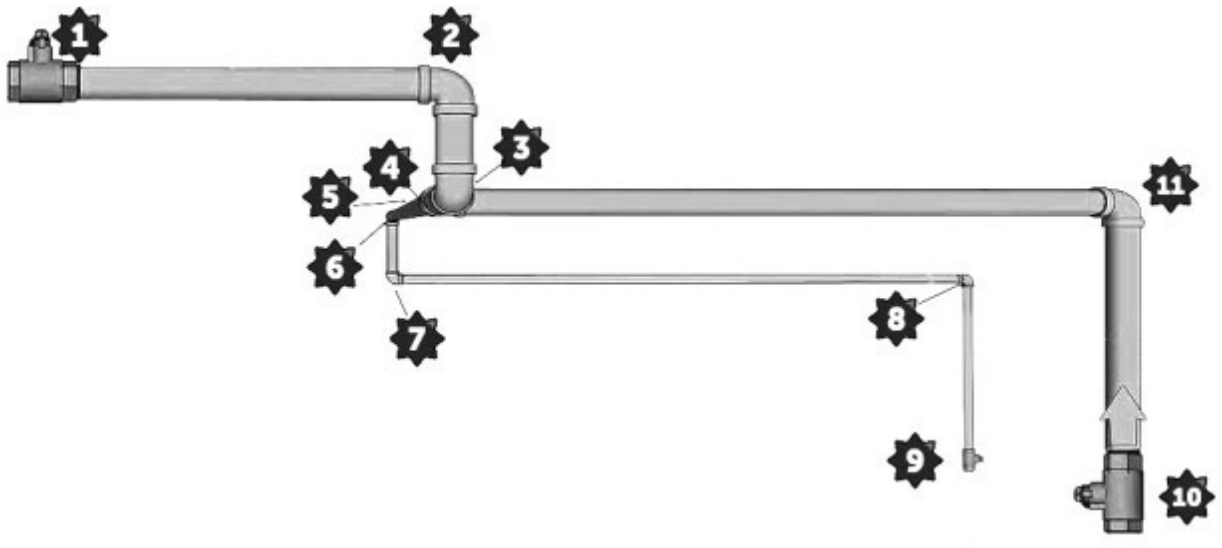


Chart A. List of materials of the section

Item	Material	Quantity
1	Ball valve NPS 2" F-F ends, threaded	1
2	90° Elbow F-F NPS 2". Malleable cast iron, threaded	1
3	90° Elbow M-F NPS 2". Malleable cast iron, threaded	1
4	Straight Tee F-F NPS 2". Malleable Cast Iron, threaded	1
5	Reduction Bushing 2" x 3/4". Malleable Cast Iron, threaded	1
6	90° Elbow F-F NPS 2". Malleable cast iron, threaded	1
7	90° Elbow F-F NPS 3/4". Malleable cast iron, threaded	1
8	90° Elbow F-F NPS 3/4". Malleable cast iron, threaded	1
9	Ball valve NPS 3/4" F-F ends	1
10	Ball valve NPS 2" F-F ends	1
11	90° Elbow F-F NPS 2". Malleable cast iron, threaded	1
12	NPS 2" hot-dip galvanized pipe. SCH 40	12 m
13	NPS 3/4" hot-dip galvanized pipe. SCH 40	8 m

Steps for executing this estimate.

1- Estimation of the weight of the supports to be used.

First, we calculate the weight of the piping section.

Chart B. Weight of piping.

Item	Material	Quantity	Unit weight	Item Weight
1	Ball valve NPS 2" F-F ends, threaded	2	1,80	3,60
2	90° Elbow F-F NPS 2". Malleable cast iron, threaded	2	0,62	1,64
3	Straight Tee F-F NPS 2". Malleable Cast Iron, threaded	1	0,76	0,76
4	Reduction Bushing 2" x 3/4". Malleable Cast Iron, threaded	1	0,30	0,30
5	90° Elbow F-F NPS 3/4". Malleable cast iron, threaded	3	0,14	0,42
6	Ball valve NPS 3/4" F-F ends	1	0,70	0,70
7	90° Elbow M-F NPS 2". Malleable cast iron, threaded	1	0,70	0,70
8	NPS 2" hot-dip galvanized pipe. SCH 40	12	5,44	65,28
9	NPS 3/4" hot-dip galvanized pipe. SCH 40	8	1,68	13,44
Total weight				86,84

The total weight of the section is 86.84 kg.

