

# Pipefitters Course

## Definition of a Pipefitter

Unfortunately the task of answering this question is not as simple as one might tend to expect. One simple and broad definition of Pipefitter is; one who installs or maintains piping. This is certainly true but it leaves us open to many misconceptions. The primary source of confusion and debate seems to be centered on matters of specialization. For example lets consider the difference between Pipefitters and Plumbers.

Plumbers are most commonly associated with residential or office building piping whereas Pipefitters are primarily associated with industrial applications, more specifically the petrochemical industry. There is also an issue of situations where two fields or professions overlap, such as Pipefitters and Steamfitters.

Steamfitters specialize in piping involved in heating and air-conditioning applications. Pipefitters also commonly work with piping for steam, chill water, or refrigerants.

## Pipefitter

Even the title of Pipefitter brings with it disagreements as to if it is one word (Pipefitter), or two (Pipe Fitter). Job postings from differing sources may use either version of the title. In some circles a Pipefitter is also a welder. Pipe welding is a specialized craft. Pipe welds are often subjected to heavy scrutiny, including x-ray testing. In certain cases there are also regulatory standards that must be adhered to. Oddly enough those positions which call for a Pipefitter to also be a Welder tend to offer less pay than is usually offered for either craft alone. It is not unusual for a Pipe Welder to have at least some Pipefitting experience yet they normally do not engage in the task performed by Pipefitters.

For the purposes of this work a Pipefitter is a craft worker who assembles, installs, removes and otherwise maintains industrial piping, primarily piping associated with petrochemical refining and processing applications.

## **Physical Demands**

The construction and installation of piping can be physically demanding at times. Piping is often located in elevated areas which are not easily accessed. The pipe and fittings used are often very heavy. The work is typically performed outdoors in difficult weather conditions.

## **Basic Rigging Skills**

Pipefitting often requires the use of lifting equipment, an understanding of the proper use of this equipment is essential.

## **Types of Industrial Pipefitters**

There are two basic types of Pipefitter positions, as well as various skill levels for these types. The titles, descriptions, responsibilities, and skill levels associated with these positions vary greatly from one employer, or assignment, to another.

## **Bolt-up Fitters and Fabricators**

In most of the cases a Pipefitter is expected to have the ability to perform both of these roles as needed. Yet the cases where the duties and skill requirements are specified and/or limited, are by no means rare.

## **Bolt-up Fitters**

This term Bolt-up Fitter refers to someone who works only with the portions of piping that are bolted together, as opposed to fabrication of welded pipe. Bolt-up work includes duties such as; installing & removing blinds, opening or closing man ways on vessels, servicing exchangers, and, installing or removing valves, and, spool pieces, some of these task are often associated with Boilermakers. The terms Bolt-up Fitter and Boilermaker are often considered to be the same thing; however one should not assume that this is always the case. There are Boilermaker positions which require far more specialized knowledge than what is involved in bolt-up work.

## **Fabricators**

The title of Fabricator may apply to any pipefitter who constructs, installs, or repairs welded piping. The term fabricate is commonly assumed to suggest prefabrication or construction of the piping in a location other than its final installation site.

In some cases the use of the term Fabricator is reserved for use in reference to those fitters who work solely in a fabrication shop environment. It is not at all uncommon for a pipefitter to assemble sections of welded piping in the field and then install them or have someone else do so.

### **Industrial Applications**

Piping also has many other industrial applications, which are crucial for moving raw and semi-processed fluids for refining into more useful products. Some of the more exotic materials of construction are Inconel, titanium, chrome-moly and various other steel alloys.

Engineering Industrial Piping Engineering has three major subfields:

- Piping Material
- Piping Design
- Stress Analysis

### **Stress Analysis Process**

Stress analysis process piping and power piping are typically checked by Pipe Stress Engineers to verify that the routing, nozzle loads, hangers, and supports are properly placed and selected such that allowable pipe stress is not exceeded under different situation such as sustain, operating, hydro test as per the ASME or any other legislative code and local government standards. It is necessary to evaluate the mechanical behavior of the piping under regular loads (internal pressure and thermal stresses) as well under occasional and intermittent loading cases such as earthquake, high wind or special vibration, and water hammer. This evaluation is usually performed with the assistance of a specialized (finite element) pipe stress analysis computer program such as Caesar II, ROHR2, CAEPIPE and AUTOPIPE.

