

NCCER PIPEFITTING CURRICULUM

The following is a brief description of subjects contained in all four levels of the pipefitting program as well as the core curricula that all level one students are expected to pass.

CORE CURRICULUM

The core curricula provides a basic introduction to construction work for all crafts. The core curriculum consists of 9 modules taught through in-person instruction and supplemented by online programming.

Basic Safety

Presents basic jobsite safety information to prepare workers for the construction environment. Describes the common causes of workplace incidents and accidents and how to avoid them. Introduces common personal protective equipment (PPE), including equipment required for work at height, and its proper use. Information related to safety in several specific environments, including welding areas and confined spaces, is also provided.

Introduction to Construction Math

Reviews basic math skills related to the construction trades and demonstrates how they apply to the trades. Covers multiple systems of measurement, decimals, fractions, and basic geometry.

Introduction to Hand Tools

Introduces common hand tools used in a variety of construction crafts. Identifies tools and how to safely use them. Proper hand tool maintenance is also presented.

Introduction to Power Tools

Identifies and describes the operation of many power tools common in the construction environment. Provides instruction on proper use, as well as on safe-handling guidelines and basic maintenance.

Introduction to Construction Drawings

Introduces the basic elements of construction drawings. The common components of drawings are presented, as well as the most common drawing types. The use of drawing scales and how to measure drawings is also covered.

Basic Rigging

Provides basic information related to rigging and rigging hardware, such as slings, rigging hitches, and hoists. Emphasizes safe working habits in the vicinity of rigging operations.

Basic Communication Skills

Provides good techniques for effective communication on the job. Includes examples that emphasize the importance of both written and verbal communication skills. Describes the importance of reading skills in the construction industry and covers proper techniques to use in a variety of different written communication formats.

Basic Employability Skills

Describes the opportunities offered by the construction trades. Discusses critical thinking and essential problem-solving skills for the construction industry. Also identifies and discusses positive social skills and their value in the workplace.

Introduction to Material Handling

Describes the hazards associated with handling materials and provides techniques to avoid both injury and property damage. Common material-handling equipment is also introduced.

PIPEFITTING – LEVEL ONE

Orientation to the Pipefitting Craft

Pipefitters work with many kinds of pipe, ranging from small, half-inch piping to that which is three or more feet in diameter. A pipefitter must know how to work with threaded, grooved, and welded piping systems and must be able to master a variety of tools and equipment.

Pipefitting Hand Tools

Pipefitters use hand tools to grip, level, fabricate, cut, and bend pipe. Fabrication tools include squares, clamps, gauges, wraparounds, and pins. Vises and stands hold the work to free the crafter to work with both hands; levels are used to ensure that a pipe is level or plumb. Specialized tools are used to cut, thread, bend, and flare pipe.

Pipefitting Power Tools

Pipefitters use power tools to cut, grind, thread, and shape all types of materials. It is very important to select the right tool for the job and make sure it is in good working order before use. Specialty tools, like threading machines and bevelers, should only be used for the specific jobs they were designed to perform. With power and pneumatic tools, it is especially important to follow all operating instructions and safety precautions because they pose safety hazards. When used correctly, these tools can greatly increase a pipefitter's productivity.

Oxyfuel Cutting

Oxyfuel cutting is a method for cutting metal that uses an intense flame produced by burning a mixture of a fuel gas and pure oxygen. It is a versatile metal cutting method that has many uses on job sites. Because of the flammable gases and open flame involved, there is a danger of fire and explosion when oxyfuel equipment is used. However, these risks can be minimized when the operator is well-trained and knowledgeable about the function and operation of each part of an oxyfuel cutting outfit.

Ladders and Scaffolds

Ladders and scaffolds are some of the most important tools on a job site. Used properly, they make a pipefitter's job much easier. Carelessness, however, can be fatal. Common accidents like falling, being struck by falling objects, and electrocution can be avoided if safety precautions are followed. Considerations for the type of ladder or scaffolding being used, as well as environmental factors, personal positioning, fall arrest systems, and proper assembly and care of all equipment, contribute to safe operations.

Motorized Equipment One

Pipefitters work with various types of motorized equipment to speed up production. From smaller items such as generators and compressors to larger machinery such as forklifts and backhoe loaders, a pipefitter must understand the capacities and limitations of each item in order to work safely and efficiently. This is because increased power means increased hazards. Anyone operating motorized equipment must be properly trained, and in some cases certified, to use it. Always follow the recommended safety precautions, manufacturer's instructions, and maintenance schedule.