Note: The weights of the valves are approximate, in each specific case you should consult the supplier.

2-Calculacion of man-hours for prefabrication and assembly of supports.

For this, we use the total weight of the section calculated in the previous step equal to 86.84 kg and we divide it by the unit weight of the 2" pipe (5.44 kg/m) to find the equivalent length in meters of NPS 2" pipe for this section of piping:

$$86,84/5,44 = 15,96 \text{ m}$$

(15.96 m is the length of a dummy pipe that weighs the same as the piping in the example), with this data and applying the following table we estimate the number of man-hours for prefabrication and assembly of supports.

Table C. Consumption of Mhrs to execute supports

NPS	Peso del caño por metro en Kilogramos		Distancia entre soportes en metros	Kg. de soportes por metro de caño		Prefabricación horas hombre por metro de caño HS-h/m		Montaje del soporte en horas hombre por metro de caño HS-h/m	
	STD	SCH 80		STD	SCH 80	STD	SCH 80	STD	SCH 80
1"	2,5	3,25	2,14	0,5	0,65	0,5	0,65	0,1	0,13
1 1/2"	4,04	5,4	2,75	0,75	1	0,6	0,8	0,14	0,15
2"	5,44	7,47	3,05	1	1,35	0,65	0,9	0,17	0,22
2 1/2"	8,5	11,5	3,35	1,25	1,7	0,71	1	0,19	0,26
3"	11,25	15,25	5,65	1,5	2	0,75	1,1	0,22	0,29
4"	16,03	22,29	4,3	2	2,7	0,9	1,2	0,27	0,36
6"	28,23	42,51	5,2	3	4,7	1,2	1,8	0,37	0,6

Mhrs calculation for executing the supports.

The Mhrs for the execution of the supports is the sum of the hours of prefabrication plus the hours of assembly, that is

$$0.65 + 0.17 = 0.82 \text{ Mhrs/m.}$$

Multiplying by the number of meters we have

$$0.82 * 15.96 = 13.09 \text{ Mhrs}$$

Chart C. Man-hours required for assembly.

Item	Material	Quantity	Mhrs	Total Mhrs	Reference
1	Ball valve NPS 2" F-F ends, threaded	2	1,50	3,00	Table N°1
2	90° Elbow F-F NPS 2". Malleable cast iron, threaded	2	2,40	4,80	Table N°1
3	Straight Tee F-F NPS 2". Malleable Cast Iron, threaded	1	3,60	3,60	Table N°1
4	Reduction Bushing 2" x 3/4". Malleable Cast Iron, threaded	1	1,20	1,20	Table N°1
5	90° Elbow F-F NPS 3/4". Malleable cast iron, threaded	3	1,20	3,60	Table N°1
6	Ball valve NPS 3/4" F-F ends	1	0,75	0,75	Table N°1
7	90° Elbow M-F NPS 2". Malleable cast iron, threaded	1	2,40	2,40	Table N°1
8	NPS 2" hot-dip galvanized pipe. SCH 40	12	0,50 Mhrs/m	6	Table A
9	NPS 3/4" hot-dip galvanized pipe. SCH 40	8	0,30 Mhrs/m	2,4	Table A
Total Mhrs				27,75	

Total man-hours for assembly are 27.75.

Total man-hours to perform the work under standard conditions:

The total is $13.09 + 27.75 = 40.84$ Mhrs.

Corrections to apply to Mhrs of TABLE

Note: The analysis below may seem excessive, but the author's idea is to give a complete panorama of the possible corrections to apply to

total standard hours.

The reader should select which factors influence his or her project.

We must correct the hours estimated by tables to adjust them to each specific project.