## **Shutdown & Turnaround Work**

Shutdown and Turnaround are practically the same thing with a few differences. The term Turnaround is most commonly associated with a scheduled maintenance event designed to improve or preserve the plants efficiency and or quality of output. The term Shutdown covers a broader scope. Shutdown can include any situation in which a portion of the facility has ceased operation. This may be a scheduled event or it may result from unexpected conditions.

In either case the facility is operating at a reduced capacity or not at all while the work is being performed. As a result the time required to complete the work and resume full operating capacity is critical. As always safety is the #1 priority. In shutdown or turnaround situations knowledge of the procedures, and hazards, found in a refinery environment are indispensable. In these situations the potential exist for encountering hazards which do not occur in a new construction environment.

### **Shutdown Task Performed**

- Installation and removal of Blinds
- Removal and installation of valves
- Opening vessels for inspection and or repairs
- Removal and installation of piping
- Hydro-testing and or pressure testing

### **New Construction Task Performed**

- Fabrication of sections of piping
- Installation of piping & supports
- Hydro-testing and or pressure testing

Structure Design and Construction

Thin flat heat pipe (heat spreader) with remote heat sink and fan, is a typical heat pipe consists of a sealed pipe or tube made of a material with high thermal conductivity such as copper or aluminium at both hot and cold ends. A vacuum pump is used to remove all air from the empty heat pipe, and then the pipe is filled with a fraction of a percent by volume of *working fluid* (or coolant) chosen to match the operating temperature. Examples of such fluids include water, ethanol, acetone, sodium, or mercury. Due to the partial vacuum that is near or below the vapor pressure of the fluid, some of the fluid will be in the liquid phase and some will be in the gas phase. The use of a vacuum eliminates the need for the working gas to diffuse through any other gas and so the bulk transfer of the vapor to the cold end of the heat pipe is at the speed of the moving molecules. In this sense, the only practical limit to the rate of heat transfer is the speed with which the gas can be condensed to a liquid at the cold end.

### **Maintenance Work**

Maintenance work may involve any of the duties of those working either new construction or shutdown work with the primary difference being that they typically work in a live unit. This commonly means that only that section of the piping that they are working on is isolated from the actively operating system. This involves numerous potential hazards which are typically absent or at least greatly reduced in a shutdown or new construction situations.

### **Blinding**

Although installation and removal of blinds is not a complicated matter it does require knowledge and experience to be performed safely and correctly.

### **Line Breaking**

Line Breaking is one of the most hazardous task pipefitters encounter. The potential for release of pressure or release of hazardous chemicals must always be taken into consideration. The potential results of a mishandled line break range from negligible to death and destruction for the workers involved as well as

others not involved in the task.

### **Removal and Installation of Valves**

When removing a valve which has previously been in service the potential exist for residual chemicals to be present. Caution is required here as well as a knowledge of how to respond in the event that contact with or a release of such chemicals should occur. Valves are usually very heavy and require the use of lifting equipment such as chain falls, come-a-longs, or cranes. Use of this equipment requires the knowledge and use of rigging. It is also important to have a knowledge of the various types of valves and their applications and characteristics, as well as the ability to identify the correct gaskets. Use of pneumatic or hydraulic equipment may be required for removing or installing and torquing bolts

### **Opening Vessels**

There are a wide variety of vessels found in refineries. These usually classified as Exchangers, Towers, Drums, or Tanks. Towers and large tanks typically are equipped with man-ways. The potential for release of pressure or trapped chemicals is always a primary concern when opening vessels. Even a relatively low amount of pressure can be serious when dealing with vessels due to large amounts of volume. Inspection and repair of vessels will almost certainly involve a Confined Space Entry.

### **Removal and Installation of Piping**

When removing piping which has been in service the potential for trapped chemicals must always be taken into consideration. Piping to be removed and or installed may be bolted into place or welded. If it is welded pipe there will be a need for cutting which may be accomplished with a cutting torch or a cold cutting method.

### **Fabricating Piping**

When fabricating piping a fitter is supplied with a drawing, generally referred to as an Iso, pipe, and fittings. The fitter reads the print(s), performs calculations as needed, cuts the pipe, verifies the proper pipe & fittings

composition, and makes all necessary preparations for welding of the pipe. Proper dimensions and orientation of all components is the responsibility of the fitter.

### **Installation of Piping and Supports**

Installation of piping and supports often proves to be quite challenging due to factors such as; elevated work areas, rigging challenges, and limited space.

