Painters and Paperhangers

(2d ed. D.O.T. 5–27.010 through .920 and 5–28.100)
(3d ed. D.O.T. 840.131, .381, .781, .884, and .887 and 841.781)

Nature of Work

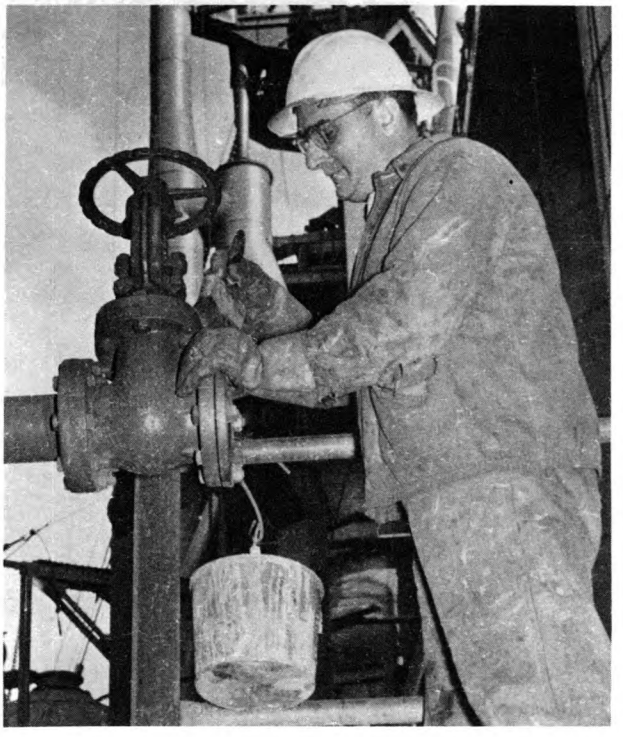
Painting and paperhanging are separate skilled building trades, although many craftsmen in these trades do both types of work. Painters prepare the surfaces of buildings and other structures and then apply paint, varnish, enamel, lacquer, and similar materials to these surfaces. Paperhangers cover room interiors with paper, fabric, vinyls, or other materials.

One of the important duties of the painter—especially in repainting—is to prepare the surface. Loose paint must be removed by scraping or by heating with a blowtorch and then scraping. Grease must be removed, nail holes and cracks filled, rough spots sandpapered, and dust brushed off. Often, surfaces must be covered with a prime coat or sealer to provide a suitable surface or base on which to apply the new paint. Paint is applied to many kinds of materials, including wood, structural steel, and clay products, generally by a brush, spray gun, or roller.

A painter must be skilled in handling brushes and other painting tools in order to apply paint thoroughly, uniformly, and rapidly to any type of surface. He must be able to mix paints, match colors, and must have a knowledge of paint composition and color harmony. He must also know the characteristics of common types of paints and finishes from the standpoints of durability, suitability for different purposes, and ease of handling and application.

Painters must know how to erect the scaffolding from which they often work, including "swing stages" (scaffolds suspended by ropes or cables attached to roof hooks) and "bosun chairs," which they use when working on tall buildings and other structures.

Painters use spray guns to paint surfaces or objects that are difficult to paint with a brush, such as lattices, cinder and concrete block, and radiators. They also use spray guns on large areas that can be sprayed with a minimum of preparation. When using a roller (a rotating applicator covered with soft material), the painter rolls the applicator over the surface to be covered.



Painter applies paint to safety valve on an overhead gas main.

The paperhanger first prepares the surface to be covered. In new work, he applies "sizing," a prepared material that makes the plaster less porous and assures better sticking of the paper to the surface. In redecorating work, it may be necessary to remove old paper by soaking or, if there are many layers, by steaming. Frequently, it is also necessary for paperhangers to do minor plaster patching in order to get a smooth surface for the covering material.

When the surface has been prepared, the paperhanger measures the area to be covered and cuts the paper to size. He mixes a paste and applies it to the reverse side of the paper. The pastecoated paper is then placed on the wall or ceiling in strips and smoothed into place with a dry brush. The paperhanger matches the adjacent edges of strips of figured paper, cuts overlapping ends, and smooths the seams between strips with a roller or other special tool. When working with wall coverings other than paper,

Paperhanger removes excess wall covering around window frame.

the paperhanger follows the same general procedure, except that he applies an adhesive other than paste.

Where Employed

Most painters and paperhangers work for contractors engaged in new building construction work. Substantial numbers of painters and paperhangers are also employed by contractors to do repair, alteration, or modernization work. Hotels, office buildings, shipyards, utility companies, manufacturing firms, schools and other government units, and other organizations that own extensive property commonly employ maintenance painters. When interior redecorating involves papering, as in hotels or apartment buildings, maintenance painters may also do the paperhanging.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship committee for the painting and decorating industry, recommend the completion of a 3-year formal apprenticeship as the best way to become a journeyman painter or paperhanger. A substantial proportion of painters and paperhangers, however, have learned the trade informally, by working for many years as helpers or handymen, observing or being taught by experienced craftsmen. Workers without formal apprentice training have gained acceptance as journeymen more easily in these crafts than in most of the other building trades.

Apprentice applicants are generally required to be between the ages of 16 and 25 and in good physical condition. A high school education is preferred although not essential. Applicants should have manual dexterity and a discerning color sense. They should not be allergic to paint fumes or to the other materials used in these trades, such as varnish, turpentine, and lacquer.

The apprenticeship for painters and paperhangers generally consists of 6,000 hours (3 years) of on-the-job training, in addition to related classroom instruction. Many apprenticeships combine painting and paperhanging. In a typical 3-year training program, the apprentice learns, among other things, to use, care for, and handle safely the tools, machines, equipment, and materials commonly used in the trade; prepare surfaces, including sizing, sandpapering, and puttying walls; match and mix colors; apply various types of interior and exterior materials, including stain, lacquer, enamel, oil, and varnish; and erect scaffolding.

In addition, the apprentice receives related classroom instruction in color harmony; paint chemistry; estimating costs; and making, mixing, and matching paints. He also learns the relationship between painting and paperhanging work and the work performed by the other building trades craftsmen.

Hourly wage rates for apprentices usually start at 50 percent of the journeyman rate and increase periodically until the journeyman rate of pay is reached upon completion of apprenticeship.

Painters and paperhangers may advance to foreman. They may also advance to jobs as estimators for painting and decorating contractors—computing material requirements and labor costs. Some may become superintendents on large contract painting jobs, or they may establish their own business as painting and decorating contractors.

Employment Outlook

Employment of painters—estimated at about 400,000 in 1964—is expected to increase slowly through 1975, assuming relatively full employment nationally and the high levels of economic activity needed to achieve this goal. In addition to employment growth, thousands of job openings will arise from the need to replace experienced painters who transfer to other occupations, retire, or die. Retirements and deaths alone are expected to provide more than 10,000 job openings annually.

The large rise anticipated in construction activity (see discussion, p. 370) is expected to result in a growing demand for painters. Moreover, recently developed paints that are heat-, abrasion-, and corrosion-resistant have resulted in new uses for paints. Furthermore a growing number of painters are expected to be needed in the maintenance departments of large industrial and commercial firms.

Technological developments are expected to continue to limit the employment of painters. New types of paint that are more easily applied and have improved "covering power" have made it easier for inexperienced workers to do work that is acceptable to some customers. Other paints that are being introduced promise to double the "life" of ordinary paints. Spray painting requires fewer painters to do the same amount of work. In addition, many items formerly painted at the building site now come from a factory with a prime coat and often with a final coat. Aluminum building products, which often require no painting, have become increasingly common in recent years.

Employment of paperhangers—estimated at about 11,000 in 1964—is expected to increase by a few thousand by 1975. In addition, some job openings will result from the need to replace experienced paperhangers who transfer to other occupations, retire, or die. Retirements and deaths alone are expected to result in nearly 400 job openings annually.

Growth in the employment of paperhangers is expected mainly because of the anticipated increase in construction activity. Also, the more widespread use of fabric, plastic, and other types of wall coverings should contribute to the demand for these workers. However, the use of paints for interior walls as well as wallpapers designed for easier application by "do-it-yourselfers" will tend to limit the employment growth of paperhangers.

Earnings and Working Conditions

Union minimum hourly wage rates for painters and paperhangers in 68 large cities averaged $4.11 and $4.04, respectively, as of July 1, 1964, according to a national survey of building trades workers. In comparison, the average rate for all journeymen in the building trades was $4.46 an hour. Among individual cities surveyed, the minimum hourly rates for painters ranged from $2.75 in Richmond, Va., to $4.52 in San Diego, Calif. The rates for paperhangers ranged from $2.75 in Richmond, Va., to $4.86 in Sacramento, Calif.

Painters and paperhangers are often required to stand for long periods of time, to climb, and to bend at their work. A painter must have strong arms because much of the work is done with arms raised overhead. Painters and paperhangers risk injury from slips or falls from ladders and scaffolds.

A large proportion of painters and paperhangers are members of the Brotherhood of Painters, Decorators and Paperhangers of America. A few are members of other unions.

Where To Go for More Information

For further information regarding painting and paperhanging apprenticeships or other work opportunities in these trades, inquiries should be directed to local painting and decorating contractors; a local of the Brotherhood of Painters, Decorators and Paperhangers of America; a local joint union-management apprenticeship committee; or the nearest office of the State apprenticeship agency or the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of painters and paperhangers may be obtained from:

Brotherhood of Painters, Decorators and Paperhangers of America,
217–219 North Sixth St., Lafayette, Ind. 47901.

Painting and Decorating Contractors Association of America.
2625 West Peterson Ave., Chicago, Ill. 60605.

Plasterers

(2d ed. D.O.T. 5–29.100, .200, and .300)
(3d ed. D.O.T. 842.381 and .781)

Nature of Work

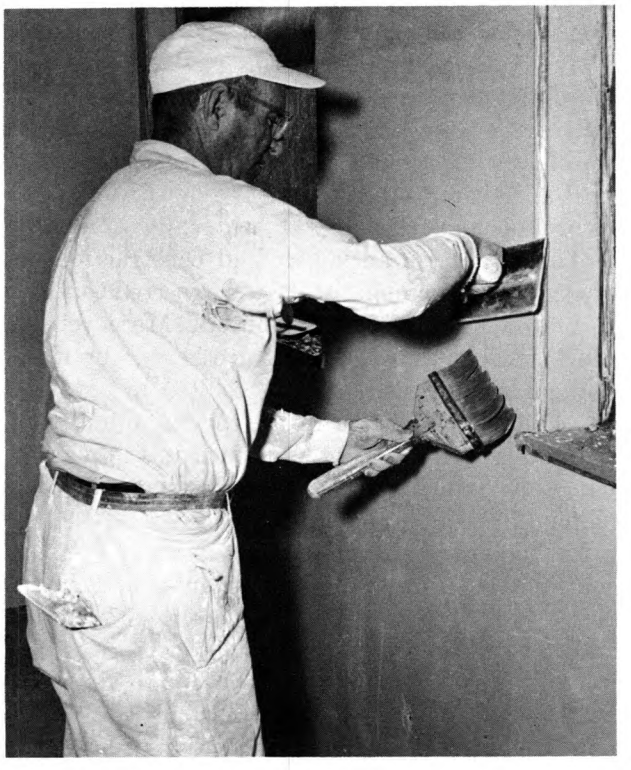
The plasterer is the building craftsman who applies plaster to interior walls and ceilings to form fire-resistant and relatively soundproof surfaces, which may then be decorated. They also apply stucco to exterior walls, and form and cast ornamental designs in plaster.

In interior work, plaster is applied to gypsum lath or wire lath (backing to which plaster adheres) or directly to masonry. The plasterer uses a hawk (a square plate of wood or metal) to hold small amounts of wet plaster, and a trowel to apply it to the lath. To obtain a uniform surface of plaster, the craftsman applies a border of plaster of the desired thickness to the top and bottom of the wall section to be covered. When these borders have hardened sufficiently, he fills in the area between them with one or two base coats of plaster. The surface of this area is then leveled to the exact thickness of the borders with a straight-edged tool. A long, flat tool, called a darby, is then used to smooth this surface.

Applying the finish coat of plaster is the last operation. This coat is relatively thin and must be applied carefully if the surface is to be smooth. Plaster wall surfaces may be finished in a number of ways, by using different tools and methods, to obtain a variety of decorative textures, such as stipple or swirl finishes.

A plasterer can do more complex types of plastering work, such as decorative and ornamental plastering. For example, he may be called upon to mold or form intricate ornamental designs such as cornices, paneling, or recesses for indirect lighting. Plasterers who do this type of work must be able to follow blueprints and other specifications furnished by the architect.

In exterior stucco work, the plasterer applies a mixture of portland cement and sand to masonry, expanded metal, or metal wire lath in the same manner as in interior plastering. The finish coat usually consists of a mixture of white cement and sand or a patented finish material, which may be applied in a variety of colors and textures.



Plasterer uses trowel and brush to finish wall.

Apprentices work with journeymen plasterers so that they may acquire a full knowledge of the craft and develop the necessary skills. Laborers (hod carriers) mix base coat materials and some finish materials and carry them to the plasterer; they also erect scaffolding when needed.

In recent years, plasterers have been making increasing use of machines that spray plaster on walls, ceilings, and structural sections of buildings. These machines are particularly desirable when used to apply the newly developed lightweight plasters. Machines used to mix plaster have been in general use for many years.

Where Employed

Most plasterers work on new building construction. In addition, plasterers work on extensive building alterations, particularly where special architectural and lighting effects are part of the building modernization. There is a rela-

tively small amount of work for plasterers in the repair and maintenance of older buildings.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship committee for the plastering trade, recommend completion of a 3- or 4-year apprenticeship as the best way to learn plastering. However, many workers in this trade have acquired some plastering skills by working for many years as helpers or laborers, observing or being taught by experienced plasterers.

Apprentice applicants in this trade are generally required to be between the ages of 18 and 25. Good physical condition and manual dexterity are important assets.

Apprenticeship programs generally consist of 6,000 to 8,000 hours (3 or 4 years) of on-the-job training, in addition to at least 144 hours of related classroom instruction annually. In a typical 4-year training program, the apprentice learns, among other things, to use and handle the tools of the trade, and the properties and appropriate handling of the different kinds of materials and mixtures used in plastering. In addition, he learns how to apply scratch (first) coat and brown (second) coat; aline walls and beams to given measurements; apply white coat and sand finish; install acoustical plaster and stucco, and acoustical tile, cork, and similar materials; use machines to apply and finish plaster; and lay out arches and ceilings. He also learns texture finishing.

The apprentice receives classroom instruction in such subjects as drafting, blueprint reading, and mathematics applicable to layout work. In the classroom and on the job, the apprentice becomes familiar with the work of other trades so that he may determine, for example, whether lathing or other preparatory work is satisfactory.

Although advancement opportunities for plasterers are limited, some may become foremen or estimators. Many plasterers are self-employed, and may employ other plasterers.

Employment Outlook

A moderate increase in the employment of plasterers—estimated at about 50,000 in 1964—is expected through 1975, assuming relatively full employment nationally and the high levels of economic activity needed to achieve this goal. In addition, the need to replace experienced plasterers who transfer to other fields of work or who retire or die will provide many job openings for new workers. Retirements and deaths alone are expected to result in about 1,000 job openings annually.

The growth in employment of these workers will result primarily from the anticipated large increase in construction activity. (See discussion, p. 370.) In addition, recent changes in plastering materials and improved methods of applying these materials are increasing the scope of the craft and creating work opportunities for plasterers. For example, improved lightweight plasters are being used increasingly because of their excellent soundproofing, acoustical, and fireproofing qualities. Another development that is expanding job opportunities for plasterers is the growing use of curved surfaces and ceilings made of plaster, both as a form of architectural treatment and to achieve special lighting and acoustical effects. Machine plastering and fireproofing have become widespread. Still other developments are the increasing use of "plaster veneer" or "high density" plaster, a thin, extremely hard material used to create a finished surface, and "marblecrete," a type of stucco in which varicolored marble chips have been imbedded.

The growth in employment resulting from these favorable developments will be limited by the continuing use of nonplaster (dry-wall) construction, which can be installed by craftsmen other than plasterers.

Earnings and Working Conditions

Hourly pay rates for plasterers rank among the highest in the skilled building trades. Union minimum hourly rates for plasterers averaged $4.59, compared with $4.46 for all journeymen in the building trades, as of July 1, 1964, according to a national survey of building trades workers in 68 cities. Among individual cities surveyed, the minimum hourly rates for plasterers ranged from $3.40 in Jackson, Miss., to $5.55 in New York City.

Plastering requires considerable standing, stooping, and lifting. Plasterers work both out-

doors, doing stucco work, and indoors, plastering walls and ceilings and forming and casting ornamental designs.

A large proportion of plasterers are members of unions. They are represented by either the Operative Plasterers' and Cement Masons' International Association of the United States and Canada, or the Bricklayers, Masons and Plasterers' International Union of America.

Where To Go for More Information

For further information regarding plastering apprenticeships or other work opportunities in the trade, inquiries should be directed to local plastering contractors; locals of the unions previously mentioned; a local joint union-management apprenticeship committee; or the nearest office of the State apprenticeship agency or the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of plasterers may be obtained from:

Bricklayers, Masons and Plasterers' International Union of America,
815 15th St. NW., Washington, D.C. 20005.

Contracting Plasterers' and Lathers' International Association,
304 Landmark Bldg., 1343 H St. NW.,
Washington, D.C. 20005.

National Bureau for Lathing and Plastering,
1725 K St. NW., Washington, D.C. 20006.

Operative Plasterers' and Cement Masons' International Association of the United States and Canada.
1125 17th St. NW., Washington, D.C. 20036.

Plumbers and Pipefitters

(2d ed. D.O.T. 5–30.010, .026, .210, and .410)
(3d ed. D.O.T. 862.381)

Nature of Work

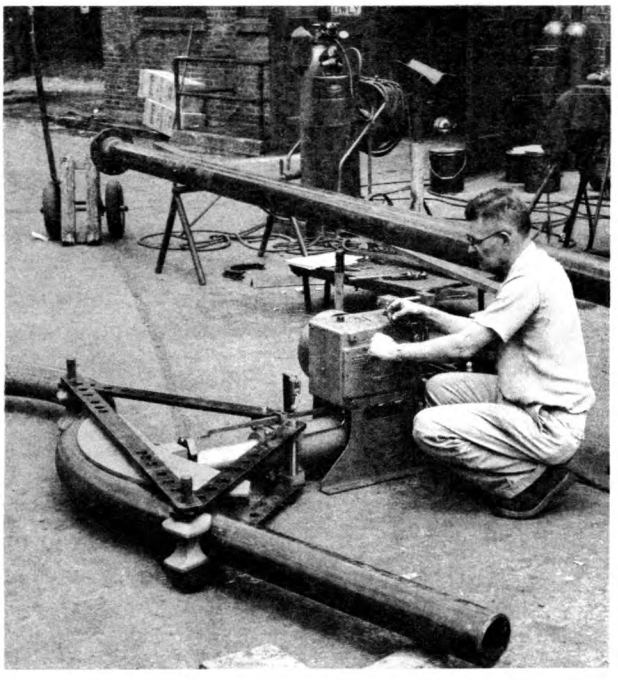
Plumbers and pipefitters are craftsmen who install pipe systems that carry water, steam, air, or other liquids or gases needed for sanitation, industrial production, or other uses. They also alter and repair existing pipe systems and install plumbing fixtures, appliances, and heating and refrigerating units.

Although plumbing and pipefitting are sometimes considered to be a single trade, journeymen in this field can specialize in either one craft or the other, particularly in large cities. Water, gas, and waste disposal systems, especially those connected to public utility systems, are installed by plumbers. Such installations are made in residential and commercial buildings, schools, industrial plants, and other structures. Pipefitters install both high- and low-pressure pipes that carry hot water, steam, and other liquids and gases, especially those in industrial and commercial buildings and defense establishments such as missile launching and testing sites. Pipefitters, for example, install ammonia-carrying pipelines in refrigeration plants, complex pipe systems in oil refineries and chemical and food-processing plants, automatic sprinkler systems, and pipelines for carrying compressed air and industrial gases in many types of industrial establishments.

Some plumbers and pipefitters specialize in either gas fitting or steam fitting. Gas fitters install and maintain the gas fittings and the central gas main extensions that connect the main gas line with those leading to homes. Steamfitters assemble and install steam or hot water systems for commercial and industrial uses.

Plumbers and pipefitters use a variety of skills when installing pipe systems. For example, they bend pipe and make welded, brazed, calked, soldered, or threaded joints. After a pipe system is installed, the plumber or pipefitter tests for leaks by filling the pipes with liquid or gas under pressure.

Plumbers and pipefitters use wrenches, reamers, drills, braces and bits, hammers, chisels, saws, and other handtools. Power machines are often used to cut, bend, and thread pipes. Hand-operated hydraulic pipe benders are also used. In addition, plumbers and pipefitters use gas or gasoline torches and welding, soldering, and brazing equipment in their work.



Pipefitter uses hydraulic pipe bender to shape pipe.

Where Employed

Most plumbers and pipefitters are employed by plumbing and pipefitting contractors in new building construction, mainly at the construction site. A substantial proportion of plumbers are self-employed or work for plumbing contractors doing repair, alteration, or modernization work. Some plumbers install and maintain pipe systems for government agencies and public utilities, and some work on the construction of ships and aircraft. Others do maintenance work in industrial and commercial establishments. Pipefitters, in particular, are employed as maintenance personnel in the petroleum, chemical, and food-processing industries where the industrial operations include the processing of fluids through pipes.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship committees for the plumbing and pipefitting industries, recommend a formal 5-year apprenticeship for plumbers or for pipefitters as the best way to learn all the aspects of these trades. A large number of plumbers and pipefitters, however, have acquired plumbing and pipefitting skills informally, by working for several years with craftsmen, receiving instruction from them and watching them work. Many of these persons have gained some of their knowledge of their trade by taking trade or correspondence school courses.

Apprentice applicants generally are required to be between the ages of 16 and 25, and in good physical condition. A high school education or its equivalent, including courses in mathematics, physics, and chemistry, is desirable. Applicants are often required to take aptitude tests, particularly to determine whether they have the high degree of mechanical aptitude required in this field.

Most apprentice training programs for plumbers and pipefitters are conducted under written agreements between the apprentices and local joint apprenticeship committees, composed of union and management representatives, who supervise the training. The apprenticeship committee determines the need for apprentices in the locality, establishes minimum apprenticeship standards of training, and, if necessary, schedules a rotating work program. This program is designed to give the apprentice diversified training by having him work for several plumbing or pipefitting contractors.

The apprenticeship program for plumbers or for pipefitters usually consists of 10,000 hours of on-the-job training, in addition to at least 144 hours of related classroom instruction annually. In a typical 5-year training program, the plumber or pipefitter apprentice learns, among other things, how to use, care for, and handle safely the tools, machines, equipment, and materials used in the trades. They also learn welding and soldering techniques and general repair work; the use of ladders and the erection and dismantling of scaffolding; and the proper use of plastic and glass piping. The plumber apprenticeship program includes training in the basic skills of the trade and in the installation of sewers, drains, and services outside the building; private water supply and drainage systems; building water supply systems; building drainage and vent systems; water heaters and treatment equipment; appliances; the testing, repair, and maintenance of these systems and equipment; and in estimating the materials required. The pipefitter apprentice-

ship program includes training in the installation of radiators, pumps, boilers, stokers, oil burners, and gas furnaces; hot water, steam panel, and radiant-heating systems; air-conditioning and powerplant piping systems; and pneumatic control systems and instrumentation. They may also learn boiler replacement.

The apprentice receives related classroom instruction in subjects such as drafting and blueprint reading, mathematics applicable to layout work, applied physics and chemistry, and local building codes and regulations that apply to the trade.

Hourly wage rates of apprentices in this trade usually start at 63 percent of the journeyman rate and increase in each 6-month period until a rate of 90 percent is reached during the last period of the apprenticeship.

In some localities, a journeyman's license is required for plumbers. To obtain this license, a person must pass a special examination to demonstrate his knowledge of the local building codes. The examination also tests his all-round knowledge of the trade.

Some journeymen plumbers and pipefitters may become foremen for plumbing or pipefitting contractors. Many journeymen go into business for themselves. As they expand their activities, they may employ other workers and become plumbing and pipefitting contractors. In most localities, contractors are required to obtain a master plumber's license.

Employment Outlook

Employment of plumbers and pipefitters—who numbered about 335,000 in 1964—is expected to rise rapidly through 1975, assuming relatively full employment nationally and the high levels of economic activity needed to achieve this goal. In addition, thousands of job opportunities will arise as a result of the need to replace experienced plumbers and pipefitters who transfer to other fields of work, retire, or die. Retirements and deaths alone are expected to result in about 7,000 job openings annually.

The most important factor that will contribute to the rapid rise in employment is the anticipated large increase in construction activity. (See discussion, p. 370.) Furthermore, plumbing and heating work is expected to become more important in many types of construction. For example, the trend toward more bathrooms per dwelling unit is likely to continue. The installation of appliances such as washing machines and waste disposals will become more widespread. The number of automatic heating system installations probably will increase. Also, in industry generally, pipework is becoming more important and plumbers and pipefitters will be needed for installation and maintenance work. For example, the chemical industry, which uses extensive pipework in its processing activities, is expected to expand its facilities. Those industries that are automating their production activities will require more pipefitting work. The increasing industrial activities related to atomic energy and the greater use of refrigeration and air-conditioning equipment will also result in more work for plumbers and pipefitters.

Technological developments are expected to limit the growth in the number of jobs for plumbers and pipefitters. For example, prefabricated plumbing assemblies can now be installed as a unit, thereby reducing the amount of on-site plumbing required. Packaged gas vents are also available. Ventpipe sections come in standardized lengths that can be fastened together by locking joint bands, thus eliminating cementing operations. Some builders are preassembling their own waste, vent, and other systems components. This work—usually performed by the employers' regular crew in well-equipped shops set up near the building site—can be performed during periods of inclement weather, or other "slow" periods.

Earnings and Working Conditions

Union minimum hourly wage rates for plumbers and for pipefitters averaged $4.70 and $4.62, respectively, as of July 1, 1964, according to a national survey of building trades workers in 68 large cities. At the same time, the average hourly rate for all journeymen in the building trades was $4.46. Among individual cities surveyed, the union minimum hourly wage rates for plumbers ranged from $3.75 in Charlotte,

N.C., to $5.71 in Oakland, Calif.; pipefitters' rates ranged from $3.75 in Charlotte, N.C., to $5.83 in Oakland. Annual earnings of workers in this field are among the highest in the building trades, because plumbing and pipefitting are affected less by seasonal factors than are most other building crafts.

The work of plumbers and pipefitters is active and sometimes strenuous, as is the work in the other building trades. They frequently must stand for prolonged periods and occasionally work in cramped or uncomfortable positions because much of their work is done in relatively inaccessible places.

Workers in this trade risk the danger of falls from ladders, cuts from sharp tools, and burns from hot pipes or steam. The number of injuries per million man-hours worked by employees of plumbing, heating, and air-conditioning contractors in the contract construction industry has been lower than that for contract construction as a whole, but higher than the average for production workers in manufacturing industries.

A large proportion of plumbers and pipefitters are members of the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada.

Where To Go for More Information

For further information regarding plumber or pipefitter apprenticeships or work opportunities in these trades, inquiries should be directed to local plumbing, heating, and air-conditioning contractors; a local union of the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; a local joint union-management apprenticeship committee; or the nearest office of the State apprenticeship agency or the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities. Some local employment service offices provide such services as screening applicants and giving aptitude tests.

General information about the work of plumbers and pipefitters may be obtained from:

National Association of Plumbing-Heating-Cooling Contractors,
1016 20th St. NW., Washington, D.C. 20036.

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada,
901 Massachusetts Ave., NW., Washington, D.C. 20001.

Roofers

(2d ed. D.O.T. 5–25.220, 7–31.100 through .500, and 7–32.661)
(3d ed. D.O.T. 804.281; 843.884; and 866.381)

Nature of Work

Roofers apply composition roofing and other materials, such as tile and slate, to the roofs of buildings. They also waterproof and dampproof walls and other building surfaces.

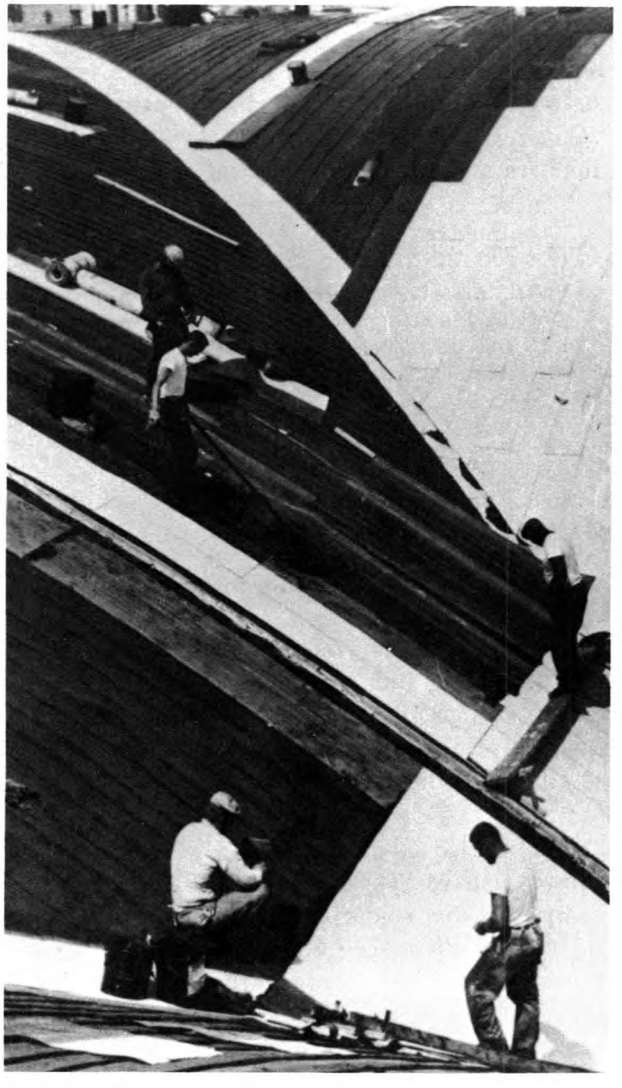
In applying composition roofing, the roofer first places overlapping strips of asphalt or tar impregnated felt over the entire surface. He then applies a coating of coal tar pitch, asphalt, or other bituminous material. This process is repeated until at least three layers of felt are in place. Finally, he applies a surfacing of coal tar pitch or asphalt and gravel or a smooth surface asphalt, to protect the roofing materials from the weather.

In applying other types of composition roofing, such as roll roofing and asphalt shingles, the roofer overlaps the roofing material and then fastens it to the roof base with nails or asphalt cement. If necessary, he cuts the material to fit corners, pipes, and chimneys. The roofer then cements or nails flashing (strips of felt or metal) wherever two roof surfaces intersect. Flashing is installed to make the intersections (joints) watertight.

Roofers also use metal, tile, and slate for the more expensive types of roofs. Metal roofs are constructed by soldering metal sheets together and nailing them to the wood sheathing. In installing tile and slate roofs, the roofer places a covering of roofing felt over the wood sheathing. He punches holes in the slate or tile that he nails to the sheathing. Each row of slate or tile is placed to overlap the preceding row. Fi-

nally, the roofer covers the exposed nailheads with roofing cement to avoid rusting and water leakage around the nailheads. Handtools usually are used in applying roof surfaces—for example, hammers, roofing knives, mops, pincers, and calking guns.

Roofers also do waterproofing and dampproofing work on parts of structures other than roofs, such as masonry or concrete walls or swimming pools and other tanks. The roofer prepares surfaces to be waterproofed by removing rough projections and roughing glazed surfaces, using a hammer and chisel. He then applies a coat of liquid compound with a brush. He may also paint or spray surfaces with a waterproofing material or nail waterproofing fabric to surfaces. In dampproofing work, he usually sprays a coating of tar or asphalt on interior or exterior surfaces to avoid the penetration of moisture.



Roofers lay composition roofing material.

Where Employed

Roofers work for roofing contractors on new building construction. They also do maintenance and repair work, especially on composition roofing. A few roofers are self-employed, doing either roofing on small, new building work or repairs and alterations. Roofers also work for government agencies or business establishments that do their own construction and repair work

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint labor-management apprenticeship and training committee for the roofing industry, recommend completion of a 3-year apprenticeship program, covering all types of roofing work, as the superior way to learn this trade. A substantial proportion of workers, however, have acquired roofing skills informally, by working for many years as helpers or handymen, observing or being taught by experienced roofers.

Apprenticeship applicants are required to be at least 18 years old; a high school education or its equivalent is desirable. Good physical condition and a good sense of balance are important assets.

The 3-year apprenticeship program generally consists of a minimum of 1,400 hours of on-the-job training annually, in addition to related classroom instruction. In a typical training program, the apprentice learns, among other things, to use, care for, and handle safely the tools, equipment, and materials commonly used in the trade; work with composition, tar, and asphalt; prepare roof surfaces for covering; apply pitch and other materials; spread gravel; do slate, tile, and terra cotta work; and do dampproofing and waterproofing work.

The trainee receives related classroom instruction in such subjects as blueprint reading and mathematics applicable to layout work.

Hourly wage rates for apprentices usually start at 65 percent of the journeyman rate and increase periodically until 90 percent of the jour-

neyman rate is reached in the final 6 months of the training period.

Roofers may advance to foreman and to superintendent for a roofing contractor. Also, they may enter business for themselves, and hire other roofers.

Employment Outlook

Employment of roofers—who numbered nearly 60,000 in 1964—is expected to increase moderately through 1975, assuming relatively full employment nationally and the high levels of economic activity needed to achieve this goal. In addition, thousands of job opportunities will result from the need to replace workers who transfer to other occupations, retire, or die. Retirements and deaths alone are expected to result in more than 800 job openings annually.

Employment of roofers is expected to increase mainly because of the anticipated rapid increase in construction activity. (See discussion, p. 370.) New construction and repairs on existing structures will provide most of the work for these craftsmen. However, dampproofing and waterproofing are expected to provide an increasing proportion of roofers' work.

Although the projected increase in construction activity will result in rising employment of roofers, employment growth will be limited by the increasing use of prestressed concrete for roofs; improved roofing materials and roofing techniques that increase the "life" of roofs; improved tools, such as nailing machines; and more efficient materials handling equipment.

Earnings and Working Conditions

Union minimum hourly wage rates for composition roofers averaged $4.17, as of July 1, 1964, according to a national survey of building trades workers in 68 large cities. For slate and tile roofers, the rate was $4.13. By comparison, the average for all journeymen in the building trades was $4.46 an hour. Among individual cities surveyed, the minimum hourly rates for composition roofers ranged from $2.05 in Norfolk, Va., to $5.25 in Newark, N.J. Slate and tile roofers had hourly rates ranging from $2.80 in Norfolk, Va., to $5.47 in New York City.

Roofers' work, like that of other building tradesmen, is sometimes strenuous. It involves prolonged standing, as well as climbing, bending, and squatting. These workers risk injuries from slips or falls from scaffolds or roofs. They may have to work outdoors in all types of weather, particularly when doing repair work.

A large proportion of roofers are members of the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association.

Where To Go for More Information

For further information concerning roofing apprenticeships or other work opportunities in this trade, inquiries should be directed to local roofing contractors; a local of the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association; a local joint union-management apprenticeship committee; or the nearest office of the State apprenticeship agency or the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship and other training opportunities.

General information about the work of roofers, may be obtained from:

National Roofing Contractors Association,
300 West Washington St., Chicago, Ill. 60606.

United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association,
1125 17th St. N.W., Washington, D.C. 20036.

Sheet-Metal Workers

(2d ed. D.O.T. 4–80.010)
(3d ed. D.O.T. 804.281 and .884)

Nature of Work

Sheet-metal workers engaged in construction-related work fabricate and install ducts that are used in ventilating, air-conditioning, and heating systems. They also fabricate and install a wide variety of other products made from thin metal sheets, such as roofing and siding, partitions, store fronts, and metal framework for neon signs.

Skilled construction sheet-metal workers should not be confused with assemblyline factory operatives who also make sheet-metal products, but can perform only a few specific operations.

In heating or air-conditioning duct work, the sheet-metal worker lays out and plans the job, determining the size and type of sheet metal to be used. The ducts are often fabricated at the sheet-metal shop. Sheet-metal workers cut the metal with hand snips, power-driven shears, and other cutting tools. They form the metal with a variety of machines, hammers, and anvils; then weld, bolt, rivet, solder, or cement the seams and joints. However, factory fabricated ducts in standard sizes are often available and these require little additional fabrication by sheet-metal workers. Some duct fabrication is done at the work site. In the installation of ducts, the components are fitted together. Hangers and braces are installed to support ducts, and joints may be soldered, connected, or welded. Some journeymen workers specialize in shopwork or on-site installation work. However, it is essential that skilled workers know all aspects of the trade.

Journeyman sheet-metal worker supervises apprentice in heating-duct installation.

Where Employed

Sheet-metal workers are employed mainly by plants that fabricate and install heating, refrigeration, and air-conditioning equipment and by contractors engaged in residential, industrial, and commercial building work. In residential construction, these workers may also work for roofing contractors who specialize in metal roofing work. Many of these craftsmen work for government agencies or business establishments that do their own construction and alteration work. Others are self-employed, mainly on repair work or on smaller types of installations.

In addition to sheet-metal workers who perform construction-related work, there are thousands of skilled sheet-metal workers employed in nonconstruction industries; for example, the railroad, aircraft, or shipbuilding industries. Some are employed in small shops manufacturing specialty products, such as custom kitchen equipment for hotels and restaurants. Firms making blowers, exhausts, electrical generating and distributing equipment, food products machinery, steam engines, and turbines also employ skilled sheet-metal workers.

Training, Other Qualifications, and Advancement

Most training authorities, including the national joint management-labor apprenticeship committee for the sheet metal industry, recommend the completion of a 4-year apprenticeship program as the best way to learn the sheet-metal trade. Some sheet-metal workers, however, have acquired skills of the trade informally, by working for many years as helpers or handymen, observing or being taught by experienced craftsmen. Many of these persons have gained some knowledge of the trade by taking correspondence or trade school courses.

Apprenticeship applicants generally are required to be between the ages of 16 and 23; a high school education or its equivalent is desirable. Good physical condition and mechanical aptitude are necessary assets.

The apprenticeship program usually consists of 8,000 hours (4 years) of on-the-job training, in addition to related classroom instruction. In a typical training program, the apprentice learns, among other things, to use, care for, and

handle safely the tools, machines, equipment, and materials commonly used in the trade; solder; do air-conditioning, heating, and ventilating work; do residential installations such as roofing, gutters, and downspouts; and do architectural and industrial sheet-metal work. He also learns general work processes such as cutting, forming, folding, grooving metal material, bending edges, and punching and drilling holes.

The trainee receives related classroom instruction in subjects such as drafting, blueprint reading, and mathematics applicable to layout work. In addition, he learns the relationship between sheet-metal work and other building trades.

Hourly wage rates for sheet-metal apprentices generally start at 50 percent of the journeyman rate and increase periodically until 90 percent of the journeyman rate is reached during the final portion of the training period.

Sheet-metal workers in the construction industry may advance to foreman, superintendent of large projects, or go into business for themselves as sheet-metal contractors and hire other sheet-metal workers. Experienced workers in this trade have more job mobility than many other building trades workers because they can transfer their skills to nonconstruction industries.

Employment Outlook

Employment of sheet-metal workers—who numbered about 50,000 in 1964—is expected to increase rapidly through 1975, assuming relatively full employment nationally and the high levels of economic activity needed to achieve this goal. In addition, thousands of job opportunities will result from the need to replace experienced workers who transfer to other fields of work, retire, or die. Retirements and deaths alone are expected to result in about 800 job openings annually.

The rapid increase in employment of sheet-metal workers is expected mainly because of the anticipated large expansion in residential, commercial, and industrial construction. (See discussion, p. 370.) In addition, large air-conditioning systems are expected to be installed in a greater number of homes, office buildings, schools, hospitals, department stores, and factories. Many of these installations will be in existing structures. Sheet-metal work should also result from growth in the number of large refrigeration systems. Such equipment will be needed in the production and storage of growing quantities of food and other perishable items required by an expanding population. The shops that fabricate sheet-metal products used in construction are also expected to require more of these skilled craftsmen.

Prefabrication is not likely to affect the growth of employment in this occupation as much as in most other building trades, because much sheet-metal work is custom made. The fabrication of ducts and fittings for ventilating installations is limited by the need to tailor these installations to meet a wide variety of structural conditions, such as the dimensions of the building and the space allowed for ducts, and also by the cost of storage space needed to store prefabricated ducts and fittings.

Earnings and Working Conditions

Union minimum hourly wage rates for sheet-metal workers averaged $4.50, compared with $4.46 for all journeymen in the building trades, as of July 1, 1964, according to a national survey of building trades workers in 68 large cities. Among individual cities surveyed, the minimum hourly rates for sheet-metal workers ranged from $3.50 in Charlotte, N.C., to $5.25 in New York City.

Many sheet-metal workers spend considerable time at the construction site, where they may work either indoors or outdoors. Other sheet-metal workers may work primarily indoors, doing fabricating and layout work.

When installing gutters, skylights, and cornices they may work high above the ground level. When installing ventilating and air-conditioning systems, they may work in awkward and relatively inaccessible places. Sheet-metal workers run the risks of cuts and burns from the materials, tools, and equipment used in their trade.

A large proportion of sheet-metal workers are members of the Sheet Metal Workers' International Association.

Where To Go for More Information

For further information regarding sheet-metal apprenticeships or other work opportunities in

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this trade, inquiries should be directed to local sheet-metal contractors or heating, refrigeration, or air-conditioning contractors; a local of the Sheet Metal Workers' International Association; a local joint union-management apprenticeship committee; or the nearest office of the State apprenticeship agency or the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of sheet-metal workers may be obtained from:

Sheet Metal and Air Conditioning Contractors' National Association, Inc.,
107 Center St., Elgin, Ill. 60120.

Sheet Metal Workers' International Association,
1000 Connecticut Ave. NW., Washington, D.C. 20036.

Stonemasons

(2d ed. D.O.T. 5–24.210)

(3d ed. D.O.T. 861.131 and .781)

Nature of Work

Stonemasons build the stone exteriors of structures. They work primarily with two types of stones—natural cut stone, such as marble, granite, limestone, or sandstone; and artificial stone, which is made to order from cement, marble chips, or other types of masonry materials. Much of the work of these craftsmen is the setting of cut stone for comparatively high-cost buildings, such as office buildings, hotels, churches, and public buildings.

The stonemason works from a set of drawings in which each stone has been numbered for identification, except where all pieces are identical. A helper or, in some cases, a derrickman, locates the pieces needed and brings them to the mason; large stones are set in place with a hoist. The stonemason sets the stone in mortar and moves it into final position with a mallet, hammer, or crowbar. He alines the stone with a plumb line and finishes the joints between the stones with a pointing trowel. He may fasten the stone to supports with metal ties, anchors, or by welding.

Occasionally, the stonemason may have to cut stone to size. To do this, he must determine the grain of the stone selected and strike blows along a predetermined line with a stonemason's hammer. Valuable stones are cut with an abrasive saw to make them fit.

Stonemasons also do some stone veneer work, in which a thin covering of cut stone is applied in various patterns to the exterior surfaces of a building. In some sections of the country, a great deal of stone is used to veneer homes. In one specialized branch of the trade known as alberene stone setting, stonemasons set acid-resistant soapstone linings for vats, tanks, and floors.

The principal handtools of the stonemason are heavy hammers, wooden mallets, and chisels. For rapid stone cutting, pneumatic tools are used, such as hammers, drills, and brushing tools. Special power tools are used for smoothing the surface of large stones. An abrasive saw is used for fine cutting.

Where Employed

Most stonemasons work on new building construction, particularly on the more expensive residential and commercial buildings. A few work for government agencies or business establishments that do their own construction and alteration work. Stonemasons are employed mainly in the larger urban areas. In many areas where there are no stonemasons, the work is performed by bricklayers.

Training, and Other Qualifications

Most training authorities, including the National Joint (labor-management) Bricklaying Apprenticeship Committee, recommend the completion of a 3-year apprenticeship program as the best way to learn the stonemason's trade. A substantial proportion of stonemasons, however, have picked up the trade by working many years as helpers, observing or being taught by experienced stonemasons.

Apprenticeship applicants generally are required to be between the ages of 17 and 24; a high school education or its equivalent is desirable. Good physical condition is an important asset.

The apprentice training program for stonemasons generally requires 6,000 hours (3 years) of on-the-job training, in addition to related classroom instruction. During the apprenticeship, the trainee learns to use, care for, and handle safely the tools, machines, and materials of the trade, and to lay out and install walls, floors, stairs, and arches. The apprenticeship program in this occupation is similar to that for bricklayer. (See discussion, p. 375.)

Employment Outlook

Little increase in the employment of stonemasons is expected through 1975, despite the anticipated large expansion in new building construction. (See discussion, p. 370.) Less use of stone masonry work is expected, because modern architectural design has emphasized simple lines, little ornamentation, and large window areas. Replacement needs will provide a small number of job opportunities for new workers each year.

Earnings and Working Conditions

Union minimum hourly wage rates for stonemasons averaged $4.51, compared with $4.46 for all journeymen in the building trades, as of July 1, 1964, according to a national survey of building trades workers in 68 large cities. Among individual cities surveyed, the minimum hourly rates for stonemasons ranged from $3.75 in Jackson, Miss., to $5.56 in New York City.

Most stonemasonry work is done outdoors. The work of the stonemason is active and sometimes strenuous, as it involves lifting heavy materials.

A large proportion of stonemasons are members of the Bricklayers, Masons and Plasterers' International Union of America.

Where To Go for More Information

For further information regarding apprenticeships for stonemasons or other work opportunities in this trade, inquiries should be directed to local bricklaying contractors; a local of the Bricklayers, Masons and Plasterers' International Union of America; a local joint union-management apprenticeship committee; or the nearest office of the State apprenticeship agency or the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about apprenticeship and other training opportunities.

General information about the work of stonemasons may be obtained from:

Associated General Contractors of America, Inc.,
1957 E St. NW., Washington, D.C. 20006.

Bricklayers, Masons and Plasterers' International Union of America,
815 15th St. NW., Washington, D.C. 20005.

Structural-, Ornamental-, and Reinforcing-Iron Workers, Riggers, and Machine Movers

(2d ed. D.O.T. 4–84.010, .020, .030, .040, .060, and 7–32.251)
(3d ed. D.O.T. 801.131, .134, .281, .381, .781, .884; 809.130, .131, .134, .380, .381, .781, .884, .887; and 869.883)

Ironworkers erect, assemble, or install fabricated metal products mainly in the construction of industrial, commercial, and large residential buildings. They also may rig heavy construction machinery (prepare the machinery for moving with the proper lines, cables, and accessories); move the machinery; and then assemble it on site. In addition to new construction work, ironworkers do some alteration work. For example, they may install steel stairs in, or add window guards to, existing buildings. In addition, they remodel existing structures and do repair work, such as replacement of metal bridge parts. Ironworkers include four related trades—structural-iron worker, rigger and machine mover, ornamental-iron worker, and reinforcing-iron worker (rodman). Although these are distinct trades, many craftsmen are skilled in, and do the work of, two or more of these trades.

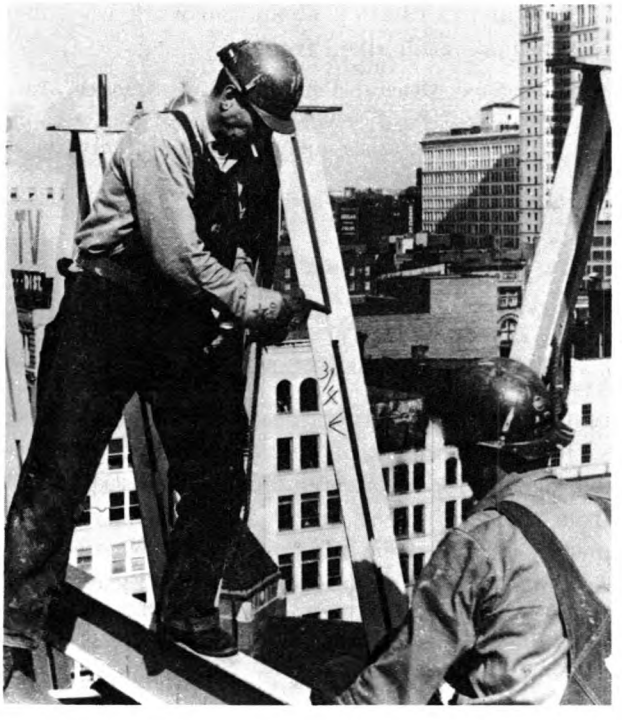
Structural-iron workers (D.O.T. 809.381) erect the steel framework of bridges, buildings, and other structures including metal storage tanks and

overhead crane runways that support heavy equipment. They install floor decking and the doors and frames of vaults.

In erecting a steel framework or structure, structural-iron workers push, pull, or pry fabricated steel beams and girders into their proper position in the structure while the steel parts are held by hoisting equipment. Next, they temporarily connect all the steel members with bolts, accurately aline the structure using plumb bobs and levels, and then fasten the pieces by welding or riveting. In the construction of a large building, ironworkers generally specialize in particular operations, such as welding or riveting. Structural-iron workers often rig, as well as erect, steel structures.

Riggers and machine movers (D.O.T. 869.883) set up and rig hoisting equipment for erecting and dismantling structural steel frames and for moving heavy construction machinery and equipment. In performing their work, riggers and machine movers study the size, shape, and weight of the object to be moved; choose the lines, and cables with which the object can be safely moved; and select the points of attachment that will provide a safe and secure hold on the load. Next, they attach the lifting device to both the hoisting equipment and the item to be moved, and direct the load into position by giving hand signals and other directions to the hoisting machine operator. In many instances, special rigging equipment must be built on the job to move or lift materials and machines with unusual shapes. This work requires a knowledge of both the uses and limitations of the hoisting equipment and lifting devices.

Ornamental-iron workers (D.O.T. 809.381) install metal stairways, catwalks, floor gratings, iron ladders (such as those used extensively in powerhouses and chemical plants), metal window sash and doors, grilles and screens (such as those used in bank tellers' compartments, and elevators), metal cabinets, and safety deposit boxes. They also install lampposts, gates, and fences. and decorative ironwork on balconies.



Structural-metal workers tie safety lines to framework before beginning steel erection.

Craftsmen set ornamental stainless steel wall panel in the building framework.

In addition to iron and steel, ornamental-iron workers work with aluminum, brass, and bronze metal shapes, frames, and panels. The products which they install have usually been fabricated in a factory or a shop—for example, the recently developed curtain-wall and window-wall, and the many types and designs of ornamental and functional building facades. Ironworkers fasten these metal products to a building or other structure by bolting, setting in concrete, or welding.

Reinforcing-iron workers (rodmen) (D.O.T. 801.884) set steel bars in concrete forms to reinforce concrete structures. They place the steel bars on suitable supports in the concrete form and tie the bars together at intersections, so that each bar receives its intended structural load. The bars are placed in the concrete form according to blueprints, specifications, or verbal instructions. The rodmen use steel pliers and other tying tools to wire the rods securely in place. Some concrete reinforcing is in the form of coarse mesh made of heavy steel wires. When using mesh, the rodmen measure the surface to be covered, cut and bend the mesh to the desired shape, place the mesh over the area to be reinforced, and hammer it into place.

Where Employed

About 65,000 structural- and ornamental-iron workers were employed in 1964. Thousands of additional workers were employed as riggers, machine movers, and reinforcing-iron workers.

A large proportion of these craftsmen are employed by general contractors on large building projects, by steel-erection contractors, or ornamental-iron contractors. Many are employed by large steel companies or their subsidiaries engaged in the construction of bridges, dams, and large buildings. Some work for government agencies, public utilities, or large industrial establishments that do their own construction work. Few of these craftsmen are self-employed.

Training and Other Qualifications

Most training authorities recommend the completion of a 3-year apprenticeship as the best way to learn these trades.

Apprenticeship applicants are required to be between the ages of 18 and 30. Good physical condition is required. A high school education or its equivalent is desirable.

The apprenticeship program for ironworkers usually consists of 6,000 hours (3 years), of on-the-job training. On-the-job instruction is given either by the foreman or an experienced journeyman. In a typical training program, the apprentice learns, among other things, to use, care for, and handle safely the tools, machines, equipment, and materials commonly used in the trade; read blueprints and working drawings; form, shape, drill, tap, and erect and assemble various metal structures; lay out and assemble steel stairs, fire escapes, grilles, railings, fences, doors, and related metal structures; and erect, place, and tie reinforcing iron. He also learns arc and gas welding; gas cutting; rigging, bolting, and riveting; and how to repair and alter metal structures.

The apprenticeship program generally includes a minimum of 144 hours a year of related classroom instruction in subjects such as drafting, blueprint reading, and mathematics applicable to layout work.

Areawide apprenticeship programs, sometimes covering an entire State or region, are found extensively in ironworking trades. They are supervised by joint apprenticeship committees composed of representatives of the International Association of Bridge, Structural and Ornamental Iron Workers' local unions and local management groups.

Hourly wage rates for apprentices start at not less than 60 percent of the journeyman rate and increase periodically until the journeyman rate is reached at the completion of the apprenticeship. In some localities, the starting rate may be as high as 75 percent of the journeyman rate.

Employment Outlook

Employment in these trades is expected to increase rapidly through 1975, assuming relatively full employment nationally and the high levels of economic activity needed to achieve this goal. In addition, the need to replace experienced ironworkers who transfer to other occupations, retire, or die will provide a few thousand job opportuni-

ties each year. Retirement and deaths alone are expected to result in about 1,300 job openings annually.

A continued rapid rise in employment of these workers is expected principally because of the anticipated large increase in construction activity. (See discussion, p. 370.) The job outlook in these trades will also be favorably affected by the increased use of structural steel in smaller buildings. Also, the development of lightweight and specialty steels has improved the competitive position of steel as a construction material and resulted in increasing job opportunities for structural-iron workers. Work opportunities for ornamental-iron workers will result from the growing use of ornamental panels of aluminum, porcelainized steel, or other metals, which are attached to the exterior walls of large buildings; and by the use of metal frames to hold large glass installations. The demand for riggers and machine movers is expected to increase, because of the expanding use of heavy construction machinery. The use of prestressed concrete in a growing variety of structures will result in increasing job opportunities for reinforcing-iron workers.

Technological developments are expected to limit employment growth of ironworkers. For example, the development of a compact squirt-welding machine has greatly reduced the time needed for field welding. Structural steel frames are being assembled on the ground and hoisted into a vertical position, thus reducing the amount of iron work required above ground. The use of prestressed steel beams makes possible longer spans with less steel; these beams are being used increasingly in bridge construction. Also available are almost completely prefabricated, and painted, short-span bridges made of prestressed steel, which can be erected in as little as 1 day. Also, prefabricated reinforcing mats, or fabrics, are being used increasingly in concrete highway and building construction. These prefabricated mats reduce requirements for on-site rod bending, tying, and welding by reinforcing-iron workers. In addition, an increasing variety of ornamental metal products are being designed by manufacturers for more efficient on-site installation.

Earnings and Working Conditions

Union minimum hourly wage rates for structural-iron workers and rodmen averaged $4.61 and $4.50, respectively, as of July 1, 1964, according to a national survey of building trades workers in 68 large cities. The average for all journeymen in the building trades surveyed was $4.46. Among the individual cities, the minimum hourly rates for structural-iron workers ranged from $3.58 in Jackson, Miss., to $5.85 in Newark, N.J. The rates for rodmen ranged from $3.33 in Jackson, Miss., to $5.85 in Newark, N.J. The rates for ornamental-iron workers, riggers, and machine movers are generally about the same as those for structural-iron workers. The earnings of ironworkers are often increased by considerable overtime work at premium pay.

Since the materials used in the ironworking trades are heavy and bulky, above average physical strength is necessary. Agility and a good sense of balance are also required because some structural work is done at great heights and on narrow footings. Although many ironworkers risk injury from falls from heights, the use of safety devices, such as nets, safety belts, and scaffolding, has reduced the frequency of accidents in recent years.

Ironwork often involves considerable travel. In most localities, the demand for ironwork is insufficient to keep local crews constantly employed. Consequently, workers must be brought in from outside the area to handle the occasional large construction projects, such as a steel frame office or factory building. Large contractors may keep a small crew continually employed, moving them from job to job and city to city.

A large proportion of workers in these trades are members of the International Association of Bridge, Structural and Ornamental Iron Workers.

Where To Go for More Information

For further information concerning apprenticeships or other work opportunities in these trades, inquiries should be directed to local general contractors, a local of the International Association of Bridge, Structural and Ornamental Iron Workers; a local joint union-management apprenticeship committee; or the

nearest office of the State apprenticeship agency or the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of ironworkers may be obtained from:

Associated General Contractors of America, Inc., 1957 E St. NW., Washington, D.C. 20006.

DRIVING OCCUPATIONS

More than 2 million employees were engaged in moving passengers and goods over highways and city streets in 1964. (Chart 28 shows percent of employment by individual occupation.) They transported thousands of products used in homes, schools, and factories, and also transported millions of people every day. In 1964, about 13 million privately owned motortrucks were registered. They were operated by stores, dairies and other farm enterprises, industrial firms, and for-hire motor carriers. In addition, Federal, State, and local governments operated about 700,000 trucks. Of the 300,000 buses registered in 1964, more than 200,000 were schoolbuses and 80,000 were commercial vehicles. Of the latter, about 50,000 were used for local transit work; 27,000 for intercity passenger traffic; and the remainder for sightseeing, charter, and other services.

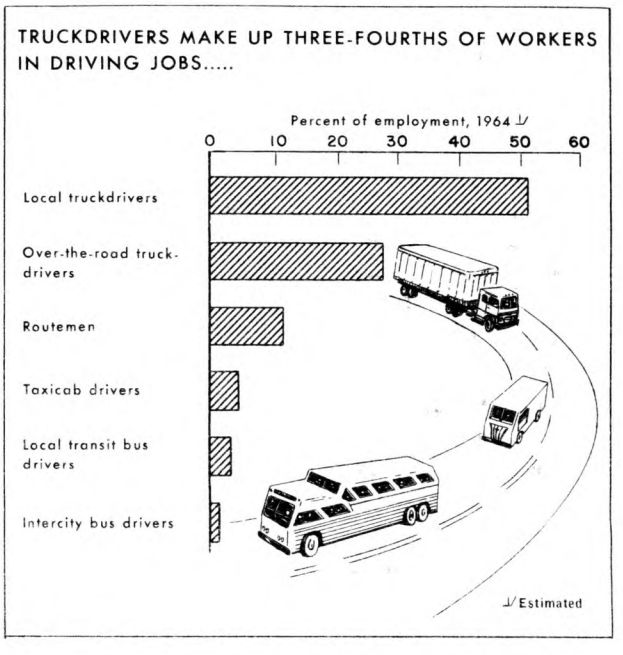
Some drivers spend practically all of their working time driving. Others spend considerable time in loading and unloading goods, making pickups and deliveries, and collecting money. Still others, like the routeman, spend a good deal of their time selling. This chapter deals only with employment opportunities for those whose principal occupation is driving intercity and local trucks and buses and taxis. For example, it does not cover schoolbus drivers, chauffeurs, part-time taxi drivers, ambulance drivers, or employees whose driving is incidental to their regular duties.

Many driving jobs require a high degree of responsibility. Drivers, for the most part, operate large and expensive equipment which they must drive carefully, obeying safety regulations and traffic laws, to deliver their passengers and freight safely. These men are on their own, away from direct supervision.

During the decade from 1965 to 1975, employment of local and over-the-road truckdrivers is expected to expand as a result of increases in the freight moved by motor carrier. Employment in other driving jobs is not expected to change much in the years ahead. Normal turnover in this large occupational field will also provide many job opportunities each year.

Driving jobs offer excellent opportunities for young men who are not planning to attend college and who have no interest in or aptitude for craft or technical occupations. The pay of most drivers is relatively high and working conditions are fairly good. Many young men will also enjoy the freedom from close supervision and the frequent contacts with people, which are characteristic of most of these jobs.

CHART 28



Over-the-Road Truckdrivers

(2d ed. D.O.T. 7-36.240)

(3d ed. D.O.T. 903.883; 904.883; 905.883; and 909.883)

Nature of Work

The men at the wheel of the big trucks on highways and turnpikes are generally the top professional drivers. They drive the largest and most expensive equipment and receive the highest wages of all drivers. They are on their own practically all the time and have a great deal of responsibility. The work requires a good deal of initiative, as they must transport goods and materials of great value which must be delivered safely and on time.

Most over-the-road drivers operate gasoline or diesel powered tractor-trailers. (The tractor is the short-chassis vehicle that draws the trailer which contains the freight.) They deliver goods usually over long distances—frequently driving at night.

Unlike the local truckdriver who spends considerable time in loading and unloading, the over-the-road driver (sometimes called intercity line-haul or long-haul driver) spends practically all of his working time in driving. He may sometimes handle the freight. Some drivers, for example, may have to unload the goods they deliver to stores at night when receiving crews are not available. Drivers of long-distance moving vans generally have to load or unload their cargoes, with the assistance of local helpers.

The truckdriver must back up big trailers to loading platforms; this requires the ability to maneuver the trailers while driving in reverse. He must also be able to judge distance accurately while driving around corners or through narrow passageways.

Because the over-the-road truckdriver spends most of his time driving, safe driving practices and courtesy are of the utmost importance. Every one has seen the emergency warning signals set out by a driver near his disabled truck on the edge of the highway. Many motorists have noted the courtesy of truckdrivers who pull off to the shoulder of the road at the top of a hill to allow the accumulated traffic to pass.

Interstate Commerce Commission (ICC) regulations require drivers to inspect their trucks before and after trips and make out reports on the condition of the vehicle at the end of the run. Drivers are also required to keep a daily log of their activities. If a driver has an accident, he must make out a detailed report. ICC also prescribes special safety precautions concerning packing and loading flammable, explosive, or otherwise hazardous materials, and over-the-road driving of trucks containing these materials.

Where Employed

About 600,000 over-the-road drivers were employed throughout the United States in 1964. Many work out of large cities such as Chicago and Los Angeles; however, some large companies have their operating headquarters in fairly small towns.

Over-the-road drivers are employed by private and for-hire carriers. Private carriers are companies, such as chain food stores or manufacturing plants, which use their own or leased trucks to transport their own goods. For-hire carriers are either common carriers (trucking companies serving the general public) or contract carriers (trucking firms hauling goods under contract for certain companies). While the drivers of the big tractor-trailers on long intercity runs are more often employed by common carriers, an increasing number of drivers in recent years have been working for private or exempt (from ICC regulation) carriers, or for specialized carriers handling large pieces of machinery, explosives, or missiles. On shorter hauls, many drivers are employed by contract and common carriers to make deliveries of machinery, food, petroleum products, household appliances, and other items, from plants to warehouses and from warehouses to large volume purchasers.

Training, Other Qualifications, and Advancement

Regulations of the Interstate Commerce Commission establish minimum qualifications for over-the-road drivers. The driver must be at

least 21 years of age, able-bodied, with good hearing and vision of at least 20/40 with or without glasses. He must be able to read and speak English, have at least 1 year's driving experience (which may include driving private automobiles), and a good driving record. Most States require truckdrivers to have a chauffeur's license, which is a commercial driving permit obtained from State Motor Vehicle Departments.

Most fleet operators have higher hiring standards than those described above. Many firms will not hire drivers under age 25; some specify height and weight limitations. Many require at least a grade school education; others require 2 years of high school. Some companies employ only applicants who have had several years of experience in handling vehicles of the type they would be required to drive.

The standards for over-the-road drivers are generally higher than those for local truckdrivers. Furthermore, these standards are more strictly adhered to than those for local drivers, whose standards may be lowered when there are not enough applicants for jobs.

The tractor-trailer often seen on highways usually costs between $20,000 and $25,000, and the load inside may be worth more than $100,000. The owners of such valuable equipment, therefore, employ experienced drivers who also can accept great responsibility.

Many training authorities and employers recommend that young men interested in becoming professional drivers should begin by taking the driver-training courses offered by many high schools. If such a course is not available, the driving schools which operate in most large cities are recommended. A high school course in automotive mechanics is also helpful.

Long-haul driving is considered a senior driving job and most such drivers have had previous experience in local trucking. Usually they enter this occupation by first driving a small, light truck; then, after gaining experience, they get jobs driving the larger and more complicated trucks. A young man may also begin as a helper to a local truckdriver, assisting him in loading and unloading the truck, and occasionally doing some relief driving.

Experience combining intercity bus and local truckdriving is considered very desirable by employers. This experience may be gained by working for an intercity bus company during the spring and summer months and for a local trucking company during the fall and winter months.

All employers are interested in obtaining good, safe, reliable drivers, but the methods of selection and training vary. Some companies have formal tests and training programs. Others hire on the basis of personal interviews, and have training programs consisting of a "break-in" period during which the new employee observes and works with an experienced driver.

Applicants for jobs as over-the-road drivers are required to pass a physical examination which is usually paid for by the employer. Many firms also give written traffic and driving knowledge tests. Some employers give tests to measure such factors as sharpness and field of vision, reaction time, ability to judge speed, and emotional stability. The last step in the selection of drivers is the road test. The applicant is expected to demonstrate his ability to handle under a variety of driving conditions, a vehicle of the type and size he will operate in regular service. A few States require such a test before licensing a driver to operate a tractor-trailer combination.

A new driver may be given a brief indoctrination course covering company policy and the preparation of various forms he will use on the job. He will then make one or more training trips with an instructor or an experienced driver.

Drivers employed by common carriers frequently start on the "extra board," bidding for regular runs on the basis of seniority as vacancies occur. (The extra board is a list of men, assigned in rotation, who substitute for regular drivers or who make extra trips when necessary.) Drivers for private carriers are more likely to begin with assigned regular routes.

Opportunities for promotion in this occupation are limited. A few drivers may advance to jobs as safety supervisors, driver supervisors, and dispatchers. These jobs are often unattractive to over-the-road truckdrivers since the starting pay on these jobs is usually less than the pay on truck-

driving jobs. Most drivers can only expect to advance, on the basis of seniority, to driving runs that provide increased earnings or preferred schedules and working conditions.

Employment Outlook

The employment of over-the-road truckdrivers is expected to increase rapidly through the mid-1970's. Substantial growth in the volume of intercity freight is anticipated, resulting from increased commercial and industrial activity and the continued decentralization of industry. A large number of job openings will also be created by transfers from this field of work, or to local truckdriving jobs. Approximately 12,000 additional job openings are expected each year as a result of retirements and deaths, and the number may be increased somewhat by the trend toward earlier retirements.

Freight carried by over-the-road trucks has been increasing as a result of the general economic growth of the Nation, and this trend is expected to continue. Many factories, warehouses, and stores are being located at great distances from each other in suburban or semi-rural areas where rail facilities are nonexistent or extremely limited. The intercity highway building program has aided the trucking industry in this regard. Furthermore, the growth of chain stores, and the trend to smaller inventories and decentralization of factories require daily coordination of shipping which can best be handled by trucks.

Improvements in trailer design have also contributed to more over-the-road trucking, by making it possible to ship certain kinds of freight, such as frozen goods and livestock, for longer distances.

Demand for trucking services may increase as a result of new trucking methods which promise reduced handling and shipping time and, therefore, reduced freight costs for small loads. One example is the increasing use of "double-bottoms"—two trailers hitched in tandem to a tractor. When two trailers (24 to 28 feet) are used, they can be unhitched at the truck terminal and promptly delivered to the customers, thus eliminating the need to unpack a larger trailer, separate its contents, and repack on local delivery trucks; on a smaller scale is the practice of packing all freight destined for a single customer or area into large containers or cargo cages which can be handled at the truck terminal more conveniently and quickly than individual packages.

Some recent freight transportation innovations will limit somewhat the anticipated increase in trucking business and driver employment. For example, the movement of highway trailers on railroad flat cars, ocean vessels, and aircraft saves the cost of driver, fuel, and tractor, and appears to have prospects for considerable expansion. To compensate for job displacement that may arise from such innovations, there is a growing practice under labor-management agreements to provide for retirement at an earlier age. (A recently negotiated union-employer contract covering over-the-road drivers in the Central and Southwestern States provides for early retirement at age 57.)

Further limitations on employment expansion among over-the-road drivers are related to changes in State laws. State limitations on truck weight, size, and speed are becoming less restrictive as a result of the construction of better highways and improved travel arteries inside the cities. The movement of bigger loads at higher average speeds could result in a need for fewer drivers than would otherwise be required to move the greatly increased over-the-road tonnage anticipated in the years ahead.

In the long run, however, the total volume of goods shipped and the convenience and mobility of motor transport is expected to be great enough to insure continued growth of driver employment in trucking.

The over-the-road driver has a better chance of remaining employed during business recessions than workers in many other occupations. Although the total tonnage moved may temporarily decline, over-the-road trucking is less affected than other means of transportation. It gets a larger share of any shrinking transportation business because manufacturers and merchants who are unable to buy merchandise in railroad carload lots can reduce inventories and still maintain their diversified stock by small daily shipments by truck. Small lots are handled primarily by trucks.

Earnings and Working Conditions

Most over-the-road drivers earned at least $150 a week in 1964, and the majority made far more. Drivers employed by class I common carriers of general freight (carriers with gross operating revenues of $1 million or more a year) had annual average earnings in excess of $9,100 in 1963, the most recent year for which such data are available. Better, experienced over-the-road drivers can earn $12,000 a year or more. The rates are fairly uniform because this is a highly unionized field and union-employer contracts are generally master agreements covering all employers within a region—an area including a number of States. Furthermore, regional contracts tend to be quite uniform because drivers working under different contracts often travel the same routes. The earnings of an individual driver are affected by such factors as mileage driven, number of hours worked, type of equipment driven or the weight of the loads carried, type of "run" (whether or not pickup or delivery enroute is required), and the nature of the cargo carried, with premium rates paid for transporting flammable or otherwise hazardous commodities.

Drivers on the longer runs are generally paid on a mileage basis for actual driving time. For all other time during which the driver is required to be on duty, he is paid at an hourly rate. This includes waiting time, delay time owing to breakdown of equipment or impassable highways, layover time (time spent at a terminal away from home beginning at some designated hour after his run ends), and time spent in making pickups or deliveries enroute. Regular drivers are usually assured minimum pay for a certain number of hours—generally 8 hours a day.

Some private carriers pay their drivers on the same basis as their other employees—a monthly, weekly, or daily wage. Generally, such a wage is for a specified number of hours and if the driver works additional hours he receives extra pay.

