and wall coverings efficiently and neatly. Near the end of their training, they may learn decorating concepts, color coordination, and cost-estimating techniques. In addition to learning craft skills, painters must become familiar with safety and health regulations so that their work is in compliance with the law.

Apprentices or helpers generally must be at least 16 years old and in good physical condition. A high school education or its equivalent, with courses in mathematics, is usually required to enter an apprenticeship program. Applicants should have good manual dexterity and color sense.

Painters and paperhangers may advance to supervisory or estimating jobs with painting and decorating contractors. Many establish their own painting and decorating businesses.

**Job Outlook**

Job prospects should be good, as thousands of painters and paperhangers transfer to other occupations or leave the labor force each year. Because there are no strict training requirements for entry, many people with limited skills work as painters or paperhangers for a short time and then move on to other types of work. Many fewer openings will occur for paperhangers because the number of these jobs is comparatively small.

In addition to the need to replace experienced workers, new jobs will be created. Employment of painters and paperhangers is expected to grow about as fast as the average for all occupations through the year 2010, reflecting increases in the level of new construction and in the stock of buildings and other structures that require maintenance and renovation. Painting is very labor-intensive and not suitable to the kinds of technological changes that might make workers more productive and thus restrict employment growth.

Jobseekers considering these occupations should expect some periods of unemployment, especially until they become fully skilled. Many construction projects are of short duration, and construction activity is cyclical and seasonal in nature. Remodeling, restoration, and maintenance projects, however, often provide many jobs for painters and paperhangers even when new construction activity declines. The most versatile painters and skilled paperhangers generally are best able to keep working steadily during downturns in the economy.

**Earnings**

In 2000, median hourly earnings of painters, construction and maintenance, were $13.10. The middle 50 percent earned between $10.36 and $16.81. The lowest 10 percent earned less than $8.56, and the highest 10 percent earned more than $22.39. Median hourly earnings in the industries employing the largest numbers of painters in 2000 are shown below:

<table>
<thead>
<tr>
<th>Industry</th>
<th>Median Hourly Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential building construction</td>
<td>12.79</td>
</tr>
<tr>
<td>Real estate operators and lessors</td>
<td>10.95</td>
</tr>
<tr>
<td>Real estate agents and managers</td>
<td>10.77</td>
</tr>
<tr>
<td>Personnel supply services</td>
<td>10.63</td>
</tr>
</tbody>
</table>

In 2000, median earnings for paperhangers were $15.33. The middle 50 percent earned between $10.89 and $19.91. The lowest 10 percent earned less than $8.04, and the highest 10 percent earned more than $24.16. Earnings for painters may be reduced on occasion because of bad weather and the short-term nature of many construction jobs. Hourly wage rates for apprentices usually start at 40 to 50 percent of the rate for experienced workers and increase periodically.

Some painters and paperhangers are members of the International Brotherhood of Painters and Allied Trades. Some maintenance painters are members of other unions.

**Related Occupations**

Painters and paperhangers apply various coverings to decorate and protect wood, drywall, metal, and other surfaces. Other construction occupations in which workers do finishing work include carpenters; carpet, floor, and tile installers and finishers; drywall installers, ceiling tile installers, and tapers; and plasterers and stucco masons.

**Sources of Additional Information**

For details about painting and paperhanging apprenticeships or work opportunities, contact local painting and decorating contractors, a local of the International Brotherhood of Painters and Allied Trades, a local joint union-management apprenticeship committee, or an office of the State apprenticeship agency or employment service.

For general information about the work of painters and paperhangers, contact:
- Associated Builders and Contractors, 1300 N. 17th St., Arlington, VA 22209. Internet: [http://www.abc.org](http://www.abc.org)
- Painting and Decorating Contractors of America, 3913 Old Lee Highway, Suite 33B, Fairfax, VA, 22030.

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**Pipelaying, Plumbing, Pipefitting, and Steamfitting**

*(O*NET 47-2151.00, 47-2152.01, 47-2152.02, 47-2152.03)*

**Significant Points**

- Job opportunities should be excellent because not enough people are seeking training.
- Most workers learn the trade through 4 or 5 years of formal apprenticeship training.
- Pipelaying, plumbing, pipefitting, and steamfitting make up one of the largest and highest paid construction occupations.

**Nature of the Work**

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 supply air-conditioning. 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.

Although pipelaying, plumbing, pipefitting, and steamfitting sometimes are considered a single trade, workers generally specialize in one of the four 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. 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 heating and cooling 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*, for example, install pipe systems that move liquids or gases under high pressure. *Sprinklerfitters* install automatic fire sprinkler systems in buildings.

Pipelayers, plumbers, 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 workers. Municipal sewerage systems, on the other hand, are made of large cast-iron pipes; installation normally requires crews of pipefitters. Despite these differences, all pipelayers, plumbers, 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 the trade. Computers often are used to create blueprints and plan layouts.