### **Pressure Testing**

Pressure testing of piping is required to insure that all connections and components will not leak or fail when placed into service. This is most commonly achieved with filling the line with water then pressurizing it. Test pressure is usually well above the anticipated operating pressure. It is not uncommon for test pressure to exceed 1000 psi.

Most people are familiar with plumbers, who come to their home to unclog a drain or install an appliance. In addition to these activities, however, pipelayers, plumbers, pipefitters, and steamfitters install, maintain, and repair many different types of pipe systems. For example, some systems move water to a municipal water treatment plant and then to residential, commercial, and public buildings. Other systems dispose of waste, provide gas to stoves and furnaces, or provide for heating and cooling needs. Pipe systems in powerplants carry the steam that powers huge turbines. Pipes also are used in manufacturing plants to move material through the production process. Specialized piping systems are very important in both pharmaceutical and computer-chip manufacturing.

### **Single Trade**

Although pipelaying, plumbing, pipefitting, and steamfitting sometimes are considered a single trade, workers generally specialize in one of five areas. *Pipelayers* lay clay, concrete, plastic, or cast-iron pipe for drains, sewers, water mains, and oil or gas lines. Before laying the pipe, pipelayers prepare and grade the trenches either manually or with machines. After laying the pipe, they weld, glue, cement or otherwise join

the pieces together. *Plumbers* install and repair the water, waste disposal, drainage, and gas systems in homes and commercial and industrial buildings. Plumbers also install plumbing fixtures—bathtubs, showers, sinks, and toilets—and appliances such as dishwashers and water heaters. *Pipefitters* install and repair both high- and low-pressure pipe systems used in manufacturing, in the generation of electricity, and in the heating and cooling of buildings. They also install automatic controls that are increasingly being used to regulate these systems. Some pipefitters specialize in only one type of system. *Steamfitters* install pipe systems that move liquids or gases under high pressure. *Sprinklerfitters* install automatic fire sprinkler systems in buildings.

## **Techniques**

Plumbers, pipelayers, pipefitters, and steamfitters use many different materials and construction techniques, depending on the type of project. Residential water systems, for example, incorporate copper, steel, and plastic pipe that can be handled and installed by one or two plumbers. Municipal sewerage systems, by contrast, are made of large cast-iron pipes; installation normally requires crews of pipefitters. Despite these differences, all plumbers, pipelayers, pipefitters, and steamfitters must be able to follow building plans or blueprints and instructions from supervisors, lay out the job, and work efficiently with the materials and tools of their trade. When plumbers working construction install piping in a new house, they work from blueprints or drawings that show the planned location of pipes, plumbing fixtures, and appliances. Recently, plumbers have become more involved in the design process. Their knowledge of codes and the operation of plumbing systems can cut costs. First they lay out the job to fit the piping into the structure of the house with the least waste of material. Then they measure and mark areas in which pipes will be installed and connected. Construction plumbers also check for obstructions such as electrical wiring and, if necessary, plan the pipe installation around the problem.

Sometimes, plumbers have to cut holes in walls, ceilings, and floors of a house. With some systems, they may hang steel supports from ceiling joists to hold the pipe in place. To assemble a system, plumbers—using saws, pipe cutters, and pipe-bending machines—cut and bend lengths of pipe. They connect the lengths of pipe with fittings, using methods that depend on the type of pipe used. For plastic pipe, plumbers connect the sections and fittings with adhesives. For copper pipe, they slide a fitting over the end of the pipe and solder it in place with a torch.

After the piping is in place in the house, plumbers install the fixtures and appliances and connect the system to the outside water or sewer lines. Finally, using pressure gauges, they check the system to ensure that the plumbing works properly.

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### **Assemble Systems**

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### **Pipefitters and Plumbers**

Pipefitters and steamfitters most often work in industrial and power plants. Plumbers work in commercial and residential settings where water and septic systems need to be installed and maintained. Pipelayers work outdoors, sometime in remote areas, as they build the pipelines that connect sources of oil, gas, and chemicals with the users of these materials. Sprinklerfitters work mostly in multistory buildings that require the use of sprinkler systems. Because pipelayers, plumbers, pipefitters, and steamfitters frequently must lift heavy pipes, stand for long periods, and sometimes work in uncomfortable or cramped positions, they need physical strength as well as stamina. They also may have to work outdoors in inclement weather. In addition, they are subject to possible falls from ladders, cuts from sharp tools, and burns from hot pipes or soldering equipment.