In recent years, nearly 200,000 motortrucks were operated by regulated carriers subject to the Interstate Commerce Commission rules governing hours of work and other matters. ICC regulations limit the hours over-the-road drivers may work in order to be certain the driver has a reasonable amount of rest. For example, no driver may be on duty for more than 60 hours in any 7-day period, but for carriers operating every day of the week, the driver may remain on duty for a maximum of 70 hours in any period of 8 consecutive days. The regulations also provide that no driver may drive more than 10 hours without first having an off-duty period of at least 8 hours. For drivers who drive less than 10 hours, but perform other work for the motor carrier in a garage, warehouse, or other place, the regulations prohibit resumption of driving after any combination of driving time and other on-duty work which totals 15 hours, unless the driver has first had at least 8 hours off duty. Many drivers, particularly on the very long runs, work fairly close to the maximum hours permitted. A workweek of at least 50 hours is very common.

Most drivers receive pay for 6 or more national, State, and local holidays. They also have paid vacations, usually from 1 to 4 weeks, depending upon their length of service. Health, insurance, and pension plans, paid for by the employers, are very common.

Over-the-road truckdrivers are often required to spend time away from home—particularly when they drive long runs. The driver often starts out in the evening and arrives at the terminal in the other city the following morning. In such instances, the company provides lodging for him either in a company dormitory or a hotel. In the evening, he starts on his return trip and arrives at the home terminal the following morning. He may make two or three such round trips a week and if the trips are part of a relay operation, another driver works a similar schedule starting from the other end of the run.

Some companies use two-man sleeper teams on their very long runs. One drives while the other sleeps in a bunk behind the cab. The vehicle goes straight through to the end of the run where there may be a layover before the return trip. Two periods of 4 hours of resting or sleeping in a berth in the truck meet the ICC requirement of 8 hours off duty following 10 hours of driving. This means that the drivers on a run may remain with the truck in some cases for over 100 hours.

Although earnings on sleeper runs are the highest in this field of work, few drivers stay with

this type of run very long. The work is very tiring and requires being away from family and friends for days and even weeks. However, many drivers go back to sleeper runs after they have had a rest or have done some relay driving for a while. The earnings of drivers of long-distance moving vans are quite high, but their hours are long and the work is strenuous. They drive more miles than the average over-the-road driver and also work more hours in loading and unloading goods.

Largely because of intensive safety programs and drivers' skill, the accident rate in over-the-road trucking is low. Injuries occur less frequently than in other forms of motor transportation.

The physical strain of over-the-road truck-driving has been reduced by more comfortable seating, better highways, and more stringent safety regulations. Sitting in one place for hours at a time, however, is tiring and the nervous strain of sustained driving at night is also fatiguing.

Most over-the-road drivers are members of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Some drivers of private carriers belong to unions representing the plant employees of the companies for which they work.

Where To Go for More Information

Information on career opportunities may be obtained from:

American Trucking Associations,
1616 P St. NW., Washington, D.C. 20036.

Local Truckdrivers

(2d ed. D.O.T. 7-36.200 through .299)
(3d ed. D.O.T. 900.883; 902.883; 903.883; 906.883; and 909.883)

Nature of Work

Much of the food, clothing, and other products required by consumers is transported by trucks. The men who move these goods from terminals, warehouses, mines, and factories to wholesalers, retailers, and consumers in the local area must be skilled drivers to avoid accidents on congested city streets. They must also be able to maneuver big trucks or tractor-trailers into tight parking spaces, through narrow alleys, and up to loading platforms. (Telephone linemen, repairmen, and many thousands of other workers for whom driving is incidental to their primary duties are not included in this discussion.)

When the local truckdriver reports to work at the terminal or warehouse, he receives his assignment to make deliveries, pickups, or both. He also receives the delivery forms he will need and checks the condition of his truck. His truck is generally loaded for him by platform men. If he does the loading himself, however, and must make many deliveries, he arranges the items in proper sequence so that there will be a minimum of handling. At the customer's place of business, the driver generally loads and unloads the merchandise himself. If he has heavy loads such as machinery or if he has many deliveries to make during the day, he may have a helper to assist him. The driver of a moving van usually has a crew of helpers to assist him in loading and unloading household or office furniture.

At the delivery points, the driver gets customers to sign receipts and freight bills, and he sometimes collects money for freight, c.o.d. deliveries, and other charges. At the end of his day, he turns in all receipts and cash collected and records his time and the deliveries made. He also reports whatever maintenance or repair is needed before his truck is used again.

Some of these workers drive special types of trucks, such as dump or oil trucks, which require the operation of mechanical levers, pedals, or other equipment. If they haul heavy machinery, they operate mechanical hoists to load and unload the machines.

Where Employed

An estimated 1.1 million workers were employed as local truckdrivers in 1964, mostly in and around large metropolitan areas. They work

in all localities, however, including the smallest villages.

A large majority of local drivers work for businesses which deliver their own products and goods—such as department stores, meatpackers and other food processors, wholesale distributors, grocery chains, petroleum companies, and construction companies. Many others are employed by local for-hire operators—trucking companies which serve the general public or specific companies under contract. Some are employed by the Federal Government including, in particular, the Post Office Department, and by States and municipalities. A large number are in business for themselves.

Training, Other Qualifications, and Advancement

Qualifications for local truckdrivers vary considerably, depending upon factors such as the type of equipment to be operated and the nature of the employer's business. Generally, applicants must be 21 years of age or older. Some employers prefer applicants who have completed grade school or, better, 2 to 4 years of high school. The applicant must be physically able to lift heavy objects and otherwise be in good health. He should have good hearing and good vision (with or without glasses). Since a driver often deals directly with the public, employers look for men who are tactful and courteous.

Making freight pickups and deliveries consumes much of local truckdriver's time.

An applicant must have a chauffeur's license, which is a commercial driving permit. Familiarity with traffic laws and safety measures is necessary, and some previous experience in driving a truck is helpful. A young man may obtain such experience by working as a truckdriver's helper. Employers also give consideration to driving experience gained in the Armed Forces.

Since he will be responsible for costly vehicles and cargo, a truckdriver must be cautious, alert, and able to judge distances and to coordinate his reactions to avoid accidents in congested traffic. To demonstrate these qualifications, an applicant's driving ability will be tested, and he may have to pass a written examination as well as a general physical examination. Employers generally will check applicants for traffic and police records.

Training given to new drivers is often informal and may consist only of riding with and observing an experienced driver on the job. Additional training may be given if they are to drive a special type of truck. Some companies give a brief indoctrination course which lasts 1 or 2 days and covers general duties, the efficient operation and loading of a truck, company policies, and the preparation of delivery forms and company records.

Although most new employees are immediately assigned to regular driving jobs, some start as extra drivers, taking over the routes of regular drivers who are ill or on vacation, or making extra trips when necessary. They receive regular assignments when openings occur.

Local truckdrivers may get jobs as dispatchers or advance to jobs as terminal managers, or supervisors, or to traffic work, i.e., planning delivery schedules. However, these jobs are relatively few. For the most part, advancement for a local truckdriver consists of earning higher hourly wages by driving heavy or special type truck

loads instead of light trucks, or by transferring to over-the-road truckdriving.

An experienced truckdriver who has some business ability and ambition can start his own trucking company when he has sufficient capital to purchase expensive trucking equipment and meet other business expenses. Truckers who own one or two vehicles continue to account for a sizable proportion of local for-hire trucking business.

Employment Outlook

A rapid increase in the employment of local truckdrivers is anticipated through the mid-1970's because of the expected increase in volume of freight. Many new workers will also be needed to replace drivers who transfer to other fields of work, retire, or die. Retirements and deaths alone will result in about 20,000 job openings each year for local truckdrivers.

The rise in total business activity anticipated in the years ahead will increase the volume of freight. Since trucks carry virtually all freight for local distribution and do not compete for hauling with other types of carriers, this anticipated increase in total intercity and local freight volume will expand local trucking business and, thereby, truckdriver employment. The continued growth of suburban areas will contribute to the employment of more drivers.

Some recent developments may offset somewhat the growth in the number of local truckdrivers that would otherwise occur with an increase in freight volume. For example, the trend toward larger deliveries to relatively fewer retail outlets is the result of the growth of chain stores and shopping centers. (On the other hand, as suburban areas expand, local truckers tend to service a wider area, increasing the travel time per truck.) The introduction of new equipment, such as power tailgates for loading and unloading may also affect the number of drivers who will be needed to deliver large and heavy loads. Also, the use of radio telephones to instruct drivers enroute will reduce the time needed for deliveries. Innovation in local trucking will continue to be limited, however, by narrow city streets, heavy traffic, and local city ordinances controlling the size and weight of local delivery trucks. However, urban renewal and urban highway building projects may improve driving conditions.

Earnings and Working Conditions

On the average, hourly union wage scales were $3.14 for local truckdrivers and $2.79 for helpers on July 1, 1964, according to a survey in 68 large cities. Average hourly pay scales for drivers ranged from $2.52 in New Orleans to $3.58 in the San Francisco–Oakland area. However, wage scales vary, even in the same city, depending on the type of trucking service (such as general freight hauling or local moving and storage), the types of product hauled, and the size and type of truck operated.

As a rule, local truckdrivers are paid by the hour and receive extra pay for working overtime, usually after 40 hours. Some drivers are guaranteed minimum daily or weekly earnings. Local truckdrivers frequently work 48 hours or more a week and thus often drive 6 days a week. Although daytime work is customary, nightwork or early morning work is sometimes necessary, particularly for drivers handling foodstuffs for chain grocery stores, produce markets, or bakeries. Most drivers deliver over regular routes or runs, although some may be assigned different routes when they report to work each day.

Local truckdrivers generally have paid vacations of 1 or 2 weeks after a year of service and up to 4 weeks after 16 years. In addition, they usually receive pay for 6 or more national, State, and local holidays.

A majority of local truckdrivers belong to unions. Most of them belong to the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Some local truckdrivers employed by private carriers are members of unions representing the plant workers of their employers.

Practically all unionized local truckdrivers and their helpers are covered by life and health insurance and pension plans which are almost always paid for by the employer. When uniforms are required, the cost is usually paid for entirely or partly by the employer, who may also provide for their upkeep.

Local truckdrivers, because they drive in heavy traffic, are subject to nervous strain. The actual

operation of a truck has become less physically demanding because of improvements such as power steering, and more comfortable seating. However, when local drivers make many deliveries during a day, their work can be exhausting. Some drivers may develop physical disorders, such as back strain and hernia. Local truckdrivers do, however, have certain work advantages, such as steady employment. Unlike over-the-road drivers, they usually work a regular daytime schedule and return home in the evenings.

Routemen

(2d ed. D.O.T. 7–35.100)
(3d ed. D.O.T. 292.358)

Nature of Work

Routemen are as much salemen as they are drivers. In fact, they are sometimes known as *driver-salesmen* or *route-salesmen.* They must, through their selling ability, increase sales to existing customers and obtain new business by canvassing potential customers within their territories. Routemen drive panel or light trucks over an assigned route, selling and delivering goods, or providing services, such as collecting and delivering laundry and dry cleaning, to retail establishments (wholesale routemen) or directly to the public (retail routemen). Wholesale routemen usually drive heavier trucks. These trucks are refrigerated when dairy products or frozen foods are carried.

Before starting on his daily route, the routeman loads or supervises the loading of his truck. The amount of merchandise in his truck is generally checked by another employee. Some routemen deliver merchandise previously ordered and obtain orders for future delivery. Others make immediate sales from the stock in the truck. In either case, they must collect payments and keep records of their transactions. When they check in at the plant after completing their routes, they empty their truck and turn in their collections to the cashier. The retail routemen serving homes make from 5 to 10 times as many stops as the wholesale routemen who serve stores and other business establishments.

Routemen's work varies according to the industry in which they are employed, the type of routes they have (retail or wholesale), and the company employing them. Some specific examples, however, may indicate in a general way what most routemen do. A typical day for a drycleaning routeman begins when he picks up cleaned garments at the processing plant and loads his truck, which is equipped with carrying racks. He delivers the garments to homes or business establishments and picks up soiled clothing. He marks the articles picked up so they may be identified at the plant. Sometimes, he makes notes of the types of stains or of special processes to be used such as waterproofing. Each cleaned garment has an itemized bill attached, so that he can collect the amount of money due.

Although all routemen must be able to get along well with people, it is particularly important for the drycleaning and laundry routeman. His reaction to complaints and requests for special services may be the difference between increasing business or losing customers. Periodically, he calls at homes and business establishments along his route which are not using his company's services to try to get their trade.

A wholesale routeman, for example, may deliver bakery products to grocery stores. His truck is loaded the night before or early in the morning, and he checks to see whether he has the proper variety and quantity of products before starting on his route. He stops at from 10 to 50 grocery stores. At each stop he brings the orders of bread and other bakery products into the store, and arranges them on the display racks, in the best possible display space he can secure. Together with the store owner or manager, he checks the merchandise he has delivered. He also credits the store for the value of the stale bread and cakes left over from the previous delivery.

The routeman prepares a list of products he plans to deliver the next day. This represents his estimate of the amount of bakery products that will be sold by the grocery stores. From time to time, he calls on grocers along his route,

who are not his customers, and tries to get orders from them.

Although the vending machine routeman merchandises his products through machines, he, like other routemen, must try to anticipate customers' needs for service and preferences for merchandise. In his continuing effort to find profitable locations for the vending machines he services, the routeman discusses with managers of commercial and other business establishments the placement and relocation of machines. He caters to customer demand by noting their preferences for merchandise sold at each machine location, and stocks the machines with items that sell best.

The vending machine routeman must also make certain that his machines are adequately supplied with merchandise, that they function properly, and are clean and attractive. At each location the routeman checks the items remaining in the machine and the money deposited in the cash box to determine that what has been sold is accounted for. He tests stock delivery and change-making mechanisms to make sure that items and change are dispensed properly when coins are inserted, and he may make minor adjustments to machines that are not working properly. He cleans the machine, removing waste, spillage, and accumulated dust, and then replaces depleted stock. The routeman keeps an exact record of the merchandise that goes into each machine, and a precise account of how much money is taken out. (A detailed description of the nature of the work, qualifications, working conditions, and job prospects for vending machine routemen appears in the *Occupational Outlook Quarterly*, September 1964, U.S. Department of Labor. Also, see the statement on Vending Machine Mechanics.)

Where Employed

About 240,000 routemen worked for a wide variety of businesses in 1964. Since most of them were employed by companies which distributed food products or provided personal services, they worked in small towns as well as in large cities throughout the country. The greatest concentration of employment, however, was in the large cities in dairies, bakeries, food and beverage distributors, and dry-cleaning plants.

Some were engaged in wholesale distribution of goods and services to stores and other business establishments, although the majority distributed goods and services to homeowners and apartment dwellers. Many companies employed both wholesale and retail routemen.

Training, Other Qualifications, and Advancement

In addition to being a good driver, a routeman must have sales ability. To induce people to buy, he must have a thorough knowledge of the product or service he is selling and a persuasive personality. Other important sales qualifications are a pleasant voice, ability to speak well, and a neat appearance. He also needs to have self-confidence, initiative, and tact.

He must be able to work without direct supervision, do simple arithmetic, and write legibly. In most States, a routeman is required to have a chauffeur's license, which is a commercial driving permit. Information regarding this license can be obtained from State Motor Vehicle Departments.

Applicants for jobs as vending machine routemen should have some mechanical ability. Routemen are expected to check the operation of automatic dispensing devices, and make necessary adjustments and minor repairs. In case of major malfunctions in equipment, they should be able to report the nature of the trouble.

Most employers require their routemen to be high school graduates, preferably 25 years of age or older. Many large companies give applicants aptitude and other psychological tests to determine whether they will make good salesmen and safe drivers. Those who handle a great deal of money may be required by employers to be bonded.

High school courses in salesmanship, public speaking, driver-training, bookkeeping and business arithmetic, and school-work programs in retail and wholesale merchandising are helpful to a person interested in entering this occupation. Immediately following high school, valuable experience may be obtained as a sales clerk in a store or in some other type of selling job.

Another method of entering this occupation is to get a job as a *routeman helper* (D.O.T. 9–35.10). For this job, employers usually hire

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boys 18 years of age or over who have a driver's license. Helpers are not likely to be used in the dairy or vending machine industries, however. Still another way of becoming a routeman is to get a job (plant or office) in a bakery, dairy, laundry, or drycleaning establishment. After learning something about the business, a young man may get a job as a routeman when an opening occurs.

Most companies give their routemen on-the-job training which varies in length and thoroughness. Many large companies have classes in salesmanship. Some companies assign newly hired routemen for brief periods to jobs in the different departments of the plant to familiarize them with all the processing operations, so they can answer customers' questions intelligently and be better salesmen.

Routemen may be promoted to route foreman or sales supervisor, but these jobs are relatively scarce. Advancement is usually limited to moving from a retail to a wholesale route where earnings are generally higher. However, some routemen obtain better paying sales jobs as a result of the experience gained in route selling.

Employment Outlook

The total number of routemen is expected to increase slightly by the mid-1970's, although job opportunities will vary among different types of employers. There will be a few thousand additional openings for new workers each year as experienced workers transfer to other fields of work, retire, or die.

The number of retail routemen declined in the decade following World War II, particularly among drivers handling milk and dairy products. However, the decline appears to have run its course, and some employment upturn is likely. The convenience of home delivery to suburban families consuming large quantities of milk and dairy products makes such service popular, despite the growth of local shopping centers. For laundry and drycleaning retail routemen, the outlook is for an increase in employment, in line with population growth, especially in areas with a large concentration of apartment houses. The increasing number of married women working outside the home will also result in more laundry or cleaning work being done commercially.

Employment of wholesale routemen probably will remain at about present levels or rise slightly. Although large supermarkets have been replacing small neighborhood stores, more supermarkets are being built in the suburban areas. The number of routemen will not increase correspondingly, however. There has been a growing trend toward larger delivery trucks. Moreover, in recent years, some manufacturers and wholesale food companies have replaced their routemen with salesmen who cover assigned territories by automobile, and truckdrivers who make the deliveries.

In the long run, population expansion, higher family incomes, and the growing tendency for housewives to take outside employment will create a continuing need for the door-to-door services of retail routemen. The demand for wholesale routemen will increase because of larger sales of traditional products and the introduction of new items. New lines of frozen foods, for example, are often introduced and marketed by wholesale routemen.

Opportunities for employment as vending machine routemen will be excellent through the mid-1970's, because of the expected rapid increase in the volume of machine-vended merchandise. Some of the factors expected to stimulate the industry's growth are: The development of new and improved machines; and the greater use of automatic food service in industrial plants, schools, hospitals, and department stores, as well as in transportation terminals, shopping centers, and other high-traffic areas.

Earnings and Working Conditions

Most routemen are paid a salary plus a percentage of the sales or collections they make. Earnings vary considerably according to the product sold and also among routemen selling the same product. To a considerable extent, the earnings of routemen may be determined by their selling ability and the amount of time they spend in canvassing. Wholesale routemen generally earn more than retail routemen because, although they receive a lower percentage of sales, they handle much larger quantities of products.

A recent survey of earnings in the fluid milk industry in 25 metropolitan areas in late 1964 indicates that average weekly earnings of milkmen

on regular retail routes ranged from $94 in Atlanta, Ga., to $141.50 in San Francisco–Oakland, Calif. The average weekly earnings of milkmen on regular wholesale routes ranged from $130.50 in Portland, Oreg., to $241 in Washington, D.C.

According to limited information available in late 1964 on baking firms in 13 Eastern States, driver-salesmen for both wholesale and home-service bakeries had minimum weekly salaries ranging from $78 to $105. They can increase their earnings by selling more bakery products to their customers and by increasing the number of customers on their routes.

The number of hours worked by routemen varies. Some work only about 30 hours a week; others may work as many as 60 hours or more a week, depending upon whether the individual has a well-established route or whether he is trying to build up a new one; whether he has a retail or a wholesale route; and how ambitious he is. For some, the hours of work generally are limited by union-management contract. In other cases, the contract specifies merely the earliest hour that work may begin and the latest quitting time. The hours may also vary according to seasonal peaks and lows. During the spring cleaning season, for example, drycleaning routemen may work about 60 hours a week; in the winter, they may work less than 30 hours a week.

Many companies require routemen to wear uniforms. Some employers pay for the uniforms and for keeping them clean.

Most routemen receive paid vacations, generally ranging from 1 to 4 weeks, depending upon length of service, and 6 or more paid holidays a year. Many employers provide hospitalization and medical benefits; some have pension plans.

The routeman is on his own to a great extent. He does not work under strict supervision and, within certain broad limits, may decide how fast he will work and where and when he will have his lunch or rest period. This freedom of action and the daily meeting and dealing with people on the route appeal to many young men. On the other hand, a retail routeman has to make deliveries in bad weather, and do a great deal of lifting, carrying, and walking up and down stairs. He may also have to work unusual hours. For example, retail routemen delivering milk generally work in the very early morning hours.

Many routemen, particularly those delivering bakery and dairy products, are members of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Some belong to the unions which represent the plant workers of their employers.

Intercity Busdrivers

(2d ed. D.O.T. 5–36.010)

(3d ed. D.O.T. 913.363 and .463)

Nature of Work

The drivers of the buses which travel between cities are selected on the basis of their driving skill, emotional stability, and courtesy. A driver's duties generally begin when he reports to the terminal for his assignment. Before beginning his scheduled trip, he inspects the bus carefully at the terminal or garage. He checks the fuel, oil, water, and tires, and makes certain that the bus is carrying safety equipment, such as fire extinguishers, first-aid kits, flags, and flares. The driver also picks up the tickets, change, report blanks, and other items needed for his trip. He receives a listing of the express and mail to be carried.

Unless the driver is to take over an already loaded bus on the highway from another driver, he moves his empty bus from the terminal or garage to the proper loading platform, where he takes on his passengers. He collects fares—tickets usually—from the passengers as they board the bus, and announces the destination, route, time of arrival, and other information concerning the trip. The driver also loads or supervises the loading of baggage and package express into the baggage compartment. He checks the loading plan so that the baggage can be unloaded at the proper destination with minimum effort. He also collects cash fares from passengers

who board the bus between stations where tickets are sold.

The driver operates the bus carefully at speeds which will enable him to arrive at and leave regular bus stops according to established time schedules. On most runs, he also stops momentarily at other designated points to discharge or pick up passengers, and load or unload baggage and package express wherever necessary. He announces regular stops and rest or lunch stops. The driver also regulates lighting, heating, and airconditioning equipment for the passengers' comfort. In an emergency, he is sometimes required to make minor road repairs such as changing tires, for which he generally receives extra pay.

Upon arriving at his final destination, the driver unloads or supervises the unloading of the remaining baggage and turns in the lists of packages or mail carried. He prepares reports on mileage, time, and fares, as required by company rules. He also keeps a log of hours as required by the Interstate Commerce Commission. The driver must make out a complete report if an accident or unusual delay occurs.

Where Employed

Approximately 27,000 intercity bus-drivers were employed by about 1,450 bus companies in 1964. About 21,500 of these drivers worked for the 151 large class I intercity companies—those with annual revenues of over $200,000. Intercity busdrivers are employed in the many small communities served by bus as well as in the larger cities in which home and regional offices and major terminals of bus companies are located.

Training, Other Qualifications, and Advancement

All intercity busdrivers are required to meet minimum age, health, and experience qualifications established by the Interstate Commerce Commission. The ICC minimum age requirement is 21 years. The applicant must be able-bodied and have good hearing and at least 20/40 eyesight with or without glasses. He must have at least 1 year's driving experience (through all four seasons) with a good driving record, and must be able to read and speak English.

Intercity busdriver gives information to passenger.

Many intercity bus companies, however, have considerably higher requirements. Most of these companies prefer applicants to be at least 23 years of age with a high school education or its equivalent. Applicants are often given comprehensive examinations to determine their driving skill, intelligence, temperament, and personality. Some large companies do not accept applicants who wear glasses.

Young persons interested in becoming busdrivers should have good foot, hand, and eye coordination, be able to judge distances accurately, and react quickly. An even temperament and emotional stability are other important qualifications because busdrivers work under considerable tension when they operate large vehicles in heavy and swiftly moving traffic. Since they represent their companies in dealing with passengers, busdrivers must also be courteous and tactful.

Although previous experience in the operation of a truck or bus is not required, it is preferred by some employers. In most States, the law requires that a trainee for a busdriver's job must have or obtain a chauffeur's license, which is a commercial driving permit.

Most intercity bus companies conduct training programs for beginning drivers. These pro-

grams, which usually last from 2 to 6 weeks, but can extend to 3 months, include both classroom and driving instruction. In the classroom, the trainee is instructed in company and Interstate Commerce Commission rules; State and municipal regulations; safe driving practices; rates, schedules, and timetables; and how to deal with the public. He is also taught how to keep clerical records, check supplies, inspect the bus, and make minor emergency repairs.

The trainee then rides with a regular driver to observe correct driving practices and other aspects of the job. He also makes trial runs, without passengers, to demonstrate his driving skill. After satisfactorily completing the training, which generally includes final driving and written examinations, the new driver begins a 'break-in" period. During this period, working under strict supervision, he makes regularly scheduled trips with passengers.

New workers start out on the "extra board," which is a list of drivers on call who are given temporary assignments. While on the extra board, the new driver may substitute for a regular driver who is ill or on vacation, drive a second or overload section, make an extra trip if necessary, or drive chartered buses. Extra drivers may have to wait several years before they have the necessary seniority to receive a regular assignment. However, if it becomes necessary for a company to lay off some of its drivers, the extra drivers will be the first to lose their jobs and the last to be rehired. In almost all companies, it is necessary for a beginning employee to serve a probationary period lasting, as a rule, from 30 to 90 days.

Opportunities for promotion are generally somewhat limited, particularly in small companies. An experienced driver may be promoted to a job as dispatcher, supervisor, or terminal manager. For most drivers, advancement consists of receiving better assignments with higher earnings, as their seniority increases.

Employment Outlook

The upward trend in the employment of intercity busdrivers in recent years is expected to continue. The number of these drivers is expected to increase moderately through the mid-1970's, as a result of further increase in intercity bus travel. Several hundred additional openings will also be available each year in this relatively small occupation as a result of transfers to other fields of work, retirements, and deaths.

Population growth and higher consumer incomes during the years ahead should result in an increase in travel generally, a portion of which is expected to be by bus. Some other factors which are expected to increase travel by bus are: More new and improved highways, which will probably continue to cut scheduled running time; increasing numbers of larger and more comfortable buses; and more deluxe express buses offering hostess services, refreshments, and other conveniences. Bus traffic will also be favorably affected by touring and charter services and by bus delivery of package express and first-class mail which have become important sources of revenue in the past several years. The further curtailment or elimination of railroad passenger service in many areas is also increasing intercity bus traffic.

Earnings and Working Conditions

Drivers (including extra men) employed by class I intercity bus companies had average earnings of $7,080 in 1963. Many regular drivers employed by these companies earned considerably more than $8,000 a year.

The wages of intercity busdrivers are typically computed on a mileage basis. Rates ranged from about 7½ to more than 13 cents a mile in 1964. Most regular drivers are guaranteed specified wages in terms of miles or hours per pay period. For all work other than their regular assignment or "tour of duty," they receive additional pay, customarily at premium rates.

Extra drivers are usually paid by the hour when they are on call but are not driving, and are paid the regular mileage rate when actually driving. Drivers usually start at a minimum rate and receive increases at intervals of 6 months or a year. The maximum rate is generally reached at the end of 2 years. Extra men generally earn slightly less than regular drivers but, if enough work is available, they may earn as much or more than regular drivers. Extra drivers receive a weekly or biweekly guarantee either in mini-

mum hours, mileage, or earnings. Trainees are usually paid a flat daily rate.

Most drivers who work for the large companies average between 32 and 36 hours driving time a week. Driving schedules may range from 6 to 10 hours a day and from 3½ to 6 days a week.

Interstate Commerce Commission regulations limit the hours of work of intercity busdrivers. According to ICC regulations, intercity drivers may drive no more than 10 consecutive hours, after which they must have at least 8 hours off. Drivers are also limited to 60 hours of "on-duty" time in a 7-day period. "On-duty" is the period from the time the driver is required to report for work until he is relieved. For those who drive less than 10 hours but perform other work for the bus company, the regulations prohibit resumption of driving after any combination of driving and other on-duty time which totals 15 hours, unless the driver has first had at least 8 hours off duty.

Most intercity busdrivers belong to the Amalgamated Transit Union. The Brotherhood of Railroad Trainmen, and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.) have also organized intercity busdrivers in some areas.

Labor-management contracts covering many intercity busdrivers provide for health and life insurance paid for by the employer, while pension plans under such agreements are usually financed jointly by the workers and their employers.

Drivers are given vacations with pay ranging from 1 to 4 weeks, depending on the company for which they work and their length of service. Many also receive 6 paid holidays. When away from home terminals overnight, drivers employed by some companies receive pay for food and lodging.

Driving an intercity bus is not usually physically burdensome, but it is demanding and requires steady nerves. The busdriver is given a great deal of independence in his job, and is solely responsible for the safety of the passengers and bus. Many drivers enjoy working without direct supervision and take pride in assuming these responsibilities. Some drivers enjoy the opportunity to travel and to meet the public.

Among the less desirable aspects of this job are weekend and holiday work and the necessity of being away from home for varying periods. Also, extra drivers are on call at all hours and may be required to work at any time on very short notice. In addition, drivers with little seniority may sometimes be laid off when business declines.

Where To Go for More Information

For information regarding job opportunities for an intercity busdriver, a young man should apply to intercity bus companies or the local office of the State employment service.

Local Transit Busdrivers

(2d ed. D.O.T. 5–36.010)

(3d ed. D.O.T. 913.363 and .463)

Nature of Work

Local busdrivers transport millions of Americans to and from work, schools, and homes, every day. These drivers follow definite time schedules and routes over city and suburban streets in order to get passengers to their destinations on time.

The local busdriver's workday begins when he reports to the terminal or garage. There, he is assigned his bus, and receives his change, tokens, transfers, passes, and any other items needed. Before starting the run, the driver is usually required to check the tires, brakes, and lights. Some very small local bus companies may also require him to check the water, oil, and fuel.

On most runs, the driver makes regular stops every block or two, where he operates the controls of the bus doors to enable passengers to enter and leave the vehicle. As the passengers board the bus, the driver collects cash fares, tokens, tickets, or transfers, and also issues transfers, sells tokens, and makes change. The local

busdriver often answers questions concerning schedules, routes, transfer points, and street numbers, and is sometimes required to call out the name of the street at each regular bus stop. He also regulates heating, air conditioning, and lighting equipment to keep the passengers comfortable.

At the end of his day's run, the busdriver turns in a trip sheet which usually includes a record of fares received, trips made, and any delays in schedule. In case of accident or an unusual delay, the driver must make out a comprehensive report on its nature and cause.

Where Employed

In 1964, about 70,000 busdrivers were employed by about 1,200 local transit bus companies. A small proportion of these drivers were women. Approximately one-half the total worked in large cities where the transit system was publicly owned, such as Boston, Chicago, Cleveland, Detroit, Los Angeles, Miami, New York, Pittsburgh, St. Louis, and San Francisco. In addition to those employed by the local transit bus industry, some local drivers work for charter and sightseeing lines, government agencies, and for companies which specialize in operating schoolbuses. (There are also 15,000 to 25,000 full-time schoolbus drivers and perhaps as many as 150,000 more part-time drivers.) A few drivers are employed by Federal, State, and local governments.

Although many drivers work in major metropolitan areas such as New York, Chicago, and Detroit, some are employed in almost every community in the Nation.

Training, Other Qualifications, and Advancement

Applicants for busdriver positions should be between the ages of 21 and 40, of average height and weight, and have good eyesight—with or without glasses. The applicant must be in good health, with no physical disabilities, and must be able to pass the written and physical examinations given by most employers. He must be able to judge distance accurately; have good foot, hand, and eye coordination; and have quick reflexes. Because the driver often works under pressure and deals with many different personalities, an even temperament and emotional stability are important. Although educational requirements are not high, many employers prefer applicants with a high school education or its equivalent.

A motor vehicle operator's permit and, generally, 1 or 2 years of driving experience on some type of motor vehicle are basic requirements. A good driving record is essential because a busdriver is responsible for the safety of his passengers. Most States require busdrivers to have a chauffeur's license which permits the holder to operate commercial motor vehicles. This license may be obtained either during or immediately after the driver's training period. Some employers prefer drivers who have had experience operating a truck or bus.

Most local transit companies conduct training courses which may last several weeks and include both classroom and driving instructions. In the classroom, the trainee is taught company rules, safety regulations, and safe driving practices. He is taught how to keep records, and how to deal tactfully and courteously with passengers. The trainee's driving instruction consists of supervised trips both with and without passengers. At the conclusion of his training, the new driver is often required to pass a written and final driving examination before he goes out on a run.

After passing the examinations, he is placed on the "extra" list. While on this list, he takes over the runs of regular drivers who are ill or on vacation and also makes extra trips in the morning or evening rush hours. He also may drive

charter and sightseeing runs, and other extra runs such as special service buses for public meetings and sporting events. In almost all companies it is necessary for a beginning employee to serve a probationary period—generally lasting for 30 to 90 days. He remains on the extra list until he has the necessary seniority to obtain a regular run. It may take from several months to several years before he is assigned a regular run.

Promotional opportunities in regular driving jobs are generally limited. Experienced drivers may advance to jobs as instructor, dispatcher, road supervisor, and, sometimes, executive. Promotion in municipally owned bus systems is usually by examination. The opportunities for advancement of most drivers are limited to assignments to more desirable runs. Only after acquiring sufficient seniority do the drivers receive these assignments.

Employment Outlook

There will be a small number of opportunities for new workers to enter this occupation each year through the mid-1970's, even though employment of local busdrivers is expected to continue to decline (but at a slower rate than in the past). These openings will result from the need to replace drivers who transfer to other fields of work, retire, or die. Retirements and deaths may account for more than 1,500 openings each year.

In recent years, there has been a considerable decline in the volume of passenger traffic handled by the local transit bus industry. The main cause of this decline has been the rapid rise in the number of private automobiles and their increasing use in both city and suburban areas. Another factor has been the rapid growth of suburbs, most of which have a wide variety of stores, theaters, restaurants, and other services in their shopping centers. Because most suburban shopping centers have good parking facilities and are easily reached by automobile, many suburban residents have found it unnecessary to use public transportation for shopping or other activities. The increasing number of people employed in suburban areas are likely to rely more on private automobile transportation than those employed in downtown areas. In addition, increasing traffic congestion and parking problems in most downtown sections have led to the decline of many central business districts. This, in turn, has resulted in some curtailment of downtown bus service between rush hours.

As local transit bus traffic declined steadily in recent years and bus schedules and routes were curtailed or entirely eliminated, the employment of busdrivers also declined. The decline in employment was limited, however, partly because transit companies are not completely free to curtail or eliminate unprofitable routes, since the companies are usually regulated by State or municipal authorities.

Downtown traffic congestion and parking problems will continue to encourage bus travel in downtown areas, and the growing need for bus service for school children in the suburbs is an additional factor which may slow the downward trend in busdriver employment. Some increase in the number of publicly owned companies may occur. This would favorably affect busdriver employment, since such companies often provide service on unprofitable routes in the public interest.

Federal legislation passed in mid-1964 offers financial assistance to urban communities to help them alleviate downtown traffic congestion and parking problems. This is to be accomplished through the construction and other improvements of public bus and rail transportation facilities. Some communities have already started such mass transportation projects. However, it is too early to determine what effect these projects and others that may be undertaken will have on employment of local transit busdrivers.

Earnings and Working Conditions

Local transit busdrivers are usually paid by the hour, and earnings vary according to locality, length of service, size of company or city, and length and type of run. Nearly all companies pay the maximum job rate after 12 months' service. According to a survey of basic hourly wage scales set by union-employer contracts for busdrivers in 67 large cities, the average hourly rate was $2.74 on July 1, 1964. For more than half

of the busdrivers covered by the contracts, scales ranged from $2.80 to $3.05 an hour. Hourly scales were highest in the larger cities in the Great Lakes, Pacific, New England, and Middle Atlantic regions. Among the cities surveyed, the hourly pay scales for experienced busdrivers ranged from $1.75 in Knoxville, Tenn., to $3.05 on one busline in New York City. Wage scales for beginning drivers were generally 5 to 15 cents an hour less.

Most busdrivers have a standard work schedule of 8 hours a day, 40 hours a week. For additional work, drivers usually receive 1½ times their hourly rates. In many companies, drivers often work in excess of their standard work schedule, thereby increasing their weekly earnings. Drivers on the extra list generally are guaranteed a minimum number of hours of work or a minimum weekly salary.

The workweek for regular drivers usually consists of any 5 consecutive days, with Saturdays and Sundays being counted as regular workdays. Most transit companies run some buses in the evening and a few companies operate 24 hours a day. Therefore, some drivers have to work at night. To accommodate the varying demands of commuter travel, it is necessary for many local transit busdrivers to work "swing shifts." On these runs the operator drives for several hours, is off duty for a period of time, then returns to work for several hours. If the total elapsed time between the beginning and end of a swing shift exceeds 10 or 11 hours, the driver generally receives extra pay. Other assignments are "straight runs" which are unbroken except for meal periods. Some union contracts require 50 to 60 percent of all assignments to be straight runs.

Nearly all local transit busdrivers are covered by labor-management contracts which provide for life and health insurance, and pension plans; the major pension plans are financed jointly by the workers and their employers, while many life and health insurance plans are paid for solely by the employer. Drivers also are given vacations with pay ranging from 1 to 5 weeks or more, depending on the length of service, and usually 6 or 7 or more paid holidays a year.

Although driving a bus is not physically exhausting, busdrivers are exposed to the nervous tension which arises from driving a large vehicle on heavily congested streets and dealing with many types of passengers. In addition to driving a bus, they must collect fares, answer questions, see that passengers are clear of the doors, and request riders to move to the rear.

Among the more favorable aspects of this job is steady year-round employment once a driver receives a regular assignment. Busdrivers are usually free of direct supervision—which many drivers also find desirable. Drivers take pride in being solely responsible for the safety of the passengers and bus and in acting as the bus company's representative to the general public.

Most busdrivers are members of the Amalgamated Transit Union. Drivers in New York City and several other large cities belong to the Transport Workers Union of America. The Brotherhood of Railroad Trainmen and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.) have also organized some local transit busdrivers.

Where To Go for More Information

For information on employment opportunities for local busdrivers, injury should be made at the transit company in the local area or to the local office of the State employment service.

Taxi Drivers

(2d ed. D.O.T. 7–36.040)
(3d ed. D.O.T. 913.363)

Nature of Work

In practically all communities, taxicabs are an essential part of the regular transportation system. Taxicab drivers, in addition to providing transportation, also perform other services. For example, they assist passengers in and out of the cab, handle their luggage, and may also pick up and deliver packages. In some communities, cabs

are used for transporting crippled children to and from school. Cabdrivers occasionally provide sightseeing tours for out-of-town visitors.

Drivers get their "fares" or passengers in one or more ways. The majority of taxicab fleets are equipped with two-way radio systems over which requests for taxicabs are transmitted to the driver. These companies also have cab stands at which drivers may wait for phone calls from their central dispatching office which will direct them to pick up passengers. Many drivers wait in front of theaters, hotels, bus terminals, railroad stations, and other buildings which may have large numbers of prospective passengers. In small cities and in suburban areas, drivers may work from a central location, such as a terminal, to which they return after each trip. Passengers may also be picked up while the driver is returning to his stand or station. A good driver keeps himself informed on what is happening in the city, where crowds will gather (for example, at theaters, and baseball and football games) and the times when the crowds will break.

Drivers are usually required to keep records, such as the date, time, and place passengers were picked up, and the destination, time of arrival, and amount of fare collected. If the cabdriver owns his own cab or if he rents a cab over an extended period of time, he may periodically clean the cab, as required by regulations in many municipalities. In large cab companies, this job is generally performed by cleaners employed by the company.

Where Employed

In 1964, approximately 100,000 taxi drivers, including a small number of women, were employed full time in the taxicab industry, which is made up of both privately owned cabs and fleets of company-owned vehicles. In addition, perhaps as many were employed part time.

Although taxicab drivers are employed in every metropolitan area in the country, the greatest concentration of these workers is found in large cities. New York City, Washington, D.C., Chicago, Philadelphia, Boston, New Orleans, Detroit, St. Louis, and Baltimore lead in the employment of cabdrivers.

Training, Other Qualifications, and Advancement

To become a taxi driver in most large cities, it is necessary to have, in addition to a State-issued chauffeur's license, a special taxicab operator's license issued by the local police, safety department, or Public Utilities Commission. Although licensing requirements vary considerably among cities, in general, applicants must be over 21 and in good health, have a good driving record, and have no criminal record. A driver's record is checked for arrests, both locally and through the Federal Bureau of Investigation (FBI).

Most large communities require an applicant for a taxi driver's license to pass a written examination on taxicab and traffic regulations. The examination may include questions on street locations, insurance regulations, accident reports, lost articles, zoning or meter rules, and passenger pickup and deliveries. In some cities, the cab company will teach the driver-applicant taxicab regulations and the location of streets and important buildings. In other cities, the driver may prepare himself for the license examination. After the driver has passed the examination, he pays an annual license fee, generally ranging from 50 cents to $5.

Although formal education is seldom required, many companies prefer applicants for a taxi driving job to have at least an eighth-grade education. A neat, well-groomed appearance is de-

sirable, as is the ability to deal tactfully and courteously with all types of people. Good foot, hand, and eye coordination are particularly desirable because taxi drivers must often operate their cabs in fast moving and heavy traffic.

Opportunities for advancement for taxi drivers are extremely limited, with promotion to the job of dispatcher often the only possible advancement. Some drivers, however, have become road supervisors, garage superintendents, or claims agents. Many drivers who work for companies try to purchase their own cabs so that they can become their own employers. In some large cities, however, the number of cabs is restricted by ordinance, which may limit the opportunity to own cabs in such areas.

Employment Outlook

There will be many opportunities for new workers to become taxi drivers during the 1965–75 decade, primarily because of the high turnover in this occupation. The number of taxi drivers has been declining during the past decade and this trend is expected to continue through the mid-1970's.

In the past, the employment of taxi drivers has been adversely affected by the increased use of privately owned automobiles, rented cars, and the continuing population shift to the suburbs where most people drive their own cars. However, increasing population, higher consumer incomes, parking difficulties, and higher local transit bus and streetcar fares are some of the factors which may lead to a greater use of taxicabs and limit the decline in employment of taxi drivers.

The high turnover in this occupation results from the lack of assurance of a steady income, long hours, and the use of this job by some workers as stopgap employment when better jobs are not available. Transfers from this occupation are expected to be the major reason that employment opportunities will be available for many new workers who wish to enter this field of driving.

Earnings and Working Conditions

Comprehensive data on earnings of taxi drivers are not available. Some taxi drivers covered by union-employer contracts have weekly guaranteed minimums up to $60 or $65 a week; a daily rate of $15 is paid in one western city.

In one major eastern city with a large number of taxicabs, a full-time taxi driver earned, with tips, about $125 a week for a 6-day week, in early 1964. Driver-owners earned about the same amount, after deduction of their overhead and driving costs.

Most taxi drivers employed by taxicab companies are paid a percentage—usually between 40 and 50 percent—of the total fare. Drivers also frequently receive tips, ranging from 10 to 20 percent of the fare. Some companies pay their drivers a salary and give them an additional commission based upon the amount of business. Many drivers rent thier cabs from the company by the day for a set price. Any receipts above the cab rental and other operating expenses are retained by the drivers.

A large percentage of full-time taxi drivers work 9 or 10 hours a day for 6 days a week. They usually begin work between 6 a.m. and 8 a.m. Many drivers work nights, starting between 3 p.m. and 5 p.m. Some drivers work on Sundays and holidays.

Many college students have been able to work their way through school by driving cabs on a part-time basis and during summer and spring holidays. Some workers also become part-time drivers in order to supplement their regular income.

Driving a taxicab is not physically strenuous. Most drivers do not change tires or do other heavy repair work. Drivers are, however, subject to nervous tension from driving in heavy traffic in all kinds of weather, and dealing with all types of passengers.

Many drivers find the lack of direct supervision by an employer one of the more desirable aspects of their job. They may, however, be subject to municipal regulations which govern their personal appearance, the fares they charge, and their driving practices.

Taxi drivers in many of the large cities belong to labor unions, particularly those drivers who work for the large taxicab companies. The main

union in this field is the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.).

Taxi drivers usually put in long hours of work and do not receive overtime pay. Many of them do not receive fringe benefits, such as pensions and severance pay, that workers in many other occupations receive. When economic conditions decline, their earnings are generally reduced because of increased competition for less business.

FORGE SHOP OCCUPATIONS

Forging is one of the principal methods of working and shaping metal. In the forging process, metal is first heated to the proper temperature in special furnaces and then shaped through pounding and squeezing by hammers and presses. Shaping metal by forging has been done for centuries by blacksmiths, but the modern forge shop, by substituting heavy power equipment and precision die blocks for the blacksmith's hand hammer and anvil, can do it much more rapidly and accurately.

Forged metal is exceptionally strong and is used for many products that must withstand great stress. Examples of forged products include automobile crankshafts, gears, wrenches, scissors, and many parts of aircraft, missiles, and space craft. Most forgings are made of steel, but aluminum, brass, bronze, copper, titanium, beryllium, and most other metals are also forged. Some forgings weigh less than a pound, but others weigh many tons.

This chapter describes the major kinds of forging production occupations; it does not discuss machining, maintenance, custodial, or other workers who are employed in forge shops but who are not directly engaged in the forging process. (For a detailed description of the duties, working conditions, and job prospects for blacksmiths, who do work similar to that of many forge shop workers, see the statement on Blacksmiths.)

Nature of Work

Before metal can be shaped by hammers and presses, workers known as heaters must first heat it in intensely hot furnaces. Then drop hammer operators, hammersmiths, press operators, upsetter operators, and other workers manipulate the glowing hot metal between a pair of metal forms, called dies, that are attached to power hammers or pressers. The hammers or presses pound or squeeze the metal with tremendous but controlled force to form it into the shape desired. Finally, trimmers, chippers, grinders, and other workers remove rough edges, excess metal, and any imperfections from forgings, and perform other finishing operations.

Two kinds of dies are used for forging—the impression (closed) die, which has a cavity shaped to the form of the metal part to be forged, and the open die, which is flat and more closely resembles the blacksmith's hammer. Impression dies are used where the need for large quantities of identical forging (for example, automobile crankshafts) justifies their expense. Open dies are used to produce relatively small numbers of forged parts, or to forge objects too large for impression dies.

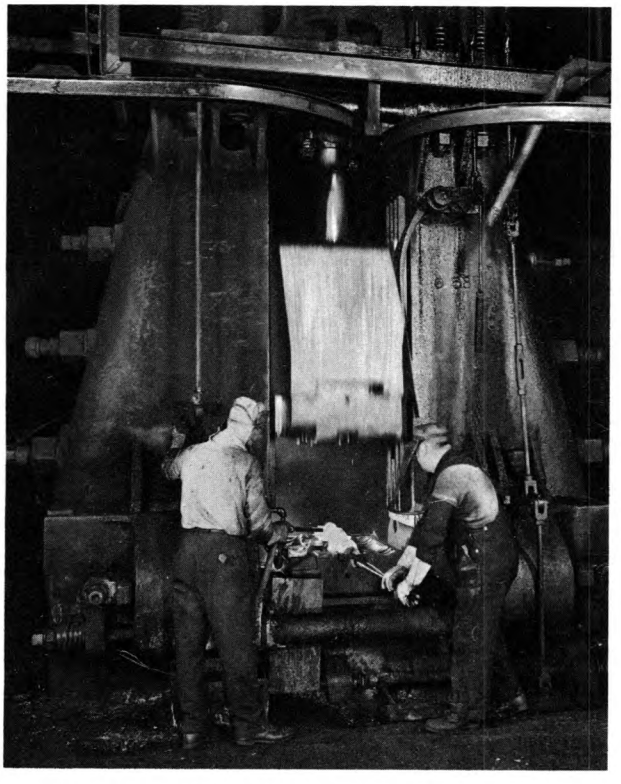
The basic equipment used by forge shop workers consists of various types of power hammers, power forming and trimming presses, dies, and furnaces. They also use handtools, such as hammers and tongs, and measuring devices, such as calipers, scales, and rules. A forging hammer or press is generally operated by a crew of from 2 to 10 men. The size of the crew depends on the size and type of equipment operated and the size and shape of the part to be formed. Crews may specialize in the operation of a particular kind of hammer or press. The work performed by workers in the major forge shop occupations is as follows:

Hammersmiths (D.O.T. 610.782) are skilled workers who operate open-die power hammers that pound pieces of hot metal, called blanks or stock, into desired shapes. The precision of parts forged with such equipment is greatly dependent on the skill of the hammersmith. He must interpret blueprints, drawings, and sketches to determine how to work the metal under the hammer; determine the force of the hammer so that the piece being forged will be shaped to specifications; and decide whether the metal being worked

needs additional heating and when and how to use various forming tools under the hammer to produce angles and curves.

The hammersmith supervises a crew consisting of a hammer driver, or hammer runner, whose main duty is to operate controls of the hammer to regulate the force of the forging blow; a craneman, who transfers metal blanks from furnace to hammer and manipulates metal under the hammer; a heater, who heats metal to correct forging temperatures; and one or more helpers.

Hammer operators (D.O.T. 610.782), often called hammermen, are skilled forgemen who operate impression-die power hammers. Generally, the larger the hammer and the larger or more intricate the shape of the metal object to be formed, the greater the skill required of the operator. With the assistance of helpers and heaters, the hammerman performs such duties as setting and alining dies in the hammer, controlling the force of the forging blow, positioning and manipulating metal under the hammer, and determining whether the metal being forged needs additional heat.



Hammer operator and helper forge automotive crankshaft.

Press operators (D.O.T. 611.782 and .885), also called press smiths, operate huge presses equipped with either open or impression dies. Their work differs from that of the hammersmith or hammer operator mainly in that they shape and form hot metal by pressing or squeezing rather than by hammering or pounding. They must know how to regulate the pressure of their machines and position metal stock between the dies. In some cases, operators need to know how to control the heating of metal. Their duties may also include setting up dies in the presses.

Skills of operators of open-die forging presses are similar to those of hammersmiths. Both types of workers manipulate metal blanks between two open dies; both must be able to understand blueprints, drawings, or sketches in order to transform heated metal into finished forgings; and both may supervise crews composed of an assistant operator, a craneman, a heater, and several helpers.

Impression die press operators work to more exacting specifications than press operators using open dies, but do not need as much manipulating skill because the die impression determines the shape of the forging. The impression-die press operator may supervise a small crew or may work alone.

Upsetter operators (D.O.T. 611.782), also called upsettermen, operate machines that shape hot metal by applying pressure through the horizontal movement of one impression die against another. With the help of a heater and several helpers, the upsetter operator performs such duties as alining dies, positioning metal stock between the dies, adjusting the machine's pressure on the metal stock, and controlling the heating of the metal. Deep-socket wrenches, aircraft engine cylinders, bolts, and valves are examples of products made in large quantities on upset machines.

Heaters (D.O.T. 509.782) control the supply of fuel and air in forge shop furnaces to obtain the correct temperature for the kind of metal and object being forged. Temperature gages and observation of the metal's color help the heater determine when the correct temperature has been reached. The heater's duties also include transferring, with tongs or mechanical handling equip-

ment, heated metal from furnace to hammer or press, and keeping furnaces clean.

Inspectors (D.O.T. 612.585) check forgings for size, shape, quality, and other specifications. Some inspectors examine forged pieces for flaws and faulty workmanship while the forgings are still hot; others inspect forgings after they have been trimmed and cleaned. Inspection may be done visually and/or with gages, micrometers, calipers, and other measuring devices. Checking for flaws may also be done with machines that test for strength and hardness, and with magnetic and electronic testing devices.

Die sinkers (D.O.T. 601.280) are highly skilled workers who make the impression dies that are used on some forging hammers and presses. Working from a blueprint, template, or drawing, a die sinker traces the outline of the object to be forged on two matched blocks of steel. He then mills the shape of this object in the steel die blocks to close tolerances, using milling machines and other machine tools. He smooths and finishes the die cavity, using scrapers, hand grinders, and other handtools. Finally, he makes a sample cast of the finished cavity, using the completed dies and checks all measurements with a micrometer and other precision measuring instruments.

Many forge shop workers are employed to clean and finish forgings. For example, *trimmers* (D.O.T. 619.887) remove excess metal from forged pieces with presses or hammers equipped with trimming dies. *Chippers* use chipping hammers and other tools to remove imperfections from the surfaces of forgings. *Grinders* (D.O.T. 705.884) remove rough edges from completed forgings with mechanically powered abrasive wheels. *Sandblasters* and *shotblasters* (D.O.T. 705.782) operate sandblasting or shotblasting equipment to clean and smooth forgings. *Picklers* (D.O.T. 503.884) dip forgings in an acid solution to remove surface scale and reveal any surface defects. *Heat treaters* (D.O.T. 504.782) heat and cool forgings under controlled conditions to attain certain desired conditions or properties in the metal, such as hardness.

Where Employed

Approximately 50,000 production workers were employed in forge shops in early 1965. More than three-fourths of these workers were employed in independent shops—those that produce forgings for sale. The remainder worked in forging departments of plants that use forgings in their final products, such as automobiles, farm machinery, handtools, and structural and ornamental metal products.

Employment of forge shop workers is concentrated mainly in Wisconsin, Ohio, Illinois, Michigan, Pennsylvania, Indiana, and Massachusetts. Forge shops are usually located near steel producing centers, which provide steel for forgings, as well as near metalworking plants, which are the major users of forged products.

Training and Other Qualifications

Most forge shop workers learn their skills through on-the-job training and work experience. They generally join a hammer or press crew as a helper, or, in some plants, as a heater. As they acquire experience, they progress to more skilled jobs. Advancement to the skilled job of hammersmith, for example, requires several years of on-the-job training and experience.

A few forge shops offer apprentice training programs for crafts such as die sinker, heat treater, hammer operator, hammersmith, and press operator. The programs, which generally last 4 years (in the case of die sinkers, from 4 to 8 years), give the apprentice a combination of classroom training and practical experience in using the tools and equipment of the trade. For example, hammersmith apprentices learn about the properties of metals and how to operate power hammers and furnaces, use handtools and welding equipment, and read blueprints.

Training requirements for inspectors vary. Those who inspect rough forgings visually or with simple gages can usually perform their jobs after on-the-job training lasting only a few weeks. Those who examine parts forged to more exact specifications and operate more complicated testing equipment may be required to have some technical background in blueprint reading and mathematics and may be given several months of on-the-job training.

Employers usually require no more than a grammar school education for helpers and heaters, but high school graduates are preferred. Young

men interested in preparing themselves for the more skilled forge shop jobs and for supervisory positions should complete high school and include mathematics (especially geometry), drafting, and shopwork in their studies.

Because forge shop work sometimes involves lifting and moving heavy forgings and dies, workers must be strong. However, cranes are used for moving very large objects. Forge shop workers must have the stamina to work under hot and noisy conditions for an entire working day.

Employment Outlook

Employment of production workers in forge shops is expected to increase moderately through the mid-1970's, assuming the realization of relatively full employment and high levels of economic activity. Most job openings, however, will arise from the need to replace experienced workers who retire, transfer to other fields of work, or die. Retirements and deaths alone are expected to result in about 1,400 job openings annually.

A rise in production worker employment is expected in the years ahead because industries that use forgings in their final products—particularly the industrial machinery and automobile industries—are expected to expand with the anticipated rise in the Nation's general economic activity. However, employment of forge-shop production workers is expected to rise at a slower rate than production. Continued improvements in forging techniques and equipment and more efficient plant operation, including materials handling, will result in greater output per worker. Forge shop employment has been sensitive to changes in general business conditions, and it is expected that substantial year-to-year changes in the level of forge shop employment will continue.

New and improved production processes and equipment have been introduced into forge shops in recent years, including the "high energy rate forging machine," the "automated hydraulic press," "no-draft forging," "radial forging," and "electrical discharge machining." Although these innovations are not expected to have any appreciable adverse effect on production worker employment in the near future, their widespread use in the years ahead may reduce the number of workers needed in conventional forge shop production occupations. The high energy rate forging machine, operated by one man, forges metal to very close tolerances—often with a single blow. Products forged by this process have improved physical properties and require less finishing, such as grinding and machining. The automated hydraulic press is controlled automatically by dialed-in instructions or by the use of punched cards, thus requiring smaller forging crews than are necessary to operate conventional equipment. No-draft forging involves the use of specially constructed dies that permit press forging to closer conformity with required sizes and shapes than is possible with conventional dies, thereby reducing machining requirements. Radial forging is a process used for the hot and cold forging of solid and hollow shafts, rifle barrels, and other internally and externally contoured products. This process produces complex shapes without the need for several machining operations. Other production techniques being introduced into forge shops include electrical discharge machining which produces the same results as broaching and grinding on electrically conductive materials without heating or distorting the work piece. This process improves the efficiency of die sinking and machining operations and provides a superior finish to the product.

Earnings and Working Conditions

Average earnings of forge shop production workers are above those for all manufacturing production workers. In 1964, production workers in iron and steel forging plants earned an average of $137.70 a week, or $3.331 an hour, compared with average weekly earnings of $102.97 and average hourly earnings of $2.53 for production workers in all manufacturing industries. In many forge shops, hammer and press crew members are paid on an incentive basis—that is, on the basis of the number of forgings they produce. Consequently, earnings of highly skilled crew members were higher than the average for all production workers in forge shops.

Collective bargaining contracts negotiated between employers and unions include provisions for various fringe benefits, such as holiday pay, vacation pay, and retirement pensions. Most union-management agreements provide for 7 or

8 paid holidays a year and, after 2 to 5 years of service, 2 weeks' vacation with pay. Other important provisions include life insurance benefits financed by the employer, as well as accident and sickness, hospital, and surgical benefits.

Working conditions in forge shops have improved in recent years. Many firms have installed ventilating fans to reduce heat and smoke and have attempted to reduce machine concussion, noise, and vibration. Although the rate of disabling work injuries in forge shops is higher than the average for all manufacturing industries, employers and unions attempt to eliminate injuries in forge shops by promoting safety training and the use of protective equipment such as face shields, ear plugs, safety glasses, metal-toe shoes, instep guards, metal helmets, and machine safety guards.

Most forge shop workers are union members. Many are members of the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers. Others are members of the United Steelworkers of America; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the International Association of Machinists and Aerospace Workers; and the International Die Sinkers' Conference (Ind.).

Where To Go for More Information

The Forging Industry Association,
55 Public Square, Cleveland, Ohio 44113.

International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers,
Eighth at State Ave., Kansas City, Kans. 66101.

Open Die Forging Institute.
366 Madison Ave., New York, N.Y. 10017.

778-316 O—65——30

MACHINING OCCUPATIONS

Almost every product made by American industry contains metal parts or is manufactured by machines made of metal parts. Many of these metal parts are shaped to precise dimensions by skilled and semiskilled machining workers using a wide variety of machine tools. Machining workers make up the largest occupational group in the metalworking trades. In early 1965, about a million workers were employed as machinists, tool and die makers, instrument makers, machine tool operators, setup men, and layout men.

Nature of Work

The principal job of most machining workers is to operate machine tools. A machine tool is a stationary, power-driven machine that holds firmly both the piece of metal to be shaped and a cutting instrument, or "tool", and brings them together so that the metal is cut to the desired shape. In some cases, the cutting tool is moved and the metal is held stationary; in others, the metal is moved against a stationary tool.

The most common types of machine tools are lathes, grinding machines, drilling and boring machines, milling machines, shapers, broachers, and planers. Lathes turn and shape metal against a sharp cutting tool. Grinding machines smooth metal parts by means of power-driven abrasive wheels. Drilling machines make holes in metal. Boring machines enlarge holes already drilled. Milling machines cut or remove excess metal with tools that have several cutting edges. Shapers, planers, and broachers are machine tools that produce flat surfaces. In addition to these common machining methods, several new metal shaping techniques have been introduced in recent years. For example, metal can now be shaped using chemicals, electricity, magnetism, sound, light, and liquids under controlled conditions.

Accuracy is of prime importance for most metal machining work. Motors, farm machinery, and typewriters are included among the wide variety of products made of separate metal parts that must be made to precise dimensions so that the parts are interchangeable and can be easily assembled for mass-production purposes. Metal parts sometimes are machined to tolerances of 10 millionths of an inch. Machining workers follow directions generally given in the form of a drawing or blueprint, upon which exact dimensions of the finished part are specified; some instructions may be less detailed. Machining workers frequently use micrometers and other precision-measuring instruments to check the accuracy of their work against the specifications.

In addition to the operation of machine tools, the skilled tool and die makers, instrument makers, machinists, and layout men spend a considerable portion of their time doing precision handwork such as laying out and assembling metal parts. After the separate parts have been machined, they use files, scrapers, emery cloths and miscellaneous small handtools in filing, scraping, and polishing the parts for exact fit in the final assembly.

All-round machinists are skilled workers who can operate most types of machine tools. Machine tool operators commonly operate only one kind of machine tool. Tool and die makers specialize in making dies for use with presses and die casting machines, devices to guide drills into metal, and special gages to determine whether the work meets specified tolerances. Instrument makers use machine tools to produce highly accurate instrument parts made of metal or other materials.

In plants that produce large numbers of metal products, machinists may specialize in setup and layout work. Setup men adjust machine tools so that semiskilled machine tool operators can run the machines. Layout men mark machining specifications on metal so that an operator can perform the proper machining operations. (Detailed

discussions of the types of work performed by workers in each of these machining occupations are presented later in this chapter.)

Since continuous attention is required when machine tools are in operation, the work may be tedious, especially on simple and repetitive machining jobs. However, where the work is varied and complex and standards of accuracy are high, a worker can experience the satisfaction that comes to a capable and conscientious craftsman in a highly skilled trade.

Location of Machining Work

An estimated 500,000 machine tool operators; 370,000 machinists, layout men, and instrument makers; 140,000 tool and die makers; and 40,000 setup men were employed in early 1965. About four-fifths of all machining workers were employed in the metalworking industries, mostly in the machinery, except electrical; transportation equipment; fabricated metal products; and electrical machinery and equipment industries. Many thousands were employed in nonmetalworking establishments, such as the repair shops of railroads and maintenance shops of factories that make textiles, paper, glass, or chemicals. A small number worked in research laboratories and shops that fabricate models of new products.

Machining workers are employed in every State and in almost every city in the country. However, more than half of all machining workers are employed in California, Ohio, New York, Michigan, Illinois, and Pennsylvania. Other States with large numbers of machining workers are New Jersey, Massachusetts, Indiana, Connecticut, Wisconsin, and Texas. Most instrument makers are employed in New York City, Chicago, and a few other large cities.

Training, Other Qualifications, and Advancement

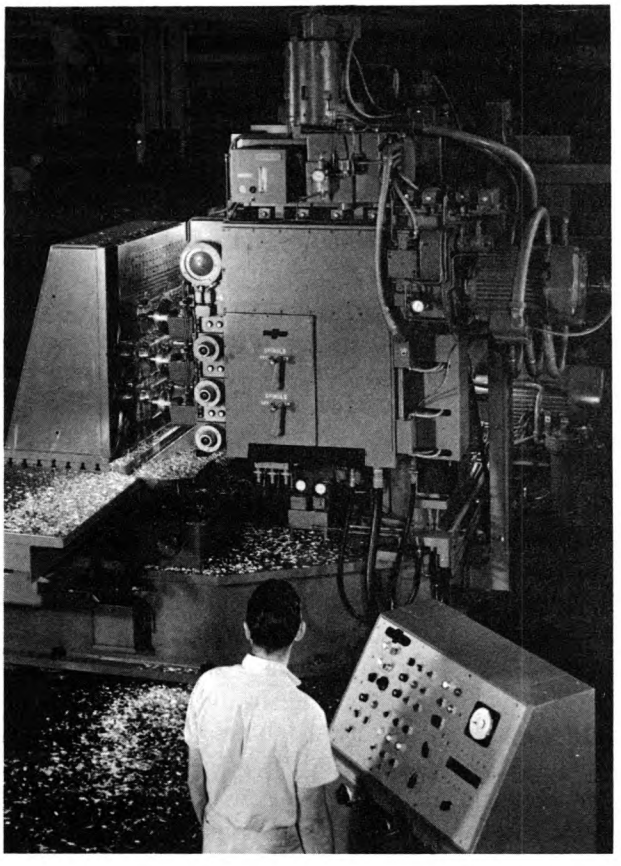
The common method of entering skilled machining occupations is through apprenticeship—a period of formal on-the-job training during which the new worker learns all the aspects of his trade. He is taught to operate machine tools, and to use handtools and measuring instruments. In addition to shop training, the apprentice is given classroom instruction in blueprint reading, mathematics, and related subjects. In choosing apprentices, employers usually prefer young men who have a high school or trade school education. Some companies use aptitude tests to help determine whether applicants for machining jobs have the necessary mechanical ability and the temperament to perform this exacting work. Machining workers must also have good vision, and superior judgment of depth and distance.

Most machine tool operators and some machinists, tool and die makers, and instrument makers "pick up" the skills of their trade informally through experience on several jobs. They generally start in the less skilled machining jobs working under the supervision of experienced craftsmen. They gradually advance to more skilled jobs as they acquire experience and knowledge. Some workers improve their skills and increase their chances for advancement by taking vocational school courses in blueprint reading, electronics, hydraulics, and shop mathematics. An increasing number of machining workers are participating in intensive training programs provided by machinery manufacturers or sponsored by labor unions. Some of these programs train machining workers to maintain and repair the numerically controlled machine tools being installed in a growing number of establishments.

Programs to train unemployed and underemployed workers, primarily for entry jobs in the machining occupations, were operating in many cities in early 1965 under the Manpower Development and Training Act. The majority of these programs, which last up to a year, were for machine tool operators, but some were for other machining occupations. The programs stressed the fundamentals of machine tool operation. With additional training and experience, graduates of these programs may eventually become skilled machining workers.

Although women are sometimes employed as machine tool operators, relatively few are employed in skilled machining occupations.

Machining workers have several advancement opportunities. For example, many can advance to foremen. Individuals with extensive machine shop experience may, with specialized training, become programers who prepare the coded paper tapes used to operate numerically controlled machines. Tool and die makers and instrument mak-



Machine tool operator monitors numerically controlled profile milling machine.

ers can advance to technical positions such as tool and die designer, instrument technician, and process or methods engineer. Machining workers also can open their own tool and die shops or machine shops.

Employment Outlook

There will be thousands of job openings for machining workers during the 1965–75 decade. Most of these openings will result from the need to replace experienced workers who transfer to other fields of work, retire, or die. Retirements and deaths alone will provide about 25,000 job openings annually. Replacements will be a particularly important factor in the skilled machining occupations, which have a relatively high proportion of older workers. Transfers of semiskilled machine tool operators to other occupations are fairly common, and some openings will result from these transfers. Other openings are expected to result from the anticipated slow increase in the demand for these workers, assuming the realization of relatively full employment nationally and high rates of economic growth necessary to achieve this goal. If these high levels of economic activity are not realized, the employment of machining workers will increase less than expected.

Employment in the various machining occupations is expected to increase at different rates. For example, the number of instrument makers is expected to increase rapidly, while little or no change is expected in the employment of machine tool operators. Laborsaving technological changes are expected to slow the employment growth of most machining occupations.

The anticipated increase in the employment of machining workers is expected to result from the rapid rise in the demand for machined products. The large increases expected in population and in the number of households, and the higher levels of personal disposable income anticipated during the decade ahead, are expected to result in a large increase in the demand for metal consumer products such as automobiles, heating and air-conditioning equipment, and household appliances. Higher levels of corporate income and rising expenditures for industrial plant capacity should stimulate the demand for metal products such as machine tools, engines, pumps, and instruments. The production of machined products used in the exploration of outer space often involves new metals and alloys that must be worked to extremely close tolerances. Special machining skills will be required to perform this type of work.

Employment of machining workers is not expected to increase as fast as the demand for machined products, because technological developments will increase output per worker. For example, automated machining lines, in which machine tools are linked together for production operations, are being used increasingly. The cutting and feeding speeds of machine tools are also increasing. In addition, the growing use of numerically controlled machine tools will adversely affect employment of machining workers, especially operators.

The use of numerically controlled machine tools broadly involves the following sequence of opera-

tions: Engineers or draftsmen translate part dimensions and tolerances, cutter shapes and sizes, cutting paths and sequences, and other data into numbers or codes representing numbers. These numbers are punched on tapes or cards which are inserted into electronic or mechanical devices that translate numbers into motions or actions such as drilling or cutting. The machine tool operator simply installs the tool, inserts and removes the workpiece, and changes the tapes or cards.

Specific future effects of numerically controlled machine tools on the employment and skill of machining workers can not be foreseen. However, numerical controls may greatly simplify the jobs of many machining workers and increase their efficiency.

Earnings and Working Conditions

The earnings of skilled machining workers compare favorably with those of other skilled industrial workers. Tool and die makers and instrument makers are the highest paid workers in the machining group, and among the highest paid skilled workers in manufacturing. Earnings information for most of the individual machining occupations is presented later in this chapter.

Most machine shops are relatively clean and well lighted. Because they work with high speed machine tools and sharp cutting instruments, workers in these occupations need good safety habits. Persons working around machine tools are prohibited from wearing loose fitting clothing. They frequently wear safety glasses and other protective equipment.

Machining work is not usually physically strenuous. The machine tools do the actual cutting while the machining worker sets the machine, watches the controls, and checks the accuracy of the work. The workers, however, usually stand at their jobs most of the day and move about frequently.

Companies that employ machining workers generally provide paid holidays and paid vacations. Life insurance, hospitalization, medical and surgical insurance, sickness and accident insurance, and pensions also are often provided for these workers.

The great majority of workers in machining occupations are members of unions. Among the labor organizations in this field are the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the International Union of Electrical, Radio and Machine Workers; the International Brotherhood of Electrical Workers; the United Steelworkers of America; and the Mechanics Educational Society of America.

Where To Go for More Information

The National Machine Tool Builders Association, 2139 Wisconsin Ave. NW., Washington, D.C. 20007—whose members build a large percentage of all machine tools used in this country—will, on request, supply information on career opportunities in the Machine Tool Industry.

The National Tool, Die and Precision Machining Association, 1411 K St. NW., Washington, D.C. 20005, offers information on apprenticeship training, including Recommended Apprenticeship Standards for Tool and Die Makers, certified by the U.S. Department of Labor's Bureau of Apprenticeship and Training.

Many local offices of the State employment service, affiliated with the U.S. Employment Service, offer free aptitude testing to persons interested in determining their capacity to acquire the skills necessary to become an all-round machinist or tool and die maker. In addition, it also may be a source of information about training opportunities under the Manpower Development and Training Act. The State employment service also refers applicants for apprentice programs to employers. In many communities, applications for apprenticeship are also received by labor-management apprenticeship committees.

Apprenticeship information also may be obtained from the following international unions (which have local offices in many cities):

International Association of Machinists and Aerospace Workers,
1300 Connecticut Ave. NW., Washington, D.C. 20036.

International Union, United Automobile, Aerospace and Agricultural Implement Workers of America,
8000 East Jefferson Ave., Detroit, Mich. 48214.

International Union of Electrical Radio and Machine Workers, 1126 16th St. NW., Washington, D.C. 20036.