When construction plumbers install piping in a house, for example, they work from blueprints or drawings that show the planned location of pipes, plumbing fixtures, and appliances. They first lay out the job to fit the piping into the structure of the house with the least waste of material and within the confines of the structure. They then 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.

Plumbers install plumbing fixtures such as faucets, sinks, and toilets.

Sometimes, plumbers have to cut holes in walls, ceilings, and floors of a house. For 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 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.

**Working Conditions**

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.

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.

**Employment**

Pipelayers, plumbers, pipefitters, and steamfitters constitute one of the largest construction occupations, holding about 568,000 jobs in 2000. About 52 percent 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, where manufacturing operations require the moving of liquids and gases through pipes. About 1 of every 7 pipelayers, plumbers, pipefitters, and steamfitters was self-employed.

Jobs for pipelayers, plumbers, pipefitters, and steamfitters are distributed across the country in about the same proportion as the general population.

**Training, Other Qualifications, and Advancement**

Virtually all pipelayers, plumbers, pipefitters, and steamfitters undergo some type of apprenticeship training. Many programs are administered by local union-management committees made up of members of the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada, and local employers who are members of either the Mechanical Contractors Association of America, the National Association of Plumbing-Heating-Cooling Contractors, or the National Fire Sprinkler Association.

Nonunion training and apprenticeship programs are administered by local chapters of 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.

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
plumbers, pipefitters, and steamfitters generally is less sensitive to local economic conditions. However, employment of pipelayers, job openings, as well as apprenticeship opportunities, fluctuate with when a project ends, pipelayers, plumbers, pipefitters, and steamfitters. Instead, when they need a plumber, they rely on work- and keep systems running smoothly. But, to reduce labor costs, have employed their own plumbers or pipefitters to maintain equip- and increasing efficient sprinkler systems; and other new technolo- gies will restrict the number of new jobs. In addition to those re- stricting systems of pipes, such as power plants, water and wastewater treatment plants, pipelines, office build- ings, and factories. However, the growing use of plastic pipe and fittings, which are much easier to install and repair than other types; increasingly efficient sprinkler systems; and other new technolo- gies will restrict the number of new jobs. In addition to those re- sulting from employment growth, many positions will become available each year from the need to replace experienced workers who retire or leave the occupation for other reasons.

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 a full-time, in-house plumber or pipefitter. Instead, when they need a plumber, they rely on workers provided under service contracts by plumbing and pipefitting contractors. Construction projects provide only temporary employment. So, when a project ends, pipelayers, plumbers, pipefitters, and steamfitters working on the project may experience bouts of unem- ployment. Because construction activity varies from area to area, job openings, as well as apprenticeship opportunities, fluctuate with local economic conditions. However, employment of pipelayers, plumbers, pipefitters, and steamfitters generally is less sensitive to changes in economic conditions than is that of some other construction trades. Even when construction activity declines, mainte- nance, rehabilitation, and replacement of existing piping systems, as well as the increasing installation of fire sprinkler systems, pro- vide many jobs for pipelayers, plumbers, pipefitters, and steamfitters.

Job Outlook
Job opportunities are expected to be excellent, as increased demand for skilled pipelayers, plumbers, pipefitters, and steamfitters is ex- pected to outpace the supply of workers trained in this craft. Em- ployment of pipelayers, plumbers, pipefitters, and steamfitters is expected to grow about as fast as the average for all occupations through the year 2010. In addition, many potential workers may prefer work that is less strenuous and has more comfortable work- ing conditions. Well-trained workers will have especially favor- able opportunities.

Demand for plumbers will stem from building renovation, in- cluding the increasing installation of sprinkler systems; repair and maintenance of existing residential systems; and maintenance activi- ties for places having extensive systems of pipes, such as power plants, water and wastewater treatment plants, pipelines, office build- ings, and factories. However, the growing use of plastic pipe and fittings, which are much easier to install and repair than other types; increasingly efficient sprinkler systems; and other new technolo- gies will restrict the number of new jobs. In addition to those re- sulting from employment growth, many positions will become available each year from the need to replace experienced workers who retire or leave the occupation for other reasons.

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Earnings
Pipelayers, plumbers, pipefitters, and steamfitters are among the highest paid construction occupations; in 2000, median hourly earn- ings of plumbers, pipefitters, and steamfitters were $18.19. The middle 50 percent earned between $14.00 and $24.24. The lowest 10 percent earned less than $10.71, and the highest 10 percent earned more than $30.06. Median hourly earnings in the industries em- ploying the largest numbers of plumbers, pipefitters, and steamfitters in 2000 are shown below.

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Median Hourly Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plumbing, heating, and air-conditioning</td>
<td>$18.20</td>
</tr>
<tr>
<td>Nonresidential building construction</td>
<td>$17.80</td>
</tr>
<tr>
<td>Heavy construction, except highway</td>
<td>$17.26</td>
</tr>
<tr>
<td>Local government</td>
<td>$17.12</td>
</tr>
<tr>
<td>Miscellaneous special trade contractors</td>
<td>$16.92</td>
</tr>
</tbody>
</table>

In 2000, median hourly earnings of pipelayers were $13.20. The middle 50 percent earned between $10.17 and $17.71. The lowest 10 percent earned less than $8.61, and the highest 10 percent earned more than $23.16.