### **Scheduling and Hours**

Pipelayers, plumbers, pipefitters, and steamfitters engaged in construction generally work a standard 40-hour week; those involved in maintaining pipe systems, including those who provide maintenance services under contract, may have to work evening or weekend shifts, as well as be on call. These maintenance workers may spend quite a bit of time traveling to and from worksites.

Pipelayers, plumbers, pipefitters, and steamfitters enter into the profession in a variety of ways. Most residential and industrial plumbers get their training in career and technical schools and community colleges

and from on-the-job training. Pipelayers, plumbers, pipefitters, and steamfitters who work mainly for commercial enterprises are usually trained through formal apprenticeship programs.

### **Apprenticeship Programs**

Apprenticeship programs generally provide the most comprehensive training available for these jobs. They are administered by either union locals and their affiliated companies or by nonunion contractor organizations. Organizations that sponsor apprenticeships include: the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada; local employers of either the Mechanical Contractors Association of America, the National Association of Plumbing-Heating-Cooling Contractors, or the National Fire Sprinkler Association; the Associated Builders and Contractors; the National Association of Plumbing-Heating-Cooling Contractors; the American Fire Sprinkler Association, or the Home Builders Institute of the National Association of Home Builders.

### **Union and Nonunion**

Apprenticeships—both union and nonunion—consist of 4 or 5 years of on-the-job training, in addition to at least 144 hours per year of related classroom instruction. Classroom subjects include drafting and blueprint reading, mathematics, applied physics and chemistry, safety, and local plumbing codes and regulations. On the job, apprentices first learn basic skills, such as identifying grades and types of pipe, using the tools of the trade, and safely unloading materials. As apprentices gain experience, they learn how to work with various types of pipe and how to install different piping systems and plumbing fixtures. Apprenticeship gives trainees a thorough knowledge of all aspects of the trade. Although most pipelayers, plumbers, pipefitters, and steamfitters are trained through apprenticeship, some still learn their skills informally on the job. Applicants for union or nonunion apprentice jobs must be at least 18 years old and in good physical condition. Apprenticeship committees may require applicants to have a high school diploma or its equivalent. Armed Forces training in pipelaying, plumbing, and pipefitting is considered very good

preparation. In fact, persons with this background may be given credit for previous experience when entering a civilian apprenticeship program. Secondary or postsecondary courses in shop, plumbing, general mathematics, drafting, blueprint reading, computers, and physics also are good preparation.

Although there are no uniform national licensing requirements, most communities require plumbers to be licensed. Licensing requirements vary from area to area, but most localities require workers to pass an examination that tests their knowledge of the trade and of local plumbing codes.

With additional training, some pipelayers, plumbers, pipefitters, and steamfitters become supervisors for mechanical and plumbing contractors. Others, especially plumbers, go into business for themselves, often starting as a self-employed plumber working from home. Some eventually become owners of businesses employing many workers and may spend most of their time as managers rather than as plumbers. Others move into closely related areas such as construction management or building inspection.

### **Licensure**

Although there are no uniform national licensing requirements, most States and communities require plumbers to be licensed. Licensing requirements vary, but most localities require workers to have 2 to 5 years of experience and to pass an examination that tests their knowledge of the trade and of local plumbing codes before they are permitted to work independently. Several States require a special license to work on gas lines. A few States require pipefitters to be licensed. Licenses usually require a test, experience, or both.

### **Other Qualifications**

Applicants for union or nonunion apprentice jobs must be at least 18 years old and in good physical condition. A drug test may be required. Apprenticeship committees may require applicants to have a high school diploma or its equivalent. For jointly administered apprenticeships approved by the U.S. Department of Labor, a high school diploma is mandatory, because these programs can earn credit from community colleges and, in some cases, from 4-year colleges. Armed Forces training in plumbing, pipefitting, and steamfitting is considered very good preparation. In fact, people with this background may be given credit for previous experience when they enroll in a civilian apprenticeship program. High school or postsecondary

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### **Certification and Advancement**

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For those who would like to advance, it is becoming increasingly important to be able to communicate in both English and Spanish in order to relay instructions and safety precautions to workers with limited understanding of English;

### **Construction Occupations**

Pipelayers, plumbers, pipefitters, and steamfitters constitute one of the largest construction occupations, holding about 561,000 jobs in 2004. About 1 in 2 worked for plumbing, heating, and air-conditioning contractors engaged in new construction, repair, modernization, or maintenance work. Others did maintenance work for a variety of industrial, commercial, and government employers. For example, pipefitters were employed as maintenance personnel in the petroleum and chemical industries, in which manufacturing operations require the moving of liquids and gases through pipes. More than 1 in 10 pipelayers, plumbers, pipefitters, and steamfitters were self-employed. Almost 1 in 3 pipelayers, plumbers, pipefitters, and steamfitters belonged to a union.