All-Round Machinists

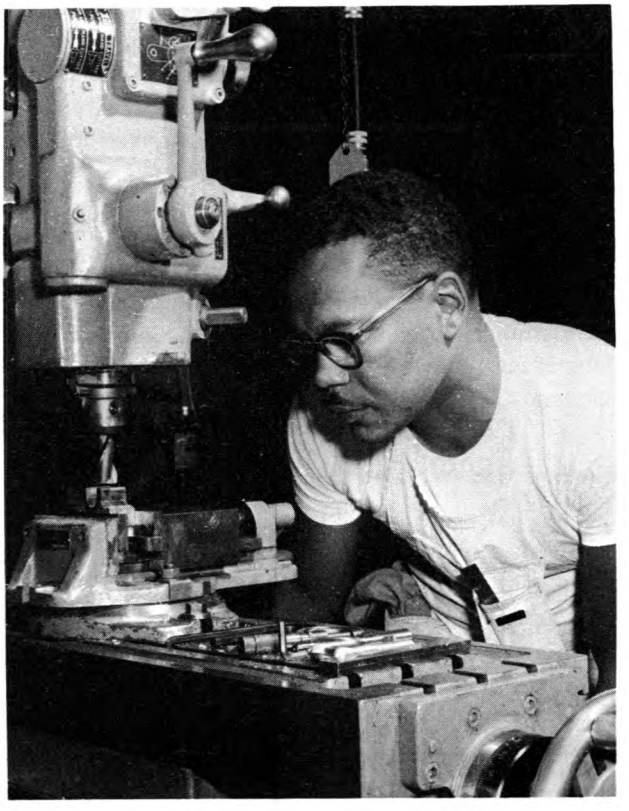
(2d ed. D.O.T. 4–75.010 and 120)
(3d ed. D.O.T. 600.280 and .281)

Nature of Work

The all-round machinist is a skilled metal worker who makes metal parts with machine tools. A machinist can set up and operate most types of machine tools. His wide knowledge of shop practice and the working properties of metals, and his understanding of what the various machine tools do, enable him to turn a block of metal into an intricate part meeting precise specifications.

Variety is the main characteristic of the work of an all-round machinist. He plans and carries through all operations needed in turning out machined products. He may switch from one kind of product to another. An all-round machinist selects the tools and material required for each job and plans the cutting and finishing operations in order to complete the finished work according to blueprint or written specifications. He makes standard shop computations relating to dimensions of work, tooling, feeds, and speeds of machining. He often uses precision-measuring instruments such as micrometers and gages to measure the accuracy of his work to thousandths and even millionths of an inch. After completing machining operations, he may finish the work by hand, using files and scrapers, and then assemble the finished parts with wrenches and screwdrivers. The all-round machinist also "heat treats" cutting tools and parts to improve machinability.

Machinists employed in maintenance departments to make or repair metal parts of machines and equipment also have a broad knowledge of mechanical principles. They sometimes adjust and test the parts they have made or repaired for a machine.



Courtesy of the U.S. Department of Navy

Machinist operates modern machine that combines several processes.

Where Employed

Almost every factory using a substantial amount of machinery employs all-round machinists to keep its mechanical equipment operating. Some all-round machinists work in the production departments of metalworking factories where large quantities of identical parts are produced; others work in machine shops where a limited number of varied products are made. Most all-round machinists work in the following industries: Machinery, including electrical; transportation equipment; fabricated metal products; and primary metals. Among the other industries employing substantial numbers of these workers are the railroads, chemical, food processing, and textile industries. The Federal Government also employs all-round machinists in Navy yards and other installations.

An important advantage of this occupation is that machinists can be employed in almost every locality and industry because their skills are required to maintain all types of machinery.

Training, Other Qualifications, and Advancement

According to most training authorities, a 4-year apprenticeship is the best way to learn the machinist trade. Many machinists, however, have qualified without an apprenticeship by picking up the trade over years of varied experience in machining jobs. Several companies have training programs which qualify some of their employees as machinists in less than 4 years.

A young person interested in becoming a machinist should be mechanically inclined and temperamentally suited to do highly accurate work that requires concentration as well as physical effort. A high school or vocational school education is desirable preparation for machinist training and is required by many employers. Courses in mathematics and physics and some knowledge of electronics and hydraulics may be helpful both during and after apprenticeship training. Some companies require their experienced machinists to take courses in mathematics and electronics, at company expense, so these workers can operate the numerically controlled machine tools coming into greater use. In addition, equipment builders generally provide training in the electrical, electronic, hydraulic, and mechanical aspects of machine-and-control systems.

A typical machinist apprentice program lasts 4 years and consists of approximately 8,000 hours of shop training and about 570 hours of related classroom instruction. Shop training includes learning the operation of various types of machine tools. The apprentice also is taught chipping, filing, hand tapping, dowel fitting, riveting, and other hand operations. In the classroom, the apprentice studies blueprint reading, mechanical drawing, shop mathematics, and shop practices.

A machinist who has just finished his apprentice training often is assigned the job of operating a single type of machine tool. With additional experience, he may be assigned jobs requiring him to operate several types of machine tools as well as to perform hand operations. Some journeymen machinists, however, remain machine tool specialists who do highly skilled work with one type of machine tool.

Numerous promotional opportunities are available to all-round machinists. Many advance to foreman of a section or to other supervisory jobs. With additional training, others may become tool and die makers or instrument makers. A skilled machinist has excellent opportunities to advance into other technical jobs in process planning, machine programing, and tooling. Machinists can also open their own machine shops.

Employment Outlook

A moderate increase in the number of all-round machinists is expected during the 1965–75 decade, as a result of the anticipated expansion of metalworking activities. (See discussion, p. 450.) However, most job openings will arise from the need to replace experienced machinists who transfer to other fields of work, retire, or die. In this large occupation, retirements and deaths alone will result in about 7,000 job openings annually.

The employment of machinists is expected to increase, especially in maintenance shops, as industries continue to use a greater volume of complex machinery and equipment. Skilled maintenance machinists are needed to prevent costly breakdowns in highly mechanized plants where machine tools often are linked together by transfer equipment. In such plants, a breakdown of one machine may stop many other machines.

Earnings and Working Conditions

The earnings of all-round machinists compare favorably with those of other skilled factory workers.

Maintenance machinists employed in various manufacturing industries in 69 areas surveyed in 1964–65 received average straight-time hourly earnings ranging from $2.15 in Greenville, S.C., to $3.60 in Milwaukee, Wis. Average straight-time hourly earnings of maintenance machinists employed in the following cities were:

Atlanta	$3.09
Birmingham	3.54
Chicago	3.58
Cincinnati	3.26
Detroit	3.59
Houston	3.41
Los Angeles–Long Beach	3.56
Memphis	3.08
Milwaukee	3.60
Minneapolis–St. Paul	3.50

New York	$3.42
Portland, Oreg	3.37
Rockford, Ill	2.88
San Francisco–Oakland	3.57
Worcester	2.86

Machinists must follow strict safety regulations when working around high-speed machine tools. The greater use of safety glasses and other protective devices in recent years has reduced the accident rate for these workers.

See introductory section of this chapter for a discussion of nonwage benefits received by machining workers, unions that organize these workers, and where to go for more information.

Machine Tool Operators

(2d ed. D.O.T. 4–78.000 through .589 and 6–78.000 through .589)

(3d ed. D.O.T. 600.280; 601.280; 602.280 through .885; 603.280 through .885; 604.280 through .885; and 605.280 through .885; and 606.280 through .885)

Machine tool operators shape metal to precise dimensions by the use of machine tools. Most operators can operate only one or two machine tools; some can operate several. Many operators are semiskilled machine tenders who perform simple, repetitive operations that can be learned quickly. Other operators, however, are skilled workers who can perform complex and varied machining operations.

A typical job of a semiskilled operator is to place rough metal stock in a machine tool on which the speeds and operation sequence have already been set by a skilled worker. The operator watches the machine and calls his supervisor when anything unusual happens. Special, easy-to-use gages help him to measure work quickly and accurately. The operator with limited training may make minor adjustments to keep his machine tool operating, but he depends on skilled machining workers for major adjustments.

The work of skilled machine tool operators is usually limited to a single type of machine and involves little or no hand fitting or assembly work. He plans and sets up the correct sequence of machining operations in accordance with blueprints, layouts, or other instructions. He adjusts speed, feed, and other controls and selects the proper cutting instruments, or tools, for each operation. He must be able to use all the special attachments of his machine because adjustments during machining operations, and changes in setup, may be required. Upon completing his work, he checks measurements with micrometers, gages, and other precision-measuring instruments to see whether the work meets specifications. The skilled machine tool operator also may select cutting and lubricating oils used to cool metal and tools during machining operations.

Lathes, drill presses, boring machines, grinding machines, milling machines, and automatic screw machines are among the machine tools used by machine operators. Both skilled and semiskilled operators have job titles based upon the kind of machine they operate, such as engine lathe operator, milling machine operator, and drill press operator.

Where Employed

Machine tool operators are mainly employed in factories that manufacture fabricated metal products, transportation equipment, and machinery in large quantities. Skilled machine tool operators work in production departments, maintenance departments, toolrooms, and job shops. Because of their limited training, few semiskilled operators work in maintenance departments or in job shops.

Training, Other Qualifications, and Advancement

Most machine tool operators learn their skills on the job. A beginner usually starts by observing a skilled operator at work. When the learner first operates a machine, he is supervised closely by a more experienced worker. The beginner learns how to use measuring instruments and to make elementary computations needed in shop work. He gradually acquires experience and learns to operate a machine tool, read blueprints, and plan the sequence of machining work.

Individual ability and effort largely determine how long it takes to become a machine tool operator. Semiskilled machine tool operators generally learn their jobs within a few months. However, it usually takes 1½ to 2 years of on-the-job training and experience to become a skilled machine tool operator. Some skilled machine tool operators' jobs are filled by men who have completed machinists' apprenticeships. Some companies have formal training programs to acquaint new employees with the details of machine tool operation and machining practice.

Although there are no special educational requirements for semiskilled operator jobs, young persons seeking such jobs can improve their job opportunities by completing courses in mathematics and blueprint reading. In hiring beginners, employers often look for persons who have mechanical aptitude and some experience working with machinery.

Skilled machine tool operators can advance to jobs as all-round machinists and tool and die makers. They may also advance to jobs in process planning, machine programing, and maintenance.

Employment Outlook

Tens of thousands of workers will be hired during the 1965–75 decade to replace experienced machine tool operators who transfer to other jobs, retire, or die. Retirements and deaths alone should result in more than 10,000 job openings annually. Little or no employment growth is expected despite the anticipated expansion of metalworking activities. (See discussion, p. 450.)

Technological developments will continue to affect both the number and skill requirements of machine tool operators. The use of faster and more versatile automatic machine tools will result in greater output per operator. Future widespread use of numerically controlled machine tools would also limit employment growth of machine tool operators. (See discussion, p. 450.) Workers with thorough backgrounds in machining operations, mathematics, blueprint reading, and good working knowledge of the properties of metals will be better able to adjust to the changing job requirements that will result from the expanding use of numerically controlled machine tools.

Earnings and Working Conditions

Machine tool operators are paid on an hourly rate or incentive basis, or on the basis of a combination of both methods. Operators employed in production shops are usually classified as class A, class B, and class C operators, according to their skill level. Class A operators are the most highly skilled and usually are paid the highest rates. In 21 selected areas surveyed in the middle of 1965, class A machine tool operators had average straight-time hourly earnings ranging from $2.66 in Dallas, Tex., to $3.61 in St. Louis, Mo. The average earnings of class B operators in a majority of the areas were at least 34 cents an hour lower than the earnings of class A operators. Similarly, the hourly earnings of class C operators were at least 40 cents below the level of class B operators in a majority of the areas. Average straight-time hourly earnings for class A drill press, engine lathe, and milling machine operators were as follows:

	Drill press operators, radial, class A	*Engine lathe operators, class A*	*Milling, machine operators, class A*
Baltimore	$3.30	$2.99	$3.28
Boston	2.90	2.81	2.94
Buffalo	------	2.94	-------
Chicago	3.15	3.22	3.23
Cleveland	3.12	3.14	3.23
Dallas	2.93	2.72	2.67
Denver	------	3.17	3.54
Detroit	3.53	3.52	3.51
Hartford–New Britain–Bristol	3.05	3.11	3.14
Houston	2.88	3.08	2.94
Los Angeles–Long Beach	3.05	3.23	3.12
Milwaukee	3.19	3.27	3.34
Minneapolis–St. Paul	2.93	2.90	2.96
Newark–Jersey City	3.08	2.97	3.01
New York	3.18	3.08	3.06
Philadelphia	2.88	2.99	2.94
Pittsburgh	2.89	3.22	3.16
Portland, Oreg	3.31	3.34	3.34
St. Louis	3.16	------	3.45
San Francisco–Oakland	3.60	3.59	-------
Worcester	2.82	2.75	2.93

Machine tool operators are required to wear protective glasses and to avoid wearing loose-

fitting garments when working around high speed machine tools. Increasing emphasis upon these and other safety regulations has reduced the accident rate for these workers.

See introductory section of this chapter for a discussion of nonwage benefits received by machining workers, unions that organize these workers, and where to go for more information.

Tool and Die Makers

(2d ed. D.O.T. 4–76.010, .040, and .210)

(3d ed. D.O.T. 601.280, .281, .380, and .381)

Nature of Work

Tool and die makers are highly skilled, creative workers whose products—tools, dies, and special guiding and holding devices—are the basis of mass production in metalworking industries. Tool makers specialize in producing jigs and fixtures (devices required to hold metal while it is being shaved, stamped, or drilled). They also make gages and other measuring devices that are used in manufacturing precision metal parts. Die makers construct metal forms (dies) which are used in stamping and forging operations to shape metal. They also make metal molds used in die-casting and in molding plastics. Tool and die makers also repair dies, gages, jigs, and fixtures. Some tool and die makers help design tools and dies.

In comparison with most other machining workers, tool and die makers have a broader knowledge of machining operations, shop practices, mathematics, and blueprint reading, and can work to closer tolerances and do more precise handwork. Tool and die makers use almost every type of machine tool and precision-measuring instrument. They work with all metals and alloys commonly used in manufacturing.

Experienced tool and die maker gives die construction pointers to apprentice.

Where Employed

The largest numbers of tool and die makers are employed in plants producing manufacturing, construction, and farm machinery and equipment. The automobile, aircraft, and other transportation equipment industries also employ large numbers of tool and die makers. Several thousand of these craftsmen work in small tool and die jobbing shops, making tools, dies, and other machine tool accessories for use in metalworking factories. Companies manufacturing electrical machinery and fabricated metal products are other important employers of tool and die makers. Many nonmetalworking industries also employ tool and die makers.

Training, Other Qualifications, and Advancement

Tool and die making requires several years of varied training and experience which can be obtained through formal apprenticeship or equivalent on-the-job training. Since this work is highly skilled, persons planning to enter the trade should have a good working knowledge of mathematics and physics as well as considerable mechanical ability, finger dexterity, and a liking for painstaking work. In selecting apprentices, most employers prefer young men with high school or trade school education. Some employers test apprentice applicants to determine their

mechanical aptitudes and their abilities in mathematics.

A tool and die apprenticeship ordinarily lasts 4 or 5 years. Most of the time is devoted to practical shop training, but some classroom work also is part of the training program. During shop training, the apprentice learns to operate major machine tools, such as lathes and milling machines. He learns to use handtools in fitting and assembling tools, gages, and other mechanical equipment. Tool and die maker apprentices study heat treating and other metalworking processes. Classroom training in shop mathematics, shop theory, mechanical drawing, tool designing, and blueprint reading also is given to apprentices. After apprenticeship, several years' experience often is necessary to qualify for more difficult tool and die work. Some companies have separate apprenticeship programs for toolmaking and die making.

Many metal machining workers have become tool and die makers without completing formal apprenticeships. After acquiring years of experience as machine tool operators or as machinists plus vocational or correspondence school training, these men have developed into all-round workers who can skillfully perform almost any metal machining operation, including tool and die making.

The increasing complexity of modern machinery and metalworking equipment is raising the technical requirements for tool and die making. A knowledge of mathematics, the basic sciences, electronics, and hydraulics will give young persons entering this occupation greater opportunities to advance their careers.

An early investment in thorough training for this occupation may lead to better paying jobs in the future. Men who have had tool and die training often advance to supervisory and administrative positions in industry. Many tool and die makers become tool designers. Some open their own tool and die shops.

Employment Outlook

Employment of tool and die makers is expected to increase moderately during the 1965–75 decade, as a result of the anticipated expansion of metalworking activity. (See discussion, p. 450.) In addition, many openings will become available as experienced tool and die makers transfer to other fields of work, retire, or die. Retirements and deaths alone should provide more than 3,000 job openings annually.

The anticipated long-range expansion in the machinery, electrical equipment, and other metalworking industries will result in a continued increase in the employment of tool and die makers. Their skills will be needed to make the tools and dies used to produce the large numbers of identical metal parts required in these industries. They will also be needed to help put many technological developments into effect. However, numerically controlled machining operations require fewer of the special tools and jigs and fixtures that are now made by tool and die makers. In addition, numerically controlled machines could replace many of the conventional machines now used in manufacturing tools, jigs, and fixtures, thus increasing output per tool and die maker. However, specific effects of numerical control on the employment of these workers cannot be foreseen at this time. (See p. 450 for a discussion of numerical control and other technological changes.)

Earnings and Working Conditions

Tool and die makers are among the highest paid machining workers. In April–June 1965, average straight-time hourly earnings of tool and die makers in machinery manufacturing shops (those producing tools, die sets, and fixtures as the end product in 13 areas) were as follows:

Boston	$3.23
Buffalo	3.25
Chicago	3.99
Cleveland	3.35
Detroit	3.95
Hartford–New Britain–Bristol	3.05
Los Angeles–Long Beach	3.63
Milwaukee	3.66
Minneapolis–St. Paul	3.43
Newark–Jersey City	3.25
New York City	3.38
Philadelphia	3.42
St. Louis	3.88

Tool and die makers in various manufacturing industries in 58 areas surveyed in 1963–64 were paid average straight-time hourly earnings

ranging from $2.74 in Miami, Fla., to $3.98 in San Francisco-Oakland, Calif.

Because tool and die makers do precision work, the areas in plants or shops where they work are generally clean and well-lighted. Tool and die makers stand part of the time when they are operating machine tools. At other times they do handwork at benches. Sometimes they operate machines to test tools and dies they have made.

Good safety habits are necessary for tool and die makers because they work with high-speed machine tools and sharp cutting instruments. The use of safety devices has reduced the injury rate for machining workers.

Tool and die makers, as a group, have a longer working life than many other workers in the labor force. Their jobs require extensive skill and knowledge that can be acquired only after many years of experience. For this reason, companies are reluctant to lay off tool and die makers, even when production is decreased. Furthermore, tool and die makers have greater occupational mobility than other workers. They can transfer to jobs as instrument makers or machinists, or find jobs in other industries.

See introductory section of this chapter for a discussion of nonwage benefits received by machining workers, unions that organize these workers, and where to go for more information.

Instrument Makers (Mechanical)

(2d ed. D.O.T. 4–75.130)
(3d ed. D.O.T. 600.280)

Nature of Work

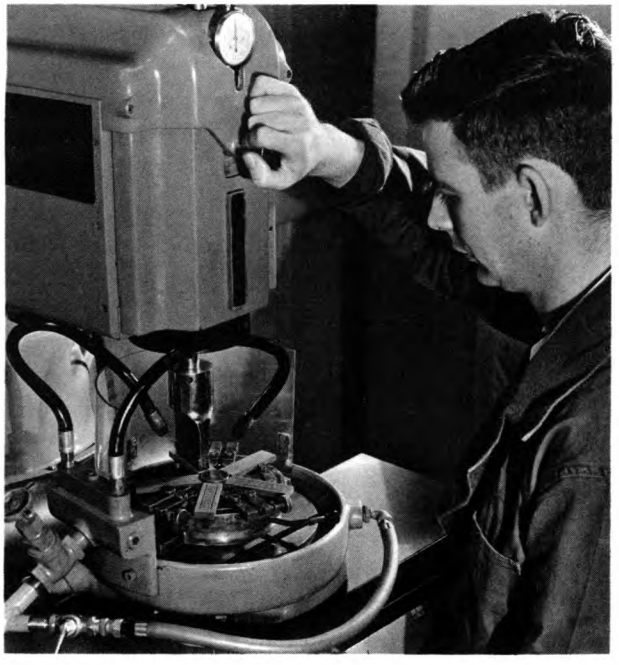
The increasing use of instruments in production, research, development, and testing work in industry and Government, is making the job of the instrument maker increasingly important. Instrument makers (also called experimental machinists and modelmakers) work closely with engineers and scientists in translating designs and ideas into experimental models, special laboratory equipment, and custom instruments. They also modify existing instruments for special purposes. Experimental devices constructed by these craftsmen are used, for example, to regulate heat, measure distance, record earthquakes, and control industrial processes. The mechanical instrument parts and models made by these workers range from simple gears to intricate parts of navigation systems used in guided missiles. Some instrument makers (who are not discussed in this brief) specialize in installing electric and electronic instrument components.

Instrument makers fabricate metal parts by operating machine tools such as lathes and milling machines, and by using handtools such as files and chisels. Because accuracy is important, they measure finished parts with a wide variety of precision-measuring equipment, including micrometers, verniers, calipers, profilometers, and dial indicators, as well as standard optical measuring instruments.

Instrument makers work from rough sketches, verbal instructions, or ideas as well as detailed blueprints. Thus, in making parts, they frequently use considerable imagination and ingenuity. Instrument makers sometimes work on parts that must not vary from specifications by more than ten millionths of an inch. To meet these standards, instrument makers commonly use special equipment or precision devices, such as the electronic height gage, which are used only infrequently by other machining workers. Instrument makers also work with a variety of materials, including plastics and rare metals such as silver and platinum.

An instrument maker may construct instruments from start to finish—making and assembling all the parts and testing finished instruments for proper operation. However, in large shops or where electrical or electronic components are to be incorporated into an instrument, an instrument maker frequently works with other instrument makers, such as electronic specialists, each making a part of a complicated instrument.

Because they usually work on their own and have highly developed manual skills and reasoning abilities, instrument makers have considerable prestige among their fellow employees.



Instrument maker uses an ultrasonic machine tool.

Where Employed

Many instrument makers are employed by firms which manufacture instruments. Research and development laboratories also employ instrument makers to make the special devices required in scientific research. The Federal Government employed about 1,200 instrument makers in early 1965.

The main centers of instrument making are located in and around a few large cities, particularly New York City, Chicago, Los Angeles, Boston, Philadelphia, and Washington, D.C.

Training, Other Qualifications, and Advancement

Some instrument makers advance from the ranks of machinists or skilled machine tool operators. These craftsmen, working at first under close supervision and doing the simpler jobs, usually need at least 1 or 2 years of instrument shop experience to qualify as instrument makers.

Most instrument makers learn their trade through instrument-maker apprenticeships which generally last 4 or 5 years. A typical 4-year instrument maker apprenticeship program consists of approximately 8,000 hours of shop training and about 570 hours of related classroom instruction. The apprentice's shop training emphasizes the use of machine tools, handtools, and measuring instruments, and the working properties of various materials. Classroom instruction covers related technical subjects such as mathematics, physics, blueprint reading and fundamental instrument design. The apprentice must learn enough shop mathematics to enable him to plan his work and use handbook formulas. A basic knowledge of mechanical principles is needed in solving gear and linkage problems.

For apprenticeship programs, employers generally prefer applicants who have a high school education, including courses in algebra, geometry, trigonometry, science, and machine shop work. Further technical schooling in electricity and electronics is often desirable, and may make possible future promotions to technician positions.

A young man interested in becoming an instrument maker should have a strong interest in mechanical subjects and a better-than-average ability to work with his hands. He must have initiative and resourcefulness, because instrument makers often work alone and almost always under minimum or no supervision. Since the instrument maker often faces new problems, he must be able to develop original solutions. The instrument maker frequently must visualize the relationship between individual parts and the complete instrument. He must understand how the instrument is used and the principles of its operation. Because of the nature of his work, the instrument maker has to be very conscientious and take considerable pride in creative work.

As the instrument maker's skill improves and as he broadens his knowledge, he may advance to increasingly responsible positions. Up to 10 years' experience is required to rise to the top skill level in instrument making. With additional training beyond the high school level in subjects such as physics and machine design, some instrument makers may advance to technician jobs. In these jobs, they plan and estimate time and material requirements for the manufacture of instruments, or provide specialized support to professional personnel. Others may become supervisors of less skilled instrument makers and help in their training.

Employment Outlook

The employment of instrument makers is expected to increase rapidly during the 1965–75 decade, as a result of anticipated expansion of metalworking activities (see discussion, p. 450) and the growing use of instruments in manufacturing processes and research and development work. However, this is a relatively small occupation and the number of openings resulting from employment growth in any one year will be small. In addition to employment growth, several hundred job openings annually are expected to result from the need to replace experienced workers who transfer to other occupations, retire, or die.

Growing numbers of instrument makers will be needed to make models of new instruments that may be mass-produced in the future, and also to make custom or special purpose instruments that are not needed in large numbers. Many devices made by these craftsmen will be needed in the expanding fields of nuclear energy and industrial automation. Also, many new precision instruments, which will be even more versatile and sensitive than those in current use, can be expected to emerge from growing research and development programs of universities, Government agencies, private laboratories, and manufacturing firms. New instruments are needed to solve many technical and scientific problems. For example, scientists who work with atomic reactors need better control systems for handling radioactive materials, as well as improved "thermometers" that can measure temperatures in the millions of degrees.

Earnings and Working Conditions

Earnings of instrument makers compare favorably with those of other highly skilled metalworkers. Wage data obtained from a small number of instrument manufacturers indicate that wages of these craftsmen in late 1964 generally ranged from $3.05 to $3.80 an hour. Instrument makers employed by the Federal Government in Washington, D.C., received from $3.49 to $3.79 an hour.

Instrument shops usually are clean and well lighted. Room temperatures usually are controlled in shops where precision measuring instruments are used. Instrument assembly rooms are usually clean, and are sometimes known as "White Rooms", where almost sterile conditions are maintained.

Serious work accidents are not common among instrument makers, but machine tools and flying particles sometimes cause finger, hand, and eye injuries. Safety rules generally require the wearing of special glasses, aprons, tightly fitted clothes, and shirts with elbow-length sleeves; the wearing of neckties is prohibited.

See introductory section of this chapter for a discussion of nonwage benefits received by machining workers, unions that organize these workers, and where to go for more information.

Setup Men (Machine Tools)

(2d ed. D.O.T. 4–75.160)

(3d ed. D.O.T. 600.380; 604.280 and .380; 605.380; and 619.380)

Nature of Work

The setup man, often called a machine tool job setter, is a skilled specialist employed in plant and machine shops that do machining in large volume. His main job is to set up machine tools—that is, to get machine tools ready for use by semiskilled operators. He may also explain to these workers the operations to be performed, and show them how to check the accuracy of their work. Usually a setup man is assigned a number of machine tools, which often are one type, such as turret lathes. However, he may set up several different machine tools such as milling machines and automatic screw machines. Working from drawings, blueprints, written specifications, or job layouts, he determines the rate at which the material is to be fed into the machines, operating speeds, tooling, and operation sequence. He then selects and installs the proper cutting or other tools, and adjusts guides, stops, and other controls. He may make trial runs and adjust the machine and tools until the parts produced conform to specifications. The machine is then turned over to a semiskilled

operator. After the machine tool has been running a while, the setup man may make additional adjustments to maintain accurate production.

Where Employed

Most setup men are employed in factories that manufacture fabricated metal products, transportation equipment, and machinery. These workers usually are employed by large companies that employ many semiskilled machine tool operators. They usually are not employed in maintenance shops or in small jobbing shops.

Training and Other Qualifications

To become a setup man, a worker usually must qualify as an all-round machinist or skilled machine tool specialist. A setup man must be thoroughly trained in the operation of one or more machine tools. He must read blueprints and make computations in selecting speeds and feeds for machine tools. He also must be able to explain to a semiskilled machine tool operator how to perform machining operations and how to check machining accuracy. Above all, a setup man must be skilled in selecting the sequence of operations so that metal parts will be made exactly to specifications. Jobs for setup men usually are filled from within a shop by promotion or reassignment.

Employment Outlook

Employment of setup men is expected to increase moderately during the 1965–75 decade, as a result of the anticipated expansion of metal working activities. This small occupation will provide relatively few job opportunities for new workers. Most openings will result from the need to replace setup men who transfer to other occupations, or who retire or die.

The demand for setup men is expected to increase slower than the increase in demand for machined products. The growing use of numerically controlled machine tools is a major factor that is expected to limit employment growth in this occupation. (See discussion, p. 450.) The use of these machines may also change the duties of setup men. In the future, setup men may only preset tools, instruct operators, and check the first few parts that are produced. Since setup men are skilled workers, their chances for advancement or transfer into other jobs will remain good.

See introductory section of this chapter for a discussion of nonwage benefits received by machining workers, unions that organize these workers, and where to go for more information.

Layout Men

(2d ed. D.O.T. 4–75.140)
(3d ed. D.O.T. 600.381)

Nature of Work

The layout man is a highly skilled specialist who marks metal castings, forgings, or metal stock to indicate where and how much machining is needed. His work enables other workers to use machine tools simply by following his lines, points, and other instructions. He uses many instruments, such as the scriber, with which he marks lines on the surface of the metal; the center punch, to indicate the centers on the ends of metal pieces to be machined or drilled; the keyseat or box rule, for drawing lines and laying off distances on curved surfaces; dividers, for transferring and comparing distances; L- or T-squares for determining right angles; and height gages, calipers and micrometers for accurate measurement. Not only must the layout man work with extreme accuracy, but he also must be familiar with the operation and capabilities of standard machine tools.

Where Employed

Layout men work primarily in the mass production metalworking industries employing large numbers of machine tool operators. Most layout men work in plants producing fabricated metal products, machinery, and transportation equipment.

Layout man uses a surface gage to mark lines and reference points for machine tool operator.

Training and Other Qualifications

From 6 to 10 years' training and experience are needed to develop the skill for this occupation. Required training includes a machinist apprenticeship, or an equivalent knowledge of machine tools, machining qualities of metals, and the proper sequence of machining operations. Layout men must learn to visualize the sequence of machining operations so they can correctly prepare detailed work plans for less skilled workers. A layout man must be well trained in mathematics and blueprint reading and be able to use various precision-measuring tools. Mechanical ability and a liking for painstaking work are other important qualifications for layout men.

These skilled jobs usually are filled from within an establishment by promotion or reassignment.

Employment Outlook

Employment of layout men is expected to increase slowly during the 1965–75 decade, as a result of the anticipated expansion of metalworking activities. (See discussion, p. 450.) Most of the employment increase will be in plants employing large numbers of machine tool operators. Because this is a small occupation, only a few hundred job openings annually are expected to result from both employment growth and the need to replace experienced layout men who transfer to other occupations, retire, or die.

The increasing use of numerically controlled machine tools is a major factor that is expected to limit employment growth in this occupation. (See discussion, p. 450.) However, correct positioning of metal stock and tools will continue to be important, and layout men will be needed to mark accurate reference points. In addition, layout men can easily transfer to other work such as process planning, which will become more important with further technological development.

See introductory section of this chapter for a discussion of nonwage benefits received by machining workers, unions that organize these workers, and where to go for more information.

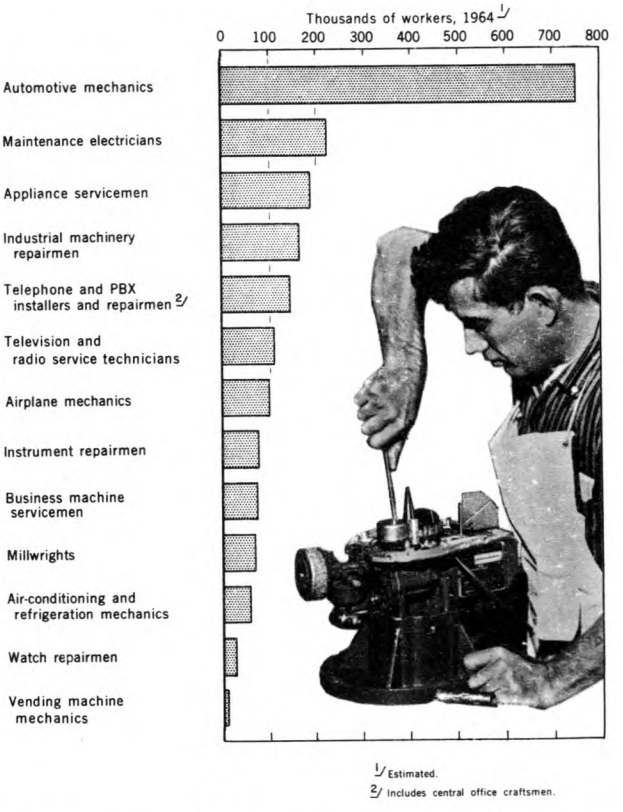
MECHANICS AND REPAIRMEN

Mechanics and repairmen—the skilled workers who keep our vehicles, instruments, consumer appliances, industrial machinery, and similar equipment operating properly—make up one of the fastest growing occupational groups in the Nation's labor force. In 1964, employment in this occupational group was nearly 2¼ million. In addition, a total of about 500,000 workers were employed in four occupations—watch repairman, millwright, maintenance electrician, and telephone repairman—who do considerable maintenance work. Of the total of 2¾ million workers, who account for 3 of every 10 skilled workers in the Nation, about 750,000 were automotive mechanics, such as automobile, truck or bus mechanics and automobile-body repairmen. Other occupations with more than 100,000 workers each included maintenance electrician, appliance serviceman, industrial machinery repairman, telephone repairman, and television and radio service technician. (See chart 29.) Some occupations had relatively few workers, including vending machine mechanic, hearing-aid repairman, musical instrument repairman, and X-ray equipment serviceman.

Young men with mechanical aptitude may wish to consider one of the maintenance and repair occupations as a career. Most of these jobs provide a variety of challenging tasks. Although the work varies greatly by occupation, it basically involves finding and correcting troubles in malfunctioning equipment, and returning the equipment to good working condition. Many persons find great satisfaction in such work. Preventive maintenance also is an important part of the work of mechanics and repairmen. In many jobs, they regularly inspect equipment and correct minor troubles that may lead to major breakdowns. Mechanics and repairmen usually specialize in work on one type of product, as indicated by job titles such as automobile mechanic, linotype repairman, gas meter serviceman, traffic signal repairman, and vending machine mechanic.

CHART 29

EMPLOYMENT IN SELECTED MAINTENANCE AND REPAIR OCCUPATIONS . . . .



1/ Estimated.
2/ Includes central office craftsmen.

An estimated 3 of every 10 mechanics and repairmen are employed in manufacturing industries, mainly in plants that produce machinery (including electrical), transportation equipment, food, primary metals, fabricated metal products, chemicals, textiles, and paper products. About 1 of every 5 is employed in wholesale and retail establishments that service motor vehicles, farm equipment, household appliances, and other mechanical equipment; and about 1 of every 6 works in shops that specialize in servicing equipment such as electric and gas appliances, watches, bicycles, locks, and automobiles.

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The transportation and public utilities industries also depend heavily on the skills of mechanics and repairmen. Large numbers of these skilled workers maintain and repair railroad equipment, airplanes, and trucks; communications equipment such as telephone and telegraph apparatus and radio and television broadcasting equipment; and meters, generators, turbines, and boilers in electric and gas utilities. Many mechanics and repairmen work for Federal, State, and local governments and for construction and mining firms.

The more populous and industrialized States offer the most employment opportunities for mechanics and repairmen. About half of them work in eight States: California, New York, Pennsylvania, Ohio, Illinois, Texas, Michigan, and New Jersey.

Training, Other Qualifications, and Advancement

Many mechanics and repairmen learn their skills on the job or through apprenticeship. Some acquire their basic training in vocational, technical, and correspondence schools, or attend such schools to increase their skills. Training and experience in the armed services also may help young men enter occupations such as airplane mechanic and television and radio serviceman.

Most training authorities agree that the best way to acquire the proficiency needed for many highly skilled maintenance and repair jobs is through formal apprentice training. Apprenticeship is a prescribed period of paid on-the-job training (usually ranging from 6,000 to 12,000 hours, or 3 to 6 years), supplemented by at least 144 hours of related classroom instruction a year. This type of training provides the apprentice with a balanced knowledge of his field of work and enables him to perform its operations competently. Formal apprenticeship agreements are registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training.

Employers look for applicants with mechanical aptitude and manual dexterity who like to tinker with things mechanical. Many employers prefer hobbyists whose interests include automobile repair, model building, and appliance fixing. A high school education is usually required and always desirable. Employers also favor applicants who have had courses in mathematics, chemistry, physics, blueprint reading, and machine shop. Trigonometry and algebra are particularly helpful for would-be instrument repairmen. Generally, apprentice applicants and other trainees are required to be at least 18 years old and in good health.

Physical requirements for work in this field vary greatly. For example, a millwright should be strong and agile, for he may need to climb ladders, lift heavy equipment, and work in awkward positions in cramped spaces. On the other hand, instrument and watch repairmen need patience, finger dexterity, and good vision. However, watch repair is a type of repair work that can be performed by persons with certain physical handicaps.

Mechanics and repairmen are usually employed the year round, since the demand for this type of work is generally less affected by fluctuations in business activity than the work performed by other manual workers. Also, they often are able to transfer from one firm or industry to another, or from one type of maintenance work to another.

Workers in most maintenance and repair occupations have several avenues of advancement. Some move into supervisory positions, such as foreman, maintenance manager, or service manager. With specialized training, some advance to sales, teaching, technical writing, and technician jobs. Substantial numbers of servicemen have been able to open their own businesses. For example, about 1 of every 3 television and radio service technicians and 1 of every 6 automotive mechanics are self-employed.

Employment Outlook

The employment outlook for maintenance and repair occupations as a whole is very favorable through the mid-1970's. Particularly rapid employment growth is anticipated for several occupations, including vending machine mechanic, business machine serviceman, instrument repairman, air-conditioning and refrigeration mechanic, and appliance serviceman. In addition to job opportunities that will result from growth of this occupational group, more than 100,000 job openings will become available annually as experi-

enced workers transfer to other occupations, retire, or die.

Many factors are expected to contribute to a growing demand for mechanics and repairmen in the decade ahead. The anticipated rise in expenditures for new plant and equipment will result in more mechanization and the use of more complex machinery and equipment in many industries. Greater research and development expenditures will yield new and, in many cases, more complex products for use by industry and consumers. Growing numbers of households and higher levels of personal spendable income will contribute to an increased demand for household appliances, automobiles, lawnmowers, boats, and other items that will need to be serviced by mechanics and repairmen.

In the years ahead, applicants for maintenance and repair jobs will have to meet higher standards of performance to maintain and repair the increasingly complex equipment coming into general use. Young men who acquire a good basic education (including courses in mathematics and science), as well as thorough job training, will be better able to compete for the higher paying jobs than applicants without this training.

This chapter includes statements on the following maintenance and repair workers: Air-conditioning and refrigeration mechanics, appliance servicemen, automatic bowling machine mechanics, automobile-body repairmen, automobile mechanics, business machine servicemen, diesel mechanics, industrial machinery repairmen, instrument repairmen, maintenance electricians, millwrights, television and radio service technicians, truck and bus mechanics, vending machine mechanics, and watch repairmen. Other maintenance and repair works are discussed in other chapters in the *Handbook*. For example, airplane mechanics are discussed in Civil Aviation Occupations, and telephone and PBX installers and repairmen in Occupations in the Telephone Industry.

Air-Conditioning and Refrigeration Mechanics

(3d ed. D.O.T. 637.281 and .381)

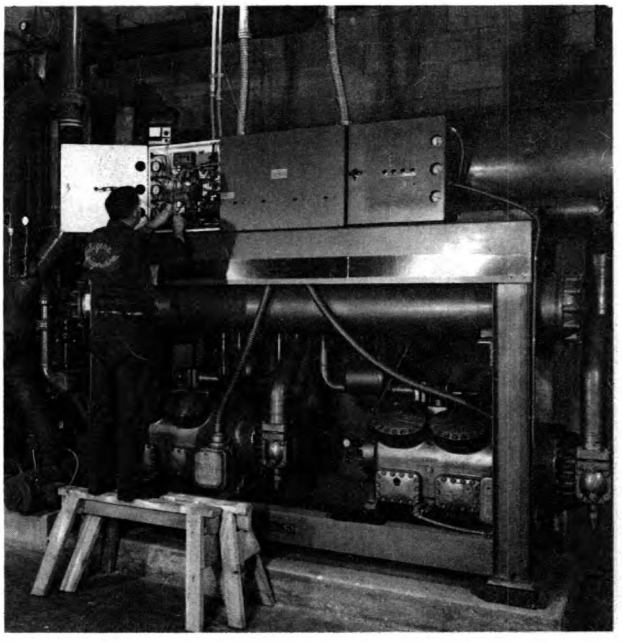
Nature of Work

The growing use of air-conditioning and refrigeration equipment throughout the Nation is providing many job opportunities for skilled mechanics who install and repair such equipment in homes, office buildings, factories, food stores, restaurants, and other establishments. (This chapter does not cover mechanics who work on railroad, truck, automotive, or marine air-conditioning and refrigeration equipment.)

The mechanic may install air-conditioning equipment ranging from small, self-contained units to large central-plant-type systems. On large installation jobs, the mechanic must read and interpret blueprints or drawings. On small installations, he may have to prepare his own working diagrams and do simple layout work, such as measuring and cutting pipe.

In installing new air-conditioning or refrigeration equipment, the mechanic puts the motors, compressors, condensers, evaporators, and other components in proper position, following design specifications. He connects duct work, refrigerant lines and other piping, and then connects the equipment to an electrical power source. After completing the installation, including temperature and pressure measuring devices, the mechanic charges the system with refrigerant and checks the unit for proper operating performance. He adjusts the electrical controls, liquid metering devices, safety devices, and other components to obtain the most efficient performance.

Mechanics engaged in maintenance work regularly clean and lubricate machinery, replenish liquid refrigerant, adjust valves, and examine other parts of the equipment to detect leaks or other defects. When air-conditioning and refrigeration equipment breaks down, mechanics must diagnose the cause and make the necessary repairs. In looking for defects, they may inspect components such as relays, thermostats, capacitors, motors, and refrigerant lines. After the cause of the trouble has been located and the defective part replaced or repaired, they reassemble the unit. Air-conditioning and refrigeration mechanics use a variety of tools and equip-



Air-conditioning mechanic checks circuitry in air-conditioner control panel.

ment, including electric drills, acetylene torches, pipe benders, hammers, screwdrivers, pliers, and testing devices such as psychrometers, refrigerant gages, ohmmeters, voltmeters, and thermometers.

Large air-conditioning or refrigeration systems and small air-conditioners (window units) may be installed or repaired by craftsmen other than air-conditioning and refrigeration mechanics. For example, on a large central-plant installation job, especially where workers are covered by union-management contracts, the duct work might be done by sheet-metal workers; the electrical work by electricians; and the installation of piping, condensers, and other components by pipefitters. The installation and repair of window air conditioners is often done by appliance servicemen. (Additional information about appliance servicemen appears elsewhere in the *Handbook*.)

Where Employed

Of the 60,000 air-conditioning and refrigeration mechanics estimated to be employed in early 1965, a large proportion worked for dealers and contractors that specialize in installing and repairing air-conditioning and refrigeration equipment. Many were employed by construction companies. Others worked for department stores, hotels, restaurant and food store chains, factories, warehouses, and other establishments large enough to require full-time maintenance men. Some operated their own repair shops.

Because of the widespread use of air-conditioning and refrigeration equipment, these workers are employed in all parts of the country. However, they are employed mainly in the large cities where most large commercial and industrial establishments are located. The States with the largest numbers of these workers are New York, Texas, California, Pennsylvania, Ohio, and Illinois.

Training, Other Qualifications, and Advancement

Most air-conditioning and refrigeration mechanics start as helpers and acquire the skills of their trade informally by working for several years with experienced craftsmen. Usually the beginners' work consists of lifting, loading, cleaning up, and performing relatively simple jobs such as insulating refrigerant lines. As trainees gain experience, they are given progressively more complicated tasks such as installing pumps and checking electrical circuits. A growing number of employers prefer on-the-job trainees to be high school graduates who have had courses in mathematics, physics, and blueprint reading.

Many high schools and vocational schools, in cooperation with local employers and the Air-Conditioning and Refrigeration Institute, offer courses designed to prepare students for entry into this trade upon graduation. These courses, which may last from 2 to 3 years, consist of shop training in manual skills as well as classroom instruction in air-conditioning and refrigeration theory and related subjects. With additional on-the-job training and work experience, students who have completed these courses can qualify as skilled mechanics.

Apprenticeship programs for the pipefitter, electrician, and sheet-metal worker often include training in air-conditioning and refrigeration work. Journeymen in these trades often specialize in installing and maintaining air-conditioning, refrigeration, and heating equipment. Additional information about these trades appears elsewhere in the *Handbook*.

Mechanical aptitude and an interest in electricity are important qualifications for workers in this

occupation. Good physical condition is also important because mechanics are often required to lift and move heavy equipment.

Young persons interested in advancing to air-conditioning and refrigeration jobs as technicians or foremen are frequently advised by training authorities to attend a technical institute. In these schools, students are taught to design and construct, as well as to install, operate, maintain, and repair, all types of air-conditioning and refrigeration equipment. They also take courses in mathematics, physics, electricity, and mechanical drawing. (Additional information about air-conditioning and refrigeration technicians appears in the chapter on Technicians.)

Employment Outlook

The number of air-conditioning and refrigeration mechanics is expected to increase rapidly through the mid-1970's. In addition to employment growth, more than a thousand job openings will arise annually from the need to replace experienced workers who are promoted, transfer to other fields of work, retire, or die.

The employment outlook for mechanics who perform air-conditioning work is especially good. The number of homes with central air conditioning, which more than doubled between 1960 and 1964, is expected to increase rapidly during the next decade. In addition, the use of central air conditioning in offices, stores, schools, and other buildings is expected to increase. Jobs for mechanics who do refrigeration work are expected to increase, because more refrigeration equipment will be needed in the production and storage of food and other perishable items.

Earnings and Working Conditions

Earnings data for air-conditioning and refrigeration mechanics are not available on a national basis. Information obtained from a small number of employers in early 1965, however, indicated that beginning rates for helpers ranged from $1.25 to $2 per hour and the top rates for mechanics ranged from $3 to more than $4.50 per hour. The rates of pay for trainees and mechanics depended on factors such as their level of skill, the size and type of equipment they worked on, the type of work they did, and the type of establishment in which they were employed. For example, mechanics who installed large commercial refrigeration and air-conditioning systems frequently had higher hourly rates of pay than those who installed small commercial and residential systems.

Although most employers try to provide their mechanics with year-round employment, they may have to lay off some of them during the winter months. In air-conditioning and refrigeration shops that also install and repair heating equipment, the mechanics may work on heating equipment during the winter months. Most mechanics work a 40-hour week. However, during the summer months they often work overtime or irregular hours. Overtime work in most shops is paid for at time and one-half the regular rate.

Mechanics are sometimes required to work at great heights while installing new equipment. They may also work in awkward or cramped positions in order to reach motors or other parts of the equipment they are repairing. Common hazards in this trade include electrical shock and torch burns, and muscle strains and other injuries that may result from handling heavy equipment.

Where To Go for More Information

A young man who wishes to obtain further information regarding air-conditioning and refrigeration mechanic work opportunities should contact the local office of the State employment service and firms that employ these workers, such as air-conditioning and refrigeration dealers and contractors. The State employment service also may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

Information about advanced training in air-conditioning and refrigeration may be obtained from the Refrigeration Service Engineers Society, 433 North Waller Ave., Chicago, Ill., 60644.

Appliance Servicemen

(2d ed. D.O.T. 5–83.043)
(3d ed. D.O.T. 723.381)

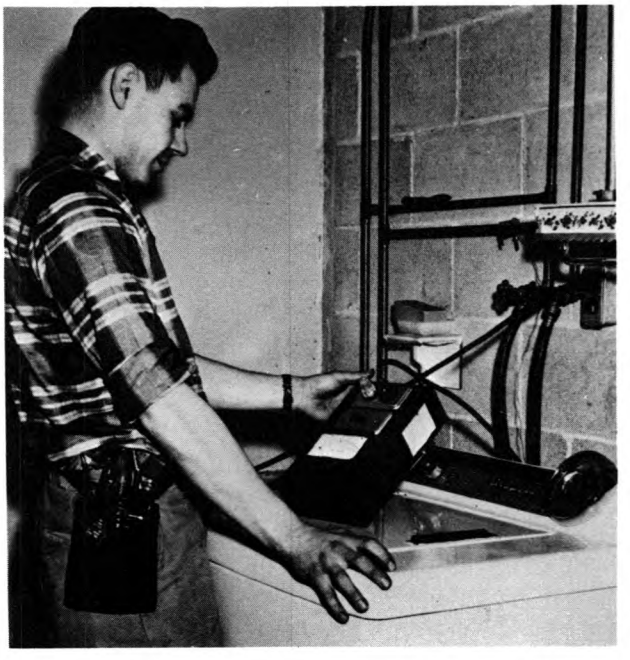
Nature of Work

Electric and gas appliances that do not operate properly are repaired by appliance servicemen. These appliances range from small, relatively uncomplicated appliances, such as toasters and food mixers, to refrigerators and washing machines, which may have complex control systems. Basically, appliance repair work involves determining why appliances do not operate properly and then installing new parts, repairing parts, or making adjustments. Appliance servicemen usually specialize in the repair of either electrical or gas appliances, and of a particular type of appliance, such as washing machines, toasters, or refrigerators.

To determine why an appliance is not working properly, servicemen ask customers how the appliance operated when it was last used. If possible, they may operate an appliance to detect unusual noises; overheating; excess vibration; and broken, worn, or loose parts. Servicemen also look for common sources of trouble, such as faulty gas, electric, and fluid lines and connections. To check electric and gas systems, they use special tools and testing devices, including wattmeters, ohmmeters, voltmeters and manometers, combustion test equipment, and vacuum and pressure gages.

After servicemen find what is wrong with an appliance, they make the necessary repairs and adjustments. Frequently, this work involves replacing parts that receive extra wear, such as electric cords on small appliances; or cleaning parts, such as the lint filters found in clothes dryers. In removing old parts and installing new ones, servicemen use common handtools, including screwdrivers and pliers, and may use special wrenches and other handtools designed for use on particular appliances.

Most repairs to refrigerators and other large appliances are usually made in the customers' homes. However, if major repairs are necessary, the appliance is removed to a repair shop or, in some cases, to the manufacturer. Small appliances are usually brought to a repair shop by the customers.



Serviceman checks wattage consumption of automatic washer.

An important part of the work of most appliance servicemen is dealing personally with customers. For example, they answer customers' questions and compaints about appliances and frequently advise customers about the care and use of their appliances, because many breakdowns are caused by improper use. They may remind housewives about the proper loading of automatic washing machines or how to stack dishes in dishwashers.

Appliance servicemen have considerable variety in their work. They may drive light trucks or automobiles, some equipped with two-way radios. They may give estimates to customers on the cost of repair jobs, and must keep records of parts used and hours worked on each repair job. Some servicemen order parts and sell new or used appliances.

Where Employed

An estimated 190,000 appliance servicemen were employed throughout the country in 1965. More than half of these servicemen owned or were

employed by independent repair shops and firms that specialize in servicing coin-operated washing and dry cleaning machines. About a fourth of all appliance servicemen were employed by retail establishments, including department stores. The remainder were employed by appliance manufacturers and wholesale distributors who operate service centers, and by gas and electric utility companies.

Appliance servicemen are employed in almost every community, because household appliances are used everywhere. However, employment of these workers is distributed geographically in much the same way as the Nation's population. Thus, most servicemen are employed in the highly populated States and major metropolitan areas.

Training, Other Qualifications, and Advancement

Appliance servicemen are usually hired as helpers and acquire their skills through on-the-job training and work experience. Inexperienced men are given relatively simple work assignments. In some companies, they work for the first few months helping to install appliances in customers' homes, driving service trucks, and learning street locations. In other companies, they begin to learn the skills of appliance servicemen by working in the shop, where they rebuild used parts such as washing machine transmissions. Gradually, trainees learn how motors, gears, and other appliance parts operate. They progress from simple repair jobs, such as replacing a switch, to more difficult jobs, such as adjusting automatic washing machine controls. In addition to practical experience on the job, trainees frequently receive classroom instruction given by appliance manufacturers and local distributors. Many trainees take correspondence courses in basic electricity or attend technical schools to increase their skills in appliance repair.

Trainees are usually supervised closely for 6 to 12 months. By this time, most gas-appliance servicemen can repair several kinds of appliances on their own, and they may be given responsibility for their own service trucks and for appliance parts and tools. Electrical-appliance servicemen usually need up to 3 years' on-the-job experience to become fully qualified. Many experienced servicemen attend training classes (often on company time) and study service manuals to become familiar with new appliances and the best ways to repair them.

Programs to train unemployed and underemployed workers for entry jobs in the appliance service field were operating in many cities, in early 1965, under the Manpower Development and Training Act. These programs lasted from several weeks to a year; most lasted longer than 5 months. With additional training and experience, graduates of these programs may eventually become skilled servicemen.

Employers look for applicants with mechanical aptitude, particularly those who are high school graduates and who have had high school or vocational school courses in electricity, mathematics, and physics. They must understand, in a practical way, how to use equipment that measures electricity and how to use such measurements to determine whether electrical currents in appliances are flowing properly. Also important in servicing electrical appliances is a knowledge of wiring diagrams, which show electrical connections and current flow between appliance parts. A knowledge of electronics is necessary to perform some appliance repair jobs.

Employers also look for men who can get along well with customers, because servicemen must be tactful and courteous. Servicemen also are expected to dress neatly and to avoid getting grease or dirt on floors and furniture in the customer's home.

Appliance servicemen who work in large repair shops or service centers and who show technical proficiency can be promoted to foreman, assistant service manager, or service manager. Preference is given to men who have also shown ability to get along well with other servicemen and with customers. A general knowledge of bookkeeping and other subjects related to managing a business is helpful. Because of their experience in repairing appliances and dealing with customers, appliance servicemen often become successful appliance salesmen. Experienced servicemen who have sufficient funds also may open their own sales or repair shops.

Servicemen who work for appliance manufacturers also can advance to higher paying jobs. For example, they can become instructors, teaching servicemen to repair new models of appli-

ances, or technical writers, preparing service manuals. Some servicemen may advance to executive positions, such as regional or national service or parts manager.

Employment Outlook

Employment of appliance servicemen is expected to increase by more than 50,000 during the 1965–75 decade. In addition to the opportunities resulting from employment growth, more than 40,000 job openings will result from the need to replace experienced servicemen who retire or die. Transfers may provide other job openings.

The number of household appliances in use is expected to increase rapidly during the decade ahead. Factors that will contribute to this growth include rising population and family formations, and rising levels of personal disposable income. The demand for appliances also will be stimulated by the introduction of new appliances, some of which may be cordless like many automatic toothbrushes now in use, and by the improved styling and design of appliances to make them attractive and easy to operate. In addition, more widespread use of such appliances as electric can openers, waste disposers, home clothes dryers, knife sharpeners, and coin-operated dry cleaning machines, is expected.

Employment of appliance servicemen is not expected to increase as rapidly as the number of appliances that will be in use. Although the automatic operation of some types of appliances has tended to make them more complicated, manufacturers are designing appliances with more durable components and appliances that can be taken apart and repaired more easily. In addition, employers are increasing the efficiency of servicemen through more widespread and more effective training.

Earnings and Working Conditions

National earnings data are not available for appliance servicemen. However, data obtained from union-management contracts, in effect in late 1964, and covering a large number of these workers employed by appliance manufacturers and service shops, indicated that servicemen in entry jobs had straight-time hourly wage rates ranging from about $1.65 to $2; experienced servicemen had rates ranging from approximately $1.75 to $3.65. Contracts covering a large number of servicemen employed by gas and electric utility companies showed that beginners had straight-time hourly wage rates ranging from about $2 to $2.85, and experienced servicemen had rates ranging from approximately $2.50 to $3.85. The wide variation in wage rates for servicemen reflects not only differences in type of employer, but other differences, such as geographical location of the job and the type of equipment serviced. Many appliance servicemen work more than 8 hours a day; some servicemen receive higher rates of pay for the overtime hours. They may also receive commissions for sales leads.

Some appliance servicemen working for manufacturers' service centers, gas and electric companies, and other employers receive paid vacations and sick leave, health insurance, and other benefits, as well as credit toward retirement pensions. Some of these companies also sponsor employee savings funds and contribute money to the accounts of employees who participate.

The shops in which appliance servicemen work are relatively quiet, well lighted, and adequately ventilated. While repairing small appliances, servicemen usually sit at benches. Working conditions outside the shop vary considerably. Servicemen sometimes work in narrow spaces, uncomfortable positions, and places that are not clean. Servicemen who work with large appliances may spend several hours a day driving in all kinds of weather between the shops where they work and customers' homes.

Appliance repair work is generally safe, although accidents are possible while the serviceman is driving, handling electrical parts, or lifting or moving large appliances. Inexperienced men are shown how to use tools safely and instructed in simple precautions against electric shock.

The work of appliance servicemen is often performed with little direct supervision. This feature of the job may appeal to many young people.

Where To Go for More Information

Further information about jobs in the appliance service field may be obtained from local ap-

pliance repair shops, appliance dealers, gas and electric utility companies, appliance manufacturers, and local offices of the State employment service. Local vocational schools that offer courses in appliance servicing, electricity, and electronics can provide helpful information about training. The State employment service also may provide information about the Manpower Development and Training Act and other programs that provide training opportunities.

Information about training programs or work opportunities in this field also may be obtained from:

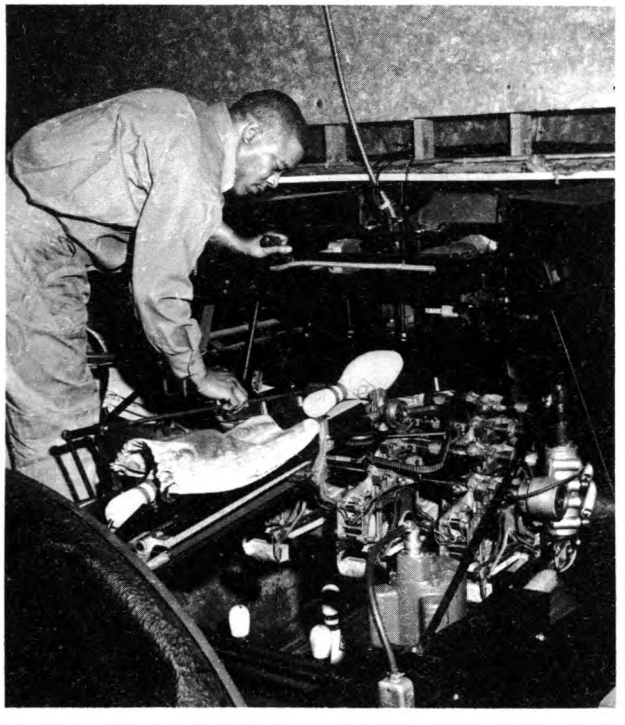
Institute of Appliance Manufacturers,
2000 K St. NW., Suite 455, Washington, D.C. 20006.
American Home Laundry Manufacturers' Association,
20 North Wacker Drive, Chicago, Ill. 60606.
National Appliance and Radio-TV Dealers Association,
364 Merchandise Mart, Chicago, Ill. 60654.

Automatic Bowling Machine Mechanics

(2d ed. D.O.T. 7–83.993)
(3d ed. D.O.T. 639.381 and 829.281)

Nature of Work

The introduction of automatic bowling machines in establishments throughout the country in recent years has created a new occupation called automatic bowling (or pinsetting) machine mechanic. These workers maintain, repair, replace, and adjust the tens of thousands of automatic bowling machines in use today. When a breakdown occurs, the mechanic determines its cause and makes the necessary adjustments or repairs. He may partially or completely disassemble components of a machine to repair or replace defective parts. After he reassembles the machine, he adjusts it for proper operation.



Automatic bowling machine mechanic inspects pin conveyor mechanism.

A pinsetting machine is a complex mechanism that automatically performs a series of operations —returns the bowling ball to the bowler, clears the alley deck of fallen pins, and conveys and distributes the pins to a pinsetting mechanism that resets them on the alley deck. These machines are controlled either mechanically or electrically. Both types of machines are electrically powered and, therefore, have both mechanical and electrical components. Typically, the duties of the pinsetting machine mechanic include maintaining various gap or clearance adjustments in belts, chains, and other drive devices; making clutch and brake adjustments; and inspecting bearings, sliding surfaces, and shock absorbers. If the machine is controlled electrically, the mechanic also maintains the electrical control system.

Much of the mechanic's worktime is spent in preventive maintenance. He regularly inspects and tests bowling machines; he cleans, oils, and greases them; and adjusts and repairs parts and wiring. In his work, the mechanic applies knowledge gained through training, on-the-job experience, and the use of operating and troubleshooting manuals.

When servicing mechanical equipment, the mechanic uses many different types of tools and equipment, such as pliers, wrenches, screwdrivers, hammers, portable hoists, and lubricating guns.

In electrical maintenance and repair work, the mechanic may use soldering irons, feeler gages, and crimping tools. He uses continuity testers, ammeters, and voltmeters to test electrical circuits, relays, solenoids, transformers, and motors. To assist him in this work, he uses diagrams of electrical circuits. Special tools used by the mechanic include a pin hook, to "break" ball jams; and a caliper, to measure wear on wooden bowling pins. Special tools are supplied by the employer. Often the mechanic will purchase his own set of handtools.

The mechanic may supervise one or more assistant mechanics, trainees, and pinchasers. He is often called upon to instruct trainees in locating and correcting minor malfunctions in bowling machines. Such instruction includes demonstrating how the machine operates as well as disassembling components and explaining their function. He shows trainees and pinchasers how to break minor jams and recondition and paint bowling pins. He also explains proper safety procedures.

Some clerical work is done by the mechanic. He maintains a stock of repair parts by keeping inventory records and ordering replacements when necessary. He may also keep records of machine breakdowns and estimate maintenance costs.

Where Employed

More than 8,000 mechanics, and an equal number of assistant mechanics, trainees, and pinchasers combined were estimated to be employed in 1964. More than 9 of every 10 of these workers were employed in commercial bowling establishments. The remainder—about 550 mechanics—were employed by manufacturers of automatic bowling machines to install and service machines that were rented rather than sold to bowling establishments. Although the primary responsibility of manufacturers' mechanics is to inspect equipment periodically for proper operation, they may be called in to repair major breakdowns that mechanics in bowling establishments cannot handle.

Although mechanics and their assistants are employed in every State, employment is concentrated in the more populated areas, approximating the geographic distribution of bowling alley establishments. Of the more than 11,000 bowling establishments in operation in 1964, the majority were located in New York, Pennsylvania, Illinois, Ohio, Michigan, California, Wisconsin, Minnesota, New Jersey, and Texas.

Training, Other Qualifications, and Advancement

Pinsetting machine mechanics start out as pinchasers, assisting mechanics in individual bowling establishments. Many pinchasers, who demonstrate mechanical ability and willingness to learn, become trainees and are sent to a mechanics' training school maintained by bowling-machine manufacturers. Trainees' wages and expenses during this training period—usually 3 weeks—are paid by the employers. During the training programs, trainees study the structure and operation of the particular type of machine manufactured by the firm operating the school and learn to locate typical sources of trouble. They learn preventive maintenance procedures, how to read wiring diagrams, and how to use the tools of the trade. Their training also includes actual repair work on demonstration machines.

After attending factory schools, trainees usually need several months of on-the-job experience before they acquire the skills of the trade. Other trainees have become mechanics solely through informal on-the-job training. Usually, 6 months to 1 year of such training and on-the-job experience is necessary for trainees to acquire mechanics' skills.

Trainees who do not attend factory schools acquire their skills on the job by observing experienced mechanics at work and by receiving instruction in machine operation and maintenance, typical malfunctions, and safety procedures. They also do actual repair work, progressing from simple to more complex jobs as their skills increase.

Employers prefer to hire pinchasers who are high school graduates, although many workers in this trade have not completed high school. Courses in electricity, blueprint reading, and machine repair are useful. Some proprietors of bowling establishments give written tests to applicants to determine their mechanical aptitude and personality traits. Mainly, employers look for trainees who display a cooperative attitude

and a willingness to work. Usually, trainees must be at least 16 years old.

Qualified mechanic trainees employed in commercial bowling establishments may be promoted to assistant mechanic and then to head mechanic. Mechanics may become managers of bowling establishments. Those who work for manufacturers may advance to the position of service manager, or instructor in a training school.

Employment Outlook

The number of pinsetting machine mechanics, assistant mechanics, and pinchasers is expected to rise rapidly during the 1965–75 decade, resulting in several thousand new job openings in this relatively small occupation. In addition, a few hundred job openings will result each year from the need to replace workers who retire or die, are promoted, or leave their jobs for other reasons.

Although automatic bowling machine installations and, therefore, employment of these workers is expected to increase rapidly through the mid-1970's, the rates of growth are expected to be below those between 1955 and 1964. During this period, the number of machines in use increased more than 14-fold and employment of repairmen expanded more than 11 times. The demand for bowling facilities will be spurred by factors such as rapidly expanding population, rising levels of personal spendable income, and more leisure time for recreation.

Earnings and Working Conditions

National wage data are not available for pinsetter mechanics and their assistants. However, wage data are available from union-management contracts, in effect in mid-1963, covering a large number of these workers employed in commercial bowling establishments in large metropolitan areas on the East and West Coasts and in the Midwest. Although these contracts show a very wide range of straight-time hourly pay rates for mechanics and their assistants, the majority provide for hourly rates ranging from about $2 to $2.75 for mechanics; $1.80 to $2.35 for assistant mechanics; and $1.40 to $1.85 for pinchasers. Several contracts specified hourly rates higher than $3 for mechanics, $2.75 for assistant mechanics, and $2.25 for pinchasers. It should be noted that many mechanics and their assistants are not covered by union-management contracts.

On the East Coast and in the Midwest, most mechanics and their assistants work a 48-hour, 6-day week. On the West Coast, most of them work a 40-hour, 5-day week. Nightwork and work on Sundays and holidays is common. Workers covered by union-management contracts receive premium pay for overtime work. Also, union-management agreements usually provide for a week's paid vacation after a year's service and 2 weeks yearly thereafter, and from 4 to 8 paid holidays a year. Some contracts provide health insurance and pension plans financed entirely by employers.

Mechanics and their assistants work in a long, relatively narrow corridor at one end of a bowling establishment where the automatic machines are located. The work area includes space for a workbench. The workspace is usually well lighted and well ventilated, but quite noisy when the lanes are in operation. When making repairs and adjustments, repairmen frequently have to climb and balance their bodies on the framework of the bowling machines, and to stoop, kneel, crouch, and crawl around the machines. Mechanics employed by manufacturers to install and service bowling machines are required to do considerable traveling.

Repairmen are not required to wear any special safety devices, such as goggles. Safety guards are provided on the bowling machines, but workers are subject to common shop hazards, such as electrical shock, cuts, falls, and bruises. Repairmen often wear coveralls to protect themselves from grease and dirt.

Mechanics, assistant mechanics, trainees, and pinchasers employed in large metropolitan areas generally are members of unions; usually the Building Service Employees' International Union or the International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America (Ind.).

Where To Go for More Information

A young man who wishes to obtain further information about training or work opportunities in this trade should direct his inquiry to proprietors

of commercial bowling establishments in his area, the local bowling proprietors' association, or locals of the unions previously mentioned. The local office of the State employment service is another source of information about employment and training opportunities.

Automobile Body Repairmen

(2d ed. D.O.T. 5–81.510)
(3d ed. D.O.T. 807.381)

Nature of Work

Automobile body repairmen are skilled metal craftsmen who repair motor vehicle bodies damaged in collisions and other accidents, by corrosion, and in other ways. Repair of damaged vehicles may involve such work as straightening bent frames, removing dents from fenders and body panels, welding torn metal, and replacing badly damaged parts. Body repairmen usually are qualified to repair all types of vehicles, although most work mainly on automobiles and small trucks. Some specialize in repairing large trucks, buses, or truck trailers.

Before making repairs, body repairmen generally receive instructions from their supervisors, who determine which parts are to be restored or replaced, and who estimate the amount of time the repairs should take. When repairing damaged fenders and other body parts, the body repairman may first remove body hardware, window operating equipment, and trim in order to get at the damaged area. In reshaping the metal, he may push large dents out with a hydraulic jack or hand prying bar, or "bump" them out with a hand tool or pneumatic hammer. He smoothes remaining small dents and creases by holding a "dolly block" (a small hand anvil) against one side of the damaged area while hammering the opposite side. Very small pits and dimples are removed from the metal with the aid of pick hammers and punches. The body repairman may remove badly damaged sections of body panels with a pneumatic metal-cutting gun or acetylene torch, and replace them by welding in new sections. If the damage includes tears in the metal, he welds the torn edges. If the metal has been stretched, he shrinks it by repeatedly heating the area with an acetylene torch and "bumping" it with a hammer until the metal's original shape is restored.

Automobile body repairmen frequently use power tools.

The automobile body repairman uses solder to fill small dents that he cannot work out of the metal. Before applying the solder, he cleans the dent and coats it with liquid tin so that the solder will adhere to the surface. He softens the solder with a torch and uses a wooden paddle or other tool to mold it to the desired shape. When the solder has solidified, the body repairman files or grinds it down to the level of the adjacent metal. He may use plastic, rather than solder, for filling small dents.

After the damaged metal has been restored to its original shape, the repaired surfaces are sanded in preparation for painting. In most shops, automobile painters do the painting. (These workers are discussed elsewhere in the *Handbook*.) Some of the smaller shops employ workers who are combination body repairmen and painters.

The automobile body repairman uses special machines to aline damaged vehicle frames and body sections. He chains or clamps the machine to the damaged metal and applies hydraulic pressure to straighten it. He may also use special devices to aline damaged vehicles that have "unit-bodies" instead of frames. In some shops, the straightening of frames and unit-bodies is done by a body repairman who specializes in this type of work.

The body repairman's work is characterized by variety, because the repair of each damaged vehicle presents a different problem. Therefore, in addition to having a broad knowledge of automobile construction and repair techniques, he must also be able to develop appropriate methods for each repair job. Most body repairmen find their work challenging and take pride in being able to restore badly damaged automobiles.

Automobile body repairmen usually work by themselves with only general directions from the foremen. In some shops, they may be assisted by helpers.

Where Employed

Most of the estimated 90,000 automobile body repairmen employed in early 1965 worked in repair shops that specialize in automobile body repairs and painting, and in the service departments of automobile and truck dealers. Other employers of body repairmen included organizations that maintain their own fleets of motor vehicles, such as trucking companies and buslines, and Federal, State, and local governments. Motor vehicle manufacturers employed a small number of these workers.