We call these corrections correction by variables, correction by location, correction by type of material to use (a specific topic that we analyze in other manuals), and correction by prefabrication or supply of spools.

a. Correction by variables or correction by the influence of variables that affect the estimation executed with the table.

For this example, we plan hypotheses on the degree of influence of the variables affecting this project, so that if the resulting value differs from the unit, that factor must adjust the table value.

We emphasize that the listed variables are not the only ones and it is the responsibility of the estimator or budgeters to define them for each budget.

We now analyze the listed variables.

1. Deviations for the consumption of hours calculated with the tables, according to the experience of the installer in the execution and

supervision of similar

Has your company executed projects of this type? how often?
what is the experience of your supervision for this project? do
you have qualified personnel available for this project?

Answer: it is a usual task of knowledge of the installer so there
is no deviation (do not vary the Mhrs).

*2. Deviations for the consumption of hours calculated with the tables,
according to the quality of the information available to elaborate the
offer.*

Is the quality of the preliminary engineering to quote sufficient?
was a visit to site work carried out with experienced personnel
who reviewed during the visit all the aspects that will influence
the performance of the personnel and the construction
equipment?

Answer: this is a simple task with optimal information quality so
there is no diversion (Mhrs do not vary).

*3. Deviations from the consumption of hours calculated with the
tables, according to the degree of labor and union demands.*

What is the working schedule, will work be done at night too?
Does the project have a very demanding schedule? Evaluate the
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Conclusion:

The total of hours to execute the work is 40,84 Mhrs

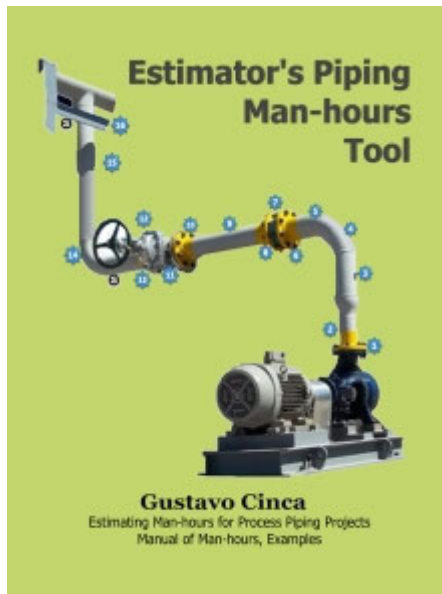
Note:

In minor works are very important costs of mobilization of work, demobilization, management of purchase of materials and indirect costs.

Further Reading: Estimator's Piping Man-hours Tool

Did you love Types of Valves in Piping?

Then you should read [Estimator's Piping Man-hours](#) by Gustavo Cinca!



Estimator's Piping Man-hours Tool.

Estimator's Piping Man-hours Tool for Process Piping Project - Basic Manual for any Engineer, Designer, Seller, Installer, or Owner with Examples.

To the reader.

We design this book for you to quickly and easily learn how to accurately estimate the number of man-hours required for carbon steel process piping assembly.

The author of this Manual has 45 years of experience in his professional practice as a Site Manager, Project Manager and finally as President of an Industrial Construction and Assembly Company.

During his career, the author has managed activities and resources for the assembly of different chemical process plants, refineries, gas compressor plants and thermal power plants in his country and abroad.

Tables with labor performance for the assembly of piping.

The 14 (fourteen) tables with labor yields presented in this book are a reproduction of those used by the author for the assembly of pipes in the different facilities.

Estimating Man-hours for piping installation.

It is necessary to understand that there are no identical projects or works in this business and that it is not possible to automate or copy.

The approach to respect is that any estimated work should be serious and professional.

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About the Author



Gustavo Miguel was born in San Rafael, Argentina, and graduated as a chemical engineer with an honorary degree from the U.N. C. In his professional career, he worked as a construction manager and finally as the president of a construction and industrial assembly company.

In his professional career, he built chemical process plants in refineries, gas pipelines, compression plants, and thermal power plants in his country and abroad.