### **Work Environment**

Plumbers work in commercial and residential settings where water and septic systems need to be installed and maintained. Pipefitters and steamfitters most often work in industrial and power plants. Pipelayers work

outdoors, sometimes in remote areas, laying pipes that connect sources of oil, gas, and chemicals with the users of these resources. Sprinklerfitters work in all buildings that require the use of fire sprinkler systems.

Because plumbers, pipelayers, pipefitters, and steamfitters frequently must lift heavy pipes, stand for long periods, and sometimes work in uncomfortable or cramped positions, they need physical strength and stamina. They also may have to work outdoors in inclement weather. In addition, they are subject to possible falls from ladders, cuts from sharp tools, and burns from hot pipes or soldering equipment. Consequently, this occupation experiences rates of nonfatal injuries and illnesses that are much higher than average.

Plumbers, pipelayers, pipefitters, and steamfitters often work more than 40 hours per week and can be on call for emergencies nights and weekends. Some pipelayers may need to travel to and from worksites.

### **Employment Opportunities**

Jobs for pipelayers, plumbers, pipefitters, and steamfitters are distributed across the country in about the same proportion as the general population. Job opportunities are expected to be excellent, as demand for skilled pipelayers, plumbers, pipefitters, and steamfitters is expected to outpace the supply of workers trained in this craft. Many employers report difficulty finding potential workers with the right qualifications. In addition, many people currently working in these trades are expected to retire over the next 10 years, which will create additional job openings. Employment of pipelayers, plumbers, pipefitters, and steamfitters is expected to grow about as fast as average for all occupations through the year 2014. Demand for plumbers will stem from new construction and building renovation. Bath remodeling, in particular, is expected to continue to grow and create more jobs for plumbers. In addition, repair and maintenance of existing residential systems will keep plumbers employed. Demand for pipefitters and steamfitters will be driven by maintenance activities for places having extensive systems of pipes, such as powerplants, water and wastewater treatment plants, office buildings, and factories. Growth of pipelayer jobs will stem from the

building of new water and sewer lines and pipelines to new oil and gas fields. Demand for sprinklerfitters will increase due to changes to State and local rules for fire protection in homes and businesses.

### **Entry Methods**

Information about apprenticeships is available from local branches of a plumbing and pipe fitting union. Construction contractors may also have information. Some employment offices give aptitude tests and screen applicants for apprenticeship programs. Another source of information about apprenticeships is the U.S. Department of Labor, Bureau of Apprenticeship and Training. Some pipe fitters assist experienced workers and learn the trade while on the job. It will generally take longer to learn the job this way, and workers do not have the advantage of working with many different contractors to learn all parts of the occupation.

### **In Tradition**

Traditionally, many organizations with extensive pipe systems have employed their own plumbers or pipefitters to maintain equipment and keep systems running smoothly. But, to reduce labor costs, many of these firms no longer employ full-time, in-house plumbers or pipefitters. Instead, when they need a plumber, they rely on workers provided under service contracts by plumbing and pipefitting contractors. Construction projects generally provide only temporary employment. When a project ends, some pipelayers, plumbers, pipefitters, and steamfitters may be unemployed until they can begin work on a new project, although most companies are trying to limit these periods of unemployment in order to retain workers. In addition, the jobs of pipelayers, plumbers, pipefitters, and steamfitters are generally less sensitive to changes in economic conditions than jobs in other construction trades. Even when construction activity declines, maintenance, rehabilitation, and replacement of existing piping systems, as well as the increasing installation of fire sprinkler systems, provide many jobs for pipelayers, plumbers, pipefitters, and steamfitters.

## **Plumbers Association**

In line with new opportunities arising from the growing need to conserve water, the Plumbing-Heating-Cooling Contractors—National Association has formed a partnership with GreenPlumbers USA to train and certify plumbers across the Nation on water-saving technologies and energy efficiency. Attainment of this certification may help people trained in this area to get more jobs and advance more quickly.