Automobile body repairmen can find employment opportunities in every section of the country. About half of them work in the eight States with the largest number of automobiles: California, New York, Pennsylvania, Ohio, Texas, Illinois, Michigan, and New Jersey.

Training, Other Qualifications, and Advancement

Most automobile body repairmen learn the trade through on-the-job experience. Young men usually start as helpers and pick up the skills of the trade from experienced workers. Helpers begin by assisting body repairmen in such tasks as removing damaged parts, installing repaired parts, and sanding repaired surfaces in preparation for painting. They gradually learn how to remove small dents and make other minor repairs, and progress to more difficult tasks as they gain experience. Generally, 3 to 4 years of on-the-job training is necessary before a helper can become a fully qualified body repairman.

Although most workers who become automobile body repairmen pick up the skills of the trade informally through on-the-job experience, most training authorities recommend the completion of a 3- or 4-year formal apprenticeship program as the best way for young men to learn this trade. Such programs include both on-the-job and related classroom instruction.

Training programs for unemployed and underemployed workers for entry automobile body repairmen jobs were in operation in early 1965 in many cities, under provisions of the Manpower Development and Training Act. These programs, which in 1965 lasted up to a year, stress the fundamentals of automobile body repair. Men who complete these programs need additional on-the-job or apprenticeship training before they can qualify as skilled body repairmen.

Young men who are interested in becoming automobile body repairmen should be in good physical condition and have good eye-hand coordination. Courses in automobile body repair—offered by a relatively small number of high schools, vocational schools, and private trade schools—provide helpful experience, as do courses in automobile mechanics. Although completion of high school is not generally a requirement for getting an entry job, it is an advantage because many employers believe it indicates that a young man can "finish a job."

Automobile body repairmen are usually required to have their own handtools, but power tools are ordinarily furnished by the employer. Many of these workers have a few hundred dollars invested in tools. Trainees are expected to accumulate tools as they gain experience.

An experienced automobile body repairman with supervisory ability may advance to shop foreman. Many body repairmen open their own shops.

Employment Outlook

Employment of automobile body repairmen is expected to increase moderately during the 1965–75 decade. In addition to the few thousand job openings anticipated to occur annually as a result of employment growth, an even greater number may result from the need to replace experienced body repairmen who retire, die, or transfer to other fields of work. Retirements and deaths alone are expected to provide about 1,500 job openings annually.

The number of body repairmen is expected to increase primarily as a result of the increasing number of motor vehicles damaged in traffic accidents. This toll is expected to continue to increase as the number of motor vehicles in use grows, even though new and improved highways, driver training courses, and stricter law enforcement may slow down the rate of increase.

The effect of the rising number of motor vehicles damaged in traffic will be slightly offset by developments that will increase the efficiency of body repair work. For example, the growing practice of replacing rather than repairing damaged parts, the use of plastics for filling dents, and improved tools will enable these workers to complete jobs in less time.

Earnings and Working Conditions

Beginning pay for inexperienced helpers and trainees in automobile body repair generally ranges from about $1 to $1.75 an hour. Young men who have some prior experience and training in this field may receive higher starting pay. Experienced body repairmen generally earn between 2 and 3 times as much as helpers and trainees.

Experienced body repairmen employed by automobile dealers in 34 cities had average straight-time hourly earnings of $3.60, based on a survey in late 1964. Average hourly earnings of these workers in individual cities ranged from $2.80 in Providence–Pawtucket, R.I., to $4.34 in Detroit, Mich. More than three-fourths of all body repairmen covered in the survey earned between $2.40 and $4.80 an hour. Body repairmen who worked for independent repair shops had earnings comparable with those employed by dealers, based on the limited data available.

Many experienced body repairmen employed by automobile dealers and independent repair shops are paid a percentage—usually about 50 percent—of the labor cost charged to the customer. Under this method, a worker's earnings depend largely on the amount of work he is assigned and how fast he completes it. Earnings may also be based on a weekly salary plus a commission on jobs completed. Body repairmen employed by trucking companies, buslines, and other organizations that repair their own vehicles usually receive an hourly wage rate. Most body repairmen work 40 to 48 hours per week.

Many employers of body repairmen provide holiday and vacation pay, and additional benefits such as life, health, and accident insurance. Others also contribute to retirement plans. Body repairmen in some shops are furnished with laundered uniforms free of charge.

Automobile body shops are noisy because of the banging of hammers against metal and the whir of power tools. Most shops are well ventilated, but often they are dusty and the odor of paint is noticeable. Body repairmen often work in awkward or cramped positions, and much of their work is strenuous and dirty. Hazards include cuts from sharp metal edges, burns from torches and heated metal, and injuries from power tools.

Unions organizing automobile body repairmen include the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the Sheet Metal Workers' International Association; and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Most of the body repairmen who belong to unions are employed by large automobile dealers and by trucking companies and buslines.

Where To Go for More Information

For further information regarding work opportunities for automobile body repairmen, inquiries should be directed to local employers, such as automobile body repair shops and automobile deal-

ers; locals of the unions previously mentioned; or the local office of the State employment service. The State employment service also may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of automobile body repairmen may be obtained from:

Automotive Service Industry Association,
168 North Michigan Ave., Chicago, Ill. 60601.

Independent Garage Owners of America, Inc.,
343 South Dearborn St., Chicago, Ill. 60604.

Automobile Mechanics

(2d ed. D.O.T. 5–81.010, .100–.449, .530, .535, .600–.699; and 7–81.920)
(3d ed. D.O.T. 620.131 through .381, .782, and .885; 721.281 and 825.281)

Nature of Work

Automobile mechanics keep the Nation's rising number of automobiles and small trucks and buses in good running order. They do preventive maintenance, diagnose breakdowns, and make repairs. (Although truck mechanics, who repair large trucks; bus mechanics, who repair large buses; and automobile body repairmen are sometimes called "automobile mechanics," they are discussed separately in the *Handbook*.)

Preventive maintenance—the systematic examination, adjustment, repair, or replacement of the operating parts of a motor vehicle—is an important responsibility of the automobile mechanic because it is vital to safe and trouble-free driving. When performing maintenance on a car, the mechanic may follow a "checklist" to make sure he examines all important parts of the car. During a periodic maintenance inspection, he may, for example, look for and replace worn parts, such as distributor points; clean, adjust, or replace spark plugs; adjust the carburetor, brakes, and clutch; and balance the car's wheels.

Automobile mechanic uses testing equipment to tune engine.

When mechanical and electrical troubles develop in a car, the mechanic first obtains a description of the symptoms from the owner. If the cause of the trouble is not immediately evident, he may visually inspect and listen to the motor, or drive the car, in order to locate the trouble. He may also use a variety of testing equipment such as motor analyzers, spark plug testers, compression gages, and electrical test meters. The ability to make an accurate diagnosis in a minimum of time is one of the mechanic's most valuable skills. It requires a thorough knowledge of the functioning of the car as well as analytical ability. Many skilled mechanics consider diagnosing "hard to find troubles" one of their most challenging and satisfying duties.

When the mechanic locates the cause of the trouble, he adjusts, repairs, or replaces defective parts. For example, he may replace a fuel pump, grind valves, adjust the ignition timing, clean the carburetor, or machine the brake drums.

In addition to the testing equipment mentioned previously, automobile mechanics use many other kinds of tools and equipment. These may range from simple handtools (screwdrivers, wrenches, pliers), to complicated and expensive machines and equipment that help the mechanic make repairs. Examples of such equipment are wheel alinement machines and headlight aimers. Mechanics also make use of repair manuals and parts catalogs.

The majority of automobile mechanics perform a variety of repairs. Other mechanics, such as automatic transmission specialists, tune-up men, automobile air-conditioning specialists, front-end mechanics, and brake mechanics, specialize in one or two types of repair. However, specialists with all-round skills may also do general automobile repair work. Other specialists, such as automobile radiator mechanics and automobile glass mechanics, who do not have all-round skills, usually work exclusively at their specialties. The types of work done by some mechanic specialists are described briefly below:

Automatic transmission specialists repair and replace linkage, gear trains, couplings, hydraulic pumps, and other parts of automatic transmissions. Automatic transmissions are complex mechanisms; their repair requires considerable experience and training, including a knowledge of hydraulics. *Tune-up men* adjust the ignition timing and valves, and adjust or replace spark plugs, distributor breaker points, and other parts to insure efficient engine performance. They are skilled in using scientific test equipment to locate malfunctions in fuel and ignition systems. *Automobile air-conditioning specialists* install automobile air-conditioners and repair and adjust compressors, condensers, and other components. *Front-end mechanics* aline and balance wheels and make repairs on steering mechanisms and suspension systems. They are skilled in using special alinement-testing and wheel-balancing machines. *Brake mechanics* adjust brakes, replace brake linings, resurface brake drums, repair hydraulic cylinders, and make other repairs on automobile brake systems. Those employed in repair shops that specialize in brake service may also replace shock absorbers, springs, and mufflers. In some shops, combination front-end and brake mechanics are employed. *Automobile-radiator mechanics* clean radiators with caustic solutions, locate and solder radiator leaks, and install new radiator cores. They may also repair automobile heaters, and solder leaks in gasoline tanks. *Automobile-glass mechanics* replace broken or pitted windshield and window glass, and repair manual and power-window mechanisms. They cut window replacement glass from flat sheets, using window patterns and glass cutting tools. Shops that repair both automobile radiators and glass may employ mechanics who are skilled in both of these specialties.

Where Employed

Most of the more than half-million automobile mechanics employed in early 1965 worked in independent repair shops (those that do all kinds of automobile repairs or specialize in repairing particular components such as brakes, automatic transmissions, radiators, and glass); the service departments of new and used car dealers; and gasoline service stations. Many others are employed by Federal, State, and local governments, taxicab and automobile leasing companies, and other organizations that maintain and repair their own automobiles. Some mechanics are employed by manufacturers of automobiles to make final adjustments and repairs at the end of the assembly line. A small but growing number of mechanics are employed by department stores that have automobile service facilities.

Most automobile mechanics work in shops employing from one to five mechanics, but some of the largest repair shops employ more than a hundred. Generally, automobile dealers in large cities have more mechanics than either independent repair shops in the same cities or automobile dealers in small communities.

Automobile mechanics can find employment opportunities in every section of the country, from the largest cities to the smallest towns. About half of them work in the eight States with the largest number of automobiles: California, New York, Pennsylvania, Ohio, Texas, Illinois, Michigan, and New Jersey.

Training, Other Qualifications, and Advancement

Most automobile mechanics learn the trade through on-the-job experience. Young men usually start as helpers, lubrication men, or gasoline service station attendants, and gradually acquire the necessary knowledge and skills by working with experienced mechanics. Although a beginner can learn to do simple kinds of repair work after a few months' experience, it generally takes at least 3 to 4 years to become an all-round mechanic, and as much as an additional year or two to learn a difficult specialty, such as automatic transmission repair. In contrast, radiator me-

chanics, glass mechanics, brake specialists, and front-end mechanics, who do not need an all-round knowledge of automobile repair, may learn their specialities in about 2 years.

Although most automobile mechanics pick up the skills of the trade informally through on-the-job experience, most training authorities recommend the completion of a 3 or 4-year formal apprenticeship program as the best way for young men to learn this trade. Such programs include both on-the-job training and related classroom instruction in nearly all phases of automobile repair.

For entry jobs, employers look for young men who have an understanding of automobile construction and operation, like mechanical work, and have mechanical aptitude. A driver's license is generally required. A background in automobile repair gained from working as a gasoline service station attendant, training in the Armed Forces, or experience repairing automobiles as a hobby is valuable. Courses in automobile repair, offered by many high schools, vocational schools, and private trade schools, are also valuable. Courses in science and mathematics help a young man better understand how an automobile operates.

Training programs for unemployed and underemployed workers seeking entry jobs as automobile mechanics are in operation in a large number of cities under provisions of the Manpower Development and Training Act. These programs, which in 1965 lasted up to a year, stress basic maintenance and repair work. Men who complete such programs are able to make simple repairs, but they need additional on-the-job or apprenticeship training before they can qualify as skilled mechanics.

Completion of high school is an advantage in getting an entry mechanic job because most employers believe it indicates that a young man can "finish a job," and has potential for advancement.

Most mechanics are required to have their own handtools. Beginners are expected to accumulate tools as they gain experience. Many experienced mechanics have several hundred dollars invested in their tools. Special tools for servicing units like automatic transmissions, and major pieces of test equipment, are ordinarily furnished by the employer.

Employers sometimes send experienced mechanics to factory training centers where they learn about repairing new car models, or receive special training in such subjects as automatic transmission repair and air-conditioning repair. Manufacturers also send representatives to local shops to conduct short training sessions. A relatively small number of young high school graduates are selected by automobile dealers to attend factory-sponsored mechanic training programs for beginners.

Capable and experienced automobile mechanics have several advancement possibilities. A mechanic in a large shop may advance to a supervisory position, such as repair shop foreman or service manager. Many mechanics open their own repair shops or gasoline service stations.

Employment Outlook

There will be many thousands of job openings for automobile mechanics during the 1965–75 decade. Several thousand of these openings are expected each year as a result of employment growth. An even greater number of job openings is expected because of the need to replace experienced mechanics who retire, die or transfer to other lines of work. Deaths and retirements alone are expected to provide about 10,000 job openings each year.

Employment of automobile mechanics is expected to increase primarily because of an anticipated increase of more than one-fourth in the number of automobiles during the next 10 years. Increases in population, new families, consumer purchasing power, and multicar ownership are all expected to contribute to the projected increase in the number of automobiles. The demand for automobile mechanics is also expected to increase because a growing number of new automobiles will be equipped with features such as air-conditioning, power steering, and power brakes—all of which increase maintenance requirements.

The favorable employment effects of increasing numbers of automobiles and their greater complexity will be partially offset by mechanics' increasing efficiency. For example, the more wide-

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spread use of automobile servicing equipment and improvements in this equipment should help mechanics more quickly locate and repair defects that cause faulty automobile operation. Other developments expected to improve efficiency include greater emphasis on replacement rather than on repair of defective parts, specialization in a single type of repair, better shop management, and improved training methods.

Earnings and Working Conditions

Beginning pay for inexperienced mechanics' helpers and trainees generally ranged from $1 to $1.75 an hour in late 1964; young men with prior experience received somewhat more, depending upon the amount of their prior experience. Experienced mechanics generally earned between 2 and 3 times as much as helpers and trainees. Highly skilled all-round mechanics, automatic transmission specialists, and tune-up men generally had the highest earnings.

Skilled automobile mechanics employed by automobile dealers in 34 cities had average straight-time hourly earnings of $3.40, based on a survey in late 1964. Average hourly earnings of these workers in individual cities ranged from $2.52 in Providence–Pawtucket, R. I., to $3.79 in Los Angeles–Long Beach, Calif. About three-fourths of all automobile mechanics covered in the survey earned between $2.40 and $4.40 an hour. Skilled automobile mechanics who worked for other types of employers had comparable earnings, on the basis of the limited data available.

A large proportion of the experienced automobile mechanics employed by automobile dealers and independent repair shops are paid a percentage—usually about 50 percent—of the labor cost charged to the customer. Under this method, the mechanic's weekly earnings depend on the amount of work he is assigned and how fast he completes it. Many other automobile mechanics receive a weekly salary plus a commission. Some automobile mechanics—for example, those employed by organizations that repair their own fleets of automobiles—receive an hourly rate. Most mechanics work between 40 and 48 hours per week, but may work even longer during busy periods. Mechanics paid on an hourly basis frequently receive overtime rates for hours worked in excess of 40 a week.

Many employers of automobile mechanics provide holiday and vacation pay, and additional benefits such as life, health, and accident insurance. Others also contribute to retirement plans. Laundered uniforms are furnished free of charge by some employers.

Generally, the mechanic's work is performed indoors. Modern automobile repair shops are well ventilated, lighted, and heated, but older shops may not have such advantages. Some mechanics make repairs outdoors, wherever breakdowns occur. Some work nights and Sundays.

The work of the mechanic frequently involves working with dirty and greasy parts, working in awkward positions, and lifting heavy objects. Minor cuts and bruises are common. More serious accidents are usually avoided by observing good safety practices.

Some auto mechanics are members of labor unions. Among the unions organizing these workers are the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the Sheet Metal Workers' International Association; and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.).

Where To Go for More Information

For further information regarding work opportunities for automobile mechanics, inquiries should be directed to local employers such as automobile dealers and independent repair shops; locals of the unions previously mentioned; or the local office of the State employment service. The State employment service may also be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of automobile mechanics may be obtained from:

Automotive Service Industry Association,
168 North Michigan Ave., Chicago, Ill. 60601.

Independent Garage Owners of America, Inc.,
343 South Dearborn St., Chicago, Ill. 60604.

National Automobile Dealers Association,
2000 K St. NW., Washington, D.C. 20006.

Business Machine Servicemen

(3d ed. D.O.T. 633.281)

Nature of Work and Where Employed

Business machine servicemen maintain and repair the increasing numbers and types of office equipment used for correspondence, for recording and processing transactions, and for duplicating and mailing information. Equipment used for these purposes includes typewriters; adding and calculating machines; cash registers; electronic computers and other data-processing devices; dictating and transcribing machines; and mailing and duplicating and microfilm equipment. These machines are becoming increasingly complex as electric and electronic control components are incorporated in them.

Servicemen do much of their work in the offices where the machines are used. Servicemen may maintain this equipment on a regular basis, returning at frequent intervals to inspect the machines, to clean and oil them, and make minor adjustments or repairs. They may also be called to an office to check and repair a defective machine. On office calls, servicemen usually question the operator about the condition of the machine. They may have to explain to operators how various features of the machines can best be used or how to avoid machine damage.

While inspecting business machines, the serviceman usually checks the operation of various parts of the equipment to make sure that they work properly or to find the source of reported trouble. For example, he may strike the keys of a typewriter or calculator, rotate the drum of a duplicating machine, or feed punchcards to a tabulator or sorter. In addition, he may check type or photographic devices for alinement, and rollers for dryness or compactness. If necessary, covers of machines may be removed to check levers, gears, belts, or spacing mechanisms. He may make voltage checks of electric or electronic components.

When overhaul or major repair is necessary, small units of equipment are generally brought to the shop of the servicing company. Here, servicemen disassemble the machine; inspect components; remove and replace worn bearings, cams, and other parts; and install new belts and feed rolls where necessary. If the machine has electric motors or controls, these also may require adjustment, or replacement of parts.

Service technician uses oscilloscope to test electronic accounting computer.

In addition to common handtools, such as screwdrivers, pliers, and adjustable wrenches, business machine servicemen frequently use gages and meters and other test equipment and tools designed for special purposes.

Business machine servicing offers considerable variety in work assignments. Such work requires the application of analytical ability to a wide range of problems. Many persons find considerable satisfaction in being able to diagnose and correct the cause of trouble in a faulty machine.

Besides responsibilities for maintenance and repair, servicemen may engage in sales activities. Most commonly, they sell preventive maintenance contracts for machine servicing on a regular basis. Some servicemen also are expected to sell supplies, such as special paper, ink, and stencils used with particular machines. Generally, commissions or bonuses based on sales are paid, in addition to wages.

Business machine servicemen are employed in several types of firms. Manufacturers of business machines employ more than half of these workers

in their sales and service offices throughout the country. Another large proportion of the more than 70,000 business machine servicemen employed in early 1965 worked in local independent establishments; some of these shops specialize in repair work, whereas others combine sales and service. The remainder were employed in large organizations which had enough machines in daily use to justify employing full-time servicemen.

Business machine servicemen employed in a manufacturer's branch office usually work on the manufacturer's products exclusively. In the large branch offices of some companies, they may specialize in servicing one or two of the various types of machines sold. In other companies, even in the larger branches, the fully trained servicemen work on the full line of company equipment. In manufacturers' branches in the smaller cities, where fewer servicemen are needed, most are "full line" servicemen, since the size of the operation makes it impractical to have the men specialize on one type of machine. In these instances, service may also be combined with selling.

Servicemen employed by independent dealers maintain and repair the many makes and models of office machines used in the community. Most dealers sell and service typewriters. Some also sell and service adding machines, dictating machines, and less complex types of duplicating equipment. Other dealers specialize in the sales and service of adding and calculating machines, cash registers, and bookkeeping-accounting machines. Most independent dealers employ fewer than 5 servicemen, although some large dealers may employ as many as 10 or 15.

Business machine servicing jobs are found throughout the country. Even relatively small communities usually have at least one or two shops which repair machines. However, most business machine servicemen work in large cities, where the majority of business machines are located.

Typewriter Servicemen (D.O.T. 633.281). The principal work of the estimated 25,000 typewriter servicemen employed in early 1965 was the maintenance and repair of manual and electric typewriters. Typewriters are the most widely used business machines. They are used in almost every business office, as well as by many individuals in their homes. Though the operation of electric typewriters and mechanical typewriters differs, the two types are enough alike that the servicemen who specialize in the repair of mechanical typewriters can usually learn to repair the electric machines, with additional training.

Typewriter servicemen are employed both in the sales and service branches of typewriter manufacturers and by local independent dealers. Many servicemen operate their own maintenance and repair shops. Typewriter servicemen are found in almost every sizable community throughout the Nation.

Adding Machine Servicemen (D.O.T. 633.281). Nearly 6,000 business machine servicemen were engaged mainly in the servicing of adding machines in early 1965. These machines are less complex than most other office calculating devices. In some cases, servicing of both adding machines and calculators is done by the same employee. The repair of adding machines and simpler calculating machines often provides experience for advancement to work on more complicated equipment, such as bookkeeping and accounting machines. In some independent shops, adding machines are serviced by men who also repair typewriters.

Adding machine servicemen are employed both in manufacturers' sales and service branches and by independent dealers. Other sources of employment are Federal, State, and local governments, and a few large banks and other firms which use large numbers of adding machines.

Calculating Machine Servicemen (D.O.T. 633.-281). About 5,000 calculating machine servicemen were employed in early 1965. Calculating machines, which have complex mechanisms, add, subtract, divide, multiply, and perform combinations of these operations. In some shops, servicing of calculators is combined with the servicing of other business machines, particularly adding machines and accounting-bookkeeping machines.

Most of the men who service calculators are employed in manufacturers' sales and service branches. Some independent dealers employ men skilled in the maintenance and repair of calculators. Others are employed by the Federal Government and some large business organizations.

Cash Register Servicemen (D.O.T. 633.281). Cash register repair and maintenance was the main work of more than 6,000 business machine servicemen in early 1965. Next to typewriters, cash registers are the most widely used business machines. The simplest models merely record transactions, add receipts, and provide a change drawer. The more complicated cash registers simultaneously record several different kinds of information on each transaction (such as identification of the clerk, department, type of merchandise, payment given, and change due), provide printed receipts, and dispense change and trading stamps to the customer.

The great majority of servicemen engaged primarily in repairing cash registers are employed in the sales and service branches of the few manufacturing firms making these machines. Some of the repair work, especially in smaller communities, is done by independent dealers who also maintain and repair other business machines.

Accounting-Bookkeeping Machine Servicemen (D.O.T. 633.281). The repair of accounting-bookkeeping machines was the main job of nearly 4,000 business machine servicemen employed in early 1965. These machines perform a variety of operations. Some post entries and some do billing, but others combine the functions of typewriters and computing devices. All models have keyboards, like those on typewriters and adding machines. These machines are used in firms that have a great deal of accounting and bookkeeping work, such as department stores, large retail and wholesale businesses, and banks. Many of the newer models are adjusted to fit the accounting procedures used in an individual customer's office. Servicemen set up the controls or programs for such machines from plans which have been devised by the customers and manufacturers' salesmen.

Most accounting-bookkeeping machine servicemen are employed in the sales and service branches of companies manufacturing this equipment. Very few work in independent repair shops.

Data-Processing Equipment Servicemen. More than 16,000 men were employed in early 1965 to install, modify, and maintain groups of machines (systems) used to process large volumes of accounting-statistical data. These men are the most skilled business machine servicemen. The machines that they service include mechanical and electromechanical devices of varying complexity and highly complicated electronic computers. However, even those machine systems which include the most advanced computers depend to a high degree on associated equipment having electromechanical operating and control mechanisms. This auxiliary equipment feeds information to the computer for data processing and converts the processed data to printed form for immediate use, and to tape, punchcard, and magnetic card coding for record keeping and further processing. Machines used in data-processing systems include computers, tabulators, card punchers, sorters, collators, converters, tape transports, printers, and numerous other devices.

Servicemen who work on these machines must have a good basic knowledge of electricity, in addition to mechanical skill. In some firms, only men with training in electronics are hired to service these machines. Many of these men have learned electronics in technical schools or in the Armed Forces. In other companies, experienced men who can repair other types of business machines are given training in electronics by their employers.

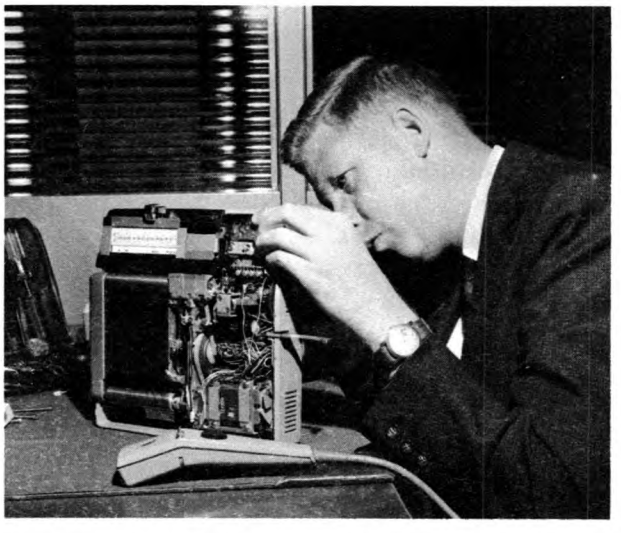
Data-processing machine servicemen are employed principally by firms which manufacture and service such equipment. They may be assigned by their companies to work anywhere in the United States, but they are usually stationed in the larger cities. Some are assigned to a large system in one location while others have territories containing a number of machines or systems.

Dictating Machine Servicemen (D.O.T. 633.281). About 2,000 men were employed to repair and service dictating machines in early 1965. These machines are used in business offices to record dictation on disks, belts, wire, or tape which can be played back for typing. In addition to standard office dictating machines, servicemen install and maintain central recording and transcribing systems.

Dictating machine servicemen must have a knowledge of electronic fundamentals in order

to maintain and repair sound-amplifying components of this equipment. Mechanical skills are essential in maintenance work on drive mechanisms needed to control the movement of the recording disk or belt.

Dictating machine servicemen are employed throughout the country with concentrations in the large business and commercial centers. Most servicemen work in the sales and service branches of business equipment manufacturers or for their distributors. Typewriter and adding machine servicemen employed by some independent dealers also service dictating machines.



Dictating machine serviceman periodically inspects equipment in customer's office.

Duplicating and Copying Machine Servicemen (D.O.T. 633.281). More than 5,000 men were employed in early 1965 to maintain and repair duplicating and copying machines. These machines are used to make one or more paper copies of printed or written information. The processes used in these machines range widely, from highly complex methods for large volume reproduction to relatively simple methods used in desk-top copiers. The equipment used in a single process may also vary considerably from relatively simple hand-operated devices used to make up to five paper copies to highly complicated electromechanical machines having automatic controls which can duplicate several hundred copies quickly.

When maintaining duplicating or copying machines, the serviceman adjusts, oils, repairs, or replaces parts such as rollers, belts, or gear mechanisms. If the equipment has electric or electronic components, he may check voltages to determine the need for adjustment or replacement of parts. He may also clean the machine so that it will function properly and produce clear copy.

Duplicating and copying machine servicemen employed by some companies also service microfilm equipment used in office operations. The maintenance and repair of paper-handling mechanisms used to speed the movement of documents, including drawings, through the photographic equipment is generally similar to that used in duplicating machines. The men who service this equipment, however, must understand the photographic process used in order to properly aline the optical devices so as to produce clear, sharp negatives.

Most duplicating and copying machine servicemen are employed in the branch sales and service offices of manufacturers or by their distributors.

Servicemen of Postage and Mailing Equipment (D.O.T. 633.281). About 3,000 servicemen were employed in early 1965 to maintain and repair the many different types of office machines and equipment needed to handle the billions of pieces of mail sent each year by business firms in this country. These office machines included postage meters, addressing and imprinting machines, and folding and inserting equipment. Data-processing machines used for tabulating and imprinting account information are also used in addressing operations where the volume of accounts justifies.

Servicemen who work on these predominantly electromechanical machines install the equipment and adjust, oil, clean, and repair or replace components to keep the equipment in working order. As with most paper handling equipment, rollers and other manipulating devices driven by belt or gear mechanisms are the components most frequently requiring maintenance. Since most postage and mailing equipment is electrically powered and an increasing number of machines use electric or electronic controls, the servicemen must have a basic knowledge of electricity. In addition, a knowledge of electronic theory is a decided advantage.

Most men who service postage and mailing equipment are employed in the branch offices of equipment manufacturers.

Training, Other Qualifications, and Advancement

Employers prefer applicants for beginning jobs as business machine servicemen to be under 30 years of age. The early years of a serviceman's career can be very active ones. In addition to meeting the requirements of a job calling for tact, good humor, and technical competence in servicing office machines throughout a local area, the serviceman is encouraged to devote at least some of his evenings each week to home-study or academic training in order to broaden his technical knowledge of business equipment and increase his general education. Men up to the age of 40, however, may be considered by some employers provided they have had applicable training or experience.

Trainees usually are required to have at least a high school education. Applicants who have not completed high school, however, are accepted by some companies if they can demonstrate superior mechanical aptitude, or have had qualifying mechanical or electrical experience. Completion of high school becomes particularly important, however, when a serviceman has acquired basic skills and is seeking to work on more complex equipment or to be promoted to supervisor. Applicants interested in servicing complex electromechanical and electronic equipment may be required to have 1 or more years' training or experience in mechanics or electronics, in addition to a high school education, to qualify.

Most employers require business machine servicemen to be bonded. Applicants for such jobs must have a record of honesty and trustworthiness because in their work on business machines, servicemen are brought in proximity to large sums of money and other valuables in banks, offices, and other establishments. Servicemen may also collect money for services performed, and office supplies delivered to their customers.

Applicants for trainee jobs frequently must pass one or more tests. Mechanical aptitude is the characteristic most frequently tested although, increasingly, knowledge of basic electricity or electronic fundamentals is also tested. Applicants may also be tested for manual dexterity, general intelligence, and abstract reasoning.

Employers look for applicants who have a pleasant, cooperative manner. Most machine servicing is done in customers' offices, and a serviceman's ability to do his work with the least interference with office routine is very important. A neat appearance and ability to converse effectively are also desired characteristics.

Young men entering the business machine servicing field generally begin as trainees and acquire their skills through on-the-job training, work experience, and instruction in manufacturers' training schools. Courses in business machine maintenance and repair, conducted by some State and city vocational schools and by private correspondence schools, are available to trainees and others interested in this field of work.

Business machine servicemen who are hired for work in a manufacturer's branch office are trained to service only the company's line of machines. Independent shops, which look for men who can service many makes of machines, will either hire men with previous experience on one or more types of machines or will give a new man informal training on several different makes. Training programs lasting from 2 to 4 years are conducted by some manufacturers and independent dealers.

Men hired as trainees in manufacturers' branch offices usually are sent to company schools for periods lasting from several weeks to several months, depending on the type of machine they will service. They then receive from 1 to 3 years of practical experience and on-the-job training before they are considered fully qualified. During this period, they may occasionally go back to factory schools for additional training. Even after becoming skilled workers, they may return to school for special instruction in new business machine developments. In addition to training in company schools, servicemen at manufacturers' branch offices are encouraged to broaden their technical and general knowledge during their nonworking hours. Many companies provide full or partial tuition grants for a variety of courses at academic institutions, as well as for home-study courses in subjects related to the serviceman's work.

Men in independent shops generally learn the trade by working with experienced servicemen

who instruct them in the skills of the trade. Occasionally, men employed by an independent dealer who is authorized to sell and service a manufacturer's products will be sent to the manufacturer's school for training. Generally, however, men in independent shops receive little formal training.

Length of training depends on the kind of shop in which a man is employed. In independent shops, the time required to become a skilled serviceman tends to be somewhat longer than in manufacturers' branches, because of the greater variety of machines and the generally informal nature of the training.

The training period also varies in relation to the complexity of the equipment and the serviceman's ability to become thoroughly skilled in the maintenance, repair, and other activities associated with less complicated business machines, such as typewriters, adding machines, and some photocopy equipment. For the servicing of calculating machines, about 2 years of training and experience are required. Cash register repairmen learn their job in from 2½ to 3½ years, the last 6 months of which are usually spent in the company school. Skilled accounting-bookkeeping machine repairmen generally must have at least 3 to 4 years of training and experience. The first 1 to 2 years may consist of servicing adding machines, calculators, or cash registers, since this is considered valuable background for servicing accounting-bookkeeping machines.

Most machines used in data-processing systems contain electrical equipment; many have electronic components. The companies which manufacture and service these machines, therefore, usually require that applicants have some knowledge of electricity or electronics. In qualifying for a job in the maintenance of the complex electronic data-processing machines, college or technical institute courses in engineering are helpful, though not essential. Young veterans who have had electronics training in the Armed Forces are specially desired by employers in this field. Men hired as trainees generally spend their first 2 months in on-the-job training. If they prove satisfactory, they are sent to a company school for a period of from 3 to 6 months. After completing the course, they work under supervision until they acquire enough skill to service and repair on their own. This period usually lasts from 12 to 18 months.

Servicemen frequently have the opportunity to move into sales jobs, where their earnings may be greater. In some cases, service and sales work are combined. Men who show exceptional abilities also have opportunies for promotion to foreman, service manager, or other supervisory jobs, and to serviceman training or product engineering divisions of their companies. Experienced men sometimes open their own repair shops; men who work in the branch offices of some manufacturers are sometimes given sales franchises from the company and become independent dealers.

Employment Outlook

The rapidly growing business machine service field will provide several thousand job opportunities for young men each year during the 1965–75 decade. Many of these job opportunities will occur because of the need to replace experienced workmen who retire, die, or transfer to other fields of work.

More than 70,000 servicemen were employed in early 1965, more than double the number working during the mid-1950's. The greater employment of servicemen has been due to the increasing use of many types of office machines to do all kinds of clerical work in our expanding commercial and industrial establishments. In recent years, there have been many technical changes in long established types of business machines. For example, electrically driven mechanical equipment, such as typewriters and adding machines, is rapidly taking the place of nonelectrical mechanical machines which do the same work. The increasing use of this more complex equipment, which requires additional maintenance, has also increased the need for business machine servicemen, especially those who have good mechanical ability and a knowledge of electricity or electronics.

Opportunities for jobs in the servicing of electronic business machines systems will be particularly favorable in the years ahead. The use of such machines has expanded greatly in recent years, and demand for this equipment is expected to be even greater in the future. Additional job

opportunities may arise as a result of new complex equipment, now being introduced, which permits automatic retrieval and printout of masses of stored information. Such equipment has great potential for widespread application in business, scientific, institutional, and other fields.

Business machine servicemen have year-round employment—steadier than that in many other skilled trades. The office machines serviced by these men must be maintained even when business slackens, since business records must be kept, correspondence carried on, and statistical reports prepared. Men who establish themselves in the business machine service field can expect continuing employment for many years.

Earnings and Working Conditions

Information obtained from a number of employers of business machine servicemen in early 1965 indicated that earnings of experienced servicemen generally ranged from $85 to $130 a week depending on the type of machine they serviced, where they were employed, and their length of service with employers. Wages were lowest for men who repair only typwriters, adding machines, or less-complex types of photocopy equipment; the earnings of these workers usually ranged from $85 to $110 a week. Cash registers, calculators, accounting-bookkeeping machines, and nonelectronic accounting-statistical machines require more skill to repair. Consequently, the men who work on them receive somewhat higher pay rates, generally from $90 to $130 a week. Highest rates are paid to men who service electronic data-processing machines. The most highly skilled electronic computer servicemen were earning as much as $200 a week.

Servicemen trainees begin at wages considerably below these levels; they receive pay increases as they become increasingly skilled during the training period. Starting wages generally ranged from $65 to $80 a week. Men with previous electronics training in the Armed Forces or civilian technical schools generally receive somewhat higher beginning wages.

In addition to their salaries, servicemen in some companies receive commissions for selling supplies or service contracts. Many servicemen employed by manufacturers and independent dealers are covered by group life and hospitalization insurance plans, and pension plans.

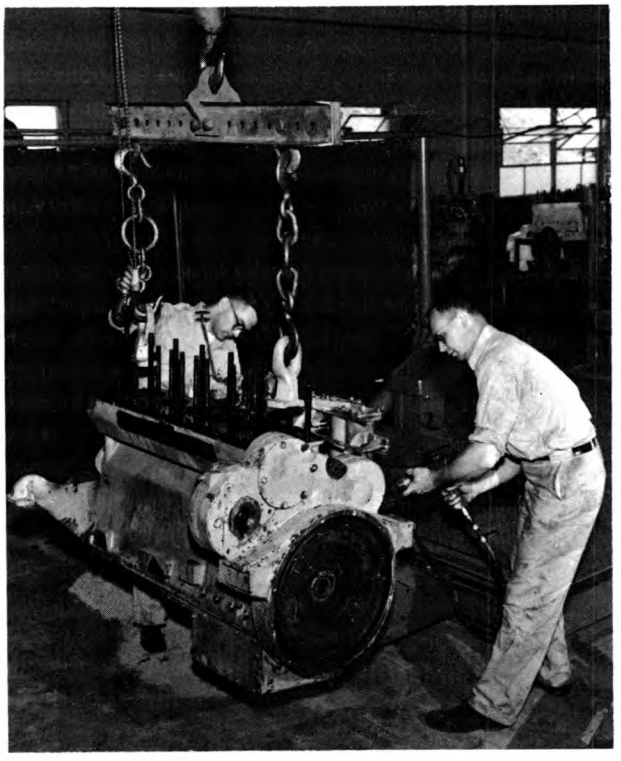
Servicing of business machines is cleaner and lighter work than the work in most other mechanical trades. Servicemen generally wear business suits and perform most of their work in the offices where the machines are used. The occupation is comparatively free from the danger of accident. Many of these jobs involve considerable traveling within the area served by the employer. For this reason, many employers require that servicemen own or have the use of a car. The serviceman generally is reimbursed for company use of his car on a mileage basis. Work tools usually are supplied by the employer.

Diesel Mechanics

(2d ed. D.O.T. 5–83.931)
(3d ed. D.O.T. 625.281)

The growing volume of diesel-powered equipment used throughout American industry is maintained and repaired by skilled diesel mechanics. Diesel engines are used extensively to power large trucks and buses; construction equipment, such as bulldozers, earthmovers, and cranes; farm equipment, such as tractors and irrigation pumps; and locomotives and other railroad equipment. Diesel engines are also used to power tugboats and ships; oil well drilling rigs; various types of generators, pumps, and compressors used in the public utilities and other industries; and many other types of equipment.

Although diesel and gasoline engines are similar in many respects, diesel mechanics need to know about fuel injection systems, turbochargers, engine speed governors, and other components not usually found in gasoline engines. Moreover,



Diesel mechanics use power tools to disassemble engine.

many diesel engines are considerably larger and more powerful than gasoline engines used in automobiles.

Many diesel mechanics make all types of diesel engine repairs; others specialize, for example, in rebuilding engines or in repairing fuel injection systems, turbochargers, cylinder heads, or starting systems. Mechanics who do all types of engine repair work first determine why the engine operates improperly by inspecting and testing engine components. They may be assisted in this work by their supervisors. After the cause of the trouble is located, mechanics then repair or replace defective parts and make necessary adjustments. Preventive maintenance—avoiding trouble before it starts—is another major responsibility of the mechanics. For example, they periodically inspect, test, and adjust engine components.

Mechanics who specialize in rebuilding diesel engines that have been operated for many hours or miles, take the entire engine apart, examine all of the parts for defects, and repair or replace defective parts. They then reassemble and adjust the engine. Some diesel mechanics also repair large natural gas engines which are used to power generators, pumps, and other industrial equipment.

Diesel mechanics often have job titles that indicate the type of diesel-powered equipment on which they work. For example, those who repair the diesel engines in trucks may be called truck mechanics (diesel). Those who work on construction equipment, such as bulldozers and earthmovers, are usually called heavy equipment mechanics (diesel). Railroads classify the workers who repair locomotive diesel engines as machinists, electricians, or sheet-metal workers, depending on the type of diesel repair work they perform. In addition to engine maintenance and repair, the mechanics listed above (except those employed by railroads) may work on other parts of diesel-powered equipment. For example, truck mechanics (diesel) may work on brake and steering systems, transmissions, and other truck parts. (See statement on Truck Mechanics and Bus Mechanics.)

Diesel mechanics use common handtools, such as pliers, wrenches, and screwdrivers, as well as special tools, including valve refacers and piston pin fitting machines. In addition, they may use complex testing equipment, such as a dynamometer, which measures engine power, and special fuel injection testing equipment. Mechanics may also use machine tools, including grinders, drills, and lathes to make replacement parts for diesel-powered equipment. They use powered hoists and other materials handling equipment for lifting and moving heavy parts.

Where Employed

Many diesel mechanics are employed in the service departments of distributors and dealers that sell diesel engines, farm and construction equipment, and trucks. Diesel mechanics are also employed by companies and government agencies that repair and maintain their own diesel-powered equipment. This group includes local and intercity buslines, construction companies, trucking companies, railroads, and State highway departments. Other employers of diesel mechanics include manufacturers of diesel engines and independent repair shops that specialize in the repair of diesel engines.

Diesel mechanics are employed in all parts of the country. Large numbers of these workers, however, are employed in California, New York, Illinois, and Texas—States where high levels of construction, commercial, industrial, and farming activity have resulted in the use of great numbers of diesel-powered machines.

Training, Other Qualifications, and Advancement

Diesel mechanics learn their skills in several different ways. Most young men who become diesel mechanics first work as mechanics repairing gasoline-powered automobiles, trucks, and buses. They usually start as helpers to experienced gasoline engine mechanics and become skilled in this work by working with them for 3 to 4 years. When employed by firms that use or repair diesel-powered equipment, they are given 6 to 18 months' training in the maintenance and repair of such equipment. While learning to fix diesel engines many of these men find it helpful to take courses in the repair and maintenance of diesel equipment, offered by vocational, trade, and correspondence schools.

Some diesel mechanics, such as those employed by diesel engine manufacturers, learn their trade through formal apprenticeship programs. These programs, which generally last 4 years, give trainees a combination of classroom training and practical experience in repairing diesel engines used by their employers. Apprentices receive classroom instruction in blueprint reading, hydraulics, welding, and other subjects related to their work. In their practical training, they learn about valves, bearings, injection systems, starting systems, cooling systems, and other parts of diesel engines.

Some young men prepare for diesel mechanic jobs by full-time attendance at trade or technical schools that offer comprehensive training in diesel engine maintenance and repair. Such training programs last from several months to 2 years, and provide practical experience and related classroom instruction. Graduates of such programs, however, usually need additional on-the-job training before they become skilled mechanics.

Training programs for diesel mechanics, and for others in occupations that involve diesel engine repair work, were in operation in several cities in 1964–65 under the provisions of the Manpower Development and Training Act. Unemployed and underemployed workers who meet certain minimum requirements are eligible to apply for such training, which, in 1964–65, usually lasted at least 36 weeks.

Other young men learn the trade through less formal training programs. Generally, they are hired as trainees by employers who use or repair large quantities of diesel-powered equipment. Trainees are taught by experienced mechanics to do all kinds of diesel repair jobs.

Experienced diesel mechanics employed by companies that sell diesel-powered equipment are sometimes sent to special training classes conducted by diesel engine manufacturers. In these classes, mechanics learn to maintain and repair the latest diesel engines, using the most modern equipment.

Employers prefer to hire trainees and apprenticeship applicants who have a high school education as well as mechanical ability. Shop courses in automobile repair and machine-shop work, which are offered by many high schools and vocational schools, are helpful. High school courses in science and mathematics are valuable, because they give a young man a better understanding of diesel engine operation. Young men interested in becoming diesel mechanics should be in good physical condition, because the work often requires lifting heavy parts.

Many diesel mechanics are required to have their own handtools. Experienced mechanics usually have several hundred dollars invested in their tools. A beginner is expected to accumulate tools as he gains experience.

Diesel mechanics who work for organizations that operate or repair large fleets of diesels, such as buslines or diesel equipment distributors, may advance to leadman and to supervisory positions —shop foreman or service manager.

Employment Outlook

Employment of diesel mechanics is expected to increase moderately during the 1965–75 decade. In addition to employment growth, many job openings will result from the need to replace experienced mechanics who are promoted, retire, transfer to other fields of work, or die.

The rise in employment of diesel mechanics is expected mainly because of the anticipated growth in the Nation's general economic activity. Most industries that use diesel engines in large numbers are expected to expand their activities in the years ahead. In addition, diesel engines will continue to replace gasoline engines in a growing variety of equipment. For example, small delivery trucks powered by diesel engines are in limited use today, but are expected to be used on a larger scale in the future. Also, farm equipment powered by diesel engines will be used increasingly.

Most new job openings in this field will be filled by mechanics who have had experience in repairing gasoline engines. Companies that are replacing gasoline engine equipment with diesel powered equipment usually retrain their experienced mechanics to service the diesel equipment. Companies that buy additional diesel engines to meet expansion needs usually hire experienced diesel mechanics. Men who have had school training in diesel repair but no practical experience may be able to find jobs only as trainees.

Earnings and Working Conditions

National wage data are not available for diesel mechanics. However, wage data collected from employers of workers who repair trucks, buses, construction equipment, and stationary engines, indicate that many diesel mechanics who repair such equipment earned from about $2.50 to $3.50 an hour in mid-1964. Machinists who repair locomotive diesel engines were paid approximately $2.75 an hour in mid-1964.

The weekly work schedule of diesel mechanics ranges from 40 to 48 hours a week. Many of them work at night or on weekends, particularly if they work on buses, diesel engines used in electric light and powerplants, or other diesel equipment used in serving the public. Some of these workers are subject to call for emergencies, at any time during the day or night. Diesel mechanics generally receive a higher rate of pay when they work overtime hours, evenings, or weekends.

Many diesel mechanics also receive vacations and holidays with pay. In addition, they may receive health and life insurance benefits, which are at least partially paid for by their employers.

Most of the larger repair shops are pleasant places in which to work, but some of the small shops have poor lighting, heating, and ventilation. Diesel mechanics who work for buslines or construction companies sometimes make repairs outdoors where the breakdowns occur. If proper safety precautions are not taken, there is some danger of injury when repairing heavy parts that are supported on jacks or hoists. In most jobs, the mechanics handle greasy tools and engine parts. It is sometimes necessary for them to stand or lie in awkward or cramped positions for extended periods of time.

Many diesel mechanics belong to labor unions. Some of the unions to which they belong are the International Association of Machinists and Aerospace Workers; the Amalgamated Transit Union; the Sheet Metal Workers' International Association; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; and the International Brotherhood of Electrical Workers.

Where To Go for More Information

A young man who wishes to obtain further information about work opportunities in this trade should direct his inquiries to the local office of the State employment service and to firms that use or service diesel-powered equipment, such as truck and buslines, truck dealers, and construction and farm equipment dealers. The State employment service also may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities. He should also contact the national offices of the unions listed below for information on work and training opportunities in this trade, or for the names and addresses of locals of the unions that can provide such information:

International Association of Machinists and Aerospace Workers,
1300 Connecticut Ave. NW., Washington, D.C. 20036.

Amalgamated Transit Union,
5025 Wisconsin Ave. NW., Washington, D.C. 20016.

Sheet Metal Workers' International Association,
1000 Connecticut Ave. NW., Washington, D.C. 20036.

International Union, United Automobile, Aerospace and Agricultural Implement Workers of America,
8000 East Jefferson Ave., Detroit, Mich. 48214.

Industrial Machinery Repairmen

(2d ed. D.O.T. 5–83.641)
(3d ed. D.O.T. 625. through 632.281 and 637. through 639.281)

Nature of Work

The great variety of machinery and equipment used throughout American industry is kept in good operating condition by tens of thousands of industrial machinery repairmen—often called *maintenance mechanics*. When breakdowns occur, repairmen determine the cause of the trouble and make the necessary repairs. They may completely or partly disassemble a machine in order to repair or replace defective parts. After the machine is reassembled, they make the necessary mechanical adjustments to insure its proper operation.

Much of a repairman's time is spent in preventive maintenance. By regularly inspecting the equipment, oiling and greasing machines, and cleaning and repairing parts, he prevents trouble which could cause breakdowns later. He also may keep maintenance records of the equipment he services.

The types of machinery on which industrial machinery repairmen work depend to a great extent on the particular industry in which they are employed. For example, in the apparel industry, these skilled workers may be employed to repair industrial sewing machines. They may take sewing machines apart in order to repair belts, adjust treadles, or replace motor bearings. In printing and publishing establishments, skilled industrial machinery repairmen may maintain and repair equipment such as printing presses and folders.

Repairmen often follow blueprints, lubrication charts, and engineering specifications in maintaining and repairing equipment. They may also use parts catalogs to order replacements for broken or defective parts. Occasionally, repairmen may sketch a part that is to be made by the plant's machine shop.

Industrial machinery repairmen use wrenches, screwdrivers, pliers, and other handtools, as well as portable power tools. They also may use welding equipment in repairing broken metal parts.

Where Employed

Industrial machinery repairmen work in almost every industrial plant that uses large amounts of machinery and equipment. However, a majority of the more than 150,000 repairmen estimated to be employed in early 1965 worked in the following industries: Food and kindred products, primary metals, machinery, chemicals, fabricated metal products, and transportation equipment. Many repairmen were also employed in the paper, textile, and rubber industries.

Because industrial machinery repairmen work in a wide variety of industrial plants, they are employed in every section of the country. The largest numbers of these workers are in New York, Pennsylvania, California, Ohio, Illinois, Michigan, New Jersey, Massachusetts, and other heavily industrialized States.

Training and Other Qualifications

Most workers who become industrial machinery repairmen start as helpers and pick up the skills of the trade informally through several years of experience. Others learn the trade through formal apprenticeship programs. Apprenticeship training usually lasts 4 years and consists of both on-the-job training and related classroom instruction. Apprentices learn the use and care of the tools of the trade, and the operation, lubrication, and adjustment of the machinery and equipment which they will maintain. Classroom instruction is given in shop mathematics, blueprint reading, safety, hydraulics, welding, and other subjects related to the craft.

Mechanical aptitude and manual dexterity are important qualifications for workers in this trade. Good physical condition and agility also are necessary, because industrial machinery repairmen are sometimes required to lift heavy objects or do considerable climbing in order to repair equipment located high above the ground.

Employment Outlook

Employment of industrial machinery repairmen is expected to increase moderately during the

1965–75 decade. In addition to employment growth, thousands of job openings will result from the need to replace experienced mechanics who transfer to other occupations, retire, or die. Retirements and deaths alone are expected to result in about 4,000 job openings annually.

The rise in employment of industrial machinery repairmen is expected mainly because of the anticipated use of more machinery and equipment to fabricate, process, assemble, inspect, and handle industrial production materials. In addition, as automatic equipment and continuous production lines become more widespread, breakdowns will lead to greater losses of production and make repair work and preventive maintenance more essential.

Earnings and Working Conditions

Average straight-time hourly earnings of industrial machinery repairmen employed by a wide variety of manufacturing establishments in 79 areas in 1964–65 ranged from $2.20 in Lubbock, Tex., to $3.59 in San Francisco-Oakland, Calif. More than 65 percent of the repairmen covered by these surveys earned $3 an hour or more.

Industrial machinery repairmen are not usually affected by seasonal changes in production. During slack periods, when production workers are laid off, repairmen are often retained. Many companies use machine repairmen to do major repair and overhaul jobs during such periods.

Because motors and other parts of machines are not always readily accessible, maintenance mechanics may work in stooped or cramped positions close to the floor or from the tops of ladders. Industrial machinery repairmen are subject to common shop injuries such as cuts and bruises. However, accidents have been reduced by the use of goggles, metaltip shoes, metal helmets, and other safety devices. Repairmen must frequently work on dirty and greasy equipment. Lighting and ventilation are usually good.

Most industrial machinery repairmen belong to labor unions. Some of the unions to which these workers belong are the United Steel Workers of America; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the International Association of Machinists and Aerospace Workers; and the International Union of Electrical, Radio and Machine Workers. Most employer-union contracts covering industrial machinery repairmen provide for fringe benefits such as paid holidays and vacations, health insurance, life insurance, and retirement pensions.

Instrument Repairmen

(2d ed. D.O.T. 5–83.971, .972, .975, and .980)
(3d ed. D.O.T. 710.281; 729.281; 823.281; and 828.281)

Nature of Work

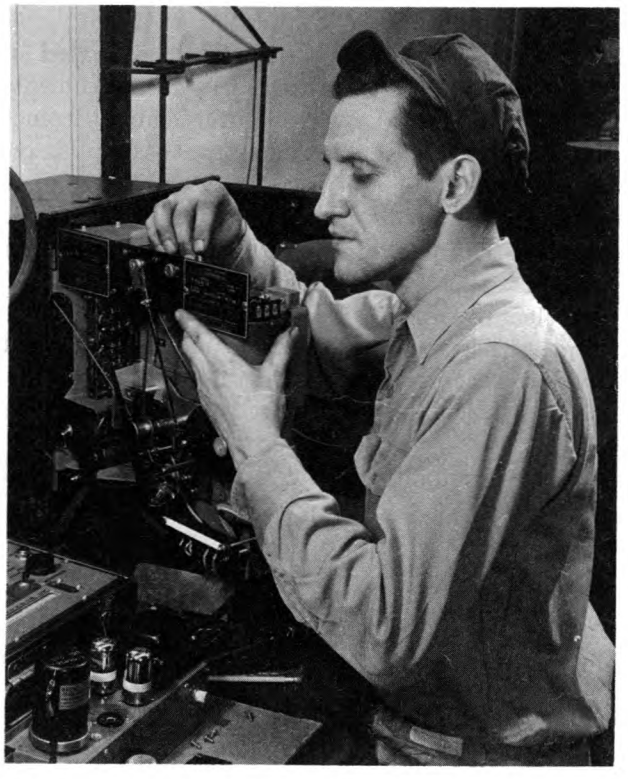
Instrument repairmen install and service the complex industrial and scientific instruments that measure, record, or control heat, electricity, pressure, flow of liquids, chemical composition, and other variables. Instruments serviced by these workers are used in refining oil, guiding airplanes and missiles, generating electricity, conducting laboratory experiments, manufacturing steel, and in hundreds of other activities. Instrument repairmen (also called *instrument mechanics*, *instrument maintenance men*, *instrument men*, and *instrument technicians*) sometimes specialize in particular kinds of instruments. For example, they may service either electronic, hydraulic, or pneumatic instruments. However, the trend is toward hiring repairmen who are able to service all types of instruments.

To locate instrument trouble, repairmen first determine that the trouble is in the instrument and not in other equipment. They disassemble malfunctioning instruments and examine and test mechanisms and circuitry for defects. They use testing equipment such as pressure and vacuum gages, speed counters, and electrical measuring instruments; for example, voltmeters, oscilloscopes, ammeters, and potentiometers. They compare the readings shown on such testing equipment with the reading that would be shown if the instruments were operating properly.

Instrument repairmen work with instruments at the site of the trouble or in specially equipped shops. They may do a major overhaul, replace

worn or damaged parts or make minor repairs such as resoldering loose connections. They use handtools such as screwdrivers, wrenches, and pliers. They also use bench tools such as jewelers' lathes, pin vises, small buffer grinders, and ultrasonic cleaners for small metal parts. In some companies, instrument repairmen operate drill presses, grinders, polishers, and other machine tools to make new parts or to change standard parts to fit particular instruments. As guides in their work, instrument repairmen frequently use instruction books and maintenance manuals (which they may help prepare) that describe how to install, operate, and maintain instruments. They also use schematic diagrams, assembly drawings, and blueprints. When instruments are reassembled, repairmen give them final checks for accurate operation.

Instrument repairmen also try to prevent trouble. Based on a maintenance schedule, they look for and correct defects which could cause breakdowns resulting in production losses. They also clean, lubricate, and adjust the instruments.



Wider use of instruments makes skilled repairmen increasingly important.

Some highly skilled instrument repairmen install and test new instruments and advise operators on how to use and care for them. Sometimes they modernize older instruments by putting in new parts. Other highly skilled instrument repairmen may assist scientists and engineers in research and development laboratories. They select and arrange instruments for tests and experiments. Occasionally, they are called upon to modify instruments to meet special requirements or to get better results. (Instrument technicians may also perform some of these duties. Technicians are discussed elsewhere in the *Handbook*.)

Where Employed

More than 75,000 instrument repairmen were employed in early 1965, primarily by gas and electric utilities; by petroleum and chemical plants; by manufacturers of instruments, pulp and paper, metals, rubber, missiles, and automobiles; and by airlines. In addition, several thousand of these repairmen worked for Federal agencies, mainly the Air Force, Navy, and Army.

Because instrument repairmen work in many different kinds of industries, they are employed in all parts of the country.

Training, Other Qualifications, and Advancement

To become a fully qualified instrument repairman usually takes at least 4 years of on-the-job training and study. However, this time may vary considerably depending upon individual ability, previous experience and training, and the complexity of the instruments being serviced.

Instrument repairmen are often hired as trainees or chosen from among plant workers. They learn their trade either informally by working with experienced men or in formal training programs. In addition to actual work experience, formal training programs include specialized courses such as instrumentation theory, mathematics, blueprint reading and process theory. These courses may be taken by correspondence or at local schools during or after working hours.

Some young men train for instrument repair work in technical institutes and junior colleges. The programs offered by these schools last about 2 years and emphasize basic engineering courses,

such as science and mathematics. As instruments become more complex, technical school training will become increasingly important and young men with this training will have a better chance for advancement.

A few instrument repairmen start as apprentices. Apprenticeship programs, which generally last 4 years, emphasize on-the-job training in repairing and maintaining instruments. Apprentices also study mathematics, physics, electronics, chemistry, blueprint reading, instrumentation theory, and process theory.

Armed Forces technical schools also offer training in instrument servicing. Young men who expect to enter the Armed Forces may wish to investigate opportunities for training and work experience while in military service. Skills acquired in this way often qualify men for civilian jobs as instrument repairmen and for other maintenance occupations.

Several instrument manufacturers offer specialized training to experienced instrument repairmen employed by the companies that buy their products. These training courses last from 1 week to 9 months, depending upon the number and complexity of the instruments that the workers are learning to service. Courses are given in theory, maintenance, and operation of the instruments produced by these manufacturers. Students learn to check instruments step by step. They also learn where to find further information about instrument servicing.

Men hired as trainees or apprentices generally must be high school graduates. Courses in algebra, trigonometry, physics, chemistry, electricity, electronics, machine shop practice, and blueprint reading are considered particularly useful. Some employers give tests to applicants to determine their mechanical or electrical aptitude. Building and maintaining a ham radio station, or hi-fi set, is good experience for a young man planning to become an instrument repairman.

Instrument repairmen who meet the public are expected to be neat in appearance and to get along well with people. Other important qualifications include the ability to work alone with little supervision and to perform a variety of duties often characterized by frequent change. Instrument repairmen must be able to evaluate data revealed by tests and observations, and be able to work to precise standards and tolerances. Good eye-hand coordination and finger dexterity are needed when handling delicate instrument parts.

Very skilled instrument repairmen may advance to positions of increasing responsibility. They can become group leaders or foremen in maintenance or assembly departments or advance to jobs as service representatives in the branch offices of instrument manufacturing companies. Some instrument repairmen become engineering assistants. Because the use of electronic components in instruments is expected to increase, a basic knowledge of electronics should help young men toward advancement.

Employment Outlook

The number of instrument repairmen is expected to increase very rapidly during the 1965–75 decade. In addition to job openings resulting from the growth in employment, many job opportunities will arise from the need to replace experienced repairmen who transfer to other lines of work, retire, or die. Deaths and retirements alone are expected to result in more than a thousand job openings annually.

More instrument repairmen will be needed in the years ahead because the use of instruments will expand rapidly as manufacturing becomes more automated, industrial output expands, research and development activities grow, and as new uses are found for instruments. For example, more instruments will be needed to help produce and distribute larger quantities of chemicals, petroleum, paper, and electricity; many more kinds of new, complex instruments will be needed for our space programs; greater numbers of instruments will be used in research laboratories; and instruments will be increasingly used by hospitals to supply diagnostic information to medical specialists.

Earnings and Working Conditions

Information obtained from a number of union-management agreements in the pulp, paper, and paperboard industry and from several instrument, chemical, and petroleum companies indicates that most instrument repairmen in 1964 had wage rates of between $3.20 and $3.60 an hour. Those specializing in electronic instru-

through which wires are run to outlets, panels, and boxes. He also may adjust equipment controls and check and adjust instruments.

The maintenance electrician uses such devices as test lamps, ammeters, volt-ohm meters, and oscilloscopes in testing electrical equipment and wiring. He sometimes works from blueprints, wiring diagrams, and other specifications. He may make mathematical computations to determine the current carrying capacities of electrical wiring and equipment. Maintenance electricians use pliers, screwdrivers, wire cutters, drills, reamers, conduit bending and threading tools, and other hand and power tools.

Although all maintenance electricians have the same basic skills, the nature of their work depends largely on the size of plant and the particular industry in which they work. In manufacturing plants, these workers usually maintain the electrical equipment operated in connection with the manufacture of a particular product. For example, steel mills and aluminum plants require a large number of electricians to maintain the electrical and electronic equipment used to power and control rolling mills, presses, and other production machinery. In plants that use large amounts of electrical equipment, electricians may specialize in the maintenance of a particular type of equipment, such as motors, welding machines, or transformers. In small plants, electricians are usually responsible for all types of electrical repair work. Maintenance electricians employed in large office buildings, apartment houses, and hospitals maintain lighting systems and other electrical equipment, such as that used in air-conditioning systems.

Maintenance electrician repairs welding machine.

Where Employed

An estimated 220,000 maintenance electricians were employed throughout the country in early 1965. More than half of these craftsmen were engaged in servicing the equipment and machinery used in manufacturing plants. Large numbers of these workers were employed by manufacturers of transportation equipment, primary metal products, nonelectrical machinery, chemicals, and paper products.

Nonmanufacturing firms that employed large numbers of maintenance electricians included those in the transportation, communications, and public utilities industries; wholesale and retail trade; and mining. Federal, State, and local governments also employed many of these skilled workers.

Maintenance electricians are employed in every State. Large numbers work in heavily industrialized States such as California, New York, Pennsylvania, Illinois, and Ohio.

Skilled workers in this trade have the advantage of being able to transfer to maintenance electrician jobs in many different industries. With some additional training they may also qualify for construction electrician jobs.

Training, Other Qualifications, and Advancement

Maintenance electricians can learn the skills of their trade through formal apprenticeship programs, or by accumulating experience through informal on-the-job training. However, training authorities generally agree that apprenticeship programs give the workers more thorough knowledge of the trade and greater job opportunities during their working life.

The apprenticeship program for maintenance electricians usually lasts 4 years. Apprentices

ments or engaged in research and development work may receive higher wages than other instrument repairmen. Some highly skilled instrument repairmen were paid at rates of more than $3.90 an hour. Instrument repairmen employed by Federal agencies in Washington, D.C., in 1964 were paid from $3.12 to $3.49 an hour, about the same rates received by most nongovernment repairmen.

Most instrument repairmen work a 40-hour, 5-day week. Those employed in petroleum refineries and chemical plants which operate 24 hours a day and 7 days a week, may work on any of three shifts or rotate among shifts. Repairmen may also be called to work on Sundays and holidays with emergency crews. They receive premium pay for night and holiday work, and most companies provide holiday and vacation pay. Many companies provide additional benefits such as life insurance, hospitalization, medical and surgical insurance, sickness and accident insurance, and retirement pensions.

Instrument repairmen may service instruments on factory floors amid noise, oil, and grease. They may also work at benches in quiet, clean, well-lighted repair shops. In some industries, such as chemical, petroleum, and steel, repairmen may be required to work outdoors in all kinds of weather. Those employed by instrument manufacturers may have to travel often.

Many instrument repairmen belong to unions, including the International Association of Machinists and Aerospace Workers; International Brotherhood of Electrical Workers; International Brotherhood of Pulp, Sulphite and Paper Mill Workers; International Chemical Workers Union; International Union of Electrical, Radio and Machine Workers; International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; Oil, Chemical and Atomic Workers International Union; and Utility Workers Union of America.

Where To Go for More Information

The local office of the State employment service may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities for those wishing to enter this occupation. Additional information about training, as well as employment opportunities in the field of instrumentation, may be obtained from:

Instrument Society of America,
530 William Penn Pl., Pittsburgh, Pa. 15200.

Inquiries concerning positions with the Federal Government should be made at the regional offices of the U.S. Civil Service Commission.

Maintenance Electricians

(2d ed. D.O.T. 4-97.420)

(3d ed. D.O.T. 825.281 and 829.134 and .281)

Nature of Work

Maintenance electricians (electrical repairmen) maintain and repair many different types of electrical equipment. In addition, they sometimes modify and install electrical equipment. Maintenance electricians work on equipment such as motors, transformers, generators, controls, instruments, and lighting systems used in industrial, commercial, and public establishments.

A large part of an electrician's work is preventive maintenance—periodic inspection of equipment to find and repair defects before breakdowns occur. When trouble does develop, the electrician must quickly find and repair the faulty circuit or equipment in order to prevent costly production losses and inconvenience. Also, in emergencies, it is his responsibility to advise management whether immediate shutdown of equipment is necessary, or if continued operation would be hazardous.

In his daily work, the maintenance electrician does many different things. For example, he may make repairs by replacing units or parts such as wiring, fuses, circuit breakers, coils, or switches. While doing repair or installation work, the electrician may connect wires by splicing or by using mechanical connectors. He may measure, cut, bend, thread, and install conduits

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are given on-the-job training and related technical classroom instruction in subjects such as mathematics, electrical and electronics theory, and blueprint reading. Training may include motor repair; wire splicing; commercial and industrial wiring; installation of light and power equipment; installation and repair of electronic controls and circuits; and welding and brazing.

A young man employed in a plant as a helper to a skilled maintenance electrician may gradually acquire the skills of this craft by observing the electrician and working under his instructions. Others learn the trade by working in the maintenance department of a plant and picking up some of the job fundamentals. By moving from job to job, they eventually acquire sufficient experience to qualify as skilled workers. However, it generally takes more than 4 years to become a maintenance electrician in this way.

A young man interested in becoming a maintenance electrician should include courses in mathematics (such as algebra and trigonometry) and basic science in his high school or vocational school curriculum. Because the electrician's craft is subject to constant change, many experienced electricians must continue to acquire technical knowledge and learn new skills. For example, some maintenance electricians who entered the trade some years ago must now learn basic electronics in order to service the new electronic equipment being introduced in the Nation's industrial establishments and large commercial and residential buildings.

In selecting apprentice applicants or trainees, employers look for young men who have manual dexterity and who are interested in learning how electrical equipment functions. These young men also need good color vision because electrical wires are frequently identified by their different colors. Although great physical strength is not essential, agility and good health are important.

All maintenance electricians should be familiar with the National Electric Code; some must be familiar with local building codes. A growing number of cities and counties require maintenance electricians to be licensed. An electrician can obtain a license by passing a comprehensive examination that tests his knowledge of electrical theory and its application.

Skilled maintenance electricians may become foremen who supervise the work of other maintenance electricians or other maintenance personnel. Ocasionally, they may advance to jobs such as plant electrical superintendent or plant maintenance superintendent.

Employment Outlook

The number of maintenance electrician jobs is expected to increase by a few thousand each year through the mid-1970's, as a result of industrial growth and the trend toward increased use of electrical and electronic equipment. Many of the new job opportunities for these workers will occur in the primary metal, fabricated metal, machinery, and chemical industries. Thousands of additional workers also will be needed to replace electricians who retire, are promoted, transfer to other fields of work, or die. Retirement and deaths alone may result in about 5,000 new job openings a year.

Earnings and Working Conditions

In general, the earnings of maintenance electricians compare favorably with those of other skilled workers. The average straight-time hourly earnings of maintenance electricians in establishments in 74 cities and areas in 1964–65 ranged from about $2.18 in Greenville, S.C., to $3.64 in San Francisco-Oakland, Calif. In about four-fifths of the cities surveyed, however, average straight-time hourly earnings for these craftsmen ranged from $2.75 to $3.53.

In establishments that operate an apprenticeship program, apprentices start at about 60 percent of the journeyman's basic hourly pay rate. They receive increases every 6 months, moving up to 85 to 90 percent of the journeyman's rate during the last year of apprenticeship.

During a single day, an electrician employed in a plant may repair electrical equipment both in a clean air-conditioned office and on the factory floor, surrounded by the noise, oil, and grease of machinery. Maintenance electricians may be called upon to climb ladders, work on scaffolds, or work in awkward or cramped positions when repairing or installing electrical equipment.

Because maintenance electricians often work around high-voltage industrial equipment, they

must be alert and accurate in carrying out their duties. Errors in wiring installations could have dangerous consequences both to the electrician and the operating employees. The safety principles that are now part of all electrician training programs have greatly reduced the frequency of accidents. Maintenance electricians are taught to use protective equipment and clothing, to respect the destructive potential of electricity, and how to handle small electrical fires.

Various labor unions have maintenance electricians in their membership. Many of these craftsmen are members of the International Brotherhood of Electrical Workers. Among other unions to which maintenance electricians belong are the International Union of Electrical, Radio and Machine Workers; the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; and the United Steelworkers of America. Most of the labor-management contracts covering maintenance electricians provide major benefit programs that may include paid holidays and vacations; hospitalization, medical, and surgical insurance; life insurance; and retirement pensions.

Where To Go for More Information

A young man who wishes to obtain further information regarding electrician apprenticeships or other work opportunities in the trade should apply to local firms that employ maintenance electricians; to a local joint union-management apprenticeship committee, if there is one in his locality; or to the local office of the Bureau of Apprenticeship and Training, U.S. Department of Labor. In addition, the local office of the State employment service may be a source of information about training opportunities. Some State employment service offices provide such services as screening applicants and giving aptitude tests.

Millwrights

(2d ed. D.O.T. 5–78.100)

(3d ed. D.O.T. 638.281)

Nature of Work

Millwrights move and install heavy industrial machinery and other equipment. These workers must have a thorough knowledge of the complex industrial equipment on which they work because it is frequently necessary for them to take apart and reassemble this equipment in order to move and/or install it. In assembling machinery, millwrights fit bearings, aline gears and wheels, attach motors, and connect belts. Millwrights often need to construct special platforms or concrete foundations on which machinery is to be mounted. To do this work, they must be able to read blueprints and work with wood, steel, concrete, and other building materials.