PIPEFITTING – LEVEL TWO

Piping Systems

Piping systems vary widely in materials, components, and procedures. The systems are subject to specific standards, depending on the materials being transported and the context of the system. Color codes warn personnel of the safety requirements for piping systems. Expansion of pipe materials due to heating and cooling is a factor in the design of pipe systems. Insulation serves several purposes in piping systems, including preventing flow interruption by freezing or liquefaction and protecting personnel from injury.

Drawings and Detail Sheets

Drawings are the instructions for pipefitters. Site plans show where all of the runs are on the job site; line lists and specifications tell the particular material, connections, and fittings for each run of pipe. Notes convey specific information on some aspect that cannot be derived from the drawing itself, and the elevations and sections show how everything goes together. Pipefitters must be able to read, understand, and communicate what is detailed on various types of drawings and they must be able to create sketches for use in the field. Each type of drawing has a different purpose and functionality; the Piping & Instrumentation Drawing (P&ID) is key to the work of pipefitters because it describes each component needed for pipeline installation and maintenance.

Identifying and Installing Valves

Valves are the steering wheels, brakes, and switches of pipe systems. Some valves function as on-and-off flow controls, while others regulate the amount of flow. Some divert flow from one direction to another. The selection and proper installation of valves is a critical pipefitting skill. To install and use valves properly, it is essential to understand the function of the valve and its characteristics, such as linings and part interactions. Each has advantages and limitations with which pipefitters must be familiar.

Pipefitting Trade Math

Pipefitters use math every day to make decisions about connections. Basic geometric equations show the relationships between the figures that are seen, such as those involving area and volume. Mathematical relationships between the sides of triangles, for example, are used in determining the unknown length of a pipe. Understanding the properties of circles and cylinders directly relates to the configuration and arrangement of pipes. Rectangles and rectangular solids are tools for understanding machine pads and tanks. With an understanding of the basics outlined in this module, a number of pipefitting tasks are made easier.

Threaded Pipe Fabrication

Every pipefitter must be able to install threaded pipe in accordance with job requirements and specifications. Threaded connections are relatively inexpensive to fabricate and are a common way to join pipe. Threaded piping systems vary greatly based on the variety of materials used for the job, so pipefitters must understand appropriate processes and procedures for each. From reading and interpreting drawings to making up the pipe and fittings, threaded pipe fabrication calls for careful attention to detail concerning materials, selections, and measurements.

Socket Weld Pipe Fabrication

Socket weld piping is quick and relatively easy to fit properly. Since it is welded together at the end, remember to measure twice and cut once, as it is better to do the fit only once. The pipefitter establishes the correct alignment between all of the parts, including the expansion gap inside the socket. The welder tack welds the assembly for the pipefitter in places where tacks are requested, and the pipefitter aligns the openings and pipes correctly. Symbols are used to denote specific types of connections in piping systems; these are used in

conjunction with math applications for determining pipe lengths between fittings and preparing and aligning pipe and fittings.

Butt Weld Pipe Fabrication

Most large, aboveground, industrial piping systems are crafted through a combination of butt welds and bolt ups. The oil, chemical, and power industries require pipefitters who are skilled with these tasks. Butt welding is more difficult than socket welding because alignment of the pipe ends is critical. The right tools and jigs are central to getting the alignment correct for the first tack, and for determining and adjusting for small differences in the actual shapes and sizes of pipes and fittings. With this and other types of welds, the craftsmanship of the pipefitter relates directly to that of the welder: if the first isn't right, the second won't be either. But where pipefitting precision comes into play, welding and completion of the pipeline are both set up for efficient operations.

Excavations

The two most dangerous environments for a pipefitter are those that require working at high elevations or at excavations. Recognizing hazards and how to address them with appropriate safety equipment and operating procedures helps reduce the risks associated with working below the ground. Pipefitters must know how to lay out the pipeline using the surveyor's reference points, as well as how to use specialized equipment for getting the pipeline trenches to hold pipe in place. Identifying soil types and characteristics of each type, as well as understanding OSHA requirements for trenching safety are fundamental to working in or around excavations.