Apprentices usually begin at about 50 percent of the wage rate paid to experienced pipelayers, plumbers, pipefitters, and steamfitters. Wages increase periodically as skills improve. After an initial waiting period, apprentices receive the same benefits as do experienced pipelayers, plumbers, pipefitters, and steamfitters.

Many pipelayers, plumbers, pipefitters, and steamfitters are members of the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada.

Related Occupations
Other occupations in which workers install and repair mechanical systems in buildings are boilermakers; electricians; elevator install- ers and repairers; heating, air-conditioning, and refrigeration me- chanics and installers; industrial machinery installation, repair, and maintenance workers; sheet-metal workers; and stationary engineers and boiler operators.

Sources of Additional Information
For information about apprenticeships or work opportunities in pipelaying, plumbing, pipefitting, and steamfitter, contact local plumbing, heating, and air-conditioning contractors; a local or State chapter of the National Association of Plumbing, Heating, and Cool- ing Contractors; a local chapter of the Mechanical Contractors Asso- ciation; a local chapter of the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada; or the nearest office of your State employ- ment service or apprenticeship agency.

For information about apprenticeship opportunities for pipelayers, plumbers, pipefitters, and steamfitters, contact:
- United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry, 901 Massachusetts Ave. NW., Washington, DC 20001.

For more information about training programs for pipelayers, plumbers, pipefitters, and steamfitters, contact:
- Associated Builders and Contractors, 1300 N. 17th St., Arlington, VA 22209. Internet: http://www.abc.org
Plasterers and Stucco Masons

Plastering—one of the oldest crafts in the building trades—is enjoying resurgence in popularity because of the introduction of newer, less costly materials and techniques. Plasterers apply plaster to interior walls and ceilings to form fire-resistant and relatively soundproof surfaces. They also apply plaster veneer over drywall to create smooth or textured abrasion-resistant finishes. In addition, plasterers install prefabricated exterior insulation systems over existing walls—for good insulation and interesting architectural effects—and cast ornamental designs in plaster. Stucco masons apply durable plasters, such as polymer-based acrylic finishes and stucco, to exterior surfaces. Drywall installers, ceiling tile installers, and tapers—who are discussed elsewhere in the Handbook—use drywall instead of plaster when erecting interior walls and ceilings.

When plasterers work with interior surfaces such as concrete block and concrete, they first apply a brown coat of gypsum plaster that provides a base, followed by a second, or finish, coat—also called “white coat”—which is a lime-based plaster. When plastering metal lath (supportive wire mesh) foundations, they apply a preparatory, or “scratch,” coat with a trowel. They spread this rich plaster mixture into and over the metal lath. Before the plaster sets, plasterers scratch its surface with a rake-like tool to produce ridges, so that the subsequent brown coat will bond tightly.

Laborers prepare a thick, smooth plaster for the brown coat. Plasterers spray or trowel this mixture onto the surface, then finish by smoothing it to an even, level surface.

For the finish coat, plasterers prepare a mixture of lime, plaster of Paris, and water. They quickly apply this to the brown coat using a “hawk”—a light, metal plate with a handle—trowel, brush, and water. This mixture, which sets very quickly, produces a very smooth, durable finish.

Plasterers also work with a plaster material that can be finished in a single coat. This “thin-coat” or gypsum veneer plaster is made of lime and plaster of Paris and is mixed with water at the jobsite. This plaster provides a smooth, durable, abrasion-resistant finish on interior masonry surfaces, special gypsum baseboard, or drywall prepared with a bonding agent.

Plasterers create decorative interior surfaces as well. They do this by pressing a brush or trowel firmly against a wet plaster surface and using a circular hand motion to create decorative swirls.

For exterior work, stucco masons usually apply stucco—a mixture of Portland cement, lime, and sand—over cement, concrete, masonry, or lath. Stucco may also be applied directly to a wire lath with a scratch coat, followed by a brown coat and then a finish coat. Stucco masons may also embed marble or gravel chips into the finish coat to achieve a pebblelike, decorative finish.

Increasingly, plasterers apply insulation to the exteriors of new and old buildings. They cover the outer wall with rigid foam insulation board and reinforcing mesh, and then trowel on a polymer-based or polymer-modified base coat. They may apply an additional coat of this material with a decorative finish.

Plasterers sometimes do complex decorative and ornamental work that requires special skill and creativity. For example, they may mold intricate wall and ceiling designs. Following an architect’s blueprint, plasterers pour or spray a special plaster into a mold and allow it to set. Workers then remove the molded plaster and put it in place, according to the plan.

Working Conditions
Most plastering jobs are indoors; however, plasterers and stucco masons work outside when applying stucco or exterior wall insulation.