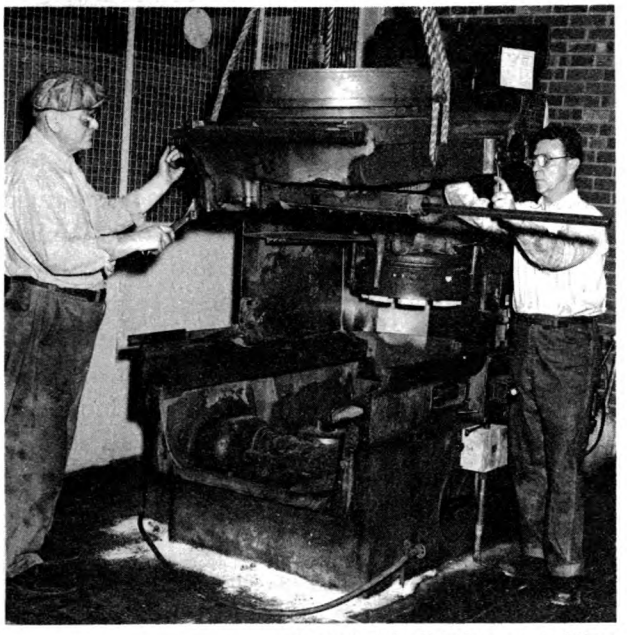
Millwrights employed by companies doing contract installation work and by construction companies are required to install a wide variety of heavy machinery, including turbines and automatic assembly equipment. Those employed in factories may be responsible for the maintenance and repair, as well as the installation, of the particular types of machinery used in the industry in which they are employed.

To do their work, millwrights must be able to use a wide variety of tools and equipment. In moving heavy machinery, millwrights use hoists, cranes, jacks, crowbars, wood blocking, and other rigging devices. In dismantling and assembling equipment, they use wrenches, screwdrivers, pliers, hammers, and other handtools. In alining and leveling equipment, they use measuring devices, such as micrometers, calipers, squares, plumb bobs, and levels.

In addition to moving and installing equipment, millwrights sometimes repair and maintain industrial machinery and other equipment, such as conveyors, cranes, hoists, scaffolds, pumps, and blowers. Such work may include replacing worn or broken belts, welding metal parts, and oiling and greasing machinery. Millwrights sometimes work as part of a maintenance team of pipefitters and machinery repairmen to keep industrial equipment operating.

Where Employed

About half of the estimated 70,000 millwrights employed in early 1965 worked in the steel, paper, machinery, and automobile manufacturing industries. Most of the remaining millwrights were employed in the construction, lumber, chemicals, and fabricated metal products industries.



Courtesy of the U.S. Department of Navy

Millwrights guide a section of grinding machine into position.

Some millwrights are employed by companies that specialize in moving, installing, and maintaining industrial machinery on a contract basis. Others work for machinery manufacturers who employ millwrights to install their products in customers' plants.

Millwrights work in every State. However, about half of them are employed in the heavily industrialized States of Michigan, Ohio, Pennsylvania, Illinois, New York, and Indiana.

Training and Other Qualifications

Millwrights learn the trade by picking up the skills informally or through apprenticeship programs. Those workers who pick up the trade informally usually work as helpers to skilled millwrights over a period of years until they acquire sufficient knowledge and experience to be classified as skilled workers. However, most training authorities agree that apprenticeship programs give young persons a more thorough preparation for this skilled trade. Apprenticeship programs generally last 4 years. Apprentices in this trade are given shop training in dismantling, moving, erecting, and repairing machinery and other equipment. They are also trained in floor layout, the installation of machinery and other equipment, carpentry, welding, and the use of structural steel, wood, and concrete. The apprenticeship program includes related classroom instruction in shop mathematics, blueprint reading, hydraulics, electricity, and safety. Many companies require that apprentice applicants be high school graduates between the ages of 18 and 26.

High school courses in science, mathematics, mechanical drawing, and machine shop practice are useful to young men interested in becoming millwrights. Because millwrights often put together and take apart complicated machinery, mechanical aptitude is important to young men entering the trade. Strength and agility are other important qualifications for millwright work, which often requires considerable lifting and climbing.

Employment Outlook

Employment of millwrights is expected to increase moderately during the 1965–75 decade. The building of new plants, the addition of new machinery, changes in plant layouts, and the maintenance of increasing amounts of heavy and complex machinery and other equipment are factors expected to increase employment of millwrights.

In addition to new job openings that will be created by industrial expansion and increased mechanization, several thousand workers will be needed annually to replace millwrights who transfer to other lines of work, retire, or die. Retirements and deaths alone are expected to result in more than 1,500 job openings annually during the next decade.

Earnings and Working Conditions

The earnings of millwrights vary widely, depending on several factors; for example, the city where they are employed and the type of business in which their employer is engaged.

Average straight-time hourly earnings of millwrights employed in manufacturing industries in 46 areas surveyed in 1964–65 ranged from $2.66 in Providence–Pawtucket, R.I., to $3.63 in San Francisco–Oakland, Calif. More than 80 percent of these workers earned $3 an hour or more.

Millwrights employed by companies doing contract installation work and by construction companies usually have higher hourly wage rates than those employed in manufacturing industries. For example, the minimum average hourly wage rates for millwrights under union-management contracts doing construction work ranged from $3.50 an hour in Charlotte, N.C., to $4.83 in Rochester, N.Y., as of July 1, 1964, according to a national survey of building trades workers in 68 large cities.

Wage rates for apprentices generally start at approximately 50 percent of the skilled worker's rate and increase to the journeyman's rate by the end of the training period.

Millwrights, most of whom work in factories, ordinarily work year round. Those who work for construction companies and for companies that manufacture and install machinery, or move and install machinery on a contract basis, may have periods of unemployment between jobs. These workers may frequently be assigned to jobs away from their homes.

The work of millwrights involves certain hazards. For example, there is danger of being struck by falling tools or other objects or by machinery that is being moved. There also is the danger of falling from high work places. In addition, millwrights are subject to the usual shop hazards, such as cuts and bruises. Accidents have been reduced by the use of protective devices, such as safety belts, safety hats, eye protection, and shoes with metal toes. Millwrights must frequently work on dirty, greasy equipment.

Most millwrights belong to labor unions. Among the unions to which these workers belong are the International Association of Machinists and Aerospace Workers; United Brotherhood of Carpenters and Joiners of America; United Steelworkers of America; International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; International Brotherhood of Pulp, Sulphite and Paper Mill Workers; and the International Union of Electrical, Radio and Machine Workers. Employer-union contracts covering millwrights usually include provisions for benefits such as paid holidays and vacations; hospitalization, medical, and surgical insurance; life insurance; sickness and accident insurance; and retirement pensions.

Where To Go for More Information

United Brotherhood of Carpenters and Joiners of America,
101 Constitution Ave. NW., Washington, D.C. 20001.

Television and Radio Service Technicians

(3d ed. D.O.T. 720.281)

Nature of Work

Skilled television and radio service technicians use their knowledge of electrical and electronic parts and circuits to install and repair a growing number of electronic products. Of these, television receivers are by far the most prominent; other major electronic products are radios (including home, automobile, and two-way mobile radios), phonographs, intercommunication equipment, tape recorders, and public address systems. Many service technicians specialize in repairing one kind of equipment; for example, color television receivers or automobile radios.

Most of the skilled work done by television and radio service technicians involves diagnosing trouble in equipment and making necessary repairs and adjustments. Equipment may operate unsatisfactorily, or break down completely, because of faulty tubes, transistors, resistors, and other components; or poor connections; aging of parts; and dirt, moisture, and other basic troubles that affect all electronic equipment. When service technicians turn on television receivers or other equipment needing repair, signs of unsatisfactory performance, such as absence or distortion of picture or sound, may indicate

what is wrong. Their job is to check and evaluate each possible cause of trouble, beginning with the simplest and most common cause—tube failure. In other routine checks, they look for loose or broken connections and for parts that are charred or burned, due to excessive current or mishandling.

When routine checks do not locate the cause of trouble, service technicians use meters and electronic test equipment to check suspected circuits. For example, they may measure voltages, until an unusual or irregular measurement indicates that part of the circuitry causing trouble. Commonly used meters are vacuum tube voltmeters, multimeters, oscilloscopes, signal generators, and other specialized instruments.

On service calls, service technicians advise customers as to what may be wrong with receivers and whether receivers must be taken to shops for further analysis and repair. If possible, they explain what must be done to repair receivers and estimate the cost of such repairs. After receivers are repaired on the customers' premises, or returned from shops, service technicians explain what has been done. They may further adjust the equipment to put it in proper operating condition.

Work usually done by television and radio service technicians in homes or other places where equipment is used includes making simple electrical checks with a voltmeter, changing tubes, and making necessary adjustments, including focusing the picture or correcting the color balance on a color receiver. Service technicians who make customer service calls carry tubes and other components that are easily replaced in the customer's home. Apprentices or less experienced television service technicians may install or repair antennas on roofs or in attics and run lead in wires from antennas to receivers.

Radios, television receivers, and other equipment small enough to be carried by customers usually are repaired in service shops. Larger television receivers are repaired in shops when they develop troubles which appear only after receivers have been operating for a few hours, or when the troubles can be located only with the more complex test equipment available only in shops.

Service technicians follow schematic diagram and use modern test equipment to check television receiver.

Television and radio service technicians usually refer to wiring diagrams and service manuals that list parts, show connections within receivers, provide adjustment information, and describe causes of trouble associated with unusual symptoms. They must know how to use soldering irons, wire cutters, long-nosed pliers, wrenches, screwdrivers and, sometimes, magnifying glasses when they remove, adjust, or replace parts, components, or complete equipment such as automobile radios. Such work requires patience as well as care to avoid damage.

Where Employed

Nearly 115,000 television and radio service technicians were estimated to be employed in early 1965, of whom about a third were self-employed. About three-fourths of all service technicians worked in service shops or in stores that sell and service television receivers, radios, and other electronic products. Most of the remaining service technicians were employed by government agencies and manufacturers, including manufacturers that operated their own service branches.

Television and radio service technicians are employed in almost every city, because the products they service are used everywhere. However, employment of these workers is distributed geographically in much the same way as the Na-

tion's population. Thus, they are employed mainly in the highly populated States and major metropolitan areas.

Training, Other Qualifications, and Advancement

Training in electronics is required to become a highly skilled television and radio service technician capable of working on various types of electronic equipment. Technical or vocational school training in electronic subjects has helped men to qualify as expert television and radio service technicians. Home study (correspondence school) courses are also helpful. Young men who enter military service may wish to investigate opportunities for training and work experience in servicing electronic equipment, because such experience often is valuable in civilian electronics work, including television and radio servicing. From 2 to 3 years' combined training and on-the-job experience are required to become a qualified television and radio service technician. Men without previous training may be hired as helpers or apprentices if they show aptitude for the work or, like the amateur ("ham") radio operator, have a hobby in electronics.

An important part of the service technicians' training is provided by many manufacturers, employers, and trade associations. Such organizations conduct training programs when new models or new products are introduced and as part of a continuing effort to keep service technicians abreast of the latest technical servicing and business methods. Service technicians also keep up with technical developments by studying manufacturers' instruction books and technical magazines, and by attending training meetings covering electronics service work.

Programs to train unemployed and underemployed workers for entry jobs in the television and radio service field were operating in several cities, in early 1965, under the Manpower Development and Training Act. These programs usually lasted from about 6 months to a year. With additional experience or training, which may include apprenticeship, graduates of these programs may become skilled service technicians.

Television and radio service technicians need a good background in mathematics and physics in order to understand the equipment with which they work. They must know how electronic components and circuits work, and why they function as they do. They must be able to understand technical publications. Television and radio service technicians must also be tactful and courteous in dealing with customers, and be able to express themselves clearly. Other essential qualifications include the ability to manipulate small parts and tools, good hand-eye coordination, normal hearing, and good eyesight and color vision. They often work with delicate wires and parts that are identified only by color codes.

Television and radio service technicians who work in large repair shops or service centers may be promoted to assistant foreman, foreman, and service manager. Frequently, they are able to obtain jobs as electronics mechanic or technician in manufacturing industries or government agencies. Those who are employed by manufacturers can advance to higher paying occupations, such as technical writer, sales engineer, design engineer, and service training instructor. In addition, experienced men who have sufficient funds, adequate business management training, and ability, may open their own sales and/or repair shops.

Young persons interested in advancing to positions such as electronic technician can improve their opportunities by taking trade school, correspondence, or technical institute courses, or other types of advanced courses in electronic engineering, television engineering, automatic controls, engineering mathematics, and other subjects related to electronics.

In early 1965, television and radio service technicians were required to be licensed in several States and cities. To obtain a license, applicants are required to pass an examination designed to test their skill in the use of testing equipment and their knowledge of electronic circuits and components.

Employment Outlook

Employment of television and radio service technicians is expected to increase rapidly during the 1965–75 decade. In addition, more than 1,400 job openings annually are expected to result from the need to replace experienced workers who retire or die. Transfers to other occupations may provide additional job openings.

Employment of service technicians is expected to increase as a result of the rapid growth in the number of radios, television receivers, and phonographs in use during the decade ahead. Factors that will contribute to this growth include rising population and family formations, and rising levels of personal spendable income. In 1964, more than 9 of every 10 households had one or more television receivers. Over the next decade, the number of households with two or more television receivers is expected to increase significantly, mainly because of the growing demand for color and lightweight, portable television receivers. Other consumer electronics products that are expected to be used increasingly include stereophonic radios, phonographs, AM–FM radios, and portable transistor radios. New consumer products, such as home video tape recorders, as well as improved styling and design of existing products, will also stimulate demand. Greater use of nonentertainment products, such as closed-circuit television, two-way radios, and various medical electronic devices, is also expected. For example, closed-circuit television is being used increasingly to monitor production processes in manufacturing plants, and to bring educational programs into classrooms.

In recent years, technological improvements in television receivers and radios (such as the use of transistors in place of tubes) have reduced the amount of service this equipment requires. Technological improvements will continue to reduce servicing requirements in the years ahead and may tend to slow employment growth. However, technological developments will increase employment opportunities for those television and radio service technicians who have theoretical as well as practical knowledge of electronic circuits and know how to use the latest test equipment. Servicing television receivers, radios, and related electronic equipment is a changing field, with constant technological advances. Service technicians will have to keep their training up to date to cope with such changes.

Earnings and Working Conditions

National earnings data are not available for television and radio service technicians. However, information obtained in major metropolitan areas from proprietors of independent service shops and manufacturers who operate service centers indicated that, in early 1965, many service technicians in entry jobs had straight-time weekly earnings ranging from about $60 to $85; many experienced service technicians had weekly earnings ranging from about $95 to $150. Some "inside" (shop) service technicians received higher weekly earnings than "outside" (field) technicians; many shop technicians had straight-time weekly earnings ranging from $130 to $165.

Television and radio service technicians employed in local service shops or dealer service departments commonly work a 6-day, 48-hour week. In large shops, including manufacturers' service branches, they usually work a basic 40-hour week. Service technicians often work more than 8 hours a day and receive higher rates of pay for overtime work. Some employers of television and radio service technicians provide paid vacations and holidays after a specified length of service. Many also provide or help pay for health and life insurance benefits. Some shops are unionized.

Television and radio service is performed in shops and homes where working conditions are usually pleasant. Inside men work at benches, normally provided with stools. Outside men may spend several hours a day driving between shops and customers. Some physical strain is involved in lifting and carrying receivers. Perhaps the greatest hazard is the risk of falling from roofs while installing or repairing antennas. Electrical shock is another hazard, but it has rarely caused serious injury.

Where To Go for More Information

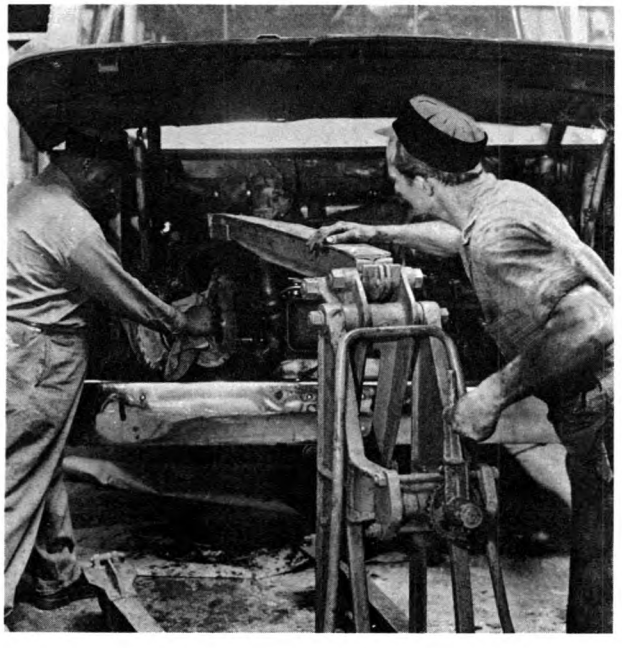
Additional information about jobs in television servicing may be obtained from local service technicians, local dealers who sell and service television receivers and other electronic equipment, local television service associations, and manufacturers who operate their own service centers. Technical and vocational schools that offer courses in television and radio repair, or electronics, can provide helpful information about training. In addition, the local office of the State employment service would be a source of information about the Manpower Development and Training Act and other programs that provide training opportunities.

Truck Mechanics and Bus Mechanics

(2d ed. D.O.T. 5–81.030 and 5–81.035)
(3d ed. D.O.T. 620.281)

Nature of Work

Truck mechanics and bus mechanics have the important job of keeping trucks and buses, which play a key role in the Nation's transportation system, in good running condition. Truck mechanics work on large intercity trucks, as well as on medium and small trucks used in local hauling. They may repair heavy trucks used on construction and mining sites. Bus mechanics maintain a variety of buses, ranging from small ones used in local transit to large transcontinental buses. Although many of the mechanical parts of large trucks and buses are basically the same as automobile parts, truck mechanics and bus mechanics repair large engines, complex transmissions and differentials, air-brakes, and other components that are different from those in automobiles.



Bus mechanics install part.

Mechanics employed in the shops of organizations that maintain and repair their own vehicles may spend much of their time in performing preventive maintenance. In these shops, each vehicle is serviced and inspected periodically. For example, in the course of a periodic maintenance check, mechanics inspect brake systems, steering mechanisms, wheel bearings, universal joints, and many other parts, and make needed repairs or adjustments. By performing preventive maintenance, mechanics help assure safe vehicle operating condition, check wear and damage to parts, and reduce costly breakdowns.

When trucks and buses do not operate properly or when breakdowns occur, these workers determine the cause of the trouble and make the necessary repairs. In large repair shops, mechanics may specialize in one or a few types of repair. For example, some mechanics do mostly major engine or transmission work. If an engine needs to be rebuilt, the mechanic removes it from the vehicle and disassembles it. He examines parts such as valves, pistons, rods, and bearings for wear or defects, and replaces or repairs defective parts. Many mechanics specialize in the repair of diesel engines, which are used widely for trucks and buses. Diesel and gasoline engines are similar, but have different fuel and ignition systems. Therefore, a mechanic who has worked only on gasoline engines needs special training before he can qualify as a diesel mechanic. (See statement on Diesel mechanics elsewhere in the *Handbook*.)

Truck mechanics and bus mechanics use common handtools such as screwdrivers, hammers, pliers, and wrenches; power and machine tools such as pneumatic wrenches, drills, grinders, lathes; special purpose tools such as pump seal installers and transmission jacks; and welding and flame cutting equipment. They also use various types of testing devices to help locate malfunctions. The latter may include relatively simple testing devices such as voltmeters, coil testers, and compression gages, and complicated analytical equipment such as oscilloscopes and dynamometers. Mechanics use hydraulic jacks and hoists to lift and move heavy parts.

When doing heavy work, such as removing engines and transmissions, two mechanics may work as a team, or a mechanic may be assisted by an apprentice or helper. They often work

alone on light repair jobs. Mechanics generally work under the supervision of a shop foreman or service manager.

Where Employed

A large proportion of the estimated 90,000 truck mechanics employed in early 1965 worked for firms that own fleets of trucks. Fleet owners include trucking companies, and companies that haul their own products, such as dairies, bakeries, and construction companies. Other employers of truck mechanics include truck dealers, truck manufacturers, independent truck repair shops, firms that rent or lease trucks, and Federal, State, and local governments.

The large majority of the estimated more than 15,000 bus mechanics employed in early 1965 worked for local transit companies and intercity buslines. A relatively small number of bus mechanics were employed by bus manufacturers.

Truck mechanics and bus mechanics are employed in every section of the country, but most of them work in large towns and cities where trucking companies, buslines, and other fleet owners have large repair shops.

Training, Other Qualifications, and Advancement

Most workers who become truck or bus mechanics learn their skills informally on-the-job. In shops where fleets of trucks and buses are serviced, beginners usually perform such tasks as cleaning, fueling, and lubrication. They may be required to drive vehicles in and out of the shop. As beginners gain experience and as vacancies become available, they usually are promoted to the job of mechanic's helper. In some other shops, young men—especially those with prior automobile repair experience—are hired as helpers. Helpers learn mechanics' skills by assisting experienced mechanics in inspection and repair work. Most helpers are able to make minor repairs after a few months' experience, and are allowed to handle increasingly difficult jobs as they prove their ability. Generally, 3 to 4 years of on-the-job experience is necessary to qualify as an all-round truck or bus mechanic. Additional training may be necessary for mechanics who wish to specialize in repairing diesel engines.

Most training authorities, including joint labor-management committees for the truck transportation industry, recommend a formal 4-year apprenticeship as the best way to learn these trades. Typical apprenticeship programs for truck and bus mechanics consist of approximately 8,000 hours of shop training and at least 576 hours of related classroom instruction.

For entry jobs, employers generally look for young men with mechanical aptitude who are at least 18 years of age and in good physical condition. Where job duties include the driving of trucks or buses, some employers require applicants to be at least 21 years of age and have, or be able to obtain, a State chauffeur's license. Completion of high school is an advantage in getting an entry mechanic job because most employers believe it indicates that a young man can "finish a job" and has potential for advancement.

Young men who are interested in becoming truck or bus mechanics can gain helpful experience by taking high school or vocational school courses in automobile repair. Courses in science and mathematics are helpful since they give a young man a better understanding of how large trucks and buses operate. Courses in diesel repair provide valuable related training. Practical experience in automobile repair gained from working in a gasoline service station, training in the Armed Forces, and working on automobiles as a hobby is also valuable.

Most employers require mechanics to have their own handtools. Experienced mechanics may have several hundred dollars invested in tools. Employers ordinarily will hire beginners who do not own handtools, but they are expected to accumulate them as they gain experience.

Employers sometimes send experienced mechanics to special training classes conducted by truck, bus, diesel engine, and parts manufacturers. In these classes, mechanics learn to repair the latest types of equipment, or receive special training in such subjects as diagnosing engine malfunctions.

Experienced mechanics who have supervisory ability may advance to shop foremen or service managers. Truck mechanics who have sales ability sometimes become truck salesmen. Some mechanics may open their own gasoline service stations or independent repair shops.

Employment Outlook

Employment of truck mechanics is expected to increase by a few thousand each year during the 1965–75 decade, as a result of significant increases in the transportation of freight by trucks. More trucks will be needed for both local and intercity hauling as a result of increased industrial activity, continued decentralization of industry, and the continued movement of the population to the suburbs. In addition to the job openings expected to occur as a result of employment growth, about 1,500 openings will occur annually because of job vacancies resulting from deaths and retirements. Opportunities to enter this occupation will also occur as some mechanics transfer to other lines of work.

A few hundred job opportunities for bus mechanics are anticipated each year during the 1965–75 decade as a result of the need to replace experienced mechanics who retire, die, or transfer to other fields of work, even though the number of bus mechanics employed during this period is expected to remain at approximately the present level. Continued growth in intercity bus travel is anticipated as a result of growing population, new and improved highways, and further curtailment or elimination of railroad passenger service in many areas. However, the favorable employment effect of increasing intercity bus travel is expected to be offset by a decline in local bus travel as a result of the growing use of private automobiles in city and suburban areas.

Earnings and Working Conditions

According to a survey covering 80 cities in late 1964 and early 1965, average straight-time hourly earnings of mechanics employed by trucking companies, buslines, and other firms that maintain their own vehicles ranged from $1.98 in Raleigh, N.C., to $3.75 in San Francisco–Oakland, Calif. In about three-fourths of the cities surveyed, the averages for these workers were greater than $2.70 an hour. These straight-time earnings exclude pay for overtime work.

Apprentices' wage rates generally start at approximately 45 to 50 percent of skilled workers' rates and are increased about every 6 months until a rate of 90 percent is reached during the last 6 months of the training period.

Most mechanics work between 40 and 48 hours per week. Because many truck and bus firms provide service around the clock, they employ mechanics on evening and night shifts, and on weekends. Mechanics usually receive a higher rate of pay when they work overtime or on evening or night shifts, weekends, or holidays. A large number of employers provide holiday and vacation pay; many pay part or all of the cost of financing employee health and life insurance programs and other employee benefits. Laundered uniforms are furnished free of charge by some employers.

Truck mechanics and bus mechanics are subject to the usual shop hazards, such as cuts and bruises. If proper safety precautions are not taken, there is also some danger of injury when repairing heavy parts supported on jacks and hoists. Mechanics handle greasy and dirty parts. They often have to stand or lie in awkward or cramped positions for extended periods of time when repairing vehicles. Mechanic's work areas are usually well lighted, heated, and ventilated, and many employers provide locker rooms and shower facilities for their employees. Although most work is performed indoors, mechanics occasionally make repairs outdoors where breakdowns occur.

Many truck mechanics and bus mechanics are members of labor unions. These include the International Association of Machinists and Aerospace Workers; the Amalgamated Transit Union; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the Transport Workers Union of America; the Sheet Metal Workers' International Association; and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.).

Where To Go for More Information

For further information regarding work opportunities for truck or bus mechanics, inquiries should be directed to local employers, such as trucking companies, truck dealers, or bus lines; locals of the unions previously mentioned; or the

local office of the State employment service. The State employment service also may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of truck mechanics and apprenticeship training may be obtained from:

American Trucking Associations, Inc.,
1616 P St. NW., Washington, D.C. 20036.

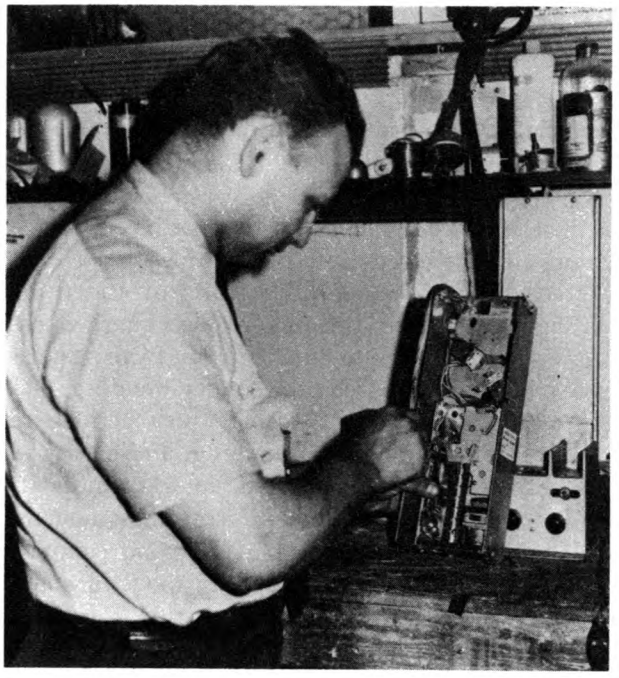
Vending Machine Mechanics

(2d ed. D.O.T. 5-83.993)

(3d ed. D.O.T. 639.381)

Nature of Work

The convenience of automatic, 24-hour merchandising and the great variety of items provided by vending machines have resulted in a nationwide industry and increasing job opportunities for skilled mechanics who maintain and repair these machines. The familiar gum ball, cigarette, or other mechanical, gravity-operated dispensing device no longer typifies modern vending machines. Today, vending machines include growing numbers of complex, electrically operated machines that dispense hot canned foods and ready-to-eat dinners, and brew individual cups of coffee flavored to taste.



Vending machine mechanic services coin rejecting device.

Most vending machine mechanics work both in repair shops maintained by operators (companies that install and service vending machines) and at locations where machines are installed, such as schools, office buildings, factories, theaters, transportation terminals, and hospitals. Some work only in repair shops; others work only in the field, traveling by car or small truck from one location to another to make machine repairs.

In the repair shop, mechanics repair complex vending machine components, such as water pumps, motors, and relays, and overhaul machines returned from locations by replacing worn or damaged parts. They may also assemble new machines in the shop, following instructional materials supplied by the manufacturer. After the machines are assembled, they are filled with products or ingredients and test run. When working on relatively complex machines—for example, beverage dispensing machines—mechanics check to see that the machine dispenses proper quantities of ingredients and that its refrigerating or heating unit operates properly. On gravity-operated machines, mechanics check springs, plungers, and merchandise-delivery systems. They also test coin and change-making mechanisms. After the machines are test run and necessary adjustments are made, mechanics disconnect, empty, clean, and otherwise prepare the machines for removal to designated locations. When installing a machine on location, mechanics make the necessary water and electrical connections and recheck the machines for proper operation.

When a machine on location is reported to be defective, the mechanic first determines the cause of the trouble. He inspects the machine for obvious troubles, such as loose electrical wires,

malfunctions of the coin mechanism, and water and other leaks. He may test the machine's components to isolate the defective parts. After the mechanic locates the cause of the trouble, he may remove and repair, or replace the defective parts, either on location or in his employer's service shop.

Preventive maintenance—avoiding trouble before it starts—is another major responsibility of the mechanic. For example, he periodically replaces coffee brewers and cleans condensers and other refrigeration components. He also cleans electrical contact points, lubricates mechanical parts, and adjusts machines to perform properly.

Both in the service shop and on location, mechanics use handtools, such as wrenches, screwdrivers, hammers, pliers, pipe cutters, electrical circuit testers and soldering irons. In the service shop, they may also use power tools, such as grinding wheels, saws, and drills.

Vending machine mechanics use operating and troubleshooting manuals in the repair of machine systems and components. They must know how and when to do soldering or brazing in order to repair piping systems; how to read diagrams of electrical circuits; and how to test electrical circuits and components. Mechanics who install and repair food vending machines must know State public health and sanitation standards as well as those established under local plumbing codes. They must also know and comply with safety procedures, especially when working with electricity and gas and when lifting heavy objects.

Repairmen are required to do some clerical work. For example, they usually fill out reports, noting the date, place, and nature of each of their repair jobs. They may prepare repair-cost estimates, keep parts inventories, and order parts. If they are chief mechanics, they prepare work schedules for other mechanics.

Mechanics often are called upon to instruct on-the-job trainees in proper machine maintenance and repair. They may demonstrate how vending machines operate and disassemble components and explain their functions. They also show trainees the proper use and care of tools and explain proper safety procedures.

Several hundred mechanics employed by small operating companies service as well as repair machines. These combination "repair-routemen," are responsible for periodically stocking machines, collecting money, filling coin and/or currency changers, and keeping daily records of merchandise distributed. (Additional information about vending machine routemen is included in the statement on routemen elsewhere in the *Handbook*. See index for page numbers.)

Where Employed

In 1964, more than 15,000 mechanics were employed to maintain and repair the more than 4 million vending machines in use. Vending machine repairmen work mainly for operators who place machines in selected locations and provide necessary services, such as cleaning, stocking, and repairing. Although vending machine operators are located throughout the country, most mechanics are employed in the major industrial and commercial centers where there are great numbers of vending machines on location.

Some highly-skilled mechanics are employed by vending machine manufacturers as instructors. These instructors explain technical innovations in machines to repair personnel employed by vending operators and teach them to repair new machines. They provide such instruction either in manufacturers' service divisions in major metropolitan areas or in operators' repair shops.

Training, Other Qualifications, and Advancement

Young men usually enter this trade as general shop helpers. If the shop helpers show promise as mechanics, they may become trainees. Some young men are hired directly as trainees.

Mechanic trainees acquire skills of the trade through on-the-job training— observing, working with, and receiving instruction from experienced mechanics. Also, the larger vending machine operators offer formal instruction to trainees in such fields as plumbing, and electrical and refrigeration theory. Sometimes, trainees attend manufacturer-sponsored training sessions, which emphasize the repair of new and complex machines. Employers usually pay the wages and expenses of their trainees during this period of training, which may last from a few days to several weeks. Experienced mechanics may also attend these sessions. Because vending machines are increasing in complexity, some operators en-

courage both trainees and experienced mechanics to take evening courses in subjects related to machine operation and repair—for example, basic electricity. At least part of the tuition and book expenses for these courses is paid for by the operators.

The duration of on-the-job training varies with the individual's capabilities and the extent of his prior education. Although it may take from 1½ to 2 years for a trainee to become skilled in his work, within 6 to 9 months he usually can handle simple repair jobs and may be sent out alone on trouble calls. Mechanics are generally "in training" throughout their working lives, since they must constantly increase their working knowledge to deal with new and improved vending equipment.

Training programs for vending machine mechanics were in operation in a few metropolitan areas, in early 1965, under the Manpower Development and Training Act. Unemployed and underemployed workers are eligible to apply for such training, which in 1965 lasted up to 52 weeks. Trainees study subjects such as vending machine plumbing, electrical theory, soldering and brazing, refrigeration systems, parts inventory control, and proper use and care of tools. Their training also includes actual repair work on demonstration machines.

Many beginners in this trade are high school graduates, although employers generally do not require a high school diploma for employment. High school or vocational school courses in electricity and machine repair help beginners to qualify for entry jobs. Such courses also may help beginners to skip the lowest rung of the job ladder—general shop helper.

Employers require prospective repairmen to demonstrate mechanical ability, either through their work experience or by scoring well on mechanical aptitude tests. Other required characteristics are honesty, since coin mechanisms and automatic currency changers are often repaired, and an interest in providing efficient service. Ability to deal tactfully with people is another important personal characteristic that employers look for when considering applicants. A commercial driver's license and a good driving record are essential for most vending machine repair jobs.

Skilled mechanics may be promoted to senior mechanic or, in large companies, to shop foreman or supervisor. Advancement to service manager, who is responsible for scheduling repair work, is possible for a few mechanics with administrative ability. Qualified mechanics are occasionally promoted to jobs outside maintenance operations—for example, to supervisory and administrative positions in sales departments.

Employment Outlook

Employment of vending machine mechanics is expected to increase rapidly through the mid-1970's. In addition, a few hundred job openings will result each year from the need to replace repairmen who retire or die. Other job openings will result from the need to replace repairmen who are promoted or who transfer to other fields of work.

The rapid growth of the automatic merchandising industry has created increasing demand for the services of qualified vending machine mechanics. Some of the factors that have directly stimulated the industry's growth are advances in vending machine technology, which have resulted in new and improved machines that dispense a growing variety of merchandise; convenient, round-the-clock service; and the rising costs of selling low-priced, standard items through conventional procedures. Other factors that have contributed to the industry's growth include rapidly expanding population; rising levels of personal disposable income; the movement of industrial plants, schools, hospitals, department stores, and other large establishments to the suburbs where restaurants are often inconveniently located; and the popularity of light, "quickie" meals and snacks.

The factors that spurred expansion of the automatic merchandising industry in the past are expected to continue to stimulate growth. Automatic food vending is expected to be an especially important factor in the industry's future expansion. For example, snack bars and "automatic restaurants" having only coin-operated vending machines, have recently been introduced on turnpikes, in transportation terminals, hospitals, and shopping centers and in other high-traffic areas where fast efficient food service is required. Large machines that vend several hundred different

items have recently been developed and are expected to be in general use by the mid-1970's. Also, improvements in currency-changing devices will make it possible to vend an even greater variety of merchandise. These and other technological improvements will increase the efficiency and versatility and, therefore, the popularity of automatic merchandising machines.

Earnings and Working Conditions

National wage data are not available for vending machine mechanics and trainees. Wage data are available, however, from union-management contracts, in effect in mid-1963, covering a large number of these workers employed by operating companies in 20 States and the District of Columbia. Although these contracts show a very wide range of straight-time hourly pay rates for mechanics, the majority provided for hourly rates between $2.25 and $2.75. Several contracts, covering mechanics in major metropolitan areas, specified rates higher than $3 an hour; a few agreements, covering mechanics in less densely populated areas, specified rates as low as $1.65 an hour. Different hourly rates for shop mechanics and for field (street) mechanics were stipulated in several contracts. In a few, mechanics' rates differed, depending on the complexity of the machines being repaired.

Most vending machine repairmen work an 8-hour day, 5 days a week, and receive premium pay for overtime work. Since vending machines can be operated 24 hours a day, mechanics are frequently required to work at night and on weekends and holidays. Some union-management contracts stipulate higher rates of pay for night-work and for emergency repair work on weekends and holidays.

Many union-management agreements covering vending machine mechanics include health insurance provisions for hospital, medical, and surgical benefits, usually financed by the employer. Some contracts provide for employer-financed retirement benefits. Vacation and holiday pay provisions are commonly included. Paid vacations are granted according to length of service—usually, 1 week after 1 year of service, 2 weeks after 2 years, and 3 weeks after 10 years. The majority of contracts call for 6 or 7 paid holidays annually.

Vending machine repair shops are generally quiet, well-lighted, and have adequate work space. Mechanics usually perform their tasks while sitting comfortably or standing; however, when working on machines on location, they may work in cramped quarters, such as passageways, where pedestrian traffic is heavy. Repair work is relatively safe, although mechanics are subject to such shop hazards as electrical shocks, and cuts from sharp tools and metal objects. Vending machine mechanics who drive trucks to and from location are subject to the usual driving hazards.

Many vending machine mechanics employed in the larger operating companies are members of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America.

Where To Go for More Information

Further information about work opportunities in this trade can be obtained from local vending machine operators and local offices of the State employment service. The State employment service also may be a source of information about the Manpower Development and Training Act and other programs that provide training opportunities. Additional information about employment in this field is available from the National Automatic Merchandising Association, 7 South Dearborn St., Chicago, Ill., 60603.

Watch Repairmen

(2d ed. D.O.T. 4–71.510)

(3d ed. D.O.T. 715.281)

Nature of Work

The skilled workers who repair, adjust, and regulate watches, clocks, chronometers, and electromechanical and other timepieces are called watch repairmen or "watchmakers." The repairman must have a keen ability to diagnose accurately the cause of trouble, often very difficult to locate in complicated mechanisms. His work

requires precise and delicate handling of tiny parts. In repairing a watch, the craftsman first removes the entire "movement" of the watch from the case and examines its working parts, such as the hands, dial, and balance wheel assembly, with the aid of a magnifying eyeglass (called a "loupe"). He may then replace the mainspring, hairspring, balance and other wheels, stems and crowns, and hands or broken jewels and adjust improperly fitted wheels and other parts. The parts are also cleaned and oiled before dials, hands, crystal, and watch band are reassembled.

The development of interchangeable mass-produced watch parts has generally decreased the watch repairman's need for making such parts by hand. However, he must frequently adjust factory-made parts for complicated timepieces to insure a "true" fit.

Watch repairmen use small lathes; timing machines; cleaning machines, including ultrasonic cleaners; and handtools, such as tiny pliers, tweezers, and screwdrivers. The repair of electric and electromechanical watches and clocks requires the use of electrical meters and, frequently, an oscilloscope.

Watch repairmen who own or work in retail jewelry stores also do minor jewelry repairing and may sell watches, jewelry, silverware, and other items such as china and lamps. They may also hire and supervise salesclerks, other watch repairmen, jewelers, and engravers; arrange window displays; purchase goods to be sold; and handle other managerial duties. As supervisory and managerial duties increase, the self-employed watch repairman tends to spend less of his time doing benchwork.

Where Employed

Employment of watch repairmen was estimated to be more than 25,000 in early 1965. The majority of watch repairmen, including a few women, worked in retail stores. About half of these repairmen were either self-employed proprietors of retail jewelry stores or managers of leased departments in jewelry or department stores; the remainder were employees of these stores. Smaller jewelry stores, in particular, are likely to be operated by watch repairmen who do their own repair work.

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Watch repairman uses a watchmakers' lathe to make a balance staff.

Of the watch repairmen who worked outside retail trade, several thousand operated their own trade shops (not usually open to the public), specializing in watch repairs for retail stores. A few hundred repairmen were employed in wholesale establishments, including those that import complete watch movements. A few hundred repairmen worked in manufacturing plants, such as those that make watches, clocks, other precision timing instruments, or electronic equipment. Several thousand trained watch repairmen used their skills in jobs such as instrument maker, repairmen, or assembler; laboratory technician; or microminiaturization specialist in research, development, and engineering laboratories, and in Federal, State, and local government agencies. Some watch repairmen were instructors in vocational schools.

The Nation's 21,000 retail jewelry stores are widely scattered throughout the country. The heaviest concentration of these stores is in large commercial and industrial centers such as New York City, Chicago, or Los Angeles.

Training, Other Qualifications, and Advancement

Many young people prepare for this trade through courses given in private watch repair schools. Some enter through public vocational high school or post-high school training. Others are trained through formal apprenticeship or other on-the-job training programs.

Programs to train unemployed and underemployed workers were in operation in a few cities in early 1965, under the provisions of the Manpower Development and Training Act. With additional training and experience, graduates of these programs may eventually become skilled watch repairmen.

Watch repair schools generally have no specific educational requirements for entrance, although most students are high school graduates. The length of time required to complete the course—usually 18 months to 2 years—is determined by its content, the ability of the individual student, and whether attendance is full or part time. In most watch repair schools, a considerable amount of time is spent taking apart and reassembling various types of watch movements, truing hairsprings, removing and replacing balance staffs and fitting friction jewels, and learning how to use a watchmaker's lathe and watch cleaning machines. Some schools offer courses in the repair of unusual types of timepieces, for example, chronographs, calendars, and timers. In most schools, students are required to furnish their own handtools. Training in instrument repair work in the armed services can be helpful for those who wish to become watch repairmen.

Students or watch repairmen interested in employment outside of the jewelry store or trade shop may require some training in related subjects such as basic electronics, instrument repair, or microminiaturization technology. Such training is provided on-the-job in many industries.

Important qualifications for success in this field are mechanical aptitude, finger dexterity, a sensitive touch, good vision (with or without glasses), and patience. For those interested in owning or working in a retail store, salesmanship and a good business sense are required. Such people should also have knowledge of business practices, accounting, and public relations.

A few States—Florida, Iowa, Indiana, Kentucky, Louisiana, Minnesota, North Dakota, Oregon, and Wisconsin—require watch repairmen to obtain a license to work at the trade. To obtain a license, they must pass an examination designed to test their skill with tools and their knowledge of watch construction and repair. Watch repairmen in all States, however, can demonstrate their ability by passing an examination given by the American Watchmakers Institute. The certificate awarded watch repairmen who pass this examination is widely recognized by employers as an indication of an acceptable standard of skill.

Beginners with sufficient funds—about $2,000 to $3,000 is needed to purchase a watch-timing machine and other tools and equipment—may open their own watch repair shops. The usual practice, however, is to work for an experienced watch repairman before starting one's own business. Some owners of watch repair shops gradually extend their services to include the sale of various items of jewelry, and may eventually establish retail jewelry stores. Such stores require a sizable financial investment.

Employment Outlook

Although total employment of watch repairmen is expected to increase only slightly through the mid-1970's, there will be hundreds of job opportunities annually for these craftsmen. Most job openings will arise from the need to replace experienced workers who retire, transfer to other fields of work, or die. Retirements and deaths alone are expected to result in more than 600 job openings annually.

The present supply of workers with watch repair training, particularly of watch repair school graduates who can do all kinds of repair work quickly and accurately, is inadequate. This shortage may last for several years, because the number of workers currently being trained is insufficient to meet the anticipated growth in employment and replacement needs. Some new job openings for watch repairmen will occur in retail stores and trade shops in small cities where business is expanding, and in newly established shopping centers in the suburbs of large cities. In addition, there will be a continuing demand for well-trained workers to use their watch repair skills in the production of miniaturized devices, especially

in industries making scientific instruments and electronic equipment.

Other factors are expected to contribute to the demand for watch repairmen. The number of watches in use will undoubtedly rise as population and family incomes increase. The trends toward owning more than one watch, wearing watches as costume jewelry, and buying more children's watches are expected to continue. The popularity of small watches, which need repair more frequently than large ones, and the increasing use of more complicated timepieces—chronographs, electronic watches, calendar watches, and self-winding watches—will also help to maintain a large volume of repair work. Increased demand for miniaturized consumer goods, such as transistor radios, television sets, and hearing aids, and the trend in the missile, aircraft, instrument, and computer industries towards smaller and lighter weight components and assemblies, are expected to increase further the demand for individuals with watch repair training to work in establishments manufacturing such equipment. On the other hand, the factors that will tend to increase the demand for watch repairmen will be partially offset by other factors that will operate to decrease it. Sales of inexpensive watches that cost no more to replace than to repair will probably continue to increase, and competition from persons who are employed in other fields, but who repair watches in their spare time, is expected to continue.

Earnings and Working Conditions

Earnings of most watch repairmen in entry jobs ranged from about $60 to $100 a week in early 1965, depending on individual ability and place of employment. Beginners employed in retail stores usually earned from $75 to $90 for a 40-hour week, and those employed in trade shops earned from $60 to $75. Beginners employed by watch manufacturing establishments generally earned from $95 to $100 a week.

Experienced journeymen employed in retail stores, trade shops, and watch manufacturing establishments received from $100 to $150 for a 40-hour week; supervisors or managers of large retail repair departments earned up to $200 a week. In addition, watch repairmen in retail stores sometimes receive commissions based on sales of watches and other items in the store. Repairmen in large retail and manufacturing establishments often have the opportunity to participate in life and health insurance programs and savings and investment plans. Watch repairmen who are in business for themselves usually earn considerably more than those working for a salary. Earnings of the self-employed depend on the amount of repair work done and, in the case of watch repairmen who own retail jewelry stores, the volume of sales and working hours.

Watch repairmen frequently work longer than the standard 40-hour week. Those who are self-employed or located in small communities usually work a 48-hour week or as long as necessary. The work involves little physical exertion and is generally performed in comfortable, well-lighted surroundings. This light, sedentary work is frequently recommended to certain handicapped workers.

Some watch repairmen are members of the International Jewelry Workers Union or the America Watch Workers Union (Ind.).

Where To Go for More Information

Information on schools giving training courses acceptable to the trade, as well as on watch repairing as a career, may be obtained from:

American Watchmakers Institute,
P.O. Box 70, Station A, Champaign, Ill. 61824.

Information on watch repair job opportunities in retail stores can be obtained from:

Retail Jewelers of America, Inc.,
1025 Vermont Ave. NW., Washington, D.C. 20005.

Further information about work opportunities or training in this trade may be available from local offices of the State employment service.

PRINTING (GRAPHIC ARTS) OCCUPATIONS

Printing is an art, a leading industry, and one of our chief means of communication. In early 1965, it provided employment for more than 900,000 workers in a wide variety of occupations. Although these occupations are found principally in the printing, publishing, and allied industries, they are also found in government agencies and in private firms that do their own printing, such as banks, and insurance companies, and manufacturers of paper products and metal containers. About a third of all printing employees work in printing craft occupations. These craft occupations are described in detail later in this chapter. Other occupations in the printing industries include printing estimator, printing technician, mailer, computer programer, and computer typist, as well as the usual administrative, clerical, maintenance and sales occupations found in all industries.

Nature and Location of the Industry

The printing process is basically a means of transferring ink impressions of words, numerals, symbols, and photographs or other illustrations to paper, metal, or other materials. The most commonly used methods of printing are letterpress, lithography, gravure, and screen printing. Each method has special advantages and requires some special skills.

Included in the printing, publishing, and allied industries are the printing and publishing of newspapers, magazines, and books; the production of business forms; the production of greeting cards and gift wrappings; commercial or job printing; bookbinding; and the provision of typesetting, photoengraving, platemaking, and other printing services, primarily for printing establishments.

In early 1965, the largest division in terms of employment was newspaper printing and publishing, with over 330,000 employees in the more than 8,000 establishments. Most daily and many weekly newspapers throughout the Nation do their own printing. Although some major newspapers employ several hundred workers, many smaller dailies and weeklies have fewer than 20 employees.

Commercial or job printing establishments, the second largest division, employed about 300,000 workers in about 17,000 establishments, including lithographic shops. Establishments in this division produce a great variety of materials such as advertising matter, letterheads, business cards, calendars, catalogs, labels, and pamphlets. They also print limited-run newspapers, books, and magazines. More than half of all workers in commercial shops are in establishments with fewer than 100 workers. A few large plants, that employ a thousand workers or more each, account for about 10 percent of all commercial printing employees.

Printing jobs are found throughout the country. Almost every town has at least one printing shop of some kind—frequently, a small newspaper plant which also may do other printing. However, more than half of the Nation's printing employees are in five States—New York, Illinois, California, Pennsylvania, and Ohio. Within these States, most printing activities are in or near manufacturing, commercial, or financial areas such as New York, Chicago, Los Angeles, Philadelphia, San Francisco–Oakland, Cincinnati, and Cleveland. Other leading centers of printing employment are Boston, Detroit, Minneapolis-St. Paul, Washington, D.C., St. Louis, and Baltimore. Employment in book and magazine printing is highly concentrated in these areas. A much larger proportion of employment in newspaper plants, however, is found outside these centers because of the great number of small local newspapers.

Printing Methods

All methods of printing have certain common characteristics. A surface of metal, stone, wood, linoleum, rubber, or plastic is so prepared that a

part of it can be covered with ink. The ink is then transferred to a sheet of paper or other material which is pressed against the prepared surface.

In relief printing, the printing surface stands up from the rest of the surrounding printing plate area. Ink is rolled over the raised surface and then paper is pressed against it. The best known and most widely used example of this method is letterpress printing; other examples of relief printing are flexography, in which a rubber plate is used, linoleum and wood block printing, and relief engraving on metal or plastic.

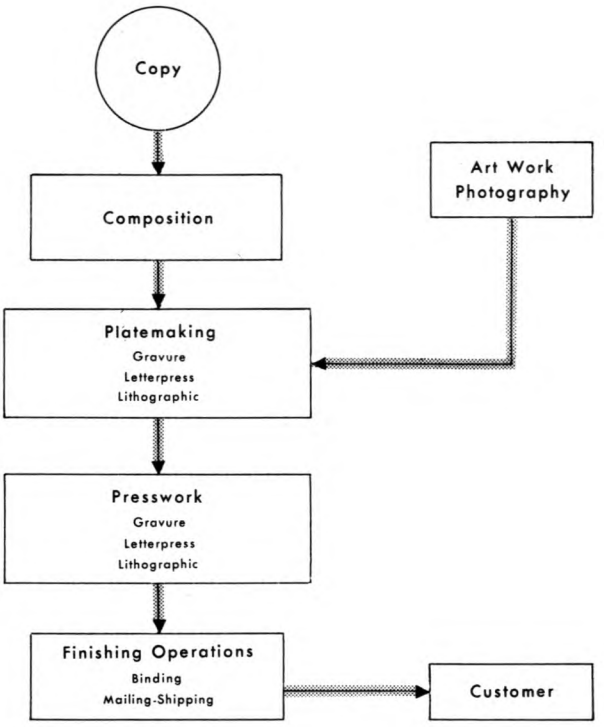
In lithography (offset printing), the printing plate surface is smooth, with both image and nonimage areas on the same level. Lithography is based on the principle that grease and water do not mix. The image areas of the plate are coated with a substance to which the greasy printing ink will stick. On the press, the plate is moistened with water before each inking, so that only the image areas take up the greasy ink from the inking roller. The inked image is transferred from the plate to a rubber blanket and then to the surface to be printed. The lithographic method can be used to produce practically all items printed by any other method. It is especially satisfactory for printing on rough-textured surfaces because of the flexibility of the rubber blanket.

In gravure printing, the material to be printed is etched into the surface of the printing plate. The whole surface is covered with ink and then wiped off, leaving ink only in the sunken or etched areas. When paper or other material is firmly pressed against the surface the ink is sucked out and appears on the paper. Copper and steel plate engraving also uses this technique.

Screen printing is a process in which inks, or other materials such as paint, varnish, and liquid plastic are forced by the action of a flexible blade through a stencil mounted on a finely woven screen, generally silk or stainless steel. The shape of the stencil openings determines the design to be printed. This process may be applied to a wide variety of surfaces such as conventional paper, cardboard, wood, glass, metal, plastic, and textiles. Screen printing is used on irregular shaped surfaces and cylindrical surfaces as well as on flat surfaces.

CHART 30

SIMPLIFIED VIEW OF THE FLOW OF PRINTING WORK . . . .



Regardless of the method used, several basic steps are involved in the production of printed matter. (See chart 30.) They include: layout—planning the composition and content of each page; typesetting and composition—producing and assembling the text type, headings, illustrations and other materials into final page form; platemaking—preparing duplicate printing plates from the original composition for use on the printing presses; printing—transferring the inked impressions to the printing surface; and finishing—binding and mailing operations.

Printing Occupations

Production of printed materials involves workers in a wide variety of occupations. A large group of printing employees are printing craftsmen who in early 1965 numbered about 360,000. Printing craftsmen usually specialize in one area of printing operations, for example, type composition, photography, platemaking, presswork, or binding. Their training, moreover, is largely

confined to only one of the basic printing methods—letterpress, lithographic, or gravure.

The estimated 175,000 skilled composing room workers employed in early 1965 were the largest group of printing craftsmen. This group includes hand compositors, typesetting machine operators, makeup men, tape-perforating machine operators (teletype-setters), and proofreaders. Other large groups of skilled printing workers are printing pressmen and their assistants; lithographic craftsmen, including cameramen, artists, strippers, platemakers, and lithographic pressmen. Bookbinders, photoengravers, electrotypers and stereotypers are other important printing craftsmen. Individual occupations are described in detail later in this chapter.

Maintenance machinists, who repair and adjust typesetting machines, printing presses, or bindery equipment, are another group of skilled workers employed in large plants.

In the skilled occupations, practically all the workers are men. However, many of the less skilled jobs, especially in the binderies, are held by women. Printing establishments also employ a great many persons as executives, salesmen, accountants, engineers, stenographers, clerks, and laborers. Newspapers and other publishers employ a considerable number of reporters and editors. These occupations are discussed elsewhere in the *Handbook*. (See index for page numbers.)

Because of the increasingly complex and highly mechanized printing equipment in use today, there is a growing need for technically trained people in all areas of printing management and production. For example, an increasing number of production technicians are being employed throughout the printing industry. These men are responsible for seeing that the standards established for each printing job are met. To do this they must be thoroughly familiar with the printing processes and the many technical instruments used in the plant to judge and control the quality of the printing.

The mailroom, chiefly in newspaper and periodical plants, is another area of employment closely related to printing production. Here workers address, bundle, and tie the printed matter for distribution. Modern mailroom processes are mechanized to a considerable extent. Mailers operate addressing, stamping, stacking, bundling, and tying machines.

Training and Other Qualifications

Apprenticeship is a common method of entry into the printing crafts. In some instances, it is the only means by which one may be trained to become a journeyman (skilled worker) in a unionized shop. Formal apprenticeship is also required for journeyman status in many larger establishments not covered by union contracts.

At the beginning of 1965 about 11,000 registered apprentices were in training in the skilled printing crafts. A registered apprentice is an employee who, under an expressed or an implied agreement, receives instruction in an apprenticeable occupation for a stipulated term and who is employed in an apprenticeship program registered with a State apprenticeship agency or the U.S. Department of Labor's Bureau of Apprenticeship and Training. In addition, several thousand apprentices were in nonregistered programs. A substantial number of persons were also learning a printing trade while working as helpers, particularly in small printing shops or lettershops, or through a combination of work experience and schooling.

Printing trades apprenticeships usually last from 4 to 6 years, depending on the occupation and the shop or area practices. The apprenticeship program covers all phases of the particular trade and generally includes classroom or correspondence study in related technical subjects in addition to training on the job. As new printing methods have been developed and introduced, they have generally been incorporated into the duties of the traditional printing crafts and included in the apprentice training programs. Apprenticeship applicants are generally required to be between 18 and 30 years of age and must pass a physical examination. However, in many printing crafts there is no maximum age limit for entry into an apprenticeship.

In selecting applicants for printing craft jobs, most employers require a high school education or its equivalent. A thorough knowledge of spelling, punctuation, the fundamentals of grammar, and basic mathematics is essential in many of

the printing trades. A knowledge of the basic principles of chemistry, electronics, and physics is becoming increasingly important because of the growing use of photomechanical and electronic processes in printing. An artistic sense is also an asset since the finished product should be pleasing in balance and design. Most printing crafts require men with good eyesight, about average physical strength, and a high degree of manual dexterity. Mental alertness, speed with accuracy, neatness, patience, and the ability to work with others are also necessary. The ability to distinguish colors is important in areas of printing where color is used. Many employers require applicants to take one or more of the aptitude tests developed for printing industry occupations by the U.S. Department of Labor. These tests are given in the local offices of State employment services. Apprentices are often chosen from among the young men already employed in various unskilled jobs in printing establishments who demonstrate the mechanical aptitudes essential for the printing crafts.

About 4,000 schools—high schools, vocational schools, technical institutes, and colleges—offer courses in printing. These courses may help a young person to be selected for apprenticeships or other job openings in the printing and publishing industries.

Employment Outlook

There will be many opportunities for young men to enter the skilled printing trades during the 1965–75 decade. These opportunities will occur primarily as a result of the need to replace experienced workers who retire, die, or transfer to other fields of work. Many of these opportunities, however, will be in new types of jobs because of technological changes in production methods. Retirements and deaths alone may provide 3,000 to 4,000 job openings each year during the decade. Slight employment increases in some printing trades are also expected to provide a small number of additional job openings annually.

A continued rise in the volume of printed material is expected because of population growth, the increasingly high level of education, the expansion of American industry, and the trend toward greater use of printed materials for information, packaging, advertising, and various industrial and commercial purposes. However, employment in skilled printing trades occupations is not expected to increase significantly because of the continuing introduction of laborsaving technological changes in printing methods. These changes, primarily in the areas of type composition, platemaking, and bindery operations, include the increasing use of electronic devices such as computers, electronic etching and color-separating equipment, and electronic controls for highly mechanized bindery equipment.

Employment growth will vary among the printing trades. For example, employment of compositors, the largest group of printing craftsmen, is expected to decrease slightly despite the continued increase in the volume of printing because of laborsaving technological changes in typesetting and composition. Employment of lithographic craftsmen, however, is expected to increase because of the growing use of lithography (offset printing).

Earnings and Working Conditions

Earnings of production workers in the printing and publishing industry, including the unskilled and semiskilled workers and printing craftsmen, are among the highest in manufacturing industries. In 1964, production workers in this industry averaged $114.35 a week, or $2.97 an hour, compared with $102.97 a week, or $2.53 an hour, for production workers in all manufacturing.

Earnings of individual printing craftsmen vary from one occupation to another. Generally, the wage rates in large cities are higher than in small communities. Wage rates also differ by type of printing establishment. The following tabulation shows the average union minimum hourly wage rates for daywork for selected printing occupations in 69 large cities on July 1, 1964. These rates are the minimum basic rates for the individual occupational classifications. They do not include overtime, other special payments, or bonuses.

	Average union hourly rate, July 1, 1964	
	Newspaper [1]	Book and job
Bookbinders	------	$3.64
Compositors		
Hand	$3.77	3.79
Machine operators	3.80	3.80
Electrotypers	------	4.00
Photoengravers	4.14	4.41
Pressmen (journeymen)	3.71	------
Pressmen (cylinder)	------	3.73
Pressmen (platen)	------	3.37
Stereotypers	3.69	4.10
Mailers	3.39	3.28

[1] Average day rates.

A standard workweek of 37½ hours was specified in labor-management contracts covering about 2 out of 5 of the organized printing trades workers, although standard workweeks of 36¼ hours and 35 hours were also in effect. A 40-hour workweek was standard in some establishments in the industry. Time and a half is generally paid for overtime. Work on Sundays and holidays is paid for at time and one-half or double-time rates in most commercial printing establishments. In newpapers plants, however, the craftsmen's workweek often includes Sundays. Time and one-half or double time is paid for these days only when they are not part of the employee's regular shift. Night-shift workers generally receive pay differentials above the standard day rates.

The starting wage rates of apprentices are generally from 40 to 50 percent of the basic rate for journeymen in the shop. Wages are increased periodically, usually every 6 months, until in the final year or half year of training, the apprentice receives from 80 to 95 percent of the journeyman rate. Apprentices with prior civilian or military experience can sometimes obtain credit which will start them above the beginning apprentice pay rate, and also reduce the length of time required to become a journeyman, if they successfully pass examinations provided for situations of this nature. In exceptional cases, these provisions also apply to apprentices with technical school training. In some of the trades, apprentices may be upgraded when they show exceptional progress.

The annual earnings of printing craftsmen depend not only on their hourly rate of pay, but also on how regularly they are employed. The printing industry has fewer seasonal fluctuations than most other manufacturing industries and this is one of the reasons why it offers steadier employment and higher average annual earnings.

Paid vacations are generally provided for printing craftsmen. The most common provision in labor-management agreements is 2 weeks' vacation with pay after 1 year's employment. Many agreements, however, provide for 3 weeks' vacation with pay after 1 or more years of employment, and an increasing number provide for 4 weeks with pay after 20 or 25 years. Other major benefits, such as paid holidays, retirement pay, life and disability insurance, hospitalization, and severance pay are also common. In addition, a number of printing trade unions have for many years operated their own programs providing their members with one or more types of benefits, such as life insurance, retirement, sickness, or disability payments.

The injury-frequency rate in the printing industry is somewhat lower than the average for all manufacturing industries.

A large proportion of the printing trades workers are members of unions affiliated with the AFL–CIO. The largest printing trades unions are the International Printing Pressmen and Assistants' Union of North America, the International Typographical Union, and the Lithographers and Photoengravers International Union. Other printing trades unions include the International Brotherhood of Bookbinders, the International Stereotypers' and Electrotypers' Union of North America, and the International Mailers Union (Ind.). The majority of unionized lithographic workers are in plants under contract with the Lithographers and Photoengravers International Union which includes both printing craftsmen and other lithographic workers.

Where To Go for More Information

Information on opportunities for apprenticeship or other types of printing employment in a particular locality may be obtained from various sources. Applicants may apply directly to the printing establishments in their areas. The names and locations of local printers can usually be obtained from the classified section of the local telephone directory. In addition, the local unions and employer associations in the printing industry can often provide information regarding

apprenticeship openings. In union shops, applicants may apply directly to the joint union-management coordinating committee. In recent years, there has been an increasing use of local offices of the State employment services as information exchanges for apprenticeship openings. Some of these offices provide services such as screening applicants and giving aptitude tests. However, the final selection is made by the employer and the joint apprenticeship committee.

General information on the printing industry may be obtained by writing to the following organizations.

American Newspaper Publishers Association,
750 Third Ave., New York, N.Y. 10017.

Book Manufacturers' Institute, Inc.,
25 West 43d St., New York, N.Y. 10036.

Education Council of the Graphic Arts Industry, Inc.,
1025 15th St. NW., Washington, D.C. 20005.

Graphic Arts Technical Foundation,
4615 Forbes Ave., Pittsburgh, Pa. 15213.

Gravure Technical Institute,
30 Rockefeller Plaza, New York, N.Y. 10020.

Printing Industries of America, Inc.,
20 Chevy Chase Circle NW., Washington, D.C. 20015.

(See sections on individual printing occupations for names of labor organizations and trade associations which can provide more information on specific printing trades.)

Composing Room Occupations

The printing process begins in a composing room where manuscript copy is set in type, proofed, and checked for errors. Machine and hand-set type, and other materials, such as photoengravings, are assembled there and prepared for the pressroom.

In early 1965, nearly half of all printing craftsmen—about 175,000—were employed in composing room occupations. These occupations offer many opportunities for young men interested in learning a skilled craft. Compositors usually have year-round employment and very good earnings. Composing room workers include compositors who set type by hand; typesetting machine operators who operate semi-automatic typesetting machines; tape-perforating machine operators who perforate tapes used to operate some typesetting machines; *bankmen* who assemble type in shallow trays called "galleys" and make trial proofs of this type; *proofreaders* who check the galley proofs with the original copy for errors; *make-up men* who assemble type and photoengravings in page forms; and *stonehands*, who arrange the pages in proper sequence.

Compositors are employed in newspaper plants, commercial printing shops, in book and periodical printing plants, and in typographic composition firms that set type for printing establishments, advertising agencies, and advertising departments of large business firms. A third of all compositors work in newspaper plants. A large number are employed in establishments that specialize in setting type for book and magazine publishers.

Skilled composing room workers are employed in almost every community throughout the country, but they are concentrated in large metropolitan areas such as New York, Chicago, Los Angeles, Philadelphia, Boston, San Francisco, Detroit, Minneapolis–St. Paul, Cleveland, and Washington D.C.

Nature of Work

Hand compositors (*typesetters*) (D.O.T. 973.381) make up the oldest composing room occupation. The majority of type that is set by hand today is for work requiring very fine composition, for advertising copy, and for small jobs where it would be impractical to set the type by machine.

In setting type by hand, the compositor, reading from the manuscript copy, first sets each line of type in a "composing stick" (a device which holds type in place) letter by letter and line by line. When this stick is full, he slides the completed lines onto a shallow metal tray called a "galley."

Typesetting machine operators are craftsmen who operate semiautomatic machines which set type much more rapidly than the hand compositors.

Linotype (*or Intertype*) *machine operators* (D.O.T. 650.582) reading from the copy clipped

to the machine's copy board, select letters and other characters by operating a keyboard which has 90 keys. As they press the keys, the letters, in forms of metal molds called matrices, are assembled into lines of words. A space-band key provides the necessary spacing between words. As they complete each line, the operators touch a lever and the machine automatically casts the line of type into a solid metal strip called a "slug." The slugs are then deposited in a galley and are later assembled into the type forms from which either the printing impressions or the plates are made. Nearly all newspaper plants, large commercial shops, and typographic composition firms use these machines and operators to set type. In the smaller plants, the typesetting machine operator maintains and repairs as well as operates the typesetting machine. In the larger plants, maintenance machinists are employed to make all but minor adjustments to the machines.

Other typesetting machine operators work on Monotype machines. One machine is called the Monotype keyboard and the other is the Monotype caster.

Monotype keyboard operators (D.O.T. 650.582) operate keyboards quite similar to those on a typewriter, but which include about four times as many keys. The keyboard machine produces a perforated paper tape which is later fed into the casting machine. The keyboard operator must be able to handle complicated copy, such as statistical tables.

Monotype caster operators (D.O.T. 654.782) operate the casting machines which automatically cast and assemble the type, guided by the perforations in the paper tape prepared by the keyboard machine. As the rolls of perforated tape are fed into the machines, the proper matrices for casting letters are automatically selected by means of the perforations in the tape. Molten metal is forced into the matrix to form the individual character. The Monotype casting machine, as the name suggests, casts type one letter or character at a time. This permits some corrections to be made by hand without the need to reset an entire line. The principal duties of caster operators are to insert the tape, adjust and tend the machine while it is operating, and do necessary maintenance and repair work. Only one caster operator is employed to every two or three keyboard operators. Typographic composition firms are the largest employers of both Monotype keyboard and caster operators.

Phototypesetting machine operators (D.O.T. 650.582) set type on machines which may be similar in appearance, or method of operation, or both, to those which cast type in hot metal. In phototypesetting, however, a photographic process replaces the function of the hot metal, and the final product is a film or photographic paper print of the type rather than a metal slug. In one type of machine, as the operator presses the keys, the individual matrices or mats, which contain small film negatives, are assembled and photographed on film, character by character, to form a line of type. In other phototypesetting machines, a perforated paper tape, or a magnetic sound tape is fed into a phototypesetting machine which "reads" the tapes and photographs the individual characters indicated on the tape.

Some typesetters operate photolettering machines which produce lines or individual characters in large-size type such as that used for newspaper headlines and for advertisements. As in phototypesetting, a photographic process is involved, and the final product is on film or paper.

In addition to machine operation, the phototypesetter must be familiar with the fundamentals of photography, including darkroom procedures, because frequently he has to develop the film on which the type has been photographed. He may also assemble and arrange developed film into pages. This process, called "stripping," corresponds to page makeup in the hot metal type process. The operator also makes minor repairs on the phototypesetting machine. Since much of this equipment has electronic controls, the operator needs a basic working knowledge of the principles of electronics.

Typesetting machine operators also set type by the "cold type" method. The type is set on paper, using machines that are similar to typewriters. These machines automatically space letters and lines. "Cold type" composition may be set directly on a paper or even a metal sheet from which the plate is to be made, or the cold type images may be cut from paper and pasted on layout sheets. The process of assembling and pasting this type on layout sheets is called paste makeup, and is somewhat similar to hand composition.

The worker who assembles and pastes up all the materials for a page is called a paste-makeup man. Cold type composition is frequently used by newspapers for display advertising, and by small newspapers to set regular text copy.

Typesetters frequently operate tape-perforating machines called teletypesetters. These are machines with keyboards similar to those of typewriters. The machines are fitted with reels of tape that are perforated as the keys are struck. The perforated tapes are inserted in line casting machines, which set the type as directed by the perforations. After the tape has been punched, it may be sent by teletype to other cities where it is automatically reperforated and used to control the operation of linecasting machines.

Training and Other Qualifications

Most compositors acquire their skills through apprenticeship training. In union shops, apprentices are often selected from among the helpers. Some compositors acquire their skills while working as helpers for several years (particularly in small shops and in the smaller communities) or through a combination of trade school and helper experience.

Tape-perforating machine operators must be expert typists. They generally acquire their typing skill in commercial courses in high school or in business school. It is not necessary for these operators to be trained as journeymen compositors to perform their work efficiently; however, they must be familiar with printing terms and measurements. The training period for tape-perforating machine operators is generally about a year. Journeymen compositors sometimes transfer to this occupation.

Generally, apprenticeship covers a 6-year period of progressively advanced training, supplemented by classroom instruction or correspondence courses. However, this period may be shortened by as much as 2 to 2½ years for apprentices who have had previous experience or schooling or who show the ability to learn the trade more rapidly. The time and emphasis spent upon any particular phase of training varies from plant to plant, depending upon the type of printing establishment.

Lockup man makes last minute changes in frame of newspaper page.

A typical apprenticeship program for compositors includes instruction in elementary hand composition, page makeup, lockup, and lineup, and proofreading. After basic training as a hand compositor, the apprentice receives intensive training in one or more specialized fields, such as the operation of typesetting machines, including phototypesetting and teletypesetting machines, as well as specialized work in hand composition and photocomposition.

Applicants for apprenticeship generally must be high school graduates and in good physical condition. They are sometimes given aptitude tests. Important qualifications include training in English, especially spelling, and in mathematics. Printing and typing courses in vocational or high schools are good preparation for apprenticeship applicants, and a general interest in electronics and photography is becoming increasingly useful. Artistic ability is an asset for a compositor in layout work.

Apprentices are paid according to a predetermined wage scale, which increases as the apprenticeship period advances. At the beginning of 1965, there were over 4,000 registered apprentices in training for skilled composing room jobs.