Underground Pipe Installation

Most municipal piping systems are underground and convey water, gas, oil, storm drain water, and sewage. Installing pipe for these systems is among the most dangerous of jobs for the pipefitter and for this reason, thorough safety training, is the top priority. Also important is understanding the connection systems used underground and the ways in which they are assembled. New technologies involving trenchless pipelaying help reduce some risks, yet knowledge of traditional methods is still important. A range of pipefitting skills, combined with solid attention to safety are the keys to meeting the challenges involved in serving entire communities with dependable piping systems.

PIPEFITTING – LEVEL THREE

Introduction to Basic Rigging

A common activity at nearly every construction site is the movement of material and equipment from one place to another using various types of lifting gear. The procedures involved in performing this task are known as rigging. Not every worker will participate in rigging operations, but nearly all will be exposed to it at one time or another. This module provides an overview of the various types of rigging equipment, common hitches used during a rigging operation, and the related Emergency Stop hand signal.

Rigging Practices

Rigging is the preparation of a load for movement, as well as preparation of the hardware and other components used to connect the load to a crane. Rigging is associated with all types of cranes, and rigging skills are also required to move and position equipment inside buildings and other areas where cranes are not involved. This module will provide insight into rigging hardware, lifting slings and their proper use, and various types of rigging equipment.

Standards and Specifications

Standards and codes set the stage for the specifics of how pipefitting is conducted. They indicate what kinds of materials to use, how to identify those materials, and what procedures to follow in using them. Understanding these areas is just as important as knowing how to cut and join pipe because pipefitters must follow the law as outlined in the codes and standards. When expectations change over the course of a project, it is essential to get agreements in writing before modifications are made. Staying in compliance is achievable with an understanding of common rules, applications, and methods of conducting business.

Advanced Pipefitting Math

Pipefitters use geometry, trigonometry, and algebra to calculate takeouts, to lay out angled cuts, and to determine the lengths of the sides of figures and offsets. Knowing which formula to use, and at what time, is central to a craftsman's success. Pipefitting calculators are specially designed to assist with each of these functions, yet it is still important to know the manual process when calculation equipment is not available. Precise calculations, no matter how they are realized, form the basis for producing a high-quality pipeline.

Motorized Equipment Two

Specialized pieces of motorized equipment, including various types of lifts and rigs, are commonly used in pipefitting work. Fall protection measures must be taken prior to starting any job that involves elevation and trained, certified personnel are required for setup and operation at these sites. Each lift presents its own set of safety considerations, but with careful planning, the risks may be managed.

Introduction to Aboveground Pipe Installation

Installing aboveground pipe calls for careful planning and communication regarding the measurement, calculation, cutting, and assembly tasks involved in creating fully-functional runs. Aboveground lines do not have the advantage of being supported by the earth of a trench, as with buried pipe and they often have to be raised to avoid obstructions. Because of these two factors, understanding when, where, and how to apply fundamental pipefitting skills becomes more important than ever.

Field Routing and Vessel Trim

Field routing and vessel trimming require pipefitters to understand more than pipe assembly. Their decisions play a key role in ensuring the safety and overall success of a job. From initial evaluation of the site and piping run to the selection of the proper erection equipment and vessel trim components, this part of their job requires them to have a thorough understanding of the competencies and skills taught in this module.

Pipe Hangers and Supports

Pipe hangers and supports must be carefully chosen to coordinate with the pipe, they are designed to support. As with other components of the system, each piece must be installed in a manner reflective of its strengths and limitations, with attention to piping drawings that outline placement of each item. Many installations and maintenance procedures call for special safety considerations, both during the operation and throughout the lifetimes of individuals and overall structures. Pipefitters with strong math skills and solid experience in the basics of the craft are ready for these more advanced activities.

Testing Piping Systems and Equipment

Once a piping system is installed, it must be tested before it's ready to use. Like many pipefitting activities, testing introduces a number of hazards that must be addressed. Whether performing hydrostatic, steam blow, or head pressure testing, precautions must be taken to reduce the known risks. A good visual inspection of the system is likely to identify certain sets of problems before testing is even begun. When conducting a test, the use of a test report is essential to guiding the overall process. Pipefitters who have mastered installations and repairs are ready to learn about procedures and protocols for testing systems and equipment.

PIPEFITTING – LEVEL FOUR

Advanced Blueprint Reading

Pipefitters need to understand how to read piping and instrumentation drawings (P&IDs), which are also known as blueprints or site plans. These schematic diagrams show process flows, functions, equipment, pipelines, valves, instruments, and controls needed to operate the system. The blueprint package included in the Appendix of this module contains plans that demonstrate how P&ID information appears on the plans and what the information means.