Employment Outlook

A few thousand job openings for composing room workers are expected annually during the 1965–75 decade because of the need to replace experienced workers who retire or die. Retirements and deaths alone should provide approxicately 2,500 job openings annually.

In spite of the anticipated expansion in the volume of printing in the United States during the decade, employment of compositors is expected to decline slightly because of technological changes in typesetting equipment that will make it possible to set type faster and with fewer operators. For example, over the past decade there has been an increasing use of automatically operated typesetting machines. These machines, which set lines of type in metal or on film, are activated by an electronic device into which perforated tapes are fed. The perforations indicate characters, words, sentences, length of lines, spacing, and hyphenation. The recent introduction of computers, programed to perforate the codes for spacing, length of line, and hyphenation, simplifies the work of the tape-perforating machine operator, and increases the speed at which type can be set.

Technological changes also will significantly affect the educational and skill requirements for composing room workers. The greater use of phototypesetting, for example, requires compositors to have some photographic skills. Since much of the new typesetting equipment is operated by electronic systems, a knowledge of the application of electronic principles to the operation of this equipment is becoming increasingly important for the compositor.

Earnings and Working Conditions

As is true for most printing crafts, wages of skilled composing room workers are relatively high compared with skilled workers generally. However, there is considerable variation in wage rates from place to place and from firm to firm. The average union minimum hourly wage rate for hand compositors on day shift in 69 large cities was $3.77 in newspaper plants and $3.79 in book and job shops on July 1, 1964. Union minimum wage rates for compositors in book and job shops ranged from $2.65 an hour in Jackson, Miss., to $4.36 in San Francisco, Calif. In newspaper establishments, the union minimum hourly wage rates for day-shift compositors ranged from $2.70 an hour in Jackson, Miss., to $4.15 in Oakland, Calif.

Working conditions for compositors vary from plant to plant. Some heat and noise are made by hot metal typesetting machines. In general, the newer plants are well lighted and clean, and many are air conditioned. Composing room jobs require about average physical strength. Hand compositors are required to stand for long periods of time, and to do some lifting. Young men with some types of physical handicaps, such as deafness, have been able to enter the trade and do the work satisfactorily. Many compositors work at night on the second or third shift for which they generally receive additional pay.

A substantial proportion of compositors are members of the International Typographical Union.

Where To Go for More Information

International Typographical Union,
P.O. Box 157, Colorado Springs, Colo. 80901.

International Typographic Composition Association, Inc.,
2333 Wisconsin Ave. N.W., Washington, D.C. 20007.

Printing Industries of America, Inc.,
20 Chevy Chase Circle NW., Washington, D.C. 20015.

See page 519 for additional sources of information.

Photoengravers

(2d ed. D.O.T. 4–47.100 through .300)

(3d ed. D.O.T. 971.381 and .382)

Nature of Work

Photoengravers make metal printing plates of illustrations and other copy that cannot be set up in type. The printing surfaces on these plates stand out in relief above the nonprinting spaces, as do the letters and the accompanying type. Similarly, gravure photoengravers, a specialized type of photoengraver, make gravure plates in which the image is etched below the surface for use in reproducing pictures and type.

In making a photoengraving plate for the letterpress process, the entire job may be done either by one man or by a number of skilled workers, each specializing in a particular operation. Specialists include cameramen, printers, etchers, finishers, routers, blockers, and proofers. In the large shops, the work is almost always divided among a number of these specialists.

A *cameraman* starts the process of making a photoengraving plate by photographing the material to be reproduced. Plates made from line drawings are called line plates and those from photographs are called halftone plates. After the cameraman develops the negative, the *printer* prints the image on a metal plate by coating the plate with a solution sensitive to light and then exposing it and the negative to arc lights. The image areas are protected by chemical means so that when the plate is placed in an acid bath by the *etcher*, only the nonimage areas are etched away, leaving the image areas standing out in relief.

A number of other photoengraving operations may be performed depending on the quality of the printing required. Photoengravings for very high quality books or periodicals, for example, require more careful finishing than those for newspapers. The *finisher* carefully inspects and touches up the plate with handtools; the *router* cuts away metal from the nonprinting part of the plate to prevent it from touching the inking rollers during printing; the *blocker* mounts the engraving on a suitable base to make it reach the right height; and the *proofer* prints a sample copy on a proof press.

Photoengraver routs metal from nonprinting areas of printing plate.

The operations involved in gravure photoengraving are much like those in letterpress photoengraving except that the image areas, rather than the background, are etched away.

Where Employed

About 17,000 journeymen photoengravers were employed in early 1965. The great majority of photoengravers (about 12,000) are employed in commercial service shops where the main business is making photoengravings for use by others. Newspaper and rotogravure shops employ several thousand photoengravers. In addition, book and periodical shops and the U.S. Government Printing Office also employ photoengravers. Many of these craftsmen have their own shops. Photoengravers' jobs are highly concentrated in the largest printing centers, particularly New York, Chicago, Philadelphia, and Los Angeles.

Gravure photoengravers work mainly in independent gravure plants. Most of them work for the small number of big firms which handle a large proportion of all gravure work. A few

large newspaper and commercial plants also have departments where this work is done. Gravure plants are concentrated in a few States, particularly New York, New Jersey, Illinois, and Ohio.

Training and Other Qualifications

The most common way to become a photoengraver is through apprenticeship training. The apprenticeship program generally covers a 5- or 6-year period and includes at least 800 hours of related classroom instruction. Besides the care and use of tools, the apprentice is taught to cut and square negatives, make combination plates, inspect negatives for defects, mix chemicals, sensitize metal, and to operate machines used in the photoengraving process.

Apprenticeship applicants must be at least 18 years of age and generally must have a high school education or its equivalent, preferably with courses in chemistry and physics and training in art. Credit for previous experience acquired in photoengraving work may shorten the required apprenticeship time. Many employers require a physical examination for prospective photoengravers; the condition of the applicant's eyes is particularly important because a photoengraver's duties involve constant close work and color discrimination.

Employment Outlook

A few hundred job openings are expected each year during the 1965–75 decade, because of the need to replace photoengravers who retire or die. However, no increase in the total number of these craftsmen is anticipated during the decade despite the growing use of photographs and other illustrations, and the increasing use of color. The introduction of more rapid etching techniques, the application of electronics to engraving and to color separation, and the increasing use of offset printing, which requires no photoengravings, will limit the number of photoengravers needed.

Earnings and Working Conditions

Photoengravers are among the highest paid printing craftsmen. The average union minimum hourly wage rate for photoengravers in 69 large cities was $4.41 in book and job shops and $4.14 for the day shift in newspaper plants. Union average minimum hourly rates ranged from $3.21 an hour in Shreveport, La., to $5 an hour in New York.

The great majority of photoengravers are union members. Nearly all unionized photoengravers are represented by the Lithographers and Photoengravers International Union.

Where To Go for More Information

American Photoengravers Association,
166 West Van Buren St., Chicago, Ill. 60604.

Lithographers and Photoengravers International Union,
233 West 49th St., New York, N.Y. 10019.

Printing Industries of America, Inc.,
20 Chevy Chase Circle NW., Washington, D.C. 20015.

See page 519 for additional sources of information.

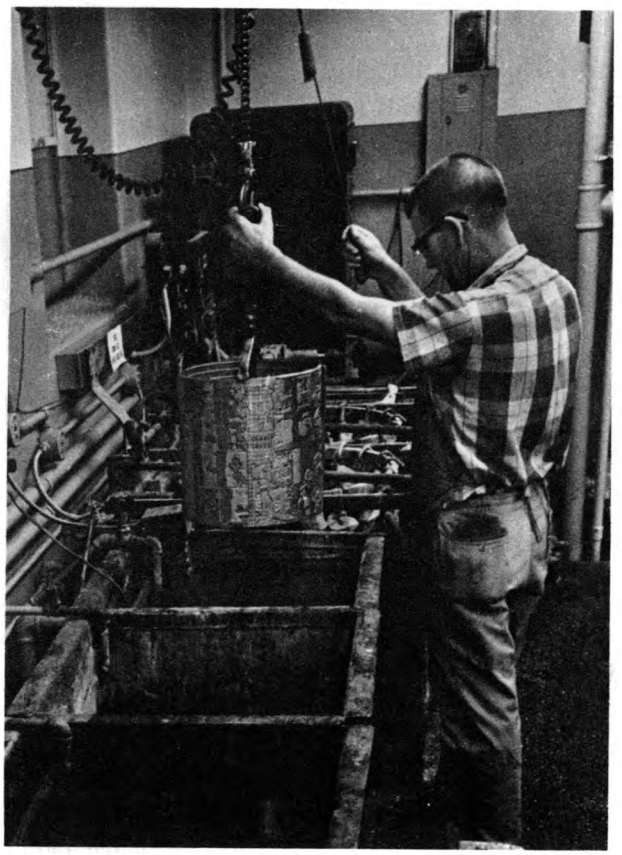
Electrotypers and Stereotypers

Nature of Work

Electrotypers (D.O.T. 974.381) and *stereotypers* (D.O.T. 975.782) make duplicate press plates of metal, rubber, and plastic for letterpress printing. These plates are made from the metal type forms prepared in the composing room. Electrotypes are used mainly in book and magazine work. Stereotypes, which are less durable, are used chiefly in newspaper work. Electrotyping and stereotyping are necessary because most volume printing requires the use of duplicate printing plates. When a large edition of a book, magazine, or newspaper is printed, several plates must be used to replace those which become too worn to make clear impressions. Also, by means of duplicate plates, printers can use several presses at the same time, and thus finish a big run quickly. This is especially important in publishing daily newspapers. Furthermore, the rotary presses used in many big plants require curved plates which can be made by either electrotyping or stereotyping processes from the flat type forms.

Several steps are required to produce a duplicate, curved metal plate ready for use in the pressroom. In electrotyping, the first step is making a wax or plastic mold of the type form, coating it with special chemical solutions, and then suspending it in an electrolytic solution containing metal. This leaves a metallic shell on the coated mold; this shell is then stripped from the mold, backed with metal or plastic, and carefully finished.

The stereotyping process is much simpler, quicker, and less expensive than electrotyping, but it does not yield as durable or as fine a plate. Stereotypers make molds or mats of papier mache (a strong material composed of paper pulp) instead of wax or plastic. This involves placing the mat on the type form, and covering it with a cork blanket and sheet of fiberboard. The covered form is run under heavy power-driven steel rollers to impress the type and photoengravings on the mat. Then the mat is placed in a stereotype casting machine which casts a composition lead plate on the mold. In many of the larger plants, stereotype plates are cast in automatic machines.



Stereotyper uses electrolytic plating equipment to give proper finish to a plate for color printing.

In many of the larger plants, electrotypers and stereotypers perform only one phase of the work, such as casting, molding, finishing, or blocking. However, journeymen must know how to handle all the tasks involved in their respective trades.

Many electrotypers work in large plants that print books and periodicals. The majority of stereotypers work in newspaper plants, but some are employed in large commercial printing plants. Electrotypers and stereotypers are also employed in independent service shops which do this work for printing firms.

Training and Other Qualifications

Nearly all electrotypers and stereotypers learn their trades through apprenticeship. Electrotyping and stereotyping are separate crafts, and there is little transferability between the two. The apprenticeship program in each trade covers all phases of the work and almost always includes classes in related technical subjects as well as training on the job. Apprenticeship training for electrotypers and stereotypers usually covers a 5- or 6-year period of reasonably continuous employment.

Apprenticeship applicants must be at least 18 years of age and, in most instances, must have a high school education or its equivalent. If possible, this education should include mechanical training and courses in chemistry. Physical examinations and aptitude tests are often given to prospective apprentices. The emphasis placed upon different phases of training varies from plant to plant, however, depending upon the type of printing establishment.

Employment Outlook

There will be some opportunities for new workers to become electrotypers and stereotypers during the 1965–75 decade because of retirements, deaths, or transfers of workers to other occupations. However, the total number of electrotypers and stereotypers, is expected to continue to decline.

This decline will occur in spite of the anticipated increase in the total volume of printing,

because of technological changes. For example, the increasing use of automatic plate casting eliminates many steps in platemaking, and plastic and rubber plates are increasingly being made outside electrotyping and stereotyping shops. Furthermore, the increasing use of offset printing reduces the need for electrotypers and stereotypers, since this type of plate is not required in offset printing.

Earnings and Working Conditions

On July 1, 1964, the union minimum hourly wage rates in 69 large cities averaged $4 an hour for electrotypers, $4.10 an hour for stereotypers in book and job shops, and $3.69 an hour for stereotypers on day shift in newspaper plants. Union minimum hourly wage rates for electrotypers in book and job plants ranged from $3.20 an hour in Richmond, Va., to $4.39 an hour in New York. In newspaper plants, rates for day-shift stereotypers ranged from $3 an hour in Springfield, Mass., to $5.27 an hour in Chicago.

Much of the work requires little physical effort since the preparation of duplicate printing plates is highly mechanized. However, there is some lifting of relatively heavy, hot press plates.

Nearly all electrotypers and stereotypers are members of the International Stereotypers' and Electrotypers' Union of North America.

Where To Go for More Information

International Stereotypers' and Electrotypers' Union of North America,
10 South LaSalle St., Chicago, Ill. 60603.

International Association of Electrotypers and Stereotypers, Inc.,
758 Leader Building, Cleveland, Ohio 44114.

Printing Industries of America, Inc.,
20 Chevy Chase Circle NW., Washington, D.C. 20015.

See page 519 for additional sources of information.

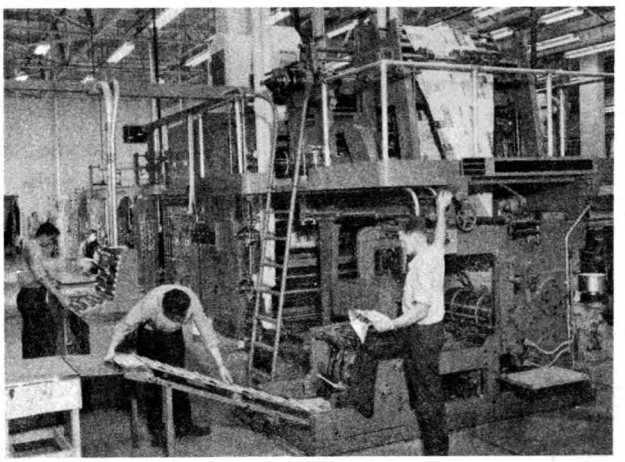
Printing Pressmen and Assistants

(2d ed. D.O.T. 4–48.010, .020, .030, and .060; 6–49.410, .420, and .430)
(3d ed. D.O.T. 651.782, .885, and .886)

Nature of Work

The actual printing operation is performed in the pressroom. Printing pressmen "makeready" (prepare) type forms and press plates for final printing and tend the presses while they are in operation.

The object of makeready, which is one of the most delicate and difficult parts of the pressman's work, is to insure printing impressions that are distinct and uniform. This is accomplished by such means as placing pieces of paper of exactly the right thickness underneath low areas of the press plates to level them, and by attaching pieces of tissue paper to the surface of the cylinder or flat platen which makes the impression. Pressmen also have to make many other adjustments—for example, those needed to control margins and the flow of ink to the inking roller. In some shops, they are responsible not only for tending the presses but also for oiling and cleaning them and making some minor repairs. On the larger presses, pressmen have assistants and helpers.



Printing pressman and assistant operate modern color press.

Pressmen's work may differ greatly from one shop to another, mainly because of differences in the kinds and sizes of presses used. Small commercial shops generally have small and relatively simple presses that are often fed paper by hand. At the other extreme are the enormous web-rotary presses used by the big newspaper

and magazine printing plants. These giant presses are fed paper in big rolls called "webs." They print the paper on both sides by means of a series of cylinders; cut, assemble, and fold the pages; and, finally, count the finished newspaper sections which emerge from the press ready for the mailing room. These steps are accomplished automatically by means of many different mechanisms, each of which calls for constant attention while a run is being made. Presses of this kind are operated by crews of journeymen and less skilled workers under the direction of a *pressman-in-charge.*

Although the basic duties of *lithographic (offset) pressmen* are similar to those of letterpress and gravure pressmen, a number of differences exist, principally because of the specialized character of lithographic presses. (See p. 529 for further details.)

The duties of *press assistants* range from feeding sheets of paper into hand-fed presses to helping pressmen makeready and operate large and complicated rotary presses. Workers whose main responsibility is feeding are often called *press feeders.* The ratio of assistants to pressmen differs from one establishment to another, depending on the size of the plant, the type of press used, and other factors. Many shops are too small to have pressroom assistants.

Training and Other Qualifications

As in the other printing crafts, the most common way of learning the pressman's trade is through apprenticeship. Some workers have been able to learn the skills of the trade while working as helpers or press assistants or through a combination of work experience in the pressroom and vocational or technical school training.

The length of apprenticeship and the content of training depend largely on the kind of press used in the plant. The apprenticeship period in commercial shops is 2 years for press assistants and 4 years for pressmen. In newspaper establishments the apprenticeship period is 5 years. The apprenticeship period for pressmen operating web presses is generally 5 years. On-the-job training includes the care of pressroom equipment, makeready, running the job, press tending and maintenance, and working with various types of inks and papers. In addition to on-the-job instruction, the apprenticeship involves related classroom or correspondence schoolwork. At the beginning of 1965, over 3,000 registered apprentices were in training and perhaps 4,000 others were in unregistered programs.

Individual companies generally choose apprentices from among press assistants and others already employed in the plant. Young men may often work for 2 or 3 years in the pressroom before they are selected to begin 2- to 4-year training periods leading to journeyman status. A high school education or its equivalent is generally required. Because of technical developments in the printing industry, a year of chemistry and a year of physics should be included. Mechanical aptitude is important in making press adjustments and repairs. An ability to visualize color is essential for work on color presses, which are used increasingly. Physical strength and endurance are necessary for work on some kinds of presses, where the pressmen have to lift heavy type forms and press plates and stand for long periods.

Employment Outlook

Employment of pressmen is expected to increase moderately throughout the 1965–75 decade. The total amount of printing and the use of color are

Chief pressman uses electronic console to control huge newspaper press.

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expected to increase, requiring larger and more complex presses. However, continued improvements in the speed and efficiency of printing presses will limit the need for additional pressmen.

The need to replace workers who retire, die, or transfer to other fields of work will also result in job opportunities for new workers. Retirements and deaths alone may result in about 1,000 job openings each year.

Earnings and Working Conditions

The earnings of pressmen depend upon the kind of press operated, the type of printing plant, and the geographical area of employment. A survey of union minimum hourly wage rates for daywork in 69 large cities shows that the average minimum hourly rate in effect on July 1, 1964, for newspaper pressmen-in-charge was $4.19; for newspaper pressmen (journeymen), $3.86; for book and job cylinder pressmen, $3.73; for book and job platen pressmen, $3.37; and for book and job press assistants and feeders, $3.12.

Pressrooms are unavoidably noisy—one State, California, now requires newspaper pressmen working in certain areas of the pressroom to wear ear protectors. There are also the usual occupational hazards associated with machinery. Pressmen often have to lift heavy type forms and printing press plates. At times, they work under pressure to meet deadlines, especially in the printing of newspapers and magazines. Many pressmen work night shifts for which the rate of pay is higher than the basic day rate.

A majority of pressroom workers are covered by union agreements. Practically all of the organized letterpress and gravure pressmen are members of the International Printing Pressmen and Assistants' Union of North America.

Where To Go for More Information

International Printing Pressmen and Assistants' Union of North America,
Pressmen's Home, Tenn. 37850.

Printing Industries of America, Inc.,
20 Chevy Chase Circle NW., Washington, D.C. 20015.

See page 519 for additional sources of information.

Lithographic Occupations

Nature of Work

Lithography (offset printing) is one of the most rapidly growing methods of printing. Practically all items printed by other processes are also produced by lithography—including books, calendars, maps, posters, labels, office forms, catalogs, folding cartons, and newspapers. Lithography has special advantages when the copy to be reproduced includes photographs, drawings, or paintings, since the rubber blanket which transfers the image from the plate to the surface to be printed permits greater flexibility in the type of paper that can be used.

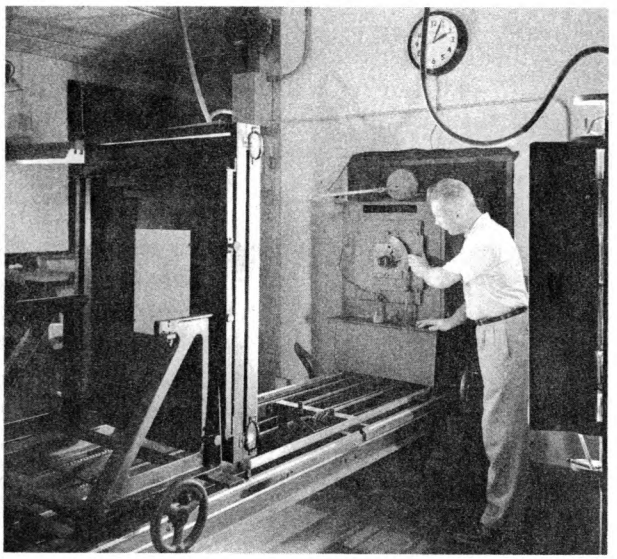
Several operations are involved in lithography, and each is performed by a specialized group of workers. The main groups of lithographic workers are cameramen, artists and letterers, strippers, platemakers, and pressmen.

The *cameraman* (D.O.T. 972.382) starts the process of making a lithographic plate by photographing the copy. He is generally classified as a line cameraman (black and white), halftone cameraman (black and white), or color separation photographer.

After the negatives have been made, they frequently need retouching to lighten or darken certain parts. Thus, it is often necessary for a *lithographic artist* (D.O.T. 972.281) to make corrections by sharpening or reshaping images on the negatives. Highly skilled workers perform this work by hand, using chemicals, dyes, and special tools.

To qualify as journeymen, these artists must be adept in one or more of the various retouching methods. Like cameramen, they are customarily assigned to only one phase of the work and may then be known, for example, as dot etchers, retouchers, or letterers, depending on their particular job.

The *stripper* (D.O.T. 971.381) makes layouts on paper, glass, or film. He arranges and pastes film or prints of type, pictures, and other art



Cameraman adjusts lens before making printing plate.

work on the layout sheets called flats or "strip-ups," from which photographic impressions are made for the lithographic press plates. The job of the stripper in the lithographic process corresponds to that of the makeup man in the letterpress process.

In lithography, employees in the platemaking department expose press plates to photographic films which are made by the cameramen and corrected by artists. The *platemaker* (D.O.T. 972.781) may cover the surface of the metal plate with a coating of photosensitive chemicals, or the metal plate may come to him with the photosensitive layer applied. The platemaker exposes the sensitized plate through the negative or positive to strong arc lights; this is commonly done in a vacuum printing frame. When a large number of the same images are to be exposed on a single plate, however, the operation is done in a photocomposing machine. The plate is then developed and chemically treated to bring out the image.

The *lithographic pressman* (D.O.T. 651.782) makes ready and tends the lithographic (offset) printing presses. He installs the plate on the press, adjusts the pressure for proper printing, cares for and adjusts the rubber blanket which takes the impression from the plate and transfers it to the paper, adjusts water and ink rollers for correct operation, mixes inks, and operates the presses. Basically, the duties of these workers are similar to those of letterpress and gravure pressmen. Some differences exist, however, because of the chemical means used to separate image and non-image areas on lithographic presses. In large plants, press feeders and helpers are employed; their duties are similar to those of assistant and helpers to letterpress and gravure pressmen. (See p. 527.)

Training and Other Qualifications

A 4- or 5-year apprenticeship covering the basic lithographic process is usually required to become an all-round lithographic craftsman. Training emphasis is on the specific occupation in which journeyman status is being sought, although generally, an attempt is made to make the apprentice familiar with all lithographic operations. At the beginning of 1965, there were about 1,500 registered apprentices in training for skilled lithographic occupations.

Usually, apprenticeship applicants must be in good physical condition, high school graduates, and at least 18 years of age. Aptitude tests are sometimes given to prospective apprentices. Vocational school training, and training in photography, mathematics, chemistry, physics, and art are helpful in learning these crafts.

A stripper pastes type and picture negatives in a "strip-up" from which a lithographic plate will be made.

Employment Outlook

A moderate rise in the number of lithographic workers is expected during the 1965–75 decade. In addition, the need to replace workers who retire, die, or transfer to other fields of work will provide some job openings. Employment growth and replacement needs together are expected to provide about 1,500 to 2,000 job opportunities for new workers, on the average, each year during the next 10 to 15 years.

Offset printing has expanded considerably in recent years, particularly in the commercial printing field, and a large number of letterpress concerns have established offset departments. Offset presses are used increasingly in smaller newspaper establishments. In 1965, an estimated 58,000 journeymen lithographic workers were employed. Offset printing employment should show continued growth because of the greater use of photographs, drawings, and illustrations in printed matter, and because of the more widespread use of color in many printed products. However, new technological developments, particularly in the camera, platemaking, and press departments, are expected to slow the increase in lithographic employment.

Earnings and Working Conditions

Union minimum hourly wage rates for lithographic occupations vary within each occupation, depending upon the degree of skill required, the type and size of equipment, and the part of the country in which the worker is employed. For example, according to information on minimum union hourly wage rates in 47 selected cities compiled by the National Association of Photo-Lithographers during 1964, wage rates for dot etchers or process artists and letterers ranged from $3.58 an hour in Tulsa, Okla., to $4.73 an hour in Los Angeles and San Diego, Calif. Rates for cameramen, which are generally below those for skilled artists, ranged from $3.17 an hour in Tulsa, to $4.67 an hour in Los Angeles and San Diego. In many plants, topgrade cameramen earn as much as the highly skilled artists, and cameramen who do multicolor work are paid more than those who do only black and white work. Minimum hourly rates of photocomposition operators ranged from $3.56 an hour in Evansville, Ind., to $4.59 an hour in Los Angeles and San Diego, and vacuum frame platemakers' hourly rates ranged from $3.17 an hour in Tulsa, to $4.59 an hour in Los Angeles and San Diego. The wide range of rates for lithographic pressmen—from $2.64 an hour for Multilith machine operators and operators of small presses in Denver to $5.67 an hour for first pressmen on large four-color presses in Providence—is due to the many different types and sizes of presses operated.

A substantial proportion of all lithographic workers are members of the Lithographers and Photoengravers International Union. A considerable number of offset pressmen and other offset workers are members of the International Printing Pressmen and Assistants' Union of North America.

Where To Go for More Information

Lithographers and Photoengravers International Union,
233 West 49th St., New York, N.Y. 10019.

International Printing Pressmen and Assistants' Union of North America,
Pressmen's Home, Tenn. 37850.

Graphic Arts Technical Foundation,
4615 Forbes Ave., Pittsburgh, Pa. 15213.

National Association of Photo-Lithographers,
230 West 41st St., New York, N.Y. 10036.

Printing Industries of America, Inc.,
20 Chevy Chase Circle NW., Washington, D.C. 20015.

See page 519 for additional sources of information.

Bookbinders and Related Workers

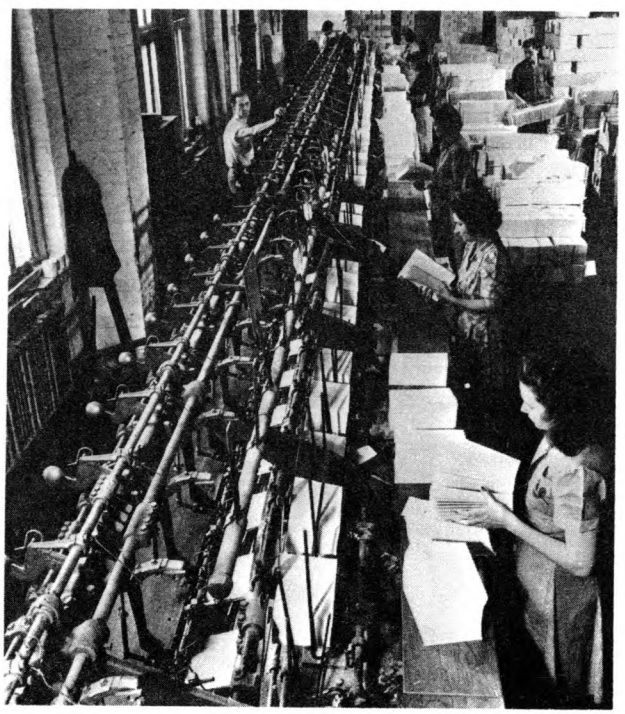
Nature of Work

Many printed items such as books, magazines, pamphlets, business forms, and calendars must be folded, sewed, stapled, or bound after they leave the printing shops. Much of this work is done by skilled *bookbinders* (D.O.T. 977.781) who numbered about 22,000 in early 1965. Many bookbinders are employed in shops whose chief business is bookbinding. However, a considerable number are employed in the bindery departments

of large book, periodical, and commercial printing plants and of large libraries.

There are several different kinds of binderies. Edition and pamphlet binderies bind books, magazines, and pamphlets printed in large quantities. Trade or job binderies do bindery work on contract for printers, publishers, or other customers. Blankbook and looseleaf binderies bind various types of blank books such as ledgers and bookkeeping and accounting volumes. They also produce loose leaf binders, and bind books in loose leaf form.

Edition binding—making books in quantity from big, flat printed sheets of paper—is by far the most complicated. The first step in the process is to fold the printed sheets into one or more units, known as "signatures," so that the sheets will be in the right order. The next steps are to insert any illustrations that have been printed separately, to gather and assemble the signatures in proper order, and to sew them together. The resulting book bodies are shaped with power presses and trimming machines, and fabric strips are glued to the backs for reinforcements. Covers are glued or pasted onto the book bodies, after which the books undergo a variety of finishing operations and, frequently, are wrapped in paper jackets. Machines are used extensively throughout the process.



Bindery workers assemble material on gathering machine.

Skilled bookbinders seldom perform all the different edition bindery tasks, although many journeymen have had training in all of them. In large shops, skilled bookbinders may be assigned to one or a few operations, most often to the operation of complicated machines.

In many binderies, especially large ones, much of the work is done by workers trained in only one operation or in a small number of relatively simple, related tasks. Most of these workers, often classified as bindery workers or bindery hands, are women (hence the common designation, bindery women). Their work closely resembles assembly line factory work. About 54,000 women and men were employed in these operations in early 1965.

Training and Other Qualifications

A 4- or 5-year apprenticeship which includes on-the-job training as well as related classroom instruction is generally required to qualify as a skilled bookbinder. Apprenticeship programs may vary considerably among the various types of bookbinding shops. When large quantities of books are bound on a mass production (edition) basis, emphasis is on the most modern machine methods. In fine hand binding, emphasis is mainly on hand methods, including artistic designing and decorating of leather covers. For many years, hand bookbinding has been declining in importance.

Apprenticeship applicants usually must have a high school education and be at least 18 years of age. Mechanical aptitude is helpful to the person entering this trade. In the course of the apprenticeship, trainees learn, among other things, to assemble signatures, renovate old, worn bindings, and use various binding machines such as punches, folders, perforators, stitchers, and power cutters.

For the less skilled bindery occupations, the training period may last from several months to 2 years. In union shops, apprenticeship programs for women bindery workers generally last 2 years. These formal programs include classroom instruction as well as on-the-job training.

Employment Outlook

A few hundred job openings for skilled bookbinders are expected each year during the 1965–75 decade because of the need to replace experienced workers who retire or die. Many openings are expected for bindery hands, the majority of whom are women, because of the considerable turnover among this group. However, some decrease in the total number of bookbinders and bindery hands is expected, despite the anticipated growth in the amount of bound printed materials, because of the increasing mechanization of bindery operations.

Earnings and Working Conditions

Wage rates for skilled bookbinders tend to be below the average of other printing crafts. A survey of union minimum hourly wage rates in 69 large cities, as of July 1, 1964, showed that the minimum hourly wage rate for bookbinders in book and job establishments averaged $3.64 an hour and rates ranged as high as $4.29 in the San Francisco area. The wage rates for bindery women are considerably lower and are among the lowest for printing industry workers. They ranged from $1.60 an hour in Memphis and Little Rock to $2.81 in the San Franscisco area.

The majority of bindery workers are union members. Most skilled bookbinders are represented by the International Brotherhood of Bookbinders.

Where To Go for More Information

International Brotherhood of Bookbinders,
1612 K St. NW., Washington, D.C. 20016.

Printing Industries of America, Inc.,
20 Chevy Chase Circle NW., Washington, D.C. 20015.

See page 519 for additional sources of information.

SOME OTHER MANUAL OCCUPATIONS

Assemblers

Nature of Work

Many of the products and parts made in factories must be assembled during various steps in the manufacturing process as well as in the final assembly of the product. For example, television sets, automobiles, and refrigerators are typical of the products which undergo many assembly operations. The workers who put together parts or finished products, nearly all of whom are semiskilled workers, are known as assemblers.

Some assemblers, known as *floor assemblers*, put together large, heavy machinery or equipment on shop floors, often fastening parts with bolts, screws, or rivets. Others, known as bench assemblers, put together small parts to make subassemblies or small complete units, while working at a bench. Many assemblers work on products or parts which move automatically past their work stations on conveyors. These workers must do their assembly job within the time period it takes the part or product to pass their work station.

The job duties of assemblers depend upon the product being manufactured and the manufacturing process being used. In aircraft and missile production, these workers may assemble and install parts into subassemblies. In the automobile industry, one assembler may start nuts on bolts and the next worker on the assembly line tightens the nuts with power-driven tools. Assemblers in electronic plants may connect parts with electrical wire.

(In contrast with the semiskilled assemblers described in this statement, who do relatively simple repetitive operations under close supervision, skilled assemblers work on the more complex parts of subassemblies with little or no supervision and are responsible for the final assembly of complex jobs. These skilled workers must know how to read blueprints and other engineering specifications and use a variety of tools and precision measuring instruments. In relatively new fields such as electronics, instrumentation, and missiles, subassembly work may require a high degree of skill.)

The kinds of tools semiskilled assemblers use depend upon the job they are doing and the product on which they are working. Pliers, screwdrivers, soldering irons, power drills, and wrenches are among the common tools used by semiskilled assemblers.

Where Employed

Assemblers work in plants that mass-produce products such as automobiles, aircraft, television sets, cameras, refrigerators, watches, and electrical motors. In early 1965, approximately 500,000 semiskilled assemblers were employed in manufacturing plants, with the great majority in electrical machinery and other metalworking plants. The majority of semiskilled assemblers were employed in California, New York, Michigan, Illinois, Ohio, Indiana, and Pennsylvania.

More than 2 out of 5 semiskilled assemblers were women, who worked primarily as bench assemblers. About half of the women assemblers worked in the electrical machinery, equipment, and supply industry. Large numbers of women assemblers also were employed in other industries—fabricated metals; machinery, except electrical; transportation equipment; and instruments and related products.

Training, Other Qualifications, and Advancement

Inexperienced workers who are hired to do semiskilled assembly work are usually trained on the job in a few days or weeks. The new worker may have his job duties explained to him by his

Many women are bench assemblers.

supervisor and then be placed under the supervision of a more experienced employee. The trainee observes the experienced employee at work or directly assists him in his work. When the learner develops sufficient speed, he is placed "on his own" and is responsible for the work he produces.

Employers generally want applicants for semiskilled assembly jobs to be physically able, dependable, and to have some aptitude for mechanical work.

High school graduates or workers who have taken vocational school courses, such as blueprint reading, are preferred by many employers although a high school diploma is not usually required. Generally, for production-line assembly jobs, employers look for applicants who can do routine work at a steady and fast pace. For other types of assembly jobs, applicants may have to meet special requirements. For example, in plants producing electrical and electronic products, which may contain many different colored wires, applicants often are tested for color blindness.

Many women are employed in semiskilled bench assembly jobs because such work is relatively light and often requires the ability to work with small and delicate objects. This is particularly true in the electrical and electronic equipment industry. Male workers are usually employed as floor or line assemblers, where the work is physically hard. Final automobile assembly, for example, is generally done by men.

A relatively small number of workers who learn to perform a variety of assembly work and who have a knowledge of blueprint reading and shop mathematics are able to become skilled assemblers. A few workers also may become skilled inspectors or foremen.

Employment Outlook

Many openings for semiskilled assemblers are expected during the 1965–75 decade. Most job opportunities in this large occupation group will result from the need to replace workers who retire, die, or transfer to other fields of work, and to replace women who leave their jobs to marry or raise a family. Deaths and retirements alone will account for about 20,000 openings each year. In addition, several thousand job openings annually are expected to result from a slow increase in employment of semiskilled assemblers.

Most of the industries that employ assemblers, especially the electrical machinery industry, are expected to increase their employment during this period; however, technological changes are expected to hold down the growth of this occupation. For example, the introduction of printed electrical circuits reduces the wiring work required in assembling radio and television sets, thus affecting the employment of assembly workers in plants producing these products. Further increases in the use of automatic assembly processes are expected to continue to slow the growth of assemblers.

Employment in metalworking manufacturing plants, which have many assemblers, is particularly sensitive to changes in business activities and national defense needs. Therefore, assemblers in those industries will continue to be subject to occasional layoffs.

Earnings and Working Conditions

Earnings of semiskilled assemblers in manufacturing industries vary widely, depending on their

skill, the type of product assembled, and factors such as the size and location of the plant in which they are employed.

Assembly jobs are commonly classified as A, B, and C, to reflect the level of skill and responsibility involved. (For the purpose of this publication, class B and C assemblers are considered to be semiskilled workers.) In mid-1965, average straight-time hourly earnings of class B male assemblers in machinery (other than electrical) plants in 20 large cities and metropolitan areas ranged from $2.13 in Dallas, Tex., to $3.06 in San Francisco-Oakland, Calif.; and earnings of class C male assemblers ranged from $1.62 in Dallas to $2.79 in Milwaukee, Wis. Hourly earnings of men assemblers varied considerably in the same city. In Dallas, for example, the straight-time hourly earnings of class B men assemblers ranged from $1.40 to $2.90; and in Milwaukee, from $2.30 to $4.20 and over. Earnings of class C women assemblers ranged from $1.48 in Dallas to $2.74 in Detroit.

The working conditions of semiskilled assemblers differ, depending on the particular job performed. Assemblers of electronic equipment may put together small components at a bench in a room which is clean, well lighted, and free from dust. Floor assemblers of industrial machinery, on the other hand, may install and assemble heavy parts and are often exposed to contact with oil and grease. Assemblers on assembly lines may be under pressure to perform their assignments in the time the conveyor moves the parts or subassemblies past their work stations. Assemblers paid incentive or piecework rates are encouraged to work more rapidly by the prospect of higher earnings.

Many semiskilled assemblers in manufacturing industries are members of labor unions. These unions include the International Association of Machinists and Aerospace Workers; the International Union of Electrical, Radio and Machine Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; and the International Brotherhood of Electrical Workers. Most labor-management contracts in the manufacturing plants in which assemblers are employed provide for fringe benefits such as holiday and vacation pay, health insurance, life insurance, and retirement pensions.

Automobile Painters

(2d ed. D.O.T. 5–16.910)

(3d ed. D.O.T. 845.781)

Nature of Work

The automobile painter's job is to make old or damaged motor vehicles "look like new." These skilled workers repaint vehicles that have lost the luster of their original paint, and the repaired portions of vehicles damaged in traffic accidents. (Production painters who work for motor vehicle manufacturers are discussed elsewhere in the *Handbook*.)

In preparing an automobile for painting, the painter, or his helper, rough sands or removes the original paint. The painter then applies primer coats to the automobile surface with a spray gun and, after the primer dries, sands the surface by hand with a fine grade of sandpaper until it is smooth enough to be painted. For rough sanding, he usually uses a pneumatic or electric sander and a coarse grade of sandpaper. If small nicks and scratches in the surface cannot be removed by sanding, he fills them with automobile-body putty. He uses masking tape and paper to cover areas not to be painted.

Before painting repaired portions of an automobile, the painter may have to mix paints in order to match the existing color of the automobile. Before applying the paint, he adjusts the nozzle of the spray gun according to the kind of lacquer or enamel being used and, if necessary, adjusts the air-pressure regulator for the needed amount of pressure. He must be skilled in handling the spray gun so that the paint is applied evenly, rapidly, and thoroughly. To speed drying, he may place the freshly painted automobile under heat lamps or in a special infrared oven. After the paint dries, the painter or his helper may have to "rub-out" and polish the newly painted surface to bring out its luster.

Automobile painter wears protective mask when applying paint.

Where Employed

An estimated 25,000 automobile painters were employed in early 1965. Almost two-thirds of these workers were employed in repair shops specializing in automobile-body repairs and painting, and in shops that do general automobile repairs. Most of the others were employed in the service departments of automobile and truck dealers. Some painters were employed by organizations that maintained and repaired their own fleets of motor vehicles, such as trucking companies and bus lines.

Although automobile painters are employed in every section of the country, about half of them work in the eight States with the largest number of automobiles: California, New York, Texas, Pennsylvania, Ohio, Michigan, Illinois and New Jersey.

Training, Other Qualifications, and Advancement

Most automobile painters start as helpers and acquire their skills informally by working for several years with experienced painters. Usually the beginner's work consists of tasks such as removing automobile trim, cleaning and sanding surfaces to be painted, and polishing painted surfaces. As helpers gain experience, they progress to more complicated tasks such as using spray guns to apply primer coats and paint small areas. It usually takes 3 to 4 years of informal on-the-job training to become a fully qualified automobile painter.

A small number of automobile painters learn their trade through apprenticeship. Apprenticeship programs for automobile painters, which generally last 3 years, consist of on-the-job training supplemented by related classroom instruction.

Young men considering this work as a career should have good health, keen eyesight, a discerning color sense, and a steady hand. Courses in automobile-body repair, which are offered by a relatively small number of high schools and vocational schools, provide helpful experience. Although a high school education is generally not a requirement for getting a job as a painter's helper, it is an advantage because many employers believe it indicates that a young man can "complete a job."

An experienced automobile painter with supervisory ability may advance to shop foreman. Many experienced painters who acquire the necessary capital eventually open their own shops.

Employment Outlook

Employment of automobile painters is expected to increase moderately during the 1965–75 decade. In addition to the few hundred job openings anticipated annually as a result of employment growth, an estimated 500 job openings are expected to result each year from the need to replace experienced painters who retire or die. Opportunities also will occur as some painters transfer to other lines of work.

Employment of automobile painters is expected to increase primarily as a result of the increasing number of motor vehicles damaged in traffic accidents. The accident toll is expected to continue to increase as the number of motor vehicles in use grows, even though new and improved highways, driver training courses, and stricter law enforcement may slow down the rate of increase. Despite the increasingly durable paint being used on new cars, the number of motor vehicles that need to be completely repainted because the original finishes have deteriorated is also expected to

increase as a result of the growth in the number of motor vehicles in use.

The employment effect of increasing numbers of motor vehicles and traffic accidents may be offset slightly by the greater use of modern painting equipment and new developments in painting equipment that should enable painters to complete jobs in less time.

Earnings and Working Conditions

Many experienced automobile painters employed by automobile dealers and independent repair shops, are paid a percentage of the labor cost charged to the customer. Under this method, a painter's earnings depend largely on the amount of work he is assigned and how fast he completes it. Earnings may be based also on other methods of wage payment—for example, a weekly salary plus a commission on jobs completed, or an hourly rate. Painters employed by trucking companies, buslines, and other organizations which repair their own vehicles usually receive an hourly rate. Most painters work 40 to 48 hours per week.

Experienced automobile painters employed by automobile dealers in 33 cities had average straight-time hourly earnings of $3.53, based on a survey in late 1964. Average hourly earnings of these workers in individual cities ranged from $2.32 in Providence-Pawtucket, R.I., to $4.29 in St. Louis, Mo. Almost three-fourths of all automobile painters covered in the survey earned between $2.40 and $4.80 an hour. Automobile painters who worked for independent repair shops had earnings comparable with those employed by dealers, based on the limited data available.

Many employers of automobile painters provide holiday and vacation pay, and additional benefits such as life, health, and accident insurance. Others also contribute to retirement plans. Painters in some shops are furnished with laundered uniforms free of charge.

Automobile painters are exposed to fumes from paint and paint-mixing ingredients. However, in most shops, the painting is performed in special ventilated booths that protect the painters from fumes. In shops not having such booths, they are furnished with protective masks that cover the nose and mouth. Painters must be agile because they often bend and stoop at their work, but no more than average physical strength is needed.

Unions organizing automobile painters include the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the Sheet Metal Workers' International Association; and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.). Most of the painters who are union members are employed by the larger automobile dealers, and by trucking companies and buslines.

Where To Go for More Information

For further information regarding work opportunities for automobile painters, inquiries should be directed to local employers, such as automobile-body repair shops and automobile dealers; locals of the unions previously mentioned; or the local office of the State employment service. The State employment service also may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of automobile painters may be obtained from:

Automotive Service Industry Association,
168 North Michigan Ave., Chicago, Ill. 60601.

Independent Garage Owners of America, Inc.,
343 South Dearborn St., Chicago, Ill. 60604.

Automobile Trimmers and Installation Men (Automobile Upholsterers)

(3d ed. D.O.T. 780.381 and .884)

Nature of Work

Automobile trimmers, frequently assisted by installation men, replace and repair upholstery and other automobile fabrics. (Workers who do upholstery work in automobile factories are not included in this statement.) Trimmers and installation men together are sometimes called "automobile upholsterers."

Automobile trimmers (D.O.T. 780.381) are skilled upholsterers who custom make coverings for automobile seats, floors, and door panels; convertible tops; and other items. In making such items, they first determine the dimensions of each piece of vinyl, leatherette, broadcloth, or other material to be used and mark the material for cutting. When determining dimensions, trimmers must make allowances for pleats, seams, shrinkage, and stretching. Although trimmers follow standard designs in making most items, at times they may be called upon to follow original designs specified by customers or to create original designs. After cutting and fitting the pieces, they stitch them together using heavy-duty sewing machines. Finished pieces are stretched and pulled to fit snugly; glued, tacked, stapled, or fastened in other ways; and then trimmed of excess material. In addition to making automobile upholstery and convertible tops, trimmers may make such items as truck seat cushions and tarpaulins, boat covers, and seats for small airplanes. They repair upholstery that has been torn, cut, burned, or damaged in other ways. They may also repair power-window and convertible top mechanisms, and cut and install automobile glass.

Automobile trimmer sews seat covers.

Automobile trimmers are often assisted by *installation men*, sometimes called seat-cover-installers (D.O.T. 780.884), whose main job is to remove the worn seat covers and convertible tops and install new ones. By doing such work, they make it possible for trimmers to concentrate on making upholstery.

Trimmers and installation men use a variety of handtools including shears, knives, screwdrivers, special pliers, various types of wrenches, tack hammers, mallets, and tape measures. They also use heavy-duty sewing machines and power tools such as air-powered staplers and wrenches. In some shops, they use electric steaming machines for shrinking fabrics, and special electronic welders for binding synthetic materials.

Where Employed

An estimated 8,000 to 10,000 automobile trimmers and installation men were employed in early 1965. Most of them worked in shops that specialize in the fabrication and replacement of automobile upholstery and convertible tops. Others worked in automotive repair and accessories sections of department stores, in automobile-body repair shops, and in automobile dealer shops. Most automobile upholstery specialty shops employ from 1 to 5 trimmers. In small shops, the number of installation men generally equals the number of trimmers. Installation men outnumber trimmers, however, in many of the larger shops, particularly those that specialize in the installation of factory-made seat covers and tops.

Although automobile upholsterers are employed throughout the country, most work in the larger cities and towns.

Training, Other Qualifications, and Advancement

Most trimmers and installation men learn their skills informally on the job. Beginners are usually hired as installation men trainees. They are first taught to remove seats and upholstery and install seat covers, and gradually learn to do more difficult jobs such as installing convertible tops. After qualifying as installation men, they progress to making seat covers, tops, and other upholstery. Although a capable beginner can become a fully qualified installation man in

as little as 3 to 6 months, it usually takes 3 to 4 years longer to become a skilled trimmer.

A small number of automobile trimmers begin as apprentices. Apprenticeship programs for automobile trimmers, which generally last 3 or 4 years, consist of on-the-job training supplemented by related classroom instruction.

Applicants for entry jobs should be mechanically inclined and in good physical condition. Employers are particularly interested in hiring those who enjoy doing creative work with their hands. A high school education is desirable but not essential. High school and vocational school courses in furniture upholstery provide valuable training. Courses in mathematics are useful because of the calculations involved in laying out and planning automobile upholstery work.

Experienced trimmers who have supervisory ability may advance to foreman in large shops. Many automobile trim shops are owned by trimmers who acquired the necessary experience, skill, and capital to establish their own businesses.

Employment Outlook

A few hundred job openings for automobile trimmers and installation men are expected annually during the 1965–75 decade. Most of these openings will result from the need to replace experienced workers who retire, die, or transfer to other lines of work. Growth of the occupations is expected to provide a small number of job opportunities annually, primarily because the growing number of automobiles in use, especially convertibles, is expected to increase the demand for custom made automobile upholstery and other fabric products. However, the demand is not expected to grow as rapidly as the number of automobiles, because of the use of more durable fabrics. Other factors that should stimulate employment growth include an increasing demand for truck cushions and tarpaulins as a result of the growing number of trucks in use, and an increasing demand for custom made boat covers and seats as a result of the growing popularity of boating.

Earnings and Working Conditions

Most trimmers and installation men are paid a weekly salary or hourly wage and work from 44 to 48 hours per week. Many receive commissions or bonuses based on sales, in addition to their regular pay. Some trimmers are paid on a straight commission basis.

Starting pay for installation men trainees generally ranged from $50 to $75 per week in late 1964. Experienced installation men generally earned $80 to $95 per week. Most trimmers earned between $110 and $175 per week although some highly skilled trimmers in large cities earned as much as $200.

Many employers of trimmers and installation men provide holiday and vacation pay and pay all, or part, of the cost of additional benefits such as life, health, and accident insurance. Some also contribute to retirement plans.

Trimmers and installation men generally work in shops that are clean, well-lighted, and relatively quiet. Their work often involves getting into awkward and uncomfortable positions for short periods. Automobile upholstery work is not considered hazardous, although these workers are subject to cuts, bruises, and other minor injuries.

A small percentage of these workers are members of the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (Ind.).

Where To Go for More Information

For further information regarding work opportunities for automobile trimmers and installation men, inquiries should be directed to local automobile trim shops or the local office of the State employment service. The State employment service also may be a source of information about the Manpower Development and Training Act, apprenticeship, and other programs that provide training opportunities.

General information about the work of automobile trimmers and installation men may be obtained from:

National Association of Auto Trim Shops,
129 Broadway, Lynbrook, L.I., N.Y. 11563.

Blacksmiths

(2d ed. D.O.T. 4–86.010 and .210)
(3d ed. D.O.T. 356.381 and 610.381)

Nature of Work

Blacksmiths make and repair many different kinds of metal articles and parts, such as forging tongs and other tools, machine frames, automobile parts, and other industrial and agricultural equipment. They also sharpen hand and machine tools, such as chisels, drills, and picks. They do their work by shaping and sometimes joining together (forge welding or fire welding) glowing hot metal which has been heated in a special type of furnace called a forge. In performing the shaping and joining processes, blacksmiths hammer heated metal on an anvil. They use handtools, such as hammers, tongs, and chisels, and may also use welding equipment, grinders, presses, and power hammers.

After a metal article or part has been formed, the blacksmith may heat-treat it to harden and temper it properly. He hardens the metal by heating it to a high temperature and then cooling it quickly in an oil or water bath. To temper the metal (make it tougher and less brittle), he also heats it, but to a lower temperature than is needed for hardening, keeps the metal at this lower temperature for a specified time, and then lets it cool gradually in the air.

Job duties of blacksmiths are similar to those of many forge shop workers, who operate heavy machinery to shape and form articles from heated metal. (For a detailed discussion of jobs and job opportunities in forge shops, see the section on Forge Shop Occupations.)

Where Employed

About two-thirds of the approximately 20,000 blacksmiths employed in the United States in early 1965 were industrial blacksmiths. The remainder worked in small shops where they repaired tools and other equipment and performed other services, such as welding and tool sharpening, or specialized in the shoeing of horses. More than four-fifths of the blacksmiths in small repair shops were self-employed.

Industrial blacksmiths were employed in a variety of industries, mostly for maintenance and repair work. Nearly half of them worked in manufacturing industries, especially in the basic iron and steel industry and in the machinery, transportation equipment, and fabricated metal products industries. About one-fifth of industrial blacksmiths worked in mining industries, chiefly in the extraction of crude petroleum and natural gas. (Where oil wells are being drilled, for example, blacksmiths sharpen and temper drill bits, repair tools, and assist drillers in the operation and maintenance of drilling equipment.) The railroads and the construction industry also employed relatively large numbers of blacksmiths.

Blacksmiths work in all parts of the country, in small rural communities as well as in large industrial centers. However, employment is concentrated in Pennsylvania, Texas, California, Illinois, Ohio, and New York.

Training and Other Qualifications

Most workers enter the occupation by getting jobs as helpers in blacksmith shops, where they gradually learn the trade. Others enter through formal apprenticeship training programs, which generally last 3 or 4 years and customarily provide training in blueprint reading, the use of tools and equipment, heat-treatment of metal, and forging methods, including forge welding. Most apprentices are found in large industrial firms rather than in small repair shops. Vocational school or high school courses in metalworking, blueprint reading, and mathematics are helpful to young persons interested in becoming blacksmiths.

Blacksmiths must have a skilled touch in order to shape metal parts to specified dimensions. They must also be in good physical condition. Pounding metal into shape and handling heavy tools and metal parts for an entire working day require considerable strength and stamina. The use of power hammers and hoists, however, reduces the physical demands of the work.

Employment Outlook

The number of blacksmiths is expected to decline moderately through the mid-1970's. However, several hundred job openings will arise each year from the need to replace experienced workers who retire, die, or transfer to other fields of work.

The employment of blacksmiths is expected to decline in the years ahead because forge shops are producing a growing variety of small metal articles formerly made by blacksmiths, and because the metalworking operations once performed only by blacksmiths is increasingly being done by others workers such as welders and forge shop craftsmen. In addition, it is now cheaper to replace many small parts than to have them repaired by blacksmiths. However, the skills of all-round blacksmiths will continue to be needed in the maintenance departments of large industrial establishments, in many small metalworking and repair shops, and to shoe horses.

Earnings and Working Conditions

National earnings data are not available for blacksmiths. However, earnings data are available from union-management contracts, in effect in mid-1964, covering a large number of blacksmiths employed in steel plants, railroad shops, and in the shipbuilding and petroleum industries. Although these contracts show a wide range of earnings for experienced blacksmiths, the majority of the contracts called for straight-time hourly earnings ranging from about $2.50 to more than $3. Contracts covering blacksmiths in the petroleum industry specified hourly rates ranging from about $3 to slightly more than $3.40. Industrial blacksmiths generally work the same number of weekly hours and have the same holiday, vacation, and other benefits as other plant workers in those industries in which they work.

Blacksmith shops tend to be hot and noisy because of the furnaces and hammers, although heat and noise have been decreased in recent years by the introduction of large ventilating fans and the lessening of machine vibration. Blacksmiths are subject to a number of job hazards, such as burns from forges and heated metals and cuts, bruises, and other injuries from manual handling of materials. Increased use of personal protective equipment, such as safety glasses, metal helmets, metal-tip shoes, instep guards, face shields, ear plugs, and leather aprons, has helped to decrease the number of injuries.

Many blacksmiths belong to unions. One important union in the trade is the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers. Other unions representing blacksmiths include the United Steelworkers of America and the International Union of Journeymen Horseshoers.

Where To Go for More Information

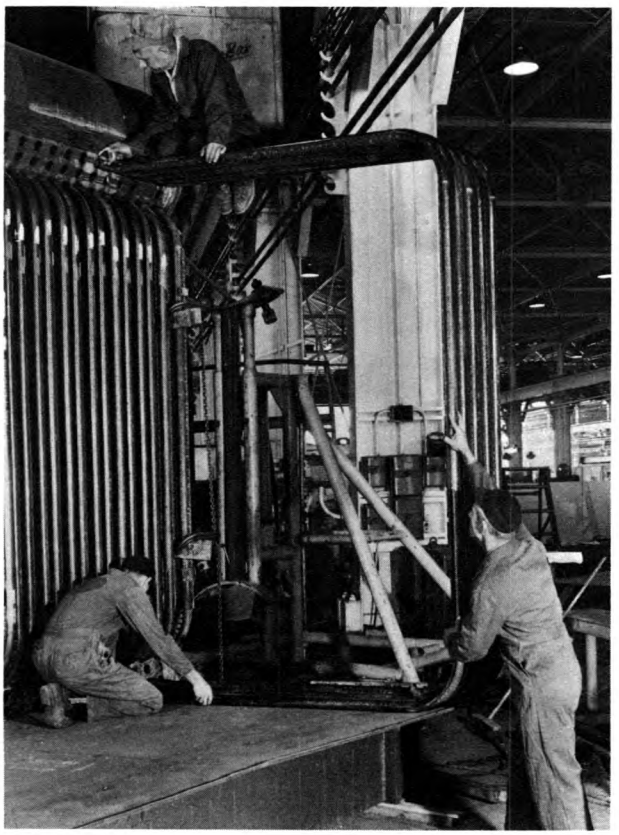
International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers, Eighth at State Ave., Kansas City, Kans. 66101.

Boilermaking Occupations

Nature of Work

Boilermakers, layout men, and fitup men are skilled workers who specialize in the repair, fabricating, and assembling of boilers, tanks, vats, pressure vessels, heat exchanges, and similar vessels made of metal plate. These boilers and other vessels are widely used throughout industry to hold liquids and gases under pressure. Boilermakers are primarily engaged in repairing and erecting boilers and vessels, while layout men and fitup men usually are employed in manufacturing new boilers and heavy tanks. The repair work performed by boilermakers requires these workers to have all-round skills; fitup men and layout men have more specialized duties.

Boilermakers (D.O.T. 805.281). These craftsmen assemble and erect prefabricated parts and fittings at construction sites where the boilers or other pressure vessels are to be used. After installation is completed, they make all necessary tests to check for defects. Boilermakers also do repair work in the field. After first determining the cause of trouble, they may then dismantle the boilers or other units and make repairs, such



Workmen assemble wall furnace tubes for watertube boiler.

as patching weak spots with metal stock, replacing defective sections with new parts, or strengthening joints. In addition to those working at construction sites, a large number of boilermakers maintain and repair boilers and other pressure vessels in the powerplants of industrial firms. Installation and repair work performed by boilermakers, must often meet standards set by State and local laws covering boilers and other pressure vessels.

Many large boilers, which formerly were assembled at their place of use, are now assembled at the plants of the manufacturers and shipped as completed packages. Boilermakers are often employed to do this assembly work, and they use the same skills for plant work as for field work.

Boilermakers use a variety of tools and equipment in assembly and repair work. They cut and shape plate to size with power shears, power rolls, power presses, or oxyacetylene torches. They use welding or riveting equipment. When assembling and erecting steel plate units at a field construction site, they may use all types of rigging equipment including hoists, jacks, and rollers.

Layout Men (D.O.T. 809.381 and .781). Metals used in the manufacture of boilers, tanks, vats, and other pressure vessels are initially prepared for fabricating operations by layout men. These workers mark on metal plates and tubes all curves, lines, points, and dimensions, which serve as directions to other workers for cutting or shaping the parts required for the pressure vessel being fabricated. They lay out parts to scale as outlined on blueprints, sketches, or patterns. Layout men use compasses, dividers, scales, surface gages, hammers, and scribers in their work.

Fitup Men (D.O.T. 819.781). Before the various parts of boilers, tanks, vats, and other pressure vessels are finally assembled, fitup men temporarily fit them together in the shop. They bolt or tack-weld parts together and correct irregularities. Fitup men also fit together nozzles, pipes, fittings, and other parts.

Fitup men read and interpret blueprints and drawings used in the manufacturing process, in order to check parts for accuracy and fit according to specifications. They use handtools such as hammers, sledges, wrenches, and punches, and equipment such as welding machines, portable drills, and grinding tools.

Where Employed

About 21,000 boilermakers, layout men, and fitup men were employed in the United States in early 1965. Several thousand were employed in the construction industry, mainly to assemble and erect boilers and other pressure vessels. Boilermakers were also employed in the maintenance and repair departments of firms in industries such as iron and steel manufacturing, petroleum refining, railroad transportation, and electric and gas utilites. Large numbers worked in Federal Government installations, principally in Navy shipyards and Federal power plants. Layout men and fitup men were employed mainly in establishments that fabricate fire-tube and water-tube boilers, heat exchangers, heavy tanks, and similar boiler-type items.

Boilermakers are employed in every State because of the widespread need for their skills in

repair and installation work. Large numbers are located in the Middle Atlantic and East North Central regions, where the metalworking industries are concentrated. Most layout men and fitup men work in these two regions also. Pennsylvania, California, Texas, Illinois, Ohio, New York, and New Jersey are among the leading States in numbers of boilermaking craftsmen.

Training and Other Qualifications

Many men have become boilermakers by working for several years as helpers to experienced boilermakers, but most training authorities agree that a 4-year apprenticeship is the best way to learn this trade. In the apprenticeship program, the apprentice works under the close supervision of a journeyman who instructs him in the skills of the craft, including the way to use the tools and machines of the trade. Apprenticeship programs usually provide for about 8,000 hours of relatively continuous employment and training, supplemented by about 600 hours of related technical instruction. Some of the related technical subjects studied by apprentice boilermakers are blueprint reading, shop mathematics, welding techniques, and shop metallurgical science covering stress and strain of metals.

Many layout men and fitup men acquire their skills on the job. They are usually hired as helpers and learn the trade by working with experienced workers. It generally takes at least 2 years to qualify as an experienced layout or fitup man in a fabricating shop where boilers and other pressure vessels are produced on a mass-production basis. In shops where products are custom made, layout and fitup jobs are generally filled by men who have first qualified as skilled boilermakers.

Employers prefer to hire beginning workers who have a high school education, and some employers require young workers to have such background. Prior training in mathematics, blueprint reading, and shopwork is helpful to young men interested in becoming boilermakers, layout men, or fitup men. Most firms require prospective employees to pass a physical examination, because good physical health and the capacity to do heavy work are necessary qualifications for work in these occupations. Mechanical aptitude and manual dexterity also are important qualifications.

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Employment Outlook

Employment of boilermakers, layout men, and fitup men is expected to increase moderately through the mid-1970's, assuming the realization of relatively full employment and high levels of economic activity. Most job openings, however, will arise from the need to replace experienced workers who retire, transfer to other fields of work, or die. Retirements and deaths alone are expected to result in more than 600 job openings annually.

The anticipated rise in employment of boilermakers, layout men, and fitup men in the decade ahead will occur mainly because of growth in the Nation's general economic activity. Such economic expansion will result in growth of industries that use boiler products—particularly the electric and gas utilities, chemical, steel, and construction industries. In addition to increased demand for boiler products, the trend toward very large, increasingly complex, custom-made boilers is expected to spur employment of skilled boilermakers to erect such equipment on site. In shops which fabricate boiler products, however, growth in the number of boilermakers, layout men, and fitup men may be limited by the increasing use of more efficient production techniques and equipment, including improved materials handling methods and welding equipment.

Earnings and Working Conditions

Wage rates of skilled boilermaking workers compare favorably with those of other craftsmen. Layout men generally are paid more than boilermakers or fitup men, although wages vary widely in each occupation because of differences in such factors as the experience and skill of the worker, the kind of industry in which he is employed, and the region of the country in which he works.

Boilermakers in field assembly and installation (construction) work generally receive higher hourly wage rates than boilermakers, layout men, and fitup men employed in industrial establishments, although they may not be as steadily employed. According to a national survey of building trades workers in the construction industry,

union minimum hourly wage rates for boilermakers in 56 large cities averaged $4.72, as of July 1, 1964. Among the individual cities surveyed, the minimum hourly rates for boilermakers included in the survey ranged from $4.20 in Dallas, Houston, and Lubbock, Tex.; Little Rock, Ark; Tulsa, Okla.; and New Orleans and Shreveport, La.; to $5.60 in New York City. Comparable data were not available covering boilermakers employed in industrial establishments. However, information on minimum hourly wage rates was available from union-management agreements, in effect in mid-1964, covering a large number of boilermakers, layout men, and fitup men employed in the fabricated plate work, petroleum, and shipbuilding industries. The majority of these agreements called for minimum hourly wage rates ranging from $3 to $4 for layout men; from slightly less than $3 to about $3.70 for boilermakers; and from slightly more than $2 to about $3.50 for fitup men.

Boilermakers, layout men, and fitup men in industrial establishments usually work the same number of weekly hours as other plant workers, generally 40 hours. Most of the union-management agreements covering these workers provide for fringe benefits such as hospitalization, and medical and surgical insurance; life insurance; sickness and accident insurance; and retirement pensions.

When engaged in boiler repair and assembly work, boilermakers are often required to work in cramped quarters or at great heights. Some work must also be done under conditions of dampness, heat, and poor ventilation.

Boilermaking is more hazardous than many other metalworking occupations. Although the rate of disabling work injuries in boilershops is higher than that for manufacturing industries as a whole, employers and unions attempt to eliminate injuries in boilershops by promoting safety training and the use of protective equipment, such as safety glasses and metal helmets.

Most boilermakers, layout men, and fitup men belong to labor unions. The principal union in these trades is the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers, and Helpers. Some boilermaking craftsmen are members of industrial unions, such as the Industrial Union of Marine and Shipbuilding Workers of America; the Oil, Chemical and Atomic Workers International Union; and the United Steelworkers of America.

Where To Go for More Information

International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers, Eighth at State Ave., Kansas City, Kans. 66101.

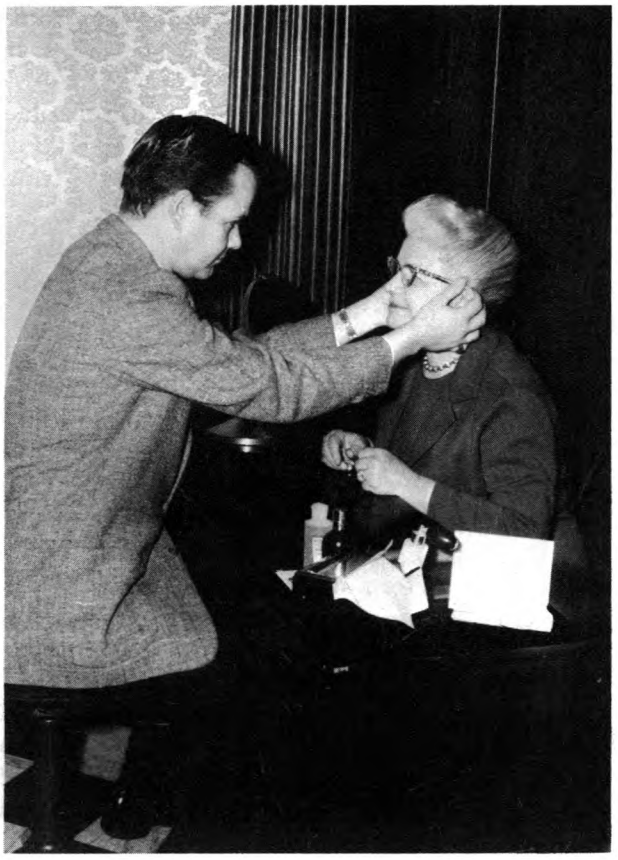
Dispensing Opticians and Optical Laboratory Mechanics

Nature of Work

Dispensing opticians and optical laboratory (shop) mechanics (also called *optical laboratory technicians*) make and fit eyeglasses prescribed by an eye physician (oculist or ophthalmologist) or optometrist to correct a patient's visual defect. The shop mechanic grinds and polishes the lenses to meet the specifications of the prescription and the dispensing optician, and assembles the lenses in a frame. Then the dispensing optician fits and adjusts the glasses to the customer's requirements. Fabricating and fitting the glasses usually involve two separate functions. Occasionally, both functions are performed by the same person.

Dispensing opticians in some States may also fit contact lenses, which are worn in contact with the eyes and used as a substitute for, or in addition to, conventional eyeglasses. The most recently developed and currently the most popular type of contact lens is the corneal lens, a tissue-thin plastic disc, about a third of an inch in diameter.

The *dispensing optician* (D.O.T. 713.251) works in a retail optical establishment. He makes certain that the glasses follow the prescription and fit the customer properly. The optician determines exactly where the lenses should be placed in relation to the pupils of the eyes by measuring the distance between the centers of the pupils. He also assists the customer in selecting the proper eyeglass frame by measuring the customer's facial features and giving considera-



Dispensing optician fits glasses for proper functioning and attractive appearance.

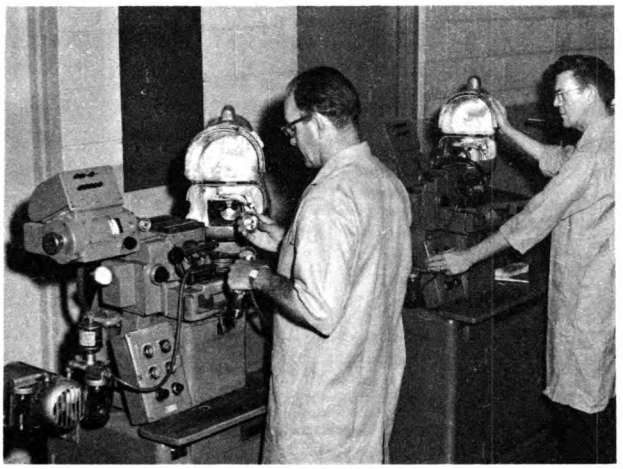
tion to the various styles and colors of the eyeglass frames.

Before prescription eyeglasses are fitted, the dispensing optician prepares a work order which gives the optical laboratory mechanic the information he needs to interpret the prescription properly, grind the lenses, and insert them in a frame. The work order consists of the lens prescription; information on the size, tint (where appropriate), optical centering of the lens, and other optical requirements; and the size, color, style, and shape of the frame. After the eyeglasses are made, the optician adjusts the frame to the contours of the customer's face and head to make sure they fit properly and comfortably. He uses small handtools, such as optical pliers, files, and screwdrivers, and also uses a precision instrument to check the power and surface quality of the lenses. In small shops, especially, he may do some lense grinding and finishing, and sell other optical goods such as binoculars, magnifying glasses, and nonprescription sunglasses.

In fitting contact lenses, the dispensing optician, following the physician's or optometrist's prescriptions, takes certain measures of the cornea of the customer's eye and then prepares specifications to be followed by a firm specializing in finishing such lenses. The dispenser uses precision instruments to measure the power and curvature of the lenses and the curvature of the cornea of the eye. Contact lens fitting requires considerably more skill, care, and patience than conventional eyeglass fitting. The dispensing optician instructs the customer in the insertion, removal, and care of the contact lenses during the initial period of adjustment, which may last several weeks. The physician or optometrist rechecks their fit, as needed. If minor adjustments are necessary, the dispensing optician makes them; if major changes are needed, he returns the lenses to the contact lens manufacturer.

The *optical mechanic* (D.O.T. 713.381) performs the shop or laboratory work required to make prescription eyeglasses; but he does not make contact lenses, which involve somewhat different operations. The two principal types of optical mechanics are the *surfacer* (D.O.T. 711.781) and the *benchman* (or finisher) (D.O.T. 711.381). The surfacer, starting with standard or stock size lens blanks, lays out the work, grinds and polishes the surfaces of the lenses, and makes sure that the ground lenses conform to the prescription requirements. In small laboratories, one man may perform all these operations, and benchwork also. In large laboratories, the work is divided into separate operations which are performed by semiskilled workers who operate power grinding and polishing machines. The surfacer uses precision instruments to measure the power of curvature of lenses.

The benchman marks and cuts the ground and polished lenses to fit the frame, bevels or smooths the edges of the lenses, and assembles the lenses and frame parts into the finished eyeglasses. In large laboratories, these duties are divided into several operations which are performed by semiskilled workers. The benchman uses small handtools, such as lens cutters, chippers, pliers, files, protractors, and diamond point glass drills, and



Optical laboratory mechanics utilize special equipment to grind lenses.

also uses precision instruments to determine, for example, if there are any imperfections in the lenses.

Both the surfacer and the benchman do repair work; they may also duplicate broken eyeglass lenses and replace damaged parts of frames.

Where Employed

An estimated 7,000 dispensing opticians and 15,000 optical laboratory mechanics were employed throughout the country in early 1965. About 70 percent of all dispensing opticians were employed by retail optical shops, or the optical departments of department stores and other retail establishments; about 20 percent were employed by eye physicians or optometrists who sell eyeglasses directly to their patients. The remainder worked in the prescription departments of wholesale optical laboratories that did work for retail optical firms; in special prescription shops in large ophthalmic goods factories; or were employed by hospitals, government agencies, construction firms, and mining companies. Nearly 70 percent of the mechanics worked in wholesale optical laboratories, and about 25 percent in retail optical establishments; the rest worked for the same types of employers as did opticians.

In addition to the dispensing opticians and optical mechanics mentioned above, many others are proprietors of retail optical establishments.

A few thousand women are employed in these trades. Many work as dispensing opticians in retail optical outlets.

Although opticians and mechanics are found in all States, more than half are located in the following States: New York, Massachusetts, Pennsylvania, Texas, California, and Illinois.

Training, Other Qualifications, and Advancement

Most optical mechanics and dispensing opticians learn their skills through informal, on-the-job training. Trainees start in jobs requiring simple skill and dexterity and gradually work into the more difficult jobs. For example, they may begin by processing lenses through a lens grinding machine, following standard procedures. After they have become skilled in this operation, the trainees perform other production operations, such as polishing, edging, lens cutting, and eyeglass assembly. Their training may include instruction in the measurement and curvature of lens surfaces, the measurement of lenses, and other subjects related to their work. When the trainees have acquired experience in all types of eyeglass production work, which usually takes about 3 years, they are considered all-round optical mechanics. Some trainees become specialists in one type of work performed by optical mechanics, such as surfacing or bench work. The training time required to become a specialist generally is less than that needed to become an all-round mechanic.

Most dispensing opticians acquire their training in dispensing offices under the guidance of experienced opticians. They usually have had prior training in optical mechanics, but a growing number start without this background. On-the-job training in dispensing work may last several years and usually includes instruction in optical mathematics, optical physics, the use of precision measuring instruments, and other related subjects.

High school graduates can prepare for both optical dispensing and mechanical work through formal apprenticeship programs. Most training authorities agree that optical mechanics and dispensing opticians who learn as apprentices have more job opportunities, improved job security, and more opportunities for advancement than those without such training. Some optical firms

have 4- or 5-year apprenticeship programs. Apprentices with exceptional ability may complete their training in a shorter period.

The typical program for an optical mechanic apprentice in eyeglass lens production includes on-the-job training and related instruction in ophthalmic optics (vision improvement). It also includes instruction in subjects such as types and measurement of lenses, the measurement and curvature of lens surfaces, and the effect of glass surfaces on light rays. This training qualifies a person for both surfacing and finishing work. However, apprentices may specialize in one phase of this work in the larger laboratories. The apprenticeship program for the surfacer emphasizes training in grinding operations, polishing, blocking, inspection, and layout. The benchman apprenticeship program concentrates on lens edging, layout for cutting, lens cutting and drilling, rimless spectacle assembly, inserting lenses into frames, and inspection of eyeglasses.

The dispensing optician apprentice is given training similar to that of the benchman apprentice. He receives additional instruction in optical mathematics, optical physics, physiology of the eye, use of precision measuring instruments, interpretation of prescriptions, the mechanics of dispensing, and the inspection of eyeglasses.

Academic training for the dispensing optician is becoming increasingly necessary. In 1965, three schools offered 2-year full-time courses at the college level in optical fabricating and dispensing work. In addition, one college offered a 2-year evening course. Another college offered a 2-year home study course in optics and optical dispensing to supplement the training of apprentices in retail optical dispensing shops. A few vocational schools have courses for optical mechanics. The larger manufacturers of contact lenses offer dispensers courses of instruction in contact lens fitting, usually lasting a few weeks.

Employers prefer applicants for entry jobs as dispensing opticians and optical mechanics to be high school graduates who have had courses in the basic sciences. A knowledge of physics, algebra, geometry, and mechanical drawing is particularly valuable. Interest in, and ability to do, precision work are essential. Because dispensing opticians deal directly with the public they must be tactful and have a pleasing personality.

In early 1965, 17 States had licensing requirements governing dispensing opticians: Arizona, California, Connecticut, Florida, Georgia, Hawaii, Kentucky, Massachusetts, Nevada, New Jersey, New York, North Carolina, Rhode Island, South Carolina, Tennessee, Virginia and Washington. Some of these States also require licenses for optical laboratory mechanics in retail optical shops or for the retail optical shop itself. Some States permit dispensing opticians to fit contact lenses while others prohibit them from doing so. To obtain a license, the applicant generally must meet certain minimum standards of education and training and also pass a written or practical examination, or both. For specific requirements, the licensing boards of individual States should be consulted.

Advancement opportunities are available to both optical mechanics and dispensing opticians. Optical laboratory mechanics can become supervisors, foremen, and managers. Many optical mechanics have become dispensing opticians, although there is a trend to train specifically for dispensing optician jobs. There are opportunities for workers in both occupations to go into business for themselves, especially for opticians with all-round training in both shop and dispensing work. Opticians may also become managers of retail optical stores. Some opticians may be employed as salesmen for wholesale optical goods companies, or for manufacturers of conventional eyeglasses or contact lenses. With college training, an optician may become an optometrist. (See statement on Optometrists.)

Employment Outlook

Employment of dispensing opticians is expected to increase moderately during the 1965–75 decade. In addition to the opportunities resulting from employment growth, about 1,500 job openings will result from the need to replace experienced workers who retire or die. Some additional job openings will become available as workers transfer to other occupations.

Little employment change is expected for optical mechanics during the decade. Several thousand job openings, however, will be available because of the need to replace experienced mechanics who retire, transfer to other occupations, or die. Re-

tirements and deaths alone should result in about 3,000 job openings during this period.

The production of prescription lenses is expected to increase considerably during the 1965–75 decade. Factors that will contribute to this growth include the increasing size, and the rising literacy, and educational level of the population; a large increase in the number of older persons (a group most likely to need eyeglasses); rising levels of personal disposable income; and the growing emphasis on good vision (more than half the population over 6 years of age now wear eyeglasses, and it is estimated that one-third of the remainder should do so). In addition, the many different styles and colors of eyeglass frames now available have increased the number of pairs of eyeglasses purchased by individuals and encouraged the wearing of eyeglasses.

The increase in production of prescription lenses will result in growing employment of dispensing opticians. However, principally as a result of more efficient methods of production, including availability of improved equipment such as surfacing machines, employment of optical mechanics is not expected to increase.

Earnings and Working Conditions

National earnings data are not available for optical mechanics and dispensing opticians. However, data obtained from firms employing a large number of these workers indicated that weekly earnings of mechanic trainees ranged from about $60 to $80 in early 1965; those of experienced mechanics ranged from about $90 to approximately $160. Dispensing opticians usually earn about 10 to 20 percent more than mechanics. Opticians who have their own businesses may earn much more. Foremen earn up to 20 percent more than skilled workers, depending on their experience, skill, and responsibilities. Apprentices start at about 60 percent of the skilled worker's rate and their wages are increased periodically, so that upon completion of the apprenticeship program, they receive the beginning rate for journeymen. Wholesale establishments usually have a 5-day, 40-hour workweek. Retail shop employees generally work a 5½- or 6-day week. Workers in these occupations usually have year-round employment.

The work of the dispensing optician requires little exertion and is generally performed in pleasant, well-lighted, and well-ventilated surroundings. Optical mechanics may work under fairly noisy conditions, because power grinding and polishing machines are used. New machines are much quieter, however.

Physically handicapped persons who have full use of their eyes and hands and can do sedentary work can perform some of the more specialized jobs in the larger laboratories.

Some optical mechanics and dispensing opticians are members of unions. One of the unions organizing these workers is the International Union of Electrical, Radio and Machine Workers.

Where To Go for More Information

American Optical Co.,
Box 1, Southbridge, Mass. 01551.

Bausch and Lomb, Inc.,
635 St. Paul St., Rochester, N.Y. 14602.

Optical Wholesalers Association,
222 West Adams St., Chicago, Ill. 60606.

International Union of Electrical,
Radio and Machine Workers,
1126 16th St., NW., Washington, D.C. 20036.

The following organizations can provide general information, the names of vocational schools, and other materials on training requirements:

Guild of Prescription Opticians of America,
1250 Connecticut Ave., NW., Washington, D.C. 20036.

American Board of Opticianry.
Frank X. Brandstetter, Secretary,
821 Eggert Rd., Buffalo, N.Y. 14226.

Electroplaters

(2d ed. D.O.T. 4–74.010)

(3d ed. D.O.T. 500.380 through .886)

Nature of Work

Electroplaters (platers) use plating solutions and electric current to coat metal articles with a layer of chromium, nickel, silver, gold, or other metal to give them a protective surface, or a more attractive appearance. Metal products that are often electroplated include such widely different items as automobile bumpers, cigarette lighters, silver-ware, costume jewelry, plumbing fixtures, electrical appliances, bearings, electronic components, and jet engine parts.

Platers' skills vary broadly among plating shops. All-round platers who work in job shops that do small lot plating of great variety may mix and analyze plating solutions, calculate the time and electric current needed for various types of plating, and perform other duties requiring a technical knowledge of the plating process. Platers who work in production shops, where large lots of metal parts of the same type are plated, usually carry out less difficult, more specialized assignments that require only limited technical knowledge.

Electroplater lowers metal parts into nickel plating bath.

In preparing an article for electroplating, the plater cleans it by dipping it in cleansing solutions, or by scouring it. He masks any surface not to be plated by covering it with lacquer, rubber, or plastic tape. To achieve the plating required by the specifications, he determines, or receives instructions from the foreman on the amount of electric current needed, the time required to plate the article, and the plating solution to use. He then places the article in a tank containing the plating solution, and adjusts the current so that the metal in the solution will be deposited on the surface of the article at the rate that will assure a good plating finish. The plater may remove the article from the solution at intervals to check on the progress of the plating. If the plating is not progressing satisfactorily, he makes the necessary adjustments or notifies his supervisor. Platers must be observant in their work because errors that go unnoticed can be very costly.

When the article is plated, the plater removes it from the solution and inspects the plating. On many types of plating work, the plater inspects objects only for visible defects. On jobs that require very close tolerances, the plater may use micrometers, calipers, and electronic devices to determine the quality of the work. Electroplaters are frequently assisted by helpers who place objects on racks before plating, remove them afterwards, and then clean tanks and racks. In some shops, platers order chemicals and other supplies for their work.

Where Employed

Several thousand electroplaters were employed in early 1965. About 2 out of 3 worked in independent job shops specializing in metal plating and polishing for other manufacturing firms and for individuals. The remaining platers were employed in the plating departments of plants primarily engaged in the manufacture of plumbing fixtures, heating and cooking utensils, lighting

fixtures, wire products, electric control apparatus, electric appliances, radio and television products, motor vehicles and parts, mechanical measuring instruments, miscellaneous hardware items, and other metal products.

Electroplaters are employed in almost every part of the country, although most work in the Northeast and Midwest near the centers of the metalworking industry. Large numbers of electroplaters work in Chicago, Detroit, New York, Cleveland, Newark, Jersey City, Providence and Los Angeles.

Training, Other Qualifications, and Advancement

Most electroplaters are hired as helpers and learn the trade on the job by working with experienced platers. It usually takes 3 years or longer to become an all-round plater in this way. Platers employed in production shops who are not required to have an all-round knowledge of plating can learn their jobs in much less time.

Another way to enter the electroplating trade is through an apprenticeship program, which lasts 3 or 4 years. Although apprentice training provides all-round preparation, only a small percentage of electroplaters have been trained this way.

The program for apprentices includes a combination of on-the-job training and related classroom instruction in the properties of metals, chemistry, and electricity as applied to plating. The apprentice does progressively more difficult work as his skill and knowledge increase. By the third or fourth year, he determines cleaning methods, does plating without supervision, makes solutions, examines plating results, and supervises helpers. Qualified journeymen may advance to foreman.

High school and vocational school courses in chemistry, electricity, physics, mathematics, and blueprint reading will prove valuable to young persons interested in becoming electroplaters. Some colleges, technical institutes, and vocational high schools offer 1- to 2-year courses in the principles and practices of electroplating. In addition to the training offered by these schools, many branches of the American Electroplaters Society conduct basic courses in the fundamentals of electroplating.

Employment Outlook

A few hundred job opportunities for electroplaters are expected each year during the 1965–75 decade. Most of these will result from the need to replace experienced workers who retire, die, or transfer to other fields of work. A small number of job opportunities are expected to occur as a result of the anticipated slight growth of the occupation.

Continuing mechanization of the electroplating process and the practice of assigning some of the plater's technical responsibilities to chemists and foremen will limit employment growth in this occupation. However, it is expected that these factors will be more than offset by the long-run expansion in the machinery and metalworking industries, and the application of the electroplating processes to a broadening group of metals and plastics.

Earnings and Working Conditions

Wage rates of electroplaters ranged from about $1.75 to $3.40 an hour in late 1964, according to a number of union contracts and information obtained from a limited number of employers. All-round platers, generally earned more than $2.50 an hour. During a worker's period of apprenticeship or on-the-job training, his wage rate usually starts at about 60 to 70 percent of an experienced worker's rate and progresses to the full rate by the end of his training period. In almost all plants, workers are paid shift premiums for working at night.

Plating work involves some hazards because acid, alkaline, or poisonous solutions are used. Humidity and odor are also problems in electroplating plants. However, most plants have installed systems of ventilation and other safety devices which have considerably reduced the occupational hazards. Protective clothing and boots provide additional protection. Mechanical devices are generally used to handle most of the lifting required, but at times the worker must lift and carry objects weighing up to 100 pounds.

Some platers are members of the Metal Polishers, Buffers, Platers and Helpers International Union. Other platers have been organized by the International Union, United Automobile, Aero-

space and Agricultural Implement Workers of America, and the International Association of Machinists and Aerospace Workers. Some of the labor-management contracts covering electroplaters provide health insurance and other benefits.

Where To Go for More Information

For educational information concerning electroplating and other metal finishing methods, write to:

American Electroplaters Society, Inc.,
445 Broad St., Newark, N.J. 07102.

For information on job opportunities, training, and other questions, write to:

National Association of Metal Finishers,
11 Park St., Montclair, N.J. 07042.

Gasoline Service Station Attendants

(2d ed. D.O.T. 7–60.500)

(3d ed. D.O.T. 915.867)

Nature of Work

Almost all of the more than 85 million motor vehicles in the United States are serviced at one time or another in a gasoline service station. When a car or truck is driven into a station, the service station attendant greets the customer and inquires about his needs. The attendant may perform a variety of services for the customer, ranging from directing the customer to a street address to making a minor repair.

When servicing a car, the attendant pumps gasoline, cleans the windshield, and, with the customer's permission, checks the water level in the radiator and battery, the oil level in the crankcase and automatic transmission, and the air pressure in the tires. He may also check the tires, fan belt, and other parts of the car for excessive wear.

The attendant has other responsibilities besides servicing cars. He sells and installs items such as tires, batteries, fan belts, and windshield wiper blades. When a customer pays his bill, the attendant makes change, or prepares a charge slip if the customer uses a credit card. He may also dispense trading stamps. In small stations particularly, he may perform minor maintenance and repair work, such as lubrication, rotating tires, repairing tires, or replacing a muffler. Some attendants, called mechanic-attendants, make more difficult repairs. Before and after doing maintenance and repair work, the attendant may drive the customer's car between a convenient parking place and the service area. He may also keep the service areas, building, and restrooms clean and neat. In some stations, the attendant helps the station manager take inventory, set up displays, and perform other duties associated with the operation of a small business.

If a gasoline station provides emergency road service, the attendant may drive a tow truck to a stalled car and change a flat tire or make other minor repairs needed to get the customer on his way again. If more extensive repairs are needed, he tows the vehicle back to the service station.

In doing maintenance and repair work, gasoline service station attendants may use simple handtools, such as screwdrivers, pliers, and wrenches; and power tools, such as pneumatic wrenches. Mechanic-attendants frequently use more complex equipment, such as motor analyzers and wheel alinement machines.

Where Employed

An estimate 350,000 service station attendants were employed in gasoline service stations in early 1965. More than half were employed in stations that had one to five workers. Several thousand additional people worked part time as service station attendants. In addition to attendants, there were about 200,000 gasoline service station managers and owners who do work similar to that done by attendants.

Gasoline service station attendants are employed in every section of the country, in the largest cities, the smallest towns, and outlying areas. About 40 percent of gasoline service station attendants are employed in the seven States that have the largest number of motor vehicles: California, New York, Texas, Pennsylvania, Ohio, Illinois, and Michigan.

Training, Other Qualifications, and Advancement

An applicant for a job as a gasoline service station attendant must have a driver's license, a general understanding of how an automobile works, and some sales ability. He should be friendly and able to speak well, present a generally neat appearance, and have self-confidence. He should know simple arithmetic so that he can make change quickly and accurately and help keep business records. An applicant should be familiar with local roads, highways, and points of interest in order to give directions to strangers and to locate vehicles whose owners have called for road service.

Although completion of high school is not generally a requirement for getting an entry job, it is an advantage because to many employers it indicates that a young man can "finish a job." A high school education is, however, generally required in order for attendants to qualify for service station management training programs conducted by oil companies, and to advance to the position of service station manager.

Gasoline service station attendants usually are trained on the job, although there are some formal training programs. Attendants who are trained on the job are first given relatively simple work assignments. They may be required to keep the station clean, wash cars, pump gas, clean windshields, and otherwise make themselves useful. Gradually, the attendant progresses to more advanced work such as making sales, writing credit charge slips, doing simple maintenance work, installing accessories on cars, and helping to keep the station records. It usually takes several months for a gasoline service station attendant to become fully qualified.

Formal training programs for young people who want to do gasoline service station work are offered in many high schools around the country. In this curriculum, known as distributive education, students in their last 2 years of high school take business education courses and work part time in a gasoline service station where they receive instruction and supervision in all phases of service station work.

Training programs for unemployed and underemployed workers who want to become gasoline service station mechanic-attendants are in operation in a large number of cities under provisions of the Manpower Development and Training Act. These programs, which lasted up to 26 weeks in early 1965, emphasize the maintenance and repair duties of the occupation.

Some attendants are enrolled in formal training programs for service station managers, conducted by most major oil companies. These programs usually last from 2 to 8 weeks and emphasize subjects such as simple automobile maintenance, salesmanship, and business management.

Several avenues of advancement are open to gasoline service station attendants. With additional training, attendants may become automobile mechanics; those with business management capabilities may advance to station manager. Many experienced station managers and automobile mechanics go into business for themselves by leasing a station from an oil company, as is most common, or buying their own service station. Some service station attendants and managers advance to positions like those of salesman or district manager with oil companies.

Employment Outlook

Employment of gasoline service station attendants is expected to increase moderately during the 1965–75 decade, creating several thousand full-time and part-time job openings annually. In this large occupation, an even greater number of job openings will result from the need to replace attendants who transfer to other fields of work, are promoted, or who retire, or die. Deaths and retirements alone are expected to provide an estimated 4,000 full-time job opportunities annually.

Employment of service station attendants is expected to increase as a result of a growing consumption of gasoline and other service station products. The number of motor vehicles registered is expected to rise by more than a fourth in the next 10 years, because of growing population, income, and multiple car ownership, and the continuing movement to the suburbs. Also, greater use is expected to be made of cars as families have more leisure to visit national parks and other points of interest, and as the highway system continues to be improved.

More attendants may also be needed to perform additional maintenance on newer, more complex cars. For example, a growing number of cars are expected to be equipped with devices that

reduce exhaust fumes, and these devices must be serviced periodically. On the other hand, the increasing number of cars that require oil changes and lubrication less frequently will partially offset the servicing requirements of additional, more complex vehicles.

Earnings and Working Conditions

Hourly earnings of gasoline service station attendants vary considerably. They are generally higher in large gasoline stations located in metropolitan areas in Western and North Central States. About two-thirds of all gasoline service station attendants had straight-time average hourly earnings between $1 and $1.60 in 1964. However, attendants employed in a few large cities earned over $2 an hour. In addition to their hourly rates, many service station attendants are paid commissions based on the value of products and services they sell. Most full-time attendants had averaged weekly earnings of about $75 in 1964.

In many stations, employers provide attendants fringe benefits such as accident and health insurance and paid vacations. Some employers furnish uniforms and pay for their cleaning; others require the attendant to bear these expenses. Most attendants work more than 40 hours a week; many work more than 48 hours. Attendants frequently work at night, and on weekends and holidays.

A gasoline service station attendant works out of doors in all kinds of weather. He must be in good physical condition because he does considerable lifting and stooping and spends much time on his feet. Possible injuries include cuts from sharp tools and burns from hot engines. The attendant frequently gets dirty because he pumps gasoline, handles oil and grease, and works with greasy tools and around dirty cars. For many attendants, however, the opportunity to meet new people and the possibility of someday managing their own service stations more than offset these disadvantages. For others, the opportunity to get part-time employment is important.

Some high school and college students have been able to work their way through school by working as gasoline service station attendants after school, and on vacations and holidays. Some workers also supplement their income from regular jobs by working part time as attendants.

Where To Go for More Information

For further information regarding work opportunities for gasoline service station attendants, inquiries should be directed to local gasoline service stations or the local office of the State employment service. The State employment service also may be a source of information about training programs operated under provisions of the Manpower Development and Training Act.

General information about the work of gasoline service station attendants may be obtained from:

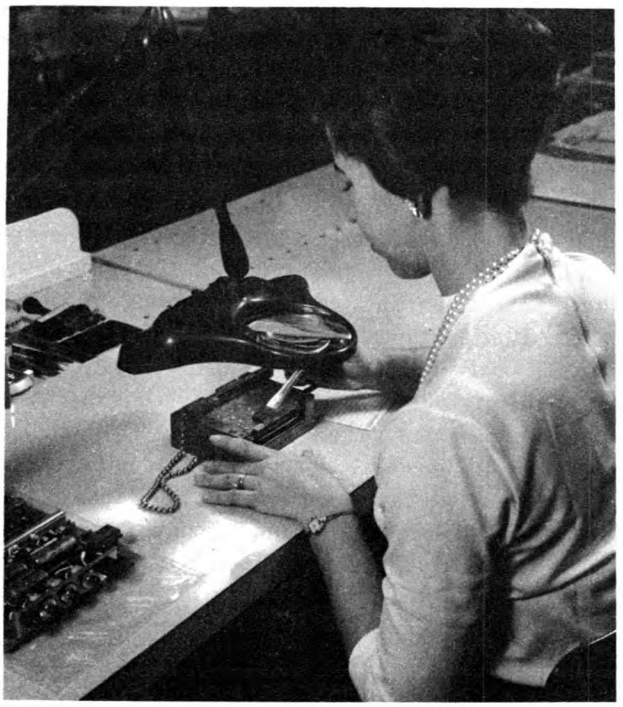
American Petroleum Institute, Marketing Division, 1271 Avenue of the Americas, New York, N.Y. 10020.

Inspectors (Manufacturing)

Nature of Work

Almost everything manufactured must be carefully inspected during the manufacturing process. The millions of automobiles, sewing machines, television sets, production machines, and other mass-produced items must be tested and inspected to make sure they operate properly. The workers who see that the size and quality of raw materials, parts, assemblies, and finished products meet specifications are known as inspectors.

Inspectors use a variety of methods in order to be certain that the products they examine conform to specifications. They may merely look for scratches and other defects in products or parts; or they may use gages, micrometers, and other measuring devices to check the accuracy of the parts. Semiskilled inspectors may be required to read simple work orders, and do arithmetic involving decimals and fractions when reading measuring instruments. Inspectors often keep records of the number of parts they have accepted, and rejected. When they find a large number of faulty pieces, they notify their supervisors so that corrections can be made on the production line. Some inspectors use handtools,



Inspector examines soldered components on printed circuit.

such as screwdrivers or pliers, in their work. In some industries, inspectors may make minor repairs and adjustments, and grade products for quality.

The kinds of products that inspectors check vary widely by industry. For example, in radio and television manufacturing plants, many inspectors test tubes and circuits to see that they meet specifications. In the automobile industry, they examine raw materials and parts during the various stages of manufacturing, as well as the complete automobile.

In addition to the semiskilled inspectors described in this statement, there are many skilled inspectors. Skilled inspectors work under general supervision, whereas semiskilled inspectors usually work under close supervision. Skilled inspectors often use a much wider variety of testing instruments; and in the metalworking industries are often required to read blueprints and interpret complex specifications. They generally have greater discretion in accepting or rejecting products and usually are responsible for inspecting the most critical parts of mass-produced goods.

Where Employed

In early 1965, about 400,000 semiskilled inspectors were employed in a wide variety of manufacturing industries. More than two-thirds of these inspectors worked in plants producing durable goods such as electrical motors, refrigerators, lathes, automobiles, and aerospace products. Others were employed in plants producing nondurable goods such as chemicals, textiles, clothing, and food products. About half of these inspectors were employed in Ohio, New York, Michigan, Illinois, Pennsylvania, California, and New Jersey.

Training, Other Qualifications, and Advancement

Semiskilled inspectors are generally trained on the job for a brief period—from a few hours or days to several months, depending upon the skill required.

Many employers look for applicants who have good health and eyesight, can follow directions, and are dependable. Some employers prefer experienced production workers for inspection jobs. A few large companies give aptitude tests in selecting new employees for inspection work. For example, in the electronics industry, new workers may be given tests to determine their ability to work with numbers. Employers also look for employees who can do work requiring constant attention. Employers may hire applicants who do not have a high school diploma, if they have qualifying aptitudes or related job experience.

More than 2 out of 5 semiskilled inspectors are women. They are employed throughout the industries that manufacture metal products, but especially in the electrical machinery industry, where many jobs are not physically demanding. They generally work in plants that produce relatively small and light products and parts, such as electrical and electronic equipment. Women inspectors predominate in many food, textile, and apparel products industries.

Some semiskilled inspectors in the metal products industries who supplement their work experience with formal educational courses, such as blueprint reading, shop mathematics, and electrical theory, may advance to skilled inspectors. A few semiskilled inspectors, after acquiring

sufficient experience and knowledge, may advance to foremen jobs.

Employment Outlook

The employment of semiskilled inspectors is expected to increase by several thousand annually during the 1965–75 decade. In addition, a considerable number of job opportunities will result as workers retire, die, or transfer to other fields of work, and as women leave their jobs to marry or raise a family. Deaths and retirements alone will account for about 15,000 openings each year.

Most of the industries that employ these workers, especially the electrical machinery industry, are expected to increase their employment in the long run. The growing complexity of the products manufactured in our factories, and rising quality standards, should also result in a need for more inspectors. These favorable factors will be partially offset, however, by the increasing use of mechanized and automatic inspection equipment.

Earnings and Working Conditions

Inspectors' earnings vary considerably depending on their skill, the type of product inspected, the method of wage payment, and the size and location of the plant in which they are employed. Inspector jobs are commonly classified as A, B, and C, to reflect the level of skill and responsibility involved. (For the purpose of this publication, class B and C inspectors are considered to be semiskilled workers.) In mid-1965, average straight-time hourly earnings of class B male inspectors in machinery (other than electrical) plants in 18 large cities and metropolitan areas ranged from $2.34 in Dallas to $3 in Houston; and earnings of class C male inspectors ranged from $2.08 in New York City to $2.86 in Detroit. Average straight-time hourly earnings of Class C women inspectors ranged from $1.96 in Boston to $2.70 in Detroit. Even among machinery plants in the same city, earnings of male inspectors of comparable skills differed. For example, among machinery plants in Dallas, straight-time hourly earnings of class B male inspectors ranged from $1.90 to $2.80; among machinery plants in Houston, the range was from $2.30 to $3.60 and over. Other studies indicate that average hourly earnings of inspectors (as a group) in the food processing, textile, and apparel industries were about equal to those of class C inspectors in metalworking industries.

The working conditions of inspectors also vary considerably. For example, some may work in well-lighted, air-conditioned workplaces in an aircraft or missile plant; others may work on the production floor of a machinery or metal fabricating plant, often exposed to high temperatures, oil, grease, and noise.

Many inspectors employed in manufacturing industries are members of labor unions. The International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the International Association of Machinists and Aerospace Workers; the International Union of Electrical, Radio and Machine Workers; and the International Brotherhood of Electrical Workers are among the larger unions to which these workers belong. Most of the labor-management contracts in manufacturing plants employing inspectors provide for fringe benefits such as paid holidays and vacations, health insurance, life insurance, and retirement pensions.

Jewelers and Jewelry Repairmen

(2d ed. D.O.T. 4–71.010, .020, and .25)
(3d ed. D.O.T. 700.281 and .381)

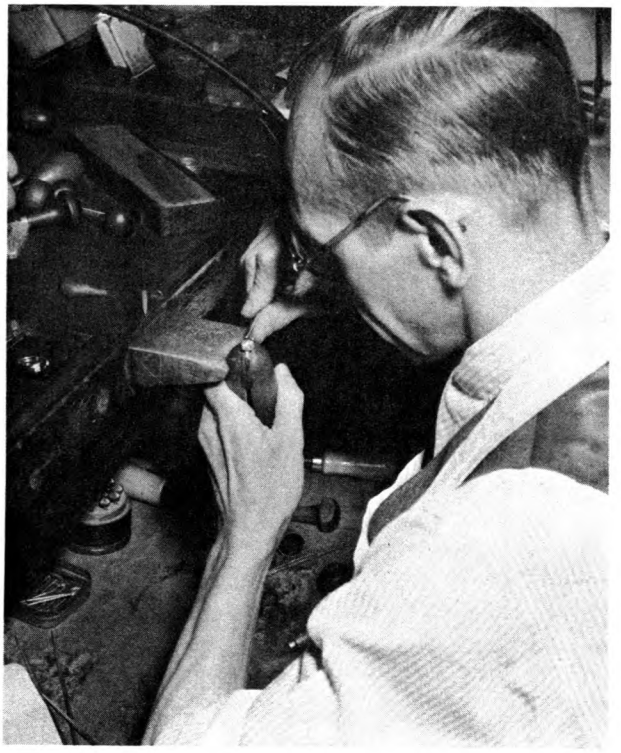
Nature of Work

Jewelers make rings, pins, necklaces, bracelets, and other precious jewelry by hand. They create jewelry by setting precious or semiprecious jewels or synthetic stones in metal such as gold, silver, and platinum; or by using these metals only. Jewelers also repair jewelry. For example, they solder broken parts, make new parts, enlarge or reduce the size of rings, reset stones, and restyle old jewelry. The jewelers' work is very delicate and must be done with care and precision, as the materials used are usually extremely expensive. An eye "loupe," or magnifying glass held over the eye, is often necessary.

In making jewelry, jewelers may follow their own design or one prepared by a design specialist. The metal is formed to follow the design in several ways. Special-order work may involve shaping metal stock with hand and machine tools or melting and casting metal in a mold. When jewelry is produced in volume, the metal usually is formed either by the casting or the stamping process.

Shaping metal stock by hand may involve the following metalworking operations: outlining, cutting, drilling, sawing, filing, shaping, engraving, and electroplating. Individual parts are polished and then joined by soldering. After the article has been assembled, surface decorations are made and jewels or stones are mounted. When jewelry is made in this manner, jewelers use tools such as files; saws; drills; dapping, carving, and chasing tools; jewelers' lathes; soldering irons; and polishing machines.

To cast gold and platinum jewelry, a model of the piece is made by a jewelry modelmaker, a craftsman who has a thorough knowledge of the casting process. A rubber mold is produced from the model, and into this mold wax or plastic is injected under pressure. The pattern so produced is placed in a plasterlike material and burned out, leaving a cavity in the material. The precious metal is then cast into this cavity by centrifugal pressure. After cooling, the cast piece is removed. Articles produced by this process require a minimum of finishing. Jewels or stones may then be set in the cast piece and it may be engraved.



Skilled jewelry worker sets a diamond.

Cast costume jewelry is similarly produced, except that the metal is cast directly into a rubber or metal mold, after which it is either tumbled and plated or finished on a polishing machine.

In the stamping process, which is used to make costume and some precious jewelry, the metal piece is formed in a stamping machine that brings together, under tremendous force, a die and the metal from which the piece is to be made. The die has a cavity shaped to the exact contour and dimension of the desired article.

As a rule, jewelers specialize in making a particular kind of jewelry, or in a particular operation, such as making models and tools, engraving, polishing, or setting diamonds and other stones. Others may, after years of experience, become all-round jewelers, capable of making and repairing any kind of jewelry. Costume jewelry and some kinds of precious jewelry are mass produced by factory workers using assemblyline methods. However, highly skilled jewelers are needed to make the models and tools for this large-scale production. They also may perform some finishing operations, such as stonesetting and engraving, on stamped or cast pieces.

Many jewelers make and repair jewelry in their own stores where they sell jewelry, watches, and, often, other merchandise, such as silverware, china, and glassware. They may also do watch repairing. Other jewelers operate trade shops that specialize in making jewelry and in doing repair work for those jewelry stores owned or operated by merchants who are not jewelry craftsmen or who take in more repair work than they can handle in their own stores.

Where Employed

Employment of jewelers and jewelry repairmen was estimated to be more than 25,000 in early 1965. About 9,000 of these jewelers and repair-

men worked in retail stores, with the number about equally divided between proprietors and employees. Approximately 7,500 jewelers and repairmen worked in manufacturing establishments; most of these workers were employees in precious jewelry manufacturing establishments. More than a thousand jewelers owned plants making precious jewelry and a small number worked in costume jewelry establishments. More than 8,000 jewelers and repairmen worked in wholesale establishments or trade shops (not usually open to the public) that specialize in jewelry repairs for retail stores. The majority of these jewelers were proprietors of such establishments.

The Nation's 21,000 retail jewelry stores are located throughout the country. The heaviest concentration of these stores, as well as the thousands of small trade shops that service them, is in large commercial and industrial centers, such as New York City, Chicago, Los Angeles, and San Francisco.

More than three-fourths of all precious jewelry manufacturing plants are in New York, New Jersey, Rhode Island, Massachusetts, and Pennsylvania. The center of precious jewelry manufacturing is the New York City metropolitan area.

Training, Other Qualifications, and Advancement

Young persons generally learn the jewelry trade either by serving a formal apprenticeship or through informal on-the-job training while working for an experienced jeweler. Jewelry repair, which is usually less complicated than jewelry making, can be learned in a short time by individuals already trained in filing, sawing, drilling, and other basic mechanical skills. Courses in jewelry repair are given in several trade schools that teach watch repairing. Other trade schools offer courses in specific types of jewelry work, such as diamond setting, jewelry design, and engraving.

Formal apprenticeship in this trade takes from 3 to 4 years, depending on the type of training. For example, 3 years are required to become a colored-stone setter and 4 years to qualify as a diamond setter. Throughout the apprenticeship, training on the job is supplemented by trade school instruction in design, quality of precious stones, the chemistry of metals, and other related subjects. First work assignments may be to set up work for soldering or to do simple soldering or rough polishing. As an apprentice gains experience, he advances to more difficult work. On completion of the apprenticeship, he becomes a fully qualified journeyman jeweler.

A high school education is desirable for young people seeking to enter the trade. Courses in chemistry, physics, mechancial drawing, and art are particularly useful. Personal qualifications important for success in this field are mechanical aptitude, finger and hand dexterity, and good eyesight. Artistic ability is necessary for work in jewelry design. For those planning to become a retail jeweler or to open a trade shop or manufacturing establishment, the ability to deal with people and manage a business is also a necessity. Because people in this trade work with precious stones and metals they must be bonded. Bonding requires an investigation of one's personal background for such traits as honesty, trustworthiness, and respect for the law.

Jewelry manufacturing establishments in the major production centers offer the best opportunities for a young person to acquire all-round skills, even though the number of trainees accepted is small. Trade shops also offer some training opportunities, but their small-size—many are one- or two-man shops—limits the number of trainees.

Jewelry workers may advance in several ways. In manufacturing, for example, they can advance from production jeweler to shop foreman. In retail stores, jewelers may become head of a sales department or store manager. Those jewelers employed in jewelry making and repair departments operated by large retail establishments may advance to department manager. Some jewelers establish their own retail stores or trade shops.

A substantial financial investment is required to open a retail jewelry store and the field is highly competitive in most parts of the country. Young jewelers interested in going into business for themselves will find it advantageous to work first in an established retail jewelry store, trade shop, or jewelry manufacturing plant. Persons planning to open their own jewelry stores should have experience in selling jewelry. Those jewelers who can also repair watches will have an advantage over those who can work on jewelry only,

since watch repair work is a substantial part of the business done in small jewelry stores, particularly in small communities. Talented and experienced jewelers of recognized integrity can establish their own trade shop or small manufacturing shop with a more moderate financial investment. The location of such shops would be limited to areas with a large volume of jewelry business. For manufacturing, this means the major production centers. Trade shops have best chances for success in the moderate size or large cities where there are many retail jewelry stores.

Employment Outlook

Several hundred job openings for jewelers and jewelry repairmen will arise annually during the 1965–75 decade, mainly because of retirements and deaths among experienced workers. Most job openings are expected to be filled by people trained in only one or two specialties of the trade, such as stone setting, engraving, model making, casting, or polishing. Nevertheless, there will be considerable demand for all-round jewelers, who have been in short supply in recent years.

In jewelry manufacturing, all-round jewelers will continue to be needed. However, most job openings will be filled by specialized craftsmen, because increasing job specialization has resulted from the mass-production of jewelry, particularly costume jewelry. In trade shops in which a large volume of custom-jewelry and jewelry-repair work permits work specialization, job openings for jewelers will mainly be filled by specialized craftsmen. In retail jewelry stores, there will be job opportunities for both all-round jewelers and specialized craftsmen. Most openings, however, will be in the very large establishments that have enough business to justify a staff of jewelry craftsmen. The smaller stores, which seldom have enough jewelry making and repair business to keep a jeweler fully employed, increasingly are contracting out such work to trade shops.

The demand for precious jewelry is expected to increase with the population and rising personal income. In addition, the more rapid rise in family formations, expected to begin in the late 1960's, will spur the demand for engagement and wedding rings, as well as for gift items. These same factors will increase the demand for costume jewelry, although costume jewelry sales fluctuate widely from year to year, mainly because of fads in jewelry fashions. Although a substantial expansion in jewelry output is anticipated, there will be little change in total employment of jewelers and jewelry repairmen, principally as a result of a continued increase in craft specialization and automated methods of production.

Earnings and Working Conditions

Jewelry repairmen employed in retail stores and trade shops started at about $80 a week in early 1965; experienced workers in these establishments earned up to $200 weekly. Jewelers who own retail stores or trade shops generally earn considerably more than jewelers working as employees in such establishments.

One agreement between employers and the International Jewelry Workers' Union, covering about 1,600 jewelry workers employed in plants manufacturing precious jewelry in New York City, provided for payment of the minimum hourly rates shown in the following tabulation to inexperienced workers (including apprentices) and to journeymen in selected crafts, as of February 1, 1965. Average hourly earnings for journeymen covered by this agreement, and employed in the occupations shown in the tabulation, ranged from about 10 to nearly 40 percent above these minimum hourly job rates in February 1965, according to the union.

Occupation	*Minimum hourly job rates*
Starting rate—all inexperienced workers	$1. 40
Journeyman's rate:	
Production jewelers	2. 50
Jewelers—handmade work	3. 00
Modelmakers	3. 05
Stone setting:	
Diamond	3. 00
Colored stones	2. 55
Handmade work	3. 25
Polishers	2. 50
Casters	2. 30

Under this agreement, all inexperienced workers, including apprentices, receive increases of 10 cents an hour every 3 months until they reach the

minimum journeyman rate for their particular job, which is considerably lower than average hourly earnings in the trades.

Skilled workers in the precious jewelry manufacturing union shops in the New York City area have a 35-hour workweek and are paid time and one-half for all work done before or after the regular workday. Because employment in jewelry manufacturing is seasonal, some jewelers may be laid off following the Christmas and Easter seasons when sales slacken. Retail jewelers and jewelry repairmen work 40 to 48 hours a week, and may work longer hours during the holiday seasons.

Where To Go for More Information

Information on employment opportunities for jewelers and jewelry repairmen in retail stores and trade shops may be obtained from:

Retail Jewelers of America, Inc.,
711 14th St. NW., Washington, D.C. 20005.

Information on employment opportunities in manufacturing establishments may be obtained from:

Manufacturing Jewelers and Silversmiths of America, Inc.,
Sheraton-Biltmore Hotel, Room S-75,
Providence, R.I. 02902.

International Jewelry Workers' Union, Local No. 1,
133 West 44th St., New York, N.Y. 10036.

Power Truck Operators

(2d ed. D.O.T. 7–88)
(3d ed. D.O.T. 892.883; 921.782 and .883; and 922.782 and .883)

Nature of Work

In the past, manual workers in factories usually did the hard physical labor of moving raw materials and products. Today, many heavy materials are moved, with little physical effort, by workers who operate various types of self-powered trucks, which can easily carry tons of material and lift it to heights of 18 feet or more.

Forklift truck operator stacks lumber.

A typical truck operated by these workers has a hydraulic or electric lifting mechanism with attachments such as forks to lift piles of cartons or other containers, and scoops to lift coal or other loose material. Some power trucks are equipped with tow bars used to pull small trailers.

Power truck operators start the truck, make it go forward or backward, stop the truck, and control the lifting mechanism and attachments by moving pedals and/or levers. Power truck operators may be required to keep records of materials moved, do some manual loading and unloading of materials, and maintain their trucks in good working condition by cleaning, oiling, checking water in batteries, and making simple adjustments.

The driver must use care and skill in driving his truck. For example, in driving through aisles where materials are stored or when loading or removing materials from stock, which may be stacked from floor to ceiling, he must be able to judge distance so that no damage occurs. The operator also must know how much the truck can lift and carry and the kinds of jobs it can do.

Where Employed

Semiskilled power truckers are employed in all types of manufacturing industries. Many of these

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workers are employed in metalworking plants that manufacture products such as automobiles and automobile parts, machinery, fabricated metal products, and iron and steel.

In 1964, more than 75,000 power truck operators worked in medium and large manufacturing plants located in metropolitan areas throughout the country. Almost half of these operators worked in the North Central States. In addition to working in factories, large numbers of these workers are employed in warehouses, depots, dock terminals, mines, and other places where great quantities of materials must be moved.

Training, Other Qualifications, and Advancement

Most workers can learn to operate a power truck in a few days. It takes several weeks, however, to learn the physical layout and operation of a plant or other establishment and the most efficient way of handling the materials to be moved.

Large companies generally require applicants for a power truck operator job to pass a physical examination. Many large employers also have formal training programs for new employees. In these training programs, the employee learns to operate the power truck, to do simple maintenance work, principles of loading and handling materials, plant layout and plant operation, and safe driving practices and rules.

There are some opportunities for advancement. A few operators may become materials movement foremen or supervisors.

Employment Outlook

Employment of power truck operators is expected to increase moderately during the 1965-75 decade. Replacement needs resulting from retirements, deaths, and transfers to other jobs also will provide many job openings.

Employment of power truck operators is expected to increase because of the need to move the increasingly huge amounts of manufactured goods demanded by the Nation's growing population and rising standard of living. Most of the industries which employ large numbers of these workers are expected to have a long-range upward trend in employment. In addition, the increasing use of containers and pallets for moving goods will increase the need for power truck operators. The favorable effects of these two factors on employment, however, will be partially offset by improved plant design and the continued development of more efficient power trucks and other mechanized materials-handling equipment. For example, better plant design and organization should reduce material movement requirements; overhead cranes may be substituted for many power trucks to reduce traffic through work areas; and conveyor systems may increasingly be adopted to move materials in fixed paths at constant rates of speed.

Earnings and Working Conditions

Power truck operators employed in manufacturing industries generally are paid an hourly rate. In 1964–65, the average straight-time hourly earnings of forklift power truck operators in manufacturing plants in 82 cities and areas ranged from $1.51 in Greenville, S. C., to $3.01 in Akron, Ohio.

Power truck operators are subject to several hazards—such as falling objects and collisions between vehicles. Safety instruction is therefore an important part of the job training in power trucking work.

The driver may operate his truck inside buildings, or outdoors where he is exposed to various weather conditions. Some operators may handle loose material that may be dirty or dusty.

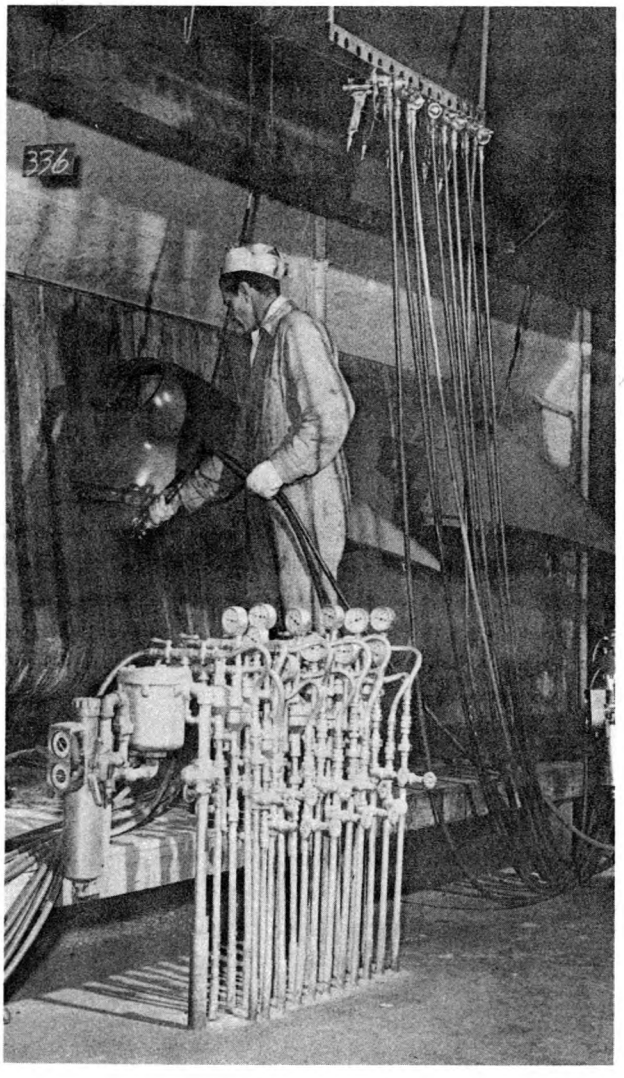
Power truck operators have somewhat varied work in moving materials throughout a plant. Their work is likely to be less repetitive and routine than that of workers who do semiskilled machine operator work.

Many power truck operators are members of labor unions. Most labor-management contracts in manufacturing plants employing power truck operators provide for fringe benefits such as paid holidays and vacations, health insurance, life insurance, and retirement pensions.

Production Painters

Nature of Work

Almost every metal or wood product manufactured by American industry is given a coating of paint or other protective material. In mass-production industries this painting is done by workers known as production painters. Most of these workers use spray guns to apply paint, lacquer, varnish, or other finishes to parts or finished manufactured products. Some production painters use brushes to apply paint and others operate semiautomatic paint spraying machines, dipping tanks, or tumbling barrels. The work done by production painters in factories is different from that performed by skilled painters who are employed in construction and maintenance work. (See statement on Painters.)



Production painter sprays body part attached to moving conveyor.

Painters who operate spray guns pour mixed paints into a spray gun container that is attached to an air-compressor unit. They adjust the nozzle of the spray gun and the air-compressor so that the paint will be applied uniformly. The objects being sprayed may be stationary or attached to a moving conveyor. Production painters who operate semi-automatic painting machines may load items into the machine or onto conveyors before applying paint. When working on objects requiring more than one color, production painters may apply masking tape to prevent overlapping of colors.

Although the duties of most production painters are simple and repetitive, the jobs of some may be varied. These production painters may make decisions involving the application of finishes, thinning of paint, and the adjustment of paint spray equipment. Production painters also may clean the surface to be painted before painting. For assignments requiring production painters to mix paints and figure the size of the area to be painted, they use simple arithmetic involving decimals and fractions. Production painters may replace nozzles and clean guns and other paint equipment when necessary. Some production painters may operate specialized spray guns such as those operated at high temperatures and used to spray powdered plastics. In addition to their painting equipment production painters use tools such as mixing paddles, pliers, wrenches, rules, and gages that indicate the consistency of liquid paint.

Where Employed

About 100,000 production painters were employed in manufacturing industries in early 1965; about 85 percent of these were in industries making durable items such as automobiles, refrigerators, furniture, electrical measuring meters, and transformers. About half of all production painters were employed in New York, Michigan, Ohio, California, Illinois, Pennsylvania, Indiana, North

Carolina, and New Jersey. Approximately 15 percent of them were women.

Training, Other Qualifications, and Advancement

Most production painters learn their jobs through on-the-job training. The length of training may vary from 2 weeks to several months.

The new worker may have his job duties explained to him by his supervisor and then work under the guidance of an experienced employee. The trainee may observe the experienced employee at work or assist him in his work.

A person going into this work should be in good health, be able to stand for long periods of time, have a steady hand, and have good eyesight so that he can distinguish between colors and see whether the paint is applied evenly. High school graduation is not generally required of applicants for these jobs.

There are some opportunities for advancement in this field of work. A small number of workers have become inspectors or foremen.

Employment Outlook

Several thousand job opportunities for new production painters are expected during the 1965–75 decade to replace workers who retire, die, or transfer to other lines of work. Deaths and retirements alone will result in almost 2,000 openings each year.

Employment of production painters is expected to remain relatively stable during the decade primarily because of the increasing development and use of mechanized and automatic painting equipment. For example, even though the number of automobiles produced is expected to increase substantially, the greater use of automatic sprayers will very likely offset any need for additional production painters.

Earnings and Working Conditions

Production painters generally are paid on an hourly basis. An examination of selected 1964 labor-management contracts in the machinery industries indicates that production painters earned from about $2 to $3 an hour.

Production painters are exposed to fumes from paint and paint-mixing ingredients. Some painters wear protective goggles and masks which cover the nose and mouth. When working on large objects, they may work in awkward and cramped positions.

Many production painters are members of unions. Among the labor organizations to which they belong are the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the United Furniture Workers of America; and the United Steelworkers of America. Many labor-management contracts in the plants in which these workers are employed provide for fringe benefits such as holiday and vacation pay, health insurance, life insurance, and retirement pensions.

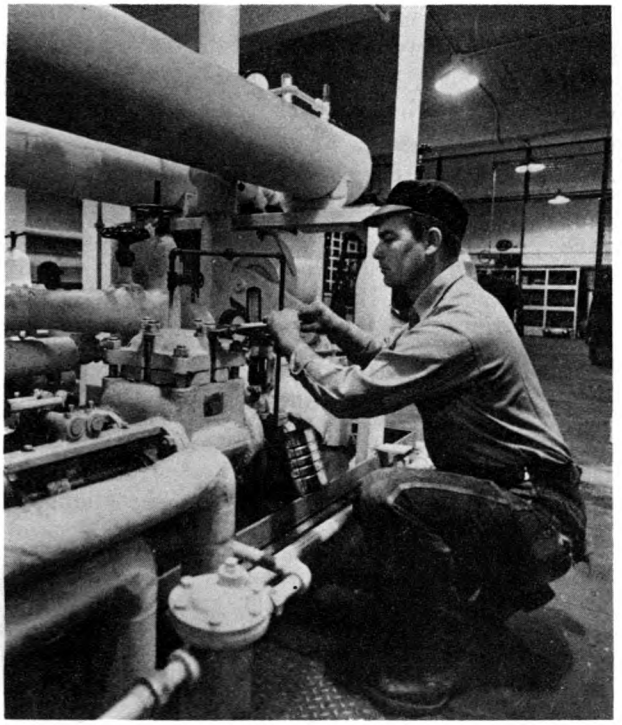
Stationary Engineers

(2d ed. D.O.T. 5–72.010)
(3d ed. D.O.T. 950.782)

Nature of Work

Stationary engineers operate and maintain equipment in industrial plants and other buildings that is essential to power generation, heating, ventilation, humidity control, and air-conditioning. These workers are needed wherever large boilers, diesel and steam engines, refrigeration and air-conditioning machines, generators, motors, turbines, pumps, compressors, and similar equipment are used. They must operate and maintain the equipment in accordance with State and local laws since the safety of many people depends upon its proper functioning.

The most important duty of the stationary engineer is to constantly observe meters, gages, and other instruments to determine the operating condition of the equipment. He also records information such as the amount of fuel used, temperature and pressure of boilers, number of pieces of equipment in use, hours of operation, and repairs made. He must detect and identify any trouble that develops by analyzing the various instrument readings and by watching and listen-



Stationary engineer adjusts a pump head.

ing to the machinery. He operates levers, throttles, switches, valves, and other devices to regulate and control the machinery so that it works efficiently. He must also regularly inspect the equipment to make sure it is working properly.

Stationary engineers usually repair the equipment they operate, using handtools of all kinds, including precision tools. Common repairs involve reseating valves, replacing gaskets, pumps, packings, bearings, and belting, and adjusting piston clearance. Occasionally, stationary engineers make mechanical changes so that the equipment will operate more efficiently or conform to the requirements of a different process.

The duties of stationary engineers depend on the size of the establishment in which they work and the type and capacity of the machinery for which they are responsible. However, their primary responsibilities are very much the same for all kinds of plants—safe and economical operation. In a large plant, the chief stationary engineer may have charge of the entire operation of the boilerroom and direct the work of assistant stationary engineers and other employees including turbine operators, boiler operators, and air-conditioning mechanics. Assistant stationary engineers may be responsible for the operation of all the equipment during a shift, or they may be in charge of a specific type of machinery such as refrigeration equipment. In relatively small establishments, stationary engineers may be responsible for the operation and maintenance of all mechanical and electrical equipment.

Where Employed

In early 1965, more than 260,000 stationary engineers were employed in a wide variety of establishments, such as power stations, factories, breweries, food-processing plants, steel mills, sewage and water-treatment plants, office and apartment buildings, hotels and hospitals. Federal, State, and local governments also employed large numbers of these workers. The size of establishments in which the engineers worked ranged from giant hydroelectric plants and large public buildings to small industrial plants. Most plants which operate on three shifts employ from 4 to 8 stationary engineers, but some have as many as 60. In many establishments, only one engineer works on each shift.

Because stationary engineers work in so many different kinds of establishments and industries, they are employed in all parts of the country. Although some are employed in small towns and in rural areas, most work in the more heavily populated areas where large industrial and commercial establishments are located. New York, Texas, California, Illinois, Pennsylvania, Ohio, New Jersey, and Michigan employ well over half of these workers.

Training, Other Qualifications, and Advancement

Many stationary engineers start as helpers or craftsmen in other trades and acquire their skills largely through informal on-the-job experience. However, most training authorities recommend formal apprenticeship as the best way to learn this trade, because of the increasing complexity of the machinery and systems.

In selecting apprentices, most joint labor-management apprenticeship committees prefer high school or trade school graduates between 18 and 25 years of age who have received instruction in such subjects as algebra, geometry, trigonometry, shop mathematics, mechanical drawing,

machine-shop practice, physics, and chemistry. Mechanical aptitude, manual dexterity, and good physical condition are also important qualifications.

A stationary engineer apprenticeship customarily lasts 4 years. Through on-the-job training, the apprentice learns to operate, maintain, and repair stationary equipment, such as blowers, generators, compressors, boilers, motors, and air-conditioning and refrigeration machinery. He is taught how to use a variety of hand and machine tools such as chisels, hammers, electric grinders, lathes, and drill presses. He also learns to use precision-measuring instruments, such as calipers and micrometers. In addition, he may be taught how to move machinery by the use of blocks, chain hoists, or other equipment. This on-the-job training is supplemented by classroom instruction and home study in such related technical subjects as practical chemistry, elementary physics, blueprint reading, applied electricity, and theory of refrigeration, air conditioning, ventilation, and heating.

Persons who become stationary engineers without going through a formal apprenticeship program usually do so only after many years of experience as assistants to licensed stationary engineers in such occupations as boiler, refrigeration, or turbine operator. This practical experience usually is supplemented by technical or other school training or home study.

Eight States and more than 50 large and medium-size cities have licensing requirements for stationary engineers. Although requirements for obtaining a license differ from place to place, the following are usual: (1) The applicant must be over 21 years of age; (2) he must have resided in the State or locality in which the examination is given for a specified period of time; and (3) he must demonstrate that he meets the experience requirements for the class of license requested. A license is issued to applicants who meet these requirements and pass an examination which may be written, oral, or a combination of both types.

There are generally several classes of stationary engineer licenses, which specify the steam pressure or horsepower of the equipment the engineer may operate. The first-class license permits the stationary engineer to operate equipment of all types and capacities without restriction. The lower class licenses limit the capacity of the equipment the engineer may operate. However, engineers with lower class licenses may operate equipment restricted by their license class, provided they are under the supervision of a higher rated engineer —usually one with a first-class license.

Stationary engineers advance to more responsible jobs by being placed in charge of larger, more powerful, or more varied equipment. Generally, the engineer advances to such jobs as he obtains higher grade licenses. Advancement, however, is not automatic. For example, an engineer with a first-class license may work for some time as an assistant to another first-class engineer before a vacancy requiring a first-class licensed engineer occurs. In general, the broader his knowledge of the operation, maintenance, and repair of various types of equipment, the better are his chances for advancement. Stationary engineers may also advance to jobs as plant engineers and as building and plant superintendents.

Employment Outlook

Employment of stationary engineers is expected to increase by a few thousand each year through the mid-1970's. In addition, it is estimated that about 7,000 new workers will enter this large occupation each year during the next decade to replace workers who retire or die. Promotions and transfers to other fields of work also will create job openings.

A rise in employment of stationary engineers is expected mainly because of the continuing increase in the use of large stationary boilers and refrigeration and air-conditioning equipment in factories, powerplants, and other buildings. Job opportunities may arise because of the continued growth of pipeline transportation and saline water conversion. However, improved efficiency from more powerful, automatic, and more centralized equipment and better utilization of workers may limit the growth in the employment of these workers.

The increasing use of atomic energy to generate power should not affect significantly the employment of stationary engineers. It is likely that both the number and skill requirements of operating jobs (i.e., stationary engineer, boiler operator, turbine operator, etc.) in nuclear plant

will be about the same as those in a new conventional powerplant.

Earnings and Working Conditions

Average straight-time hourly earnings of all classes of stationary engineers in 62 cities and areas ranged from $2.19 in Greenville, S.C., to $3.86 in New York City, according to a 1964–65 survey. In about 4 out of 5 of the cities surveyed, hourly earnings ranged from $2.75 to $3.50. Stationary engineers in charge of large boilerroom operations may earn considerably more than these hourly averages; some earn more than $180 a week.

Stationary engineers generally have steady year-round employment. They usually work a straight 8-hour day and 40 to 48 hours a week. In plants or institutions that operate around the clock, they may be assigned to any one of three shifts—often on a rotating basis—and to Sunday and holiday work.

Many stationary engineers are employed in plants which have union-employer contracts. Most of these contracts provide fringe benefits, which may include hospitalization, medical and surgical insurance; life insurance; sickness and accident insurance; and retirement pensions. Similar benefits may also be provided in plants which do not have union-employer contracts. Among the unions to which these workers belong are the International Union of Operating Engineers and the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America.

Most enginerooms, powerplants, or boilerrooms where stationary engineers work are clean and well-lighted. However, even under the most favorable conditions, some stationary engineers are exposed to high temperatures, dust, dirt, contact with oil and grease, and odors from oil, gas, coal, or smoke. In repair or maintenance work, they may have to crawl inside a boiler and work in a crouching or kneeling position to clean or repair the interior.

Because stationary engineers often work around boilers and electrical and mechanical equipment, they must be alert to avoid burns, electric shock, and injury from moving machinery. If the equipment is defective or is not operated correctly, it may be dangerous to them and to other persons in the vicinity.

Where To Go for More Information

Information about training or work opportunities in this trade may be obtained from the local office of the State employment service and locals of the International Union of Operating Engineers. Further information may also be obtained from State or local licensing agencies and the International Union of Operating Engineers, 1125 17th St. NW., Washington, D.C. 20036.

Stationary Firemen (Boiler)

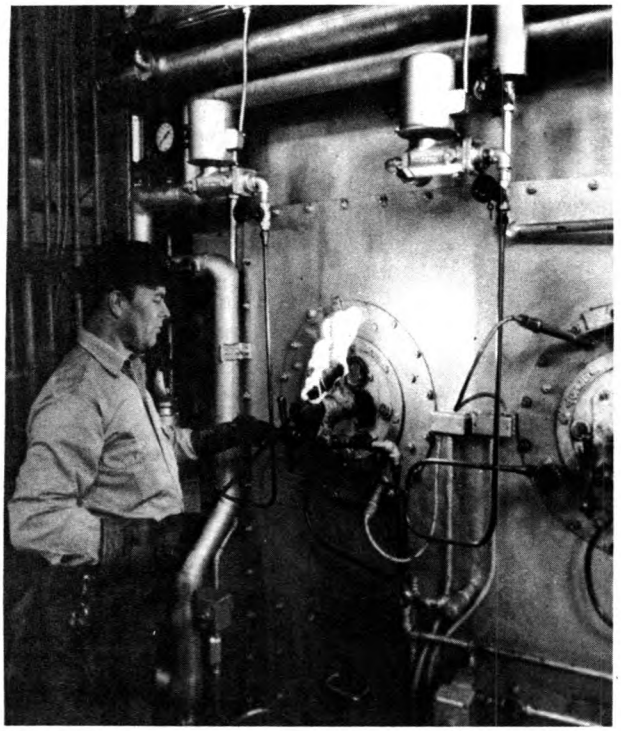
(3d ed. D.O.T. 951.885)

Nature of Work

Stationary firemen employed in manufacturing plants are semiskilled workers who operate and maintain steam boilers used to power industrial machinery, and to heat factories. Some experienced stationary firemen may be responsible for inspecting boiler equipment, for lighting boilers, and building up steam pressure. On the other hand, the responsibilities of some stationary firemen may be limited to keeping equipment in good working order by cleaning, oiling, and greasing moving machinery parts.

In most plants, stationary firemen operate mechanical devices that control the flow of air, gas, oil, or powdered coal into the firebox in order to keep proper steam pressures in the boilers. Duties of these workers may include reading meters and other instruments to make sure that the boilers are operating efficiently and in accordance with safety regulations.

Fully qualified stationary firemen should be able to detect malfunctions without relying entirely on safety devices. In some plants, stationary firemen may be expected to know how to make minor repairs. Stationary firemen are often supervised by stationary engineers. (The stationary engineer is a skilled worker who is responsible for the operation and maintenance of a variety of equipment, including boilers, diesel and steam engines, and refrigeration and



Stationary fireman lights a boiler.

air-conditioning equipment. See statement on Stationary Engineers.)

Where Employed

About 45,000 stationary firemen were employed in a wide variety of manufacturing industries in early 1965. Generally, these workers are employed in industries which are large users of power generating equipment. Leading industries in the employment of stationary firemen are lumber, food, iron and steel, paper, chemicals, and transportation equipment.

Because stationary firemen work in so many different industries, they are employed in all parts of the country. Although some are employed in small towns and even rural areas, most work in the more heavily populated areas where large manufacturing plants are located. The States of Ohio, New York, Pennsylvania, Illinois, Michigan, New Jersey, and California accounted for about 45 percent of the total number of firemen.

Training, Other Qualifications, and Advancement

Some large cities, and a few States, require stationary firemen to be licensed. Applicants can obtain the knowledge and experience to pass the license examination by first working as a helper in a boilerroom, or working as a stationary fireman under a conditional license.

License requirements differ from city to city and from State to State. However, the applicant usually must prove that he meets the experience requirements for the license and pass an examination testing his knowledge of the job. For specific information on licensing requirements, consult your State or local licensing authorities.

There are two types of stationary firemen licenses—for low and high pressure boilers. Low pressure firemen operate low pressure boilers generally used for heating. High pressure firemen operate the more powerful high pressure boilers and auxiliary boiler equipment used to power machinery and equipment in addition to heating buildings. Both high and low pressure operators, however, may operate equipment of any pressure class, provided a stationary engineer is on duty.

Stationary firemen should understand the operation of machinery and must have normal vision and good hearing. (Because of the mechanization of equipment, physical strength is no longer a major requirement for this type of work.)

Stationary firemen may advance to jobs as stationary engineers. To become stationary engineers, firemen sometimes supplement their on-the-job training by taking courses in subjects such as practical chemistry; elementary physics; blueprint reading; applied electricity; and theory of refrigeration, air conditioning, ventilation, and heating. Stationary firemen may also advance to jobs as maintenance mechanics.

Employment Outlook

Employment of stationary firemen in manufacturing industries is expected to decline during the 1965–75 decade. Some opportunities for new workers, however, will result each year from the need to replace workers who transfer to other fields of work or who retire or die.

An increase in the use of stationary boilers and auxiliary equipment is expected during the next 10 to 15 years. However, use of automatic, more powerful, and more centralized equipment, and better use of manpower are expected to result in a decline in the number of stationary firemen. In large plants where turbines and engines are housed under a separate roof and where there is a need for constant surveillance of boilers, firemen will continue to be needed.

Earnings and Working Conditions

Among the factors affecting the earnings of stationary firemen are the type of equipment which these workers operate and the industry in which they are employed. In 1964–65, stationary firemen in manufacturing plants located in 82 cities throughout the country had average straight-time hourly earnings of $2.66. Straight-time average hourly earnings ranged from $1.44 in Raleigh, N. C., to $3.40 in Detroit, Mich.

Although many boilerrooms where stationary firemen work are clean and well lighted, these conditions do not always exist. Most stationary firemen, even under the most favorable conditions, are at times exposed to noise, high temperatures, dirt, dust, contact with oil and grease, odors and fumes from oil, gas, coal, or smoke. In repair or maintenance work, these workers may have to crawl inside a boiler and work in a crouching or kneeling position.

Stationary firemen are subject to burns and falls, and injury from moving machinery. Boilers and auxiliary equipment that are not operated correctly, or are defective, may be dangerous to these workers and to other persons in the work vicinity. However, modern equipment and safety procedures have reduced accidents considerably in recent years.

Many stationary firemen are employed in plants that have labor-management contracts, most of which provide benefits that may include paid holidays and vacations, hospitalization, medical and surgical insurance, sickness and accident insurance, and retirement pensions. Among the unions to which these workers belong are the International Brotherhood of Firemen and Oilers and the International Union of Operating Engineers.

Welders and Oxygen and Arc Cutters

Nature of Work

Welding is one of the most common means of joining metal parts. Many of the parts used in the manufacture of automobiles, missiles and spacecraft, airplanes, household appliances, and thousands of other products are joined in this way. Structural metal used in bridges, buildings, storage tanks, and other structures is often welded. Welding is also widely used to repair broken metal parts.

Welding is a method of joining pieces of metal by applying heat, pressure, or both, with or without filler metal, to produce a permanent bond. Although there are more than 40 different welding processes, most of the processes fall under three basic categories: arc, gas, and resistance welding. Arc and gas welding can be performed manually or by machine. Resistance welding is mainly a machine process.

Most manual welding is done by *arc welders*, *gas welders*, and *combination welders* who do both arc and gas welding. Manual welders may be either skilled or semiskilled. The skilled, all-round manual welder is able to plan and lay out work from drawings, blueprints, or other written specifications. He has a knowledge of the welding properties of steel, stainless steel, cast iron, bronze, aluminum, nickel, and other metals and alloys. He is also able to determine the proper sequence of work operations for each job and to weld all types of joints held in various positions (flat, vertical, horizontal, and overhead). The semiskilled manual welder usually performs repetitive work, or work which does not involve critical safety and strength requirements. The surfaces welded by him are primarily in only one position.

The principal duty of the welder using the manual technique is to control the melting of the metal edges by directing heat to the edges, either from an electric arc or from a gas-welding torch, and to add filler metal where necessary to complete the joint. In one of the most commonly used manual arc welding processes, the welder

Arc welder joins sections of aluminum pipe.

obtains a suitable electrode and adjusts the electric current. The welder first "strikes" an arc (creates an electric circuit) by touching the metal with the electrode. After the arc is made, the welder guides the electrode at a suitable distance from the edges to be welded. The intense heat caused by the arc melts the edges and the electrode tip. The molten metal from the electrode is deposited in the joint and, with the molten metal edges, solidifies to form a solid connection. During the past decade or so, there has been a considerable increase in the use of arc-welding processes that employ inert gas for shielding the weld area. This type of welding was developed for joining hard-to-weld metals such as aluminum, magnesium, stainless steel, and titanium. Many welders now specialize in this process.

In gas welding, the welder uses a gas welding torch to apply an intensely hot flame (obtained from the combustion of a mixture of fuel gas—most commonly acetylene and oxygen) to the metal edges. After the welder obtains the proper types of welding rods and welding torch tips and adjusts the regulators on the oxygen and acetylene cylinders, he lights his welding torch. He then adjusts the oxygen and acetylene valves on the torch to obtain the proper size and quality of flame. The kind of flame selected depends on the type of metal to be joined and the type of joint to be made. The welder heats the metal by directing the flame against the metal until it begins to melt. He then applies the welding rod to the molten metal to supply additional metal for the weld.

In production processes, especially where the work is repetitive and the items to be welded are relatively uniform, the welding may be done by semiskilled workers who operate welding machines. In resistance welding, the most common type of machine welding, *resistance welding operators* (D.O.T. 813.885) feed and aline the work, and remove it after the welding operation is completed. Occasionally, they may adjust the controls of the machine for the desired electric current and pressure.

Workers other than welders frequently use welding in maintenance and repair work. For example, the boilermaker, the structural steel worker, the machinist, and the plumber may at times do manual arc and gas welding.