Advanced Pipe Fabrication

Pipe fabrication involves the use of either ordinate tables or trigonometry to create fittings and pipe assemblies that suit a process application. Producing ordinates and using them to lay out miters and laterals is important, as are alternative methods for laying out the cuts for laterals, saddles, and mitered turns. In this module, formulas are provided for putting together multiple offsets around obstacles of both equal and unequal spread.

Stress Relieving and Aligning

Stress relieving is the process of preheating and post weld heat treatment to keep welds from distorting a pipe assembly. Alignment is the reason for stress relieving, because if the pipe will not fit up accurately to machinery, dynamically balanced pumps will be unbalanced by the distortions of the piping attachments. A skilled pipefitter takes charge of these situations, working with millwrights and others to prevent misalignments and problems which stem from them.

In-Line Specialties

Special fittings and instruments used in process piping equipment are known as in-line specialties and described in system documentation as “specials.” This category includes steam traps, desuperheaters, bursting discs, strainers, and related equipment. Steam traps protect the lines against water hammer while desuperheaters reduce the temperature of steam. Strainers are used with many types of fluids to keep solids from clogging pipes. Bursting discs provide emergency pressure relief to prevent very high-pressure surges from damaging equipment. Each in-line specialty item serves a specific purpose and must be installed, monitored, and removed by knowledgeable pipefitters who may be working in tandem with other professionals for coordinated activities across the pipe run.

Special Piping

Pipefitters must be prepared to assemble small piping and tubing. While these jobs are infrequent, they still require a clear understanding of the skills needed to correctly and safely connect and route pipe on a smaller scale. Some of these skills include brazing, soldering, pipe bending, and installing various fittings made of copper, stainless steel, aluminum, and brass.

Hot Taps

When it is necessary to connect to pipes that cannot be shut down or emptied; fluid pressure must be contained to prevent leaks. The method for doing this is referred to as hot tapping, and its procedures will vary according to what is being conveyed through the line. In some situations, it may be possible to temporarily stop the flow while connections are made; this is where line stop plugs, pipe freezing and pipe plugging become important. Hot tapping is not a regular part of a pipefitter’s career, but it is important to understand the environmental factors associated with it as well as ways to safely assist any contractors called on to perform it.

Maintaining Valves

Understanding the function and assembly of valves is essential to the pipefitter’s career. While most valves are replaced rather than maintained, it is important to understand the procedures for both. Knowledge of valve

maintenance contributes to troubleshooting issues within a pipe run, with the function of valves as a pivotal point.

Fundamentals of Crew Leadership

When a crew is assembled to complete a job, one person is appointed the leader. This person is usually an experienced craft professional who has demonstrated leadership qualities. While having natural leadership qualities helps in becoming an effective leader, it is more true that “leaders are made, not born.” Whether you are a crew leader or want to become one, this module will help you learn more about the requirements and skills needed to succeed.



THE NCCER PROGRAM

NCCER (National Center for Construction Education & Research) maintains a portable and widely recognized credentialing and certification system through its Registry. This Registry assures portability of skills by providing transcripts, certificates and wallet cards to students who successfully complete the NCCER Curriculum through an accredited sponsor. These valuable industry credentials benefit students as they seek employment and build their careers. To be entered in NCCER’s Automated National Registry, you must complete and sign a Registration and Release Form. This form will be completed on the first night of class in each semester and requires your Social Security Number and your signature.

NCCER has developed a consistent program of accreditation, instructor certification, standardized curriculum, registry, assessment and certification, which are key elements in developing a skilled workforce of craft professionals.

NCCER is the accrediting body for the industry and establishes the benchmark for quality training and assessments. By partnering with industry and academia, NCCER has developed a system for program accreditation that is similar to those found in institutions of higher learning. This process ensures that students receive quality training based on uniform standards and criteria.

The NCCER Curriculum, in cooperation with publishing partner Pearson, has developed and publishes a world-class curriculum created by “Subject Matter Experts” representing contractors and schools from around the country. “Subject Matter Experts” ensure exceptional training programs that meet or exceed national industry standards. The NCCER Curriculum, which includes more than 60 craft areas, is taught worldwide by contractors, associations, construction users, and secondary and post-secondary schools. In addition, multiple State Departments of Education recognize the curriculum along with the U.S. Department of Labor - Office of Apprenticeship.