Semiskilled *oxygen cutters* (D.O.T. 816.782 and .884) and *arc cutters* (D.O.T. 816.884), sometimes called flame or thermal cutters, commonly use hand-guided torches to cut or trim metals. In the oxygen-cutting process, for example, the oxygen cutter directs a flame of oxygen and fuel gas on the area to be cut until the metal begins to melt. He then releases an additional stream of oxygen which cuts the metal. The oxygen cutter prepares for the cutting job by attaching the proper torch tip for the particular job, connecting the torch to the gas and oxygen hoses, and regulating the flow of gases into the torch for the desired cutting flame. He then cuts through the metal, manually guiding the torch along previously marked lines or following a pattern. He may mark guidelines on the metal by following blueprints or other instructions. Arc cutting differs from oxygen cutting because an electric arc is used as the original source of heat. However, as in oxygen cutting, an additional stream of gas may be released in cutting the metal.

Oxygen and arc cutters may also operate a torch or torches mounted on an electrically or mechanically controlled machine which by electrical or mechanical control automatically follows the proper guideline.

Where Employed

In early 1965, an estimated 400,000 welders and oxygen and arc cutters were employed throughout the country. About 300,000 of these workers were employed in manufacturing industries. Large numbers were employed in the fabricated metal products, primary metals, machinery, and transportation equipment manufacturing industries. Of the approximately 100,000 welders and oxygen and arc cutters employed in nonmanufacturing industries, almost two-thirds were employed by construction firms, and establishments performing miscellaneous repair services; the remainder were widely distributed among other nonmanufacturing establishments.

The widespread use of the welding and cutting processes in industry enables welders and cutters to find jobs in every State. Most of these jobs, however, are in the major metalworking areas, with more than 40 percent of them concentrated in Pennsylvania, California, Ohio, Michigan, and Illinois. Large numbers of welders and cutters are employed in Detroit, Chicago, Philadelphia, Los Angeles, and other important metalworking centers.

Training, Other Qualifications, and Advancement

Generally, it takes several years of training to become a skilled manual arc or gas welder, and somewhat longer to become a combination welder. However, some manual jobs can be learned after a few months of on-the-job training.

Training requirements for the resistance-welding machine operator's job depend upon the particular type of equipment used; most of these operators learn their work in a few weeks. Little skill is required for most oxygen- and arc-cutting jobs; generally, they can be learned in a few weeks of on-the-job training. However, the cutting of some of the newer alloys requires a knowledge of the properties of metals as well as greater skill in cutting.

Welding and oxygen- and arc-cutting work require manual dexterity, a steady hand, good eye-hand coordination, and good eyesight. For entry manual welding jobs, most employers prefer to hire young men who have high school or vocational school training in welding methods. Courses in mathematics, physics, mechanical drawing, and blueprint reading are also valuable.

A formal apprenticeship generally is not required for manual welders. However, a few large companies offer apprenticeship programs for this occupation. Also the U.S. Department of the Navy, at several of its installations, conducts 4-year welding apprenticeship programs for its civilian employees.

Programs to train unemployed and underemployed workers for entry level welding jobs were operating in many cities in 1964–65, under provisions of the Manpower Development and Training Act. These programs, which lasted up to 1 year, stressed the fundamentals of welding. With additional work experience and on-the-job training, graduates of these programs may qualify as skilled welders.

Young persons entering the welding trade often start in simple manual welding production jobs where the type and thickness of metal, as well as the position of the welding operation, rarely change. Occasionally, they are first given jobs as oxygen or arc cutters and later move into manual welding jobs. Some large companies employ general helpers in maintenance jobs who, if they show promise, may be given opportunities to become welders by serving as helpers to experienced welders and learning the skills of the trade on the job.

Before being assigned to work where the strength of the weld is a highly critical factor, welders may be required to pass a qualifying examination. The test may be given by an employer, a municipal agency, a private agency designated by local government inspection authorities, or a naval facility. Certification tests are also given to welders on some construction jobs or to those who may be engaged in the fabrication or repair of steam or other pressure vessels where critical safety factors are involved. In addition to certification, some localities require welders to obtain a license before they can do certain types of outside construction work. New developments in some manufacturing industries are increasing the skill requirements of welders.

This is particularly true in fields such as atomic energy or missile manufacture, which have high standards for the reliability of welds and require more precise work.

With 2 years' training at a vocational school or technical institute, the skilled welder may qualify as a welding technician. Generally, workers in this small but growing occupation interpret the engineers' plans and instructions. Occasionally, welders may be promoted to jobs as inspectors where they check welds for general conformance with specifications and for quality of workmanship. Welders also may become foremen who supervise the work of other welders. A small number of experienced welders establish their own welding and repair shops.

Employment Outlook

The number of welding jobs is expected to increase by several thousand each year through the mid-1970's as a result of the generally favorable longrun outlook for metalworking industries and the wider use of the welding process. In addition, about 8,000 job openings will occur each year because of vacancies resulting from retirements and deaths. Opportunities will also result as some welders transfer to other lines of work.

Many more manual welders will be needed for maintenance and repair work in the growing metalworking industries. The number of manual welders engaged in production work is expected to increase in plants manufacturing structural-metal products, such as metal doors, boilers, storage tanks, and sheet-metal products. The construction industry will need an increasing number of welders as the use of welded steel structure expands.

Employment prospects for resistance welders are expected to continue to be favorable because of the increased use of the machine resistance-welding process in activities such as the manufacture of motor vehicles, aircraft and missiles, and the production of light, streamlined railroad cars. The use of faster and more highly automatic welding machines, however, will slow down the growth in the number of these welders.

The number of jobs for oxygen and arc cutters is expected to rise somewhat during the years ahead as the result of the general expansion of metalworking activity. The increased use of oxygen- and arc-cutting machines, however, will tend to restrict the growth of this occupation.

Earnings and Working Conditions

The earnings a welder can expect depend to a great extent on the skill requirements of his job and on the industry or activity in which he is employed. Earnings of highly skilled manual welders generally compare favorably with those of other skilled metalworking occupations. Machine welders, such as resistance welders, who require little training, generally earn less than skilled manual welders.

Average straight-time hourly earnings for skilled manual welders in machinery manufacturing industries in 21 cities and metropolitan areas in mid-1965 ranged from $2.51 in Dallas, Tex., to $3.51 in San Francisco–Oakland, Calif. In about two-thirds of the cities, average hourly earnings for these workers were more than $3. Average hourly earnings of semiskilled manual welders in these 21 cities ranged from $2.08 to $3.21. Welders who are covered by union contracts may earn considerably more than these average earnings.

Many welders and cutters are union members. Among the labor organizations which include welders and cutters in their membership are the International Association of Machinists and Aerospace Workers; the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; and the United Electrical, Radio and Machine Workers of America (Ind.). Labor-management contracts covering welders and oxygen and arc cutters provide employees with benefit programs, which may include paid holidays and vacations, hospitalization, medical and surgical insurance, life insurance, sickness and accident insurance, and retirement pensions.

Welders and cutters use protective clothing, goggles, helmets with protective lenses, and other devices to prevent burns and eye injuries. Although lighting and ventilation are usually adequate, welders occasionally work in the presence

of toxic gases and fumes generated by the melting of some metals. Welders are often in contact with rust, grease, paint, and other elements found on the surface of the metal parts to be welded. Operators of resistance-welding machines are largely free from the hazards associated with hand welding. A clear eyeshield or clear goggles generally offer adequate protection to these operators.

Where To Go for More Information

For further information regarding work opportunities for welders, inquiries should be directed to local employers or the local office of the State employment service. The State employment service also may be a source of information about the Manpower Development and Training Act, apprenticeship and other programs that provide training opportunities. General information about welders may be obtained from:

The American Welding Society,
345 East 47th St., New York, N.Y. 10017.

International Association of Machinists and Aerospace Workers,
1300 Connecticut Ave. NW., Washington, D.C. 20036.

International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers,
8th at State Ave., Kansas City, Kans. 66101.

International Union, United Automobile, Aerospace and Agricultural Implement Workers of America,
8000 East Jefferson Ave., Detroit, Mich. 48214.

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada,
901 Massachusetts Ave. NW., Washington, D.C. 20001.

State Supervisor of Trade and Industrial Education or the local Director of Vocational Education in the State and/or city in which a person wishes to receive training.

Some Major Industries and Their Occupations

OCCUPATIONS IN AIRCRAFT, MISSILE, AND SPACECRAFT MANUFACTURING

America's entry into the space age has caused rapid growth in the aircraft, missile, and spacecraft field. The rate of growth has slowed in the past few years, however, and barring unforeseen changes in our international relations, present levels of the industry's activity and employment in this field are not expected to change significantly during the 1965–75 decade. In early 1965, about 1.3 million persons were employed in the manufacture of aircraft, missiles, and spacecraft.

Known generally as the "aerospace" industry, this field is one of the most rapidly changing in the country. Major post-World War II developments include jet aircraft, rocket propulsion, supersonic flight, and space exploration. Because of these innovations, intensive effort has been required to develop the new materials and products, and the communications and control concepts necessary for ultrasonic travel in space. Continued efforts to improve and develop aerospace products and technology are expected to ensure our superior defense capability and further advances in space exploration.

Because this industry's products are complex and changing, the majority of job openings will be for workers having a college education or a specialized skill. Scientists, engineers, and technicians represent a much larger proportion of total employment in the aerospace industry than in most other manufacturing industries, and probably will account for an even higher proportion during the 1965–75 decade. In addition to professional and technical workers, increases are also expected in the employment of skilled workers, such as tool and die makers, skilled assemblers and inspectors, welders, and various types of mechanics. Employment of semiskilled and unskilled workers, on the other hand, is not expected to grow, and may even decline.

Nature and Location of the Industry

Aircraft, missiles, and spacecraft have the same main components: A frame to hold and support the rest of the vehicle, an engine to propel the vehicle, and a guidance and control system. A major difference between them is that missiles and spacecraft can reach into space and attain speeds many times that of sound, whereas aircraft fly in the earth's atmosphere and at slower speeds. Another difference is that aircraft are manned whereas missiles and most spacecraft are not.

Types of aircraft vary from small personal planes, costing not much more than an automobile, to multimillion-dollar giant bombers and supersonic fighters. Aircraft plants also produce transport planes, helicopters, dirigibles, balloons, and gliders. About three-fourths of aircraft production in dollar value is manufactured for military use; the rest is for commercial passenger and freight traffic, private business and pleasure use, and civilian flying instruction.

Missiles and spacecraft also vary greatly in the purposes for which they are made, and in their size and capabilities. Missiles are produced chiefly for military use and generally carry destructive warheads. Some can travel only a few miles and are intended for such purposes as the support of ground troops and defense against low flying aircraft. Others, such as the Atlas, Titan, and Minuteman, have intercontinental

ranges of 5,000 miles or more. Some missiles are designed for launching from land or underground sites, others for firing from aircraft, submarines, or ships.

Spacecraft are sent aloft carrying instruments which can measure and record conditions in space and transmit the data to receiving stations on earth. Manned spacecraft also include a cabin capsule for astronauts. The first American space vehicles had payloads (useful cargo) weighing only 20 to 30 pounds or less; the Saturn V launch vehicle, currently being developed, will be able to lift 120-ton payloads into near-earth orbit, or send almost 50 tons to the vicinity of the moon. Some space vehicles probe the space environment and then fall back to earth. Others are put into orbit and become artificial satellites around the earth, sun, or other celestial body. Nearly all this country's missiles and spacecraft are built for the Air Force, Navy, Army, or the National Aeronautics and Space Administration (NASA).

Because the aerospace industry makes many kinds of finished products, it uses many kinds of engines, electronic systems, and other components. Aircraft engines may be reciprocating (piston), jet, or rocket. Missile engines may be jet or rocket. Spacecraft are always rocket powered, because rockets are the most powerful type of engine and can operate in airless space whereas other engine types need oxygen from the air for combustion. Today's rocket engines are powered by chemical propellants, which may be either liquid or solid. New sources of rocket propulsion, such as nuclear or electric energy, are being investigated and may be available in the future. Guidance, control, and instrument-payload systems are largely electronic. Because missiles and most spacecraft are unmanned, they generally have more complex guidance and control systems than aircraft.

An aircraft, missile, or spacecraft is manufactured usually under the technical direction of a prime contractor. He manages and coordinates the entire project, subject to periodic inspections by the Federal agency or the airline ordering the vehicle. His engineering department prepares design drawings, blueprints, and other specifications. These go to the production department, where planners work on the many details regarding machines, materials, and operations needed to manufacture the vehicle in the numbers required. Decisions must be made as to what part of the production work will be done by the prime contractor and what part will be contracted to outside firms.

Special tools, dies, jigs, and fixtures are required in manufacturing the vehicle. Many sheet-metal workers, machinists, machine tool operators, and other metal processors are involved in producing these tools and the thousands of parts and components which go into the craft. All parts and equipment must be inspected and tested many times, both before and after they are assembled, and all assembly work must be thoroughly inspected and checked. In every stage of the production process, assemblers and installers are needed to fit together, hook up, and install systems and components. After its final assembly, the vehicle is checked out by a team of mechanics, flight tested if an aircraft, and then prepared for delivery.

Many thousands of subcontractors participate in the production of parts and subassemblies that go into aircraft, missiles, and spacecraft. Some subcontractors make individual parts or supplies, such as metal forgings, bearings, plastic material, rocket fuels, or special lubricants. Others produce subassemblies, such as communications or telemetry equipment, guidance instruments, or jet engines, and may depend on other subcontractors to supply parts for the subassemblies. The prime contractor, too, may manufacture components of a craft, as well as do the final assembly work.

Aerospace plants range in size from the large factories of major manufacturers, each with thousands of employees, to the shops of small subcontractors and suppliers with only a few workers each. Jobs in aerospace work may be found in practically every State, although roughly one-third are concentrated in California. Other States with large numbers of aerospace jobs include New York, Connecticut, Massachusetts, New Jersey, Pennsylvania, Ohio, Florida, Alabama, Maryland, Washington, Texas, Missouri, and Kansas.

An estimated 1.3 million people—about one-fifth of them women—were working on aerospace products in early 1965. About half a million of these workers were producing missiles and spacecraft; about the same number were making air-

craft, aircraft engines, and propellers; and more than 150,000 worked in the electronics field producing equipment for aircraft, missiles, and spacecraft. The remainder were mostly civilian employees of the Federal Government working in the aerospace field—approximately 150,000 in the Department of Defense, 33,000 in the National Aeronautics and Space Administration, and a small number in a few other agencies.

Occupations in Aircraft, Missile, and Spacecraft Manufacturing

Workers with many different kinds of educational backgrounds and job skills are needed to design and manufacture aircraft, missiles, and spacecraft. For example, engineers and scientists with advanced degrees, as well as plant workers who can learn their jobs after a few days or weeks of training, are employed.

Occupational needs vary among establishments in the industry, depending on the work being done. Research and development laboratories employ mainly engineers, scientists, and supporting technicians and craftsmen. These laboratories are run by manufacturers, universities, independent research organizations, and Government agencies such as the Air Force, Navy, Army, and the National Aeronautics and Space Administration. Factories engaged in production, on the other hand, employ mostly plant workers such as assemblers, inspectors, tool and die makers, sheet-metal workers, machinists, and machine tool operators.

Some of the more important jobs found in aerospace-products manufacturing are described below, under three major categories; professional and technical occupations; administrative, clerical, and related occupations; and plant occupations. (Many of the jobs in this industry are found in other industries as well and are discussed in greater detail elsewhere in the *Handbook*, in the sections covering individual occupations.)

Professional and Technical Occupations. Before production of an aircraft, missile, or spacecraft can begin, a design must be approved. This requires many experiments and "feasibility" studies to determine how well various design possibilities meet the conditions under which the vehicle will be operated. A scale model is made from the approved design. It is tested in wind, temperature, and shock tunnels, on ballistic ranges, and in centrifuges where actual flight conditions are simulated. The next step is to develop a full-size experimental model or prototype, which is thoroughly tested in the air and on the ground. If test results are satisfactory, production may begin. Many modifications in the craft are normally made during the course of design and development, and often even after production has started.

Courtesy of the National Aeronautics and Space Administration

Under simulated space conditions, engineering technicians check alinement of optical equipment.

The pace of discovery and change is so rapid that much equipment becomes obsolete while still in the experimental stage or soon after being put into operation. Research and development are vital in the industry, particularly in the missiles and spacecraft field. An intensive effort is being made to develop aerospace vehicles with greater speeds, ranges, and reliability; engines with more power; and metals and plastics with wider capabilities. The industry's research and development capability has encouraged aerospace firms to apply their abilities to other new areas of exploration such as oceanographic research, and the design and development of hydrofoil ocean vessels.

Increasing emphasis on research and development makes the aerospace industry an important and growing source of jobs for engineers, scientists, and technicians. It is estimated that in early 1965 nearly one-fourth of all employees in plants making aerospace products were engineers, scientists, and technicians, a considerably higher proportion of such personnel than in most other manufacturing industries.

Many kinds of engineers and scientists are employed in aerospace work. For example, over 30 different college degree fields are represented among the engineers and scientists employed by the National Aeronautics and Space Administration. Among the more important types of engineers working in the industry are electronics, electrical, aerospace, chemical, nuclear, mechanical, and industrial engineers. Some of the types of scientists employed in the industry include physicist, mathematician, chemist, metallurgist, psychologist, physiologist, and astronomer. Aerospace engineers and scientists work in a wide and varied range of applied fields, such as materials and structures, energy and power systems, fluid and flight mechanics, measurement and control systems, communications and data systems, life sciences and systems, and space sciences.

Engineers and scientists are assisted by many types of workers, such as draftsmen, mathematics aids, laboratory technicians, electronics technicians, research mechanics, and research electricians. They work also with *production planners* (D.O.T. 012.188), who plan the layout of machinery, movement of materials, and sequence of operations so that manufacturing processes will flow efficiently from one step to the next; and they work with *technical writers* (D.O.T. 139.288) and *technical illustrators* (D.O.T. 017.281), who produce technical manuals and other literature used to describe the operation and maintenance of air and space craft and their many parts.

Administrative, Clerical, and Related Occupations. Managerial and administrative jobs are generally comparable with similar jobs in other industries, except that they are generally more closely related to engineering because of the importance of research and development in the aerospace field. Personnel in these jobs include executives, responsible for the direction and supervision of research and production, and officials in departments such as sales, purchasing, accounting, public relations, advertising, and industrial relations. Many thousands of clerks, secretaries, stenographers, typists, tabulating machine operators, and other office personnel are employed also.

Plant Occupations. About half of all workers in the aircraft, missile, and spacecraft field were employed in plant jobs in early 1965. Plant jobs can be classified into the following groups: Sheet-metal work; machining and tool fabrication; other metal processing; assembly and installation; inspecting and testing; flight checkout; and materials handling, maintenance, and custodial.

Sheet-Metal Occupations. Sheet-metal workers shape parts from sheet metal by hand or machine methods. When hand methods are used, the worker shapes the part by pounding it with a mallet and by bending, cutting, and punching it with handtools. Machine methods involve the use of power hammers and presses, saws, tube benders, and drill presses. The all-round *sheet-metal worker* (D.O.T. 804.281) lays out the sequence of operations on the basis of blueprints and other engineering information. He then fabricates complicated metal shapes, using handtools or machines. Less complex parts, as well as those produced in large numbers, are fabricated by less skilled sheet-metal workers or workers who specialize in operating a single machine. They have such titles as *power brake operator* (D.O.T. 617.380), *power hammer operator* (D.O.T. 617.782), *power shear operator* (D.O.T. 615.782 and 615.885), *punch press operator* (D.O.T. 615.782), and *profile cutting machine operator* (D.O.T. 816.782).

Machining and tool fabrication occupations. Another important group of workers engaged in shaping and finishing metal parts with machine tools are *machinists* (D.O.T. 600.280 and .281) and *machine tool operators* (D.O.T. 609.885). The most skilled of these are the all-round or general machinists who can lay out the work and set up and operate several types of machine tools. They perform machining operations of a highly varied and nonrepetitive nature. They are most frequently employed in departments engaged in experimental and prototype production.

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Machine tool operators are employed in the large-volume production of metal parts. They generally specialize in the operation of a single type of machine tool, such as a lathe, drill press, or milling machine. The more skilled machine tool operators are able to set up the work on a machine and handle difficult and varied jobs. The less skilled operators usually do more repetitive work.

Machinists and machine tool operators represent a higher proportion of the work force in engine and propeller plants, which are basically metalworking establishments, than in plants performing the final assembly of air and space vehicles. Among engine plants, those manufacturing reciprocating engines do relatively more machining and less sheet-metal work than those producing jet or rocket engines.

Many of the plants in the aerospace industry make a large proportion of the jigs, fixtures, tools, and dies they use. Fabrication of these items requires skilled metal-processing workers, chiefly *jig and fixture builders* (D.O.T. 761.381) and *tool and die makers* (D.O.T. 601.280). Jig and fixture builders make the work-holding and tool-guiding devices used in production and assembly operations. On the basis of information received from the engineering department, they plan the sequence of metal machining operations involved in making a jig and carry the job through to completion. Tool and die makers make the cutting tools and fixtures used in machine tool operations and the dies used in forging and punch press work. They must be experts in the use of machine tools.

Other metal-processing occupations. Other metalworkers, such as tube benders, riveters, and welders are also employed. *Tube benders* (D.O.T. 709.884) form tubings used for oil, fuel, hydraulic, and electrical conduit lines. *Riveters* (D.O.T. 800.884) and *welders* (D.O.T. 810.782 and .884; 811.782 and .884; 812.884 and 813.380 and .885) join fabricated parts by hand or machine riveting and by electric arc, gas, or electric resistance welding.

Additional metal fabricating is performed by skilled foundry workers such as patternmakers, molders, and coremakers. Drop hammer operators and other forge shop workers are employed in the forging departments.

Many aircraft, missile, and spacecraft parts are chemically and heat treated during several stages of their manufacture in order to clean, change, or protect their surface or structural condition. Sheet-metal parts are heat treated to keep the metal soft and malleable while it is being worked into the required shape. Many processes, such as painting and plating, are used on the surfaces of parts. Workers in these metal-processing jobs have such titles as *heat treater* (D.O.T. 504.782), *painter* (D.O.T. 845.781), and *plater* (D.O.T. 500.380).

Assembly and installation occupations. Assembly and installation workers are a major occupational group, employed in practically all plants in the industry. Many work in factories producing engines, electronic equipment, and auxiliary components, but the majority are found in plants which assemble air or space craft into completed form. They perform such final assembly work as the fitting together of major subassemblies and the installing of major components. In the case of aircraft, for example, this work involves joining wings and tail to the fuselage and installing the engine and auxiliary equipment such as the fuel system and flight controls. In the course of their duties, assemblers perform such operations as riveting, drilling, filing, bolting, soldering, cementing, and gluing.

A large proportion of assemblers are semiskilled workers doing repetitive work, but some are skilled mechanics and installers. Many of the latter perform diversified assembly or installation operations, and often work on experimental, prototype, or special craft. They assemble, take apart, inspect, and install complex mechanical and electronic assemblies. They read blueprints and interpret other engineering specifications. They may be called *final assemblers* of complete aircraft (D.O.T. 806.781), *missile assembly mechanics* or *rocket assembly mechanics* (D.O.T. 652.281).

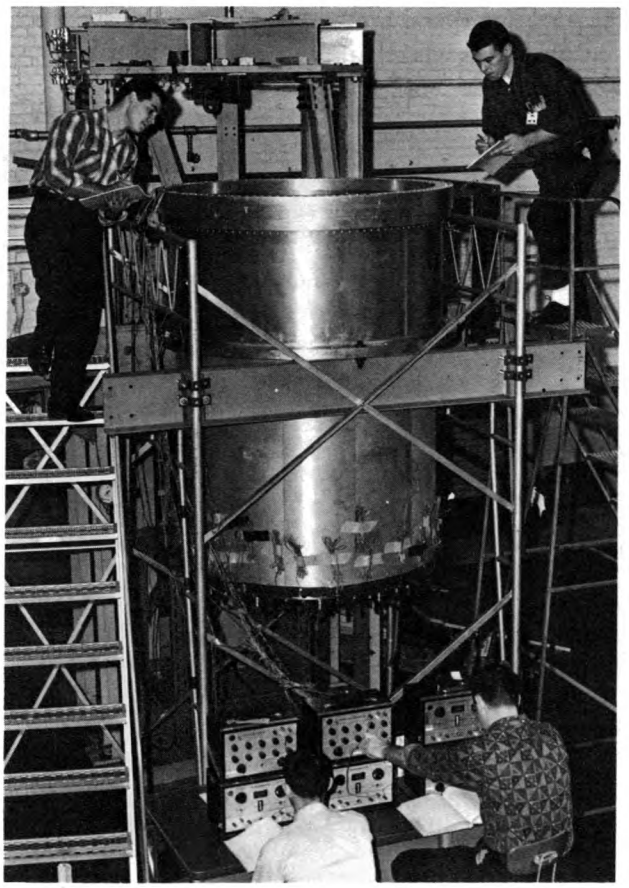
Some skilled assemblers are employed in plants which produce relatively large numbers of aircraft and missiles rather than a few experimental types. These assemblers usually specialize in one or more fields of work. They are often assisted by less skilled assemblers who do the more routine work. For example, a *class A armament assembler* (D.O.T. 801.381) typically does such work as assembling, installing, and

alining power turrets, weapons, gun cameras, and related accessories. Lower rated armament assemblers typically do such work as uncrating and cleaning weapons, loading ammunition, installing armor plate, and placing parts in jigs. *Power plant installers* (D.O.T. 621.381), sometimes known as engine mechanics, install, aline, and check the various types of engines and accessories. Skilled *electrical assemblers* (D.O.T. 728.884), sometimes called electricians, install, hook up, and check major units in electrical or radio systems. They are assisted by less skilled assemblers, who do the more routine installations and wire routings by following standard wiring diagrams and charts. Assemblers also specialize in other systems, such as plumbing, hydraulic, heating and ventilating, and rigging and controls.

Inspecting and testing occupations. Because aircraft, missiles, and spacecraft are extremely complex, thousands of painstaking inspections and tests must be made as each component and part moves toward final assembly of the whole system. Inspections are made not only by employees of the manufacturers but also by civilian employees of Federal agencies which have contracted for the equipment.

Some inspectors specialize in examining materials and equipment purchased from the outside, others inspect components during fabrication and subassembly within their own plants, while still others inspect completed craft after their final assembly. Many inspection jobs require highly skilled workers. On the other hand, some tests are made by automatic equipment which can be run by relatively unskilled persons. Such equipment not only checks the component or assembly under test but may also run simultaneous checks on itself.

Some of the most skilled inspectors, especially in final assembly plants, are *outside production inspectors* (D.O.T. 806.381). They examine machined parts, subassemblies, and tools and dies which have been ordered from other firms. They also serve as liaison men between their own engineering departments and supplying companies. Other inspectors, frequently known as *receiving inspectors* (D.O.T. 806.384), with less responsibility than outside production inspectors, check purchased materials and parts for conformity with blueprints, armed services requirements, and other established standards. They operate testing equipment and must be familiar with specifications of the parts and materials purchased from different sellers.



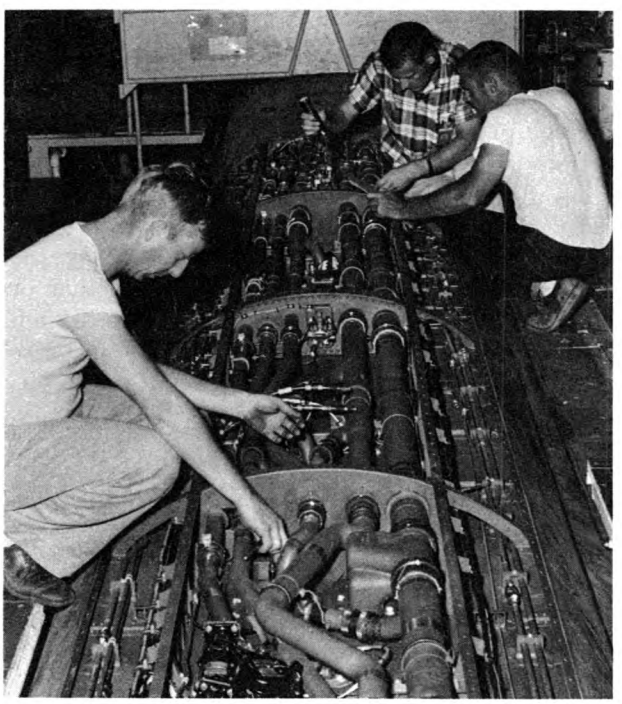
Technicians check physical properties of reactor vessel.

In the production department, *machined parts inspectors* (D.O.T. 609.381) determine, by the use of precision testing instruments, whether or not a part has been properly machined to conform to blueprint specifications. They may also test for hardness and porosity and determine the "machineability" of castings and forgings. *Fabrication inspectors* (D.O.T. 807.381) are generally skilled sheet-metal workers. They inspect fabricated sheet-metal work and complex parts which have required numerous fabricating operations.

As the parts are fitted together they undergo numerous inspections by *assembly inspectors* (D.O.T. 806.381). These inspectors are employed, for the most part, in the later stages of the assembly process. They usually inspect

complete major assemblies and installations, such as fuselage, wing, and nose sections, to insure their proper final fitting. They also check the functioning of such systems as hydraulics, plumbing, and controls. Subassemblies are usually inspected by less skilled assembly inspectors. Final testing must be especially rigorous with missiles and most spacecraft since, unlike aircraft, they have no human guidance aboard to correct for improper working of components which may cause a target miss or other failure of the mission.

Flight checkout occupations. The job of checking out an air or space craft before its first flight requires a team of mechanics with different levels and types of skills. Sometimes the checking-out process involves making repairs or returning the craft to the plant for repairs. The *chief mechanic* or *crew chief*, who is the most skilled worker of the team, is responsible for the entire checking-out operation including repair work. He usually directs the work of a crew of mechanics, each of whom specializes in one or more fields. For example, *engine mechanics* specialize in checking out the power plant, including the engine, propellers, and oil and fuel systems. They use handtools, testing equipment, and precision measuring instruments. The *electronics checkout men* perform or supervise the final operational checkout of such systems as radio, radar, automatic pilot, fire control, and complete electronic guidance systems. Other skilled workers may specialize in checking out and repairing armament, instruments, rigging and controls, plumbing, and hydraulic systems. In some cases, less skilled mechanics help conduct tests and make repairs.



Aircraft production mechanics install and inspect fuel and hydraulic lines in an aircraft fuselage.

Materials handling, maintenance, and custodial occupations. Aerospace plants employ large numbers of materials handlers, such as truckdrivers, crane operators, shipping clerks, stock clerks, and tool crib attendants. Maintenance workers, who keep equipment and buildings in good operating condition and make changes in the layout of the plant, include maintenance mechanics, millwrights, electricians, carpenters, plumbers, painters, and welders. Guards, firemen, and janitors make up a major portion of the plant's protective and custodial employees.

Training, Other Qualifications, and Advancement

A college degree in engineering or in one of the sciences is usually the minimum requirement for engineering and scientific jobs in the aerospace industry. A few workers may get jobs as professional engineers without a college degree, but only after years of semiprofessional work experience and some college-level training. Since many kinds of engineers and scientists are employed in aerospace work, college graduates in many different degree fields may qualify for professional jobs in the industry. Regardless of his degree field, the undergraduate student preparing for professional aerospace work is well advised to get as solid a grounding as possible in fundamental concepts and basic general areas of engineering and science. Mathematics and physics courses are especially important, since these sciences provide the necessary language understood by the variety of engineers and scientists working on any given project. Education or training in the more specialized fields of the aerospace industry is generally received in graduate school or on the job.

An increasing number of semiprofessional workers, such as electronics technicians, engineering aids, draftsmen, production planners, and tool designers receive training for their jobs

through 2 years of formal education in a technical institute or junior college. Others qualify through several years of diversified shop experience.

Training requirements for plant jobs vary from a few days of on-the-job instruction to several years of formal apprenticeship. Apprenticeship programs develop craftsmen, such as machinists, tool and die makers, sheet-metal workers, patternmakers, aircraft mechanics, and electricians. These programs vary in length from 3 to 5 years depending on the trade; during this time, the apprentice handles work of progressively increasing difficulty. Besides on-the-job experience, he receives classroom instruction in subjects related to his craft. Such instruction for a machinist apprentice, for example, would include courses in blueprint reading, mechanical drawing, shop mathematics, trade theory, physics, safe working practices, and other subjects.

Many levels of skill are required for other factory jobs. Workers with little or no previous training or experience are hired for the less skilled assembly jobs. On the other hand, skilled assemblers may need 2 to 4 years of plant experience in addition to a high school or vocational school education or its equivalent. Skilled assemblers must be able to read and interpret engineering blueprints, schematic diagrams, and production illustrations.

Skilled inspectors often have several years of machine shop experience. They must be able to install and use various kinds of testing equipment and instruments, read blueprints and other engineering specifications, and use shop mathematics. New workers with little or no experience in shop trades may also be hired and trained for jobs requiring less skilled inspectors.

Mechanics who perform the final checkout of air and space craft qualify for their jobs in several ways. Many gain experience as mechanics by working in earlier stages of the plant's production line, before final checkout of the craft. Others receive all their training in checkout work, or come from "line maintenance" jobs with commercial airlines.

Chief mechanics usually need 3 to 5 years of experience in the manufacture of aircraft, missiles, and spacecraft, including at least 1 year as a checkout mechanic. Specialized mechanics, working under the supervision of the chief mechanic, are usually required to have at least 2 years' experience. Workers with less experience serve as helpers or assistants and pick up the mechanic's skills on the job and through plant training courses.

Because the manufacture of their complex and rapidly changing products requires workers who are highly trained and aware of new developments, the majority of aerospace plants support some kind of formal worker training. Instruction of this type supplements day-to-day job experience and helps workers advance more rapidly to higher skills and better paid work. Many of the industry's major producers conduct educational and training classes themselves, others pay tuition and related costs for outside courses taken by their employees, and some do both. Some classes are held during working hours, in which case trainees are paid for class time, and other classes are after working hours. Courses are available for practically every occupational group, and cover many skills and areas of knowledge. Examples of subjects typically offered include blueprint reading, drafting, welding, aircraft maintenance and repair, electronic data processing, shop mathematics, supervisory practices, and safe working practices. Most trainees take short-term courses designed to meet immediate skill needs. Only a relatively few employees are enrolled in long-term programs scheduled to run for several years, such as apprenticeship.

Employment Outlook

Although employment in the aerospace industry is expected to show little significant change over the 1965–75 decade, there will still be tens of thousands of job opportunities annually in this large field. Most of these will result from the need to replace workers who transfer to other fields of work, retire, or die. Retirements and deaths alone will result in an estimated 20,000 to 30,000 job openings each year during the next decade.

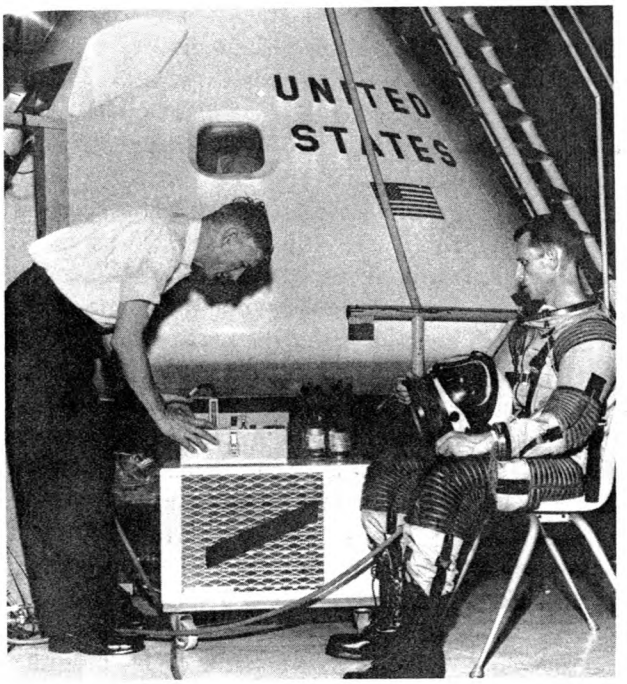
Products of the aerospace industry have been developed primarily to assure our national security and to advance our goals in the conquest of space. The industry's future, therefore, depends largely on Government spending. Unless the international situation changes significantly from that prevailing in early 1965, the level of Government expenditures for aerospace products is not

expected to change appreciably during the decade ahead.

Changes in the relative importance of various segments of aerospace activity, however, may be expected during the next decade. Jobs in the spacecraft field will probably increase moderately because of factors such as the continuing effort to accomplish a manned landing on and exploration of the moon during the early 1970's. Continued employment growth is anticipated in plants that produce electronic units for this industry, because of the increasing importance of electronic systems and components for use in aerospace products. Following rapid employment growth in the 1950's, employment in the production of missiles has turned downward in recent years and is expected to decline further during the 1965–75 decade. In aircraft manufacturing, the downward trend in employment appears to be leveling off and little significant change in the employment level is expected.

Expenditures for research and development should continue at the current high level or rise slightly. Employment opportunities will, therefore, be favorable for workers such as engineers, scientists, draftsmen, electronics technicians, mathematics aids, and research craftsmen. Many job openings in these occupations will become available not only in manufacturing concerns but also in university laboratories, independent research organizations, and Federal agencies such as the Air Force, Navy, Army, and the National Aeronautics and Space Administration.

Many job openings will become available also for skilled plant personnel, such as tool and die makers, skilled assemblers and inspectors, and maintenance craftsmen. Because of the continuing emphasis on custom production of relatively small numbers of many diversified products, employment of semiskilled and unskilled plant workers is not expected to increase and may even decrease. Many semiskilled and unskilled workers as well as some scientists, engineers, and technicians, are likely to be laid off during production cutbacks. Aerospace employment has fluctuated sharply in the past, mainly because of changes in the needs of the industry's major customer—the Federal Government.



Courtesy of the National Aeronautics and Space Administration

Suit technician adjusts spacesuit air controls.

Earnings and Working Conditions

Plant workers' earnings in the aerospace industry are higher than those in most other manufacturing industries. In 1964, for example, production workers in plants making aircraft and parts earned on the average $124.72 a week or $3.04 an hour, while production workers in all manufacturing industries as a whole averaged $102.73 a week or $2.53 an hour. Production workers in the Department of Defense and other Federal agencies receive wages equal to prevailing rates paid for comparable jobs by local private employers.

Information on earnings for professional and technical workers in the aerospace field indicates that they are higher than those for similar work in most other industries. The relatively favorable position of these workers is due mainly to the rapid growth of research and development activity for missiles and spacecraft, which has created an urgent need for well-qualified engineers, scientists, and technicians. (General information on earnings of professional and technical personnel may be found in the sections on individual occupations in the *Handbook.*)

The following tabulation indicates an approximate range of hourly wage rates for selected occupations in early 1965, obtained from the collective bargaining agreements of a number of major aerospace companies; these rates do not include incentive earnings. The ranges in the various jobs are wide, partly because wages within an occupation vary according to workers' skills and experience, and partly because wages differ from plant to plant, depending upon type of plant, locality, and other factors.

Aircraft mechanics	$2.08–$3.55
Assemblers	2.06– 3.19
Electronics technicians	2.12– 3.46
Heat treaters	2.06– 3.26
Inspectors and testers	2.06– 4.02
Jig and fixture builders	2.06– 3.74
Laboratory technicians	2.15– 3.55
Machine tool operators	2.10– 3.40
Machinists	2.12– 3.59
Maintenance craftsmen	2.06– 3.55
Riveters	2.24– 2.73
Tool and die makers	2.16– 3.74
Welders	2.06– 3.32

Fringe benefits are common in the industry. Workers usually get 2 weeks of paid vacation after 1 or 2 years of service, and 3 weeks after 10 or 12 years. They generally get 6 to 8 paid holidays a year and 1 week of paid sick leave. Other major benefits include life insurance; medical, surgical, and hospital insurance; accident and sickness insurance; and retirement pensions. Fringe benefits in Federal aerospace employment are comparable with those in the rest of the industry.

Most employees work in modern factory buildings which are clean, light, and airy. Some work is done outdoors. Operations such as sheet-metal processing, riveting, and welding may be noisy, and some assemblers may work in cramped quarters. Aerospace plants are comparatively safe working places, with an injury-frequency rate which, in 1963, averaged only about one-third of that for manufacturing as a whole.

Most plant workers in the aerospace field are union members. They are represented by several unions, among them the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; and the International Union of Electrical, Radio and Machine Workers. Some craftsmen, guards, and truckdrivers are members of unions which represent their specific occupational groups.

Where To Go for More Information

National Aeronautics and Space Administration,
Washington, D.C. 20546.

Aerospace Industries Association of America, Inc.,
1725 DeSales St. NW., Washington, D.C. 20036.

International Association of Machinists and Aerospace Workers,
1300 Connecticut Ave. NW., Washington, D.C. 20036.

International Union, United Automobile, Aerospace and Agricultural Implement Workers of America,
8000 East Jefferson Ave., Detroit, Mich. 48214.

International Union of Electrical, Radio and Machine Workers,
1126 16th St. N.W., Washington, D.C. 20036.

Electronics Industries Association,
1721 DeSales St. NW., Washington, D.C. 20036.

OCCUPATIONS IN THE APPAREL INDUSTRY

Well over a million workers are employed in making clothing for the Nation's population. The apparel industry produces about $70 worth of clothing annually for every man, woman, and child.

The industry is an important source of jobs for workers with widely different skills and interests. Some of the jobs in this industry can be learned in a few weeks; others take several years.

Four out of five garment workers are women, making this industry the Nation's largest employer of women in manufacturing. Most women are sewing machine operators. However, many others work in jobs such as hand sewer, bookkeeper, and designer. Men usually predominate in such jobs as cutter and marker, production manager, engineer, and salesman.

Nature and Location of the Industry

More than 1.3 million men and women were employed in the apparel industry in early 1965. About 400,000 made women's garments, such as dresses, skirts, blouses, suits, and coats. Approximately 75,000 made apparel for girls and children. About 115,000 produced tailored clothing (suits and coats) for men and boys. More than 340,000 made men's and boys' shirts, slacks, work clothes, separate trousers, nightwear, and other furnishings. More than 30,000 produced hats, caps, and millinery. About 125,000 produced undergarments for women and children. Another 80,000 made fur goods and miscellaneous apparel such as raincoats, gloves, and dressing gowns. About 165,000 workers classified in the apparel industry produced curtains and draperies.

Apparel factories usually are small. Although there has been a growing trend toward larger establishments in recent years, only a handful employ more than a thousand people each. Most of these large plants make men's and boys' apparel. The great majority of the tens of thousands of apparel establishments in the United States employ fewer than 100 workers each. Plants that manufacture garments subject to rapid style changes tend to be smaller than those making standard type garments.

New York City is the Nation's fashion center for women's apparel. Store buyers flock to its many showrooms to see the latest styles. About half of all women's apparel plants and about one third of all women's apparel workers are located in the New York–Northeastern New Jersey metropolitan area. Many jobs for workers who manufacture women's dresses, coats, and suits are also available in Wilkes-Barre–Hazleton, Los Angeles–Long Beach, Fall River, New Bedford, Chicago, Philadelphia, St. Louis, Dallas, and Boston. The major manufacturing centers of the men's and boys' tailored clothing industry are New York City, Philadelphia, Chicago, Rochester, Baltimore, Boston, Cincinnati, Los Angeles–Long Beach, and St. Louis. Large numbers of apparel workers are also employed in plants located throughout the South and Southwest, frequently in small communities. These plants generally manufacture items such as separate trousers, work clothing, skirts, pajamas, and children's clothing.

Occupations in the Industry

The major operations in making apparel are designing the garment, cutting the cloth, sewing the pieces together, and pressing the assembled garment. Generally, high-grade clothing and style-oriented garments are more carefully designed and involve more handwork and fewer machine operations than the cheaper, more standardized garments. For example, making men's high-quality suits requires a great amount of hand sewing. Similarly, much hand detailing goes into a high-priced woman's fashionable cocktail dress. In contrast, standardized garments such as men's undershirts, overalls, and work shirts are

usually sewn entirely by machine. To make the many different types, styles, and grades of garments, workers with various skills and educational backgrounds are employed in the apparel industry.

Most employees, however, work as operatives and are classified as semiskilled workers.

Designing Room Occupations. Typically, the manufacturing process begins with the *designer* (D.O.T. 142.081) who creates original designs for new types and styles of apparel. He may get ideas for designs by visiting museums, libraries, and major fashion centers in both the United States and Europe. He makes sketches of his designs and presents them to the management and sales staff of his company for approval. The sketches include information about the type of fabric, trim, and color. The designer, who usually works with one type of apparel, makes an experimental garment in muslin from approved sketches. He cuts, pins, sews, and adjusts the muslin on a dress form or on a live model until the garment matches his sketch. In large manufacturing plants, a *sample stitcher* (D.O.T. 785.381) prepares these sample garments by following the designer's sketch and performing all necessary machine and hand sewing operations.

Since designing is a creative job, designers usually work without close supervision, but they must produce a satisfactory number of successful styles during a season. A large garment manufacturer generally has one designer and several assistants who often have specialized designing responsibilities of their own. Most small plants and plants making standardized garments do not employ designers, but purchase readymade designs or patterns.

When the sample garment or sketch has been approved, it is sent to a *patternmaker* (D.O.T. 781.381) who constructs a full-size master pattern. Working closely with the designer, the patternmaker translates the sketch or sample garment into paper or fiberboard pattern pieces to be used as guides for cutting fabric. In drawing and cutting pattern pieces, the patternmaker must make allowances for pleats, tucks, yokes, seams, and shrinkage. In some shops, designers or all-round tailors make patterns, whereas in other shops the assistant designer performs the pattern-making tasks.

The master pattern serves as a guide for the *pattern grader* (D.O.T. 781.381) who makes a wide range of sizes in each garment style. In a sense, the pattern grader is a specialized draftsman. He measures the pieces that make up the master pattern and modifies them to fit all sizes. The pattern grader then draws an outline of each revised pattern piece on fiberboard and cuts out the pieces by following the outlines. After he completes a set of pattern pieces for each garment size, he attaches a label to identify the part and size of the garment.

Cutting Room Occupations. Workers in the cutting room prepare cloth for sewing into articles of wearing apparel. There are five basic operations in the cutting department: spreading, marking, cutting, assembling, and ticketing. In small shops, two or more of these operations may be combined into a single job. Most jobs in the cutting room are held by men.

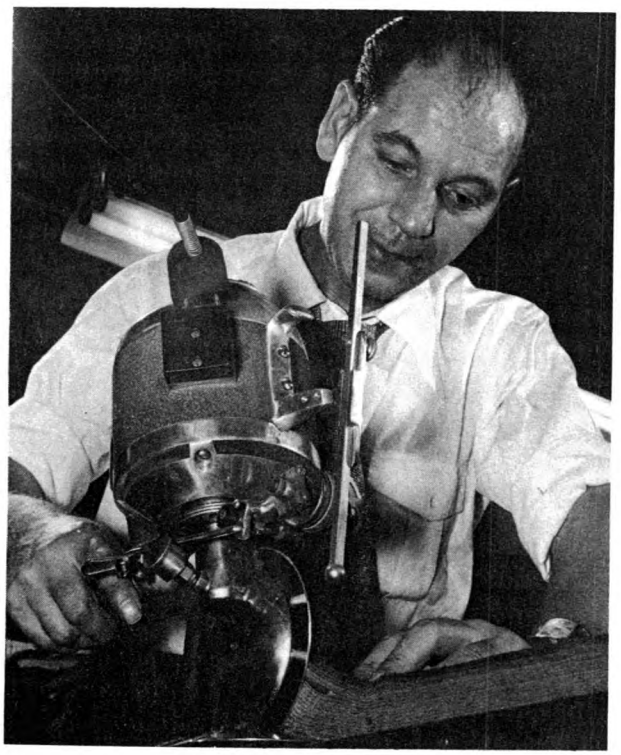
Spreading may be performed by *hand spreaders* who lay out bolts of cloth by hand, neatly piling the layers into exact lengths on the cutting table.

Marker arranges pattern pieces on cloth to guide cutter.

In large plants, *machine spreaders* (D.O.T. 781.-884) do this work, using a machine which lays the cloth by traveling back and forth over the table.

In most plants, *markers* (D.O.T. 781.484) trace the fiberboard pattern pieces on large sheets of paper, making several carbon copies of these tracings. In plants that make men's and boys' suits and coats, the pattern pieces are traced with chalk directly on the cloth itself, rather than on paper. In order to get the greatest number of cuttings from a given quantity of cloth, markers arrange pattern pieces so that there is just enough distance between them for the cutter to work. Figured materials must be marked in such a way that adjoining garment parts will match when the garment is assembled.

The job of a *cutter* (D.O.T. 781.884) is to cut out the various garment pieces from the layers of cloth which are spread on the cutting table. He follows the outline of the pattern on the cloth with an electrically powered cutting knife which cuts through all the layers at once. Sometimes layers of cloth are as high as 9 inches. The work of a cutter and a marker is frequently combined into the single job of cutter-marker.



Cutter uses round knife machine to cut through many layers of cloth.

Other types of cutters are employed in shops making high-quality garments. *Hand cutters* or *shapers* (D.O.T. 781.887) trim and cut the pieces for these garments to make them conform exactly to the original pattern. Sometimes cutters sit in sewing rooms so that they can trim and shape garments as they advance through sewing operations.

The pieces of cloth that have been cut are prepared for the sewing room by another group of specialized workers. *Assemblers*, sometimes called *bundlers*, (D.O.T. 229.588) bring together and bundle garment pieces and accessories (linings, tapes, and trimmings) needed to make a complete garment. They sort the pieces by matching color, size, and fabric design. In addition, assemblers may mark locations for pockets, buttonholes, buttons, and other trimmings with chalk or thread. They identify each bundle with a ticket. The ticket is also used to figure the earnings of workers who are paid on the basis of the number of pieces they produce. The bundles are then routed to the various sections of the sewing room.

Sewing Room Occupations. Almost half of all clothing workers are sewers and stitchers. Most of the employees in these jobs are women. Sewers stitch garment cuttings together either by machine or by hand. The quality and style of the finished garment usually determine how much handwork is involved. Generally, higher priced clothing, such as suits and coats, require more handwork than do standardized garments. In the average plant, however, the work is broken down into a large number of machine operations, with some handwork when the garment nears completion.

Sewing machine operators (D.O.T. 787.782) use sewing machines that are generally heavier and capable of faster speeds than the sewing machines found in the home. Special devices or attachments that hold buttons, guide stitches, or fold seams are often used. Some sewing machine operators specialize in a single operation such as sewing shoulder seams, attaching cuffs to sleeves, or hemming blouses. Others make garment sections such as pockets, collars, or sleeves. Still

others assemble these completed sections and join them to the main parts of the garment. Some sewing machine operators employed in shops making high priced dresses and women's coats and suits perform all the machine operations on a garment.

Sewing machine operators are generally classified according to the type of machine they use, such as single-needle sewing machine operator or blind-stitch machine operator. Others are known by the type of work performed, such as collar stitcher, sleeve finisher, cuff tacker, or coat baster.

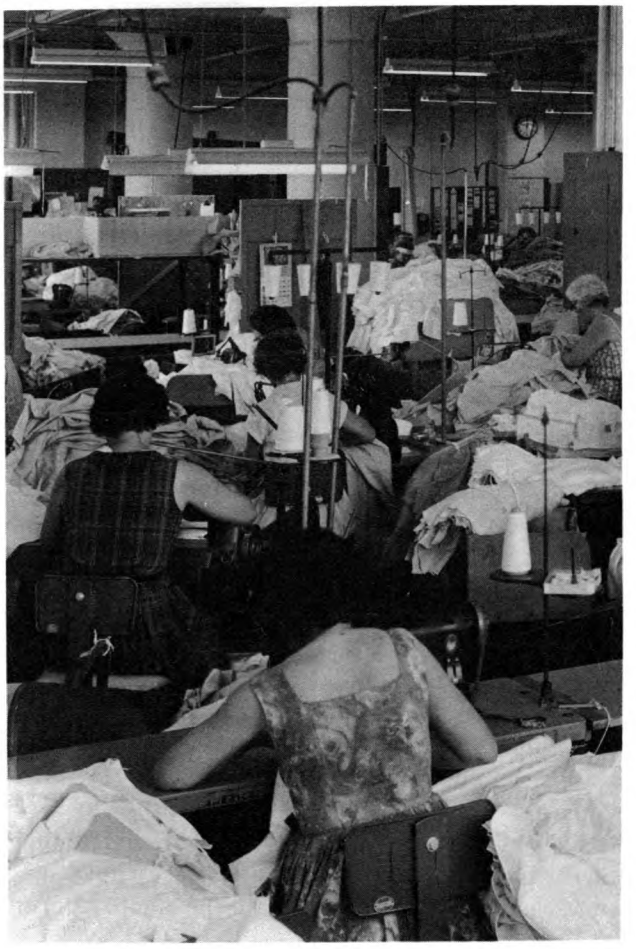
Hand sewing is done on better quality or highly styled dresses, suits, or coats to produce garments which are superior in fit and drape. *Hand sewers* (D.O.T. 782.884) use needle and thread to perform various operations ranging from simple sewing to complex stitching. Many hand sewers specialize in a single operation such as buttonhole making, lapel basting, or lining stitching.

In a typical garment factory, bundles of cut garment pieces move through the sewing department where the garments take form as they pass through a series of sewing operations. Each operator performs one or two assigned tasks on each piece in the bundle and then passes the bundle to the next operator. Some plants employ *work distributors.* (D.O.T. 787.782), often called floor boys or floor girls, who move garment pieces from one sewing operation to another.

At various stages of the sewing operations, *inspectors* (D.O.T. 789.687) and *checkers* (D.O.T. 789. 687) examine garments for proper workmanship. They mark such defects as skipped stitches or bad seams, which are repaired before passing the garments on to the next sewing operation. Inspectors sometimes make minor repairs. *Thread trimmers* and *cleaners* (D.O.T. 789.687) remove loose threads, basting stitches, and lint from garments.

Tailoring Occupations. Tailors (D.O.T. 785.381 and .261) and *dressmakers* (D.O.T. 785.361) are able to make a garment from start to finish by hand or by machine. Some skilled tailors who are employed in plants making men's, women's, and children's outer garments may make up sample garments from the designer's specifications.

Bushelmen, or alteration tailors, repair defects in finished garments that were rejected by the inspector. They alter garment parts that have not been sewn correctly, rearrange padding in coats and suits, and do other sewing necessary to correct defects.



Most sewing machine operators are women.

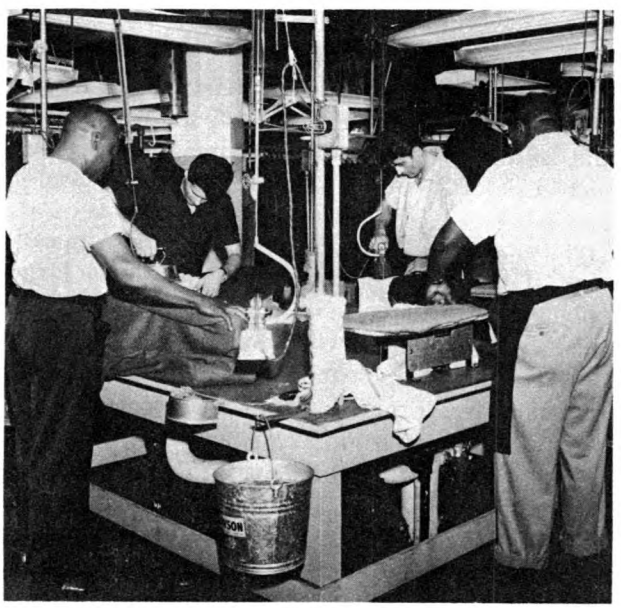
Pressing Occupations. The shape and appearance of the finished garment depend to a large extent on the amount of pressing that is done during and after sewing operations. Pressing is particularly important in making high-quality garments. For example, from time to time during the sewing of suits, coats, and better quality dresses, seams are pressed open in order to produce a better fitting and neater garment and to make it easier to assemble the garment. In the manufacture of lighter weight garments, on the other hand, pressing is done only after completion of all the sewing operations.

Pressers (D.O.T. 363.782 and .884) use various types of steam pressing machines or hand irons to flatten seams and to shape garment parts and finished garments. Pressers may specialize in one type of pressing or ironing. For example, in a shirt factory, a *collar pointer* (D.O.T. 583.885) operates a pressing machine that shapes and presses points of shirt collars.

There are two basic types of pressers—underpressers and finish pressers. Underpressers specialize on particular garment parts, such as collars, shoulders, seams, or pockets. Their duties vary from simple smoothing of cloth and flattening of seams to skillful shaping of garment parts. Finish pressers generally do final pressing and ironing at the end of the sewing operations.

Fur Shop Occupations. The apparel industry includes plants that manufacture garments made of fur. Because furs are expensive and difficult to work with, each operation in making a fur garment requires skilled handwork by an experienced craftsman. Many of these workers have special skills not found in plants that make other types of apparel.

The most skilled job in a fur garment manufacturing plant is that of a cutter who sometimes is also the foreman in the shop. A *fur cutter* (D.O.T. 783.781) selects and matches enough fur skins to make a single garment such as a fur coat or jacket. He arranges and cuts the skins on pattern pieces so that the choice sections of fur are placed where they will show. Following the sewing instruction given by the cutter, *fur machine operators* (D.O.T. 787.782) stitch these pelts together to form the major garment sections. A *fur nailer* (D.O.T. 783.884) wets the sewn garment sections, stretches them by hand, and nails them on a board so that they will cover the pattern. When the sections are dry, the nailer removes the nails and trims the fur exactly along the outline of the pattern. The fur machine operator then finishes sewing the various sections together to make the complete garment. *Fur finishers* (D.O.T. 783.381) sew in the lining, tape edges, make pockets, and sew on buttons and loops.



Pressers use hand irons to shape men's suit jackets

Administrative, Sales, and Maintenance Occupations. The majority of the administrative positions in an apparel plant are in the production department. The production manager occupies a strategic position in apparel firms. He is responsible for estimating production costs, scheduling the flow of work, hiring and training workers, controlling quality, and supervising the overall production activities of the plant.

The industrial engineer advises management about the efficient use of machines, materials, and workers. (Further discussion of industrial engineers is included elsewhere in the *Handbook.*)

Clerks, bookkeepers, stenographers, and other office workers make up payrolls, prepare invoices, keep records, and attend to other paperwork required in this industry. Salesmen, purchasing agents, models, credit managers, and accountants are among other types of workers in the apparel industry. Sewing machine mechanics are responsible for keeping the industry's large number of sewing machines in good running order. (Discussions of many of these jobs can be found elsewhere in the *Handbook.*)

Training, Other Qualifications, and Advancement

Training requirements for production (plant) jobs in the apparel industry range from a few days of on-the-job training to several years of training and experience. The difference in train-

ing time needed before an employee can reach his maximum speed and efficiency depends on the type of job and the worker's aptitude. Many plant workers pick up their skills while working as helpers or assistants to experienced workers. Apprenticeship is infrequent and is limited mainly to designing, cutting, or tailoring jobs. Some private and public schools in garment manufacturing centers offer instruction in occupations such as designing, patternmaking, and cutting as well as machine and hand sewing.

Physical requirements for most production jobs in the apparel industry are not high, but good eyesight and manual dexterity are essential. Many occupations are well suited for handicapped workers since the majority of the jobs are performed while seated and require little physical exertion. Older workers and women workers also perform well in a variety of jobs. Many workers in their fifties and sixties are among the industry's most skilled and productive. Women are employed in most of the occupations in this industry, although men hold most of the cutting, tailoring, and pressing jobs.

Designers enter the industry in various ways. Many receive their training by working on the job with experienced designers, by advancing from cutting or patternmaking jobs, or through apprenticeship. There is an increasing tendency for apparel firms to recruit designers from colleges that offer specialized training in design. Some young people with a background in designing may take jobs as designers with small firms and once their reputations have been established, transfer to jobs in larger, better paying firms. In large firms, young people may start as assistant designers.

A designer should have artistic ability, including a talent for sketching, a thorough knowledge of fabrics, a keen sense of color, and the ability to translate design ideas into a finished garment. He should also be acquainted with garmentmaking techniques which he may learn by working briefly at various operative jobs such as machine sewing, draping, sample making, and cutting.

The production manager usually begins as a management trainee, and the industrial engineer as a junior engineer. A college education is increasingly being required for these jobs. Many years of on-the-job training in all production processes ranging from selection of fabrics to shipment of finished apparel are often required to qualify as a production manager.

Most patternmakers pick up the skills of the trade by working for several years as helpers to experienced patternmakers. Pattern graders and cutters are occasionally promoted to patternmaking jobs. Patternmakers must have the ability to visualize from a sketch or model furnished by the designer the size, shape, and number of pattern pieces required. Patternmakers must also have a detailed understanding of how garments are made as well as a knowledge of body proportions. Like the designer, they must also have a thorough knowledge of fabrics.

Pattern graders are usually selected from employees working in the cutting room or in other plant jobs. Training in drafting is helpful since much of the work requires the use of drafting tools and techniques.

Most workers enter the cutting room by taking jobs as assemblers, or bundlers. Patience and the ability to match colors and patterns are necessary qualifications for these jobs. Assemblers, or bundlers, may sometimes be promoted to jobs such as spreader. Several years of experience in the cutting room are required before an employee can become a skilled marker or cutter. A small number of the larger plants have apprenticeship programs which usually last 4 years and include training in spreading, cutting, marking, and patternmaking.

Entry into beginning hand- or machine-sewing jobs is relatively easy for young women since there are few restrictions regarding education, and physical condition. Some previous training in sewing operations is preferred, but many apparel plants hire workers who have had no experience in sewing. Training is generally informal and received on the job. New workers usually start by sewing straight seams, under the supervision of a section foreman or experienced worker.

Most sewing jobs require the ability to do routine work rapidly. The same sewing operation is repeated on each identical garment piece. Since almost all these workers are paid on the basis of the number of pieces produced, any clumsiness of hand may reduce the worker's earnings. Good eyesight and ability to work at

a steady and fast pace are essential for both hand- and machine-sewing jobs.

The average sewer has little opportunity for promotion beyond section forelady, although some sewers have worked their way up to the job of production manager. Most sewers stay on the same general type of operation throughout most of their working lives. Promotion is largely from beginning sewing jobs to more skilled and better paid sewing jobs in the same field.

Some tailors and dressmakers learn the trade through vocational training in day or evening schools. Graduates from vocational schools frequently are hired and given additional training on the job. Others learn the trade informally, on the job, first doing relatively easy sewing operations and progessively advancing to more difficult operations. It requires several years of experience to become an all-round tailor or dressmaker. Most dressmakers are women, and most tailors are men.

Tailors and dressmakers may qualify for jobs as a fitter or alteration tailor in department stores, clothing stores, and cleaning and dyeing shops.

Pressers usually begin as underpressers working on simple seams and garment parts. This job can be learned in a very short time. After the pressers gain experience, they work on more difficult operations and eventually may be promoted to the job of finish presser. Pressing, like tailoring, is one of the few needle trades in which workers can find similar employment in stores and in cleaning and dyeing shops. There is some transferring back and forth between pressing jobs inside and outside the apparel industry.

Employment Outlook

The apparel industry will offer many thousands of job opportunities for new workers annually during the 1965–75 decade. Total employment in the industry is expected to increase moderately above the more than 1.3 million employed in early 1965. In addition to the job opportunities expected to result from employment growth, a considerable number of opportunities for young people to enter the apparel industry will occur because of the tens of thousands of experienced workers who will leave. About three-fourths of the needle trades' workers are women, a large number of whom leave the industry each year to marry or to raise families.

Demand for apparel in the next 10 years will grow substantially and will be the major reason for the rise in employment. The increased need for apparel will be due mainly to rapidly growing population, but other factors will also be important. For example, the number of people in their teens and early twenties will rise greatly in the next decade, and these are the age groups in which spending for apparel is greatest. The trend toward more workers in clerical, sales, professional, and other white-collar occupations will increase the demand for apparel since these workers spend more for apparel than other workers. Increasing numbers of working women, particularly those in secretarial and other office jobs that require "dressing up," will stimulate apparel purchases. Men, also, are buying more clothing that is highly styled because they are becoming more fashion-conscious.

Employment is not expected to increase as rapidly as demand, because of the increasing use of laborsaving innovations such as faster operating sewing machines; sewing machines that can position needles and trim threads automatically; equipment that automatically spreads fabrics; computers that aid in the detailed planning of pattern placement; and better methods of moving fabrics and apparel through the plant. Most of the opportunities for employment will be in sewing-machine operator jobs because this is the largest occupational group and because this group is made up mostly of women. Some job openings will also occur in tailoring occupations in which a large proportion of the employees are older workers. There will be many opportunities for designers because this group also is made up largely of women.

There will be a few thousand job opportunities each for industrial engineers and salaried managers because of the growth in the size of individual apparel establishments and in the number and size of companies operating more than one establishment.

Opportunities for jobs as tailors, sample makers, and other skilled occupations in the apparel industry will continue to be mainly in the metropolitan centers where plants manufacturing

dresses, women's suits and coats, or men's and boys' suits and coats are located. There will be a small number of new employment opportunities in men's clothing designing, patternmaking, and cutting room jobs.

Earnings and Working Conditions

In mid-1965, average earnings of production workers in the apparel industry were $66.21 a week or $1.82 an hour, compared with $108.21 a week or $2.62 an hour for those in all manufacturing industries. Production workers in this industry generally worked fewer hours per week than those in manufacturing as a whole. Production workers have much higher earnings in some kinds of garment factories than in others. For example, those making women's suits, coats, and skirts averaged $81.77 a week in mid-1965, whereas those producing men's work clothing averaged $57.30 a week. Earnings of apparel workers also vary by occupation and geographical area. For example, average hourly earnings of cutters and pressers in almost all areas are higher than those of sewing machine operators and average hourly earnings are generally lower in the South than in the Middle Atlantic States.

Because most production workers in this industry are paid on the basis of the number of pieces they produce, their total earnings depend upon speed as well as skill. Sewing machine operators, hand sewers, and pressers are generally paid on a piecework basis. Cutters are paid either piecework rates or hourly wages, depending upon the practice in the area or shop in which they work. Most of the other workers, including tailors, patternmakers, graders, inspectors, and work distributors, are paid by the hour or week.

In most metropolitan areas, the bulk of apparel employees work in shops that have union contracts. New employees in plants which have these agreements are required to join the union after 30 days of employment. These agreements deal with such subjects as wages; hours of work; vacation and holiday pay; seniority; health, insurance, and pension plans; and other employment matters. Among the unions to which apparel workers belong are the Amalgamated Clothing Workers of America (ACWA), International Ladies' Garment Workers' Union (ILGWU), and United Garment Workers of America (UGW). The ILGWU sponsors vacation resorts for union members and their families. Both the ACWA and the ILGWU operate health centers for garment workers in major producing areas.

Workers in the apparel industry can expect to lose very little work time as a result of strikes or other work stoppages because the industry has had many years of peaceful labor-management relations. However, workers making certain types of garments may have layoffs of several weeks during slack seasons. Generally, such layoffs occur more often in plants making seasonal garments, such as women's coats and suits, than in plants producing standardized garments, such as pajamas and men's shirts, which are worn all year long. In many plants, the available work during slack periods is divided so that workers can be assured of at least some earnings. Also, more and more firms are diversifying the types of apparel they make, which reduces seasonal employment declines.

Old buildings, whose surroundings and facilities may frequently leave much to be desired, continue to house most apparel establishments, especially those in metropolitan areas. Newly constructed plants usually have ample space, good lighting, and air conditioning. Some of the new plants have cafeterias, and health clinics with a registered nurse on duty.

Most sewing jobs are performed while sitting and are not physically strenuous. The working pace is rapid because worker's earnings depend on their production. In addition, many tasks are extremely monotonous. Serious accidents among sewers are rare, although a sewer may occasionally pierce a finger with a needle. On the other hand, pressing may be strenuous work and involves working with hot steam.

Working conditions in cutting and designing rooms are pleasant. In manufacturing establishments, designing and cutting are often performed in a separate area away from the main sewing and pressing operations. Jobs in designing and cutting operations are more interesting and less monotonous than most other apparel jobs. Moreover, since accuracy and skill as well as individual talent and judgment are valued more than speed in these jobs, the work pace is less rapid.

Where To Go for More Information

Information relating to vocational and high schools that offer training in designing, tailoring, and sewing may be obtained from the Division of Vocational Education of the Department of Education in the State capital.

Information concerning apprenticeships may be obtained from the Apprenticeship Council of the State Labor Department or the local office of the U.S. Employment Service. Some local Employment Service offices offer training courses for sewing machine operators. Others give tests to determine hand-eye coordination.

Information of a general nature may be obtained from the following sources:

Amalgamated Clothing Workers of America,
15 Union Square, New York, N.Y. 10003.

American Apparel Manufacturers Association, Inc.,
2000 K St. NW., Washington, D.C. 20006.

Clothing Manufacturers Association of U.S.A.,
220 Fifth Ave., New York, N.Y. 10001.

International Ladies' Garment Workers' Union,
1710 Broadway, New York, N.Y. 10019.

United Garment Workers of America,
31 Union Square, New York, N.Y. 10003.

OCCUPATIONS IN THE ATOMIC ENERGY FIELD

In 1964, nearly 200,000 workers had jobs in a variety of atomic energy activities. Large numbers of these workers were employed in research and development work. Others were engaged in activities such as the manufacture of nuclear weapons and other defense materials, the design and manufacture of nuclear reactors, and the production of nuclear fuels. Scientists, engineers, technicians, and craftsmen accounted for over one-half of the atomic energy workers. Employment opportunities for such workers will continue to be especially favorable in the 1965-75 decade.

Applications of Atomic Energy

Atomic energy is an enormous source of heat and radiation which can be used in many important ways for both peaceful and military purposes. One use of this energy of great potential significance is the production of commercial electricity using nuclear reactors as the heat source. A nuclear reactor (chart 31) can be thought of as an atomic furnace, although there is no fire or combustion in the usual sense. Steam produced by such "furnaces" (power reactors) is already generating electricity for public consumption and more of these facilities are being built. Reactors are used to power submarines and surface ships. Intensive research is in progress toward developing nuclear propulsion systems and auxiliary nuclear-electronic power devices for space vehicles.

Another significant application of atomic energy is the production of radioisotopes in reactors, built primarily as a source of radiation rather than heat. Radioisotopes have become very valuable as research tools in agriculture, medicine, and industry and for use in industrial inspection and control devices. Their value lies in their unique property of emitting one or more kinds of radiation which can be detected even in minute quantities by sensitive instruments.

One important use of radioisotopes is as tracers. Radioisotopes can be placed in the blood stream of man or animal, for example, so that the path of the radioactive material can be traced by instruments. In medicine, this aids the physician in diagnosing a patient's illness. Tracers may also be used to study such diverse processes as the assimilation of fertilizer by plants and the wear of automobile engine parts.

Radioisotopes are also used as high intensity radiation sources to kill bacteria, to destroy cancerous tissue, to sterilize insect pests, and to develop better strains of plants. They are used in radiography units (similar to X-ray machines) to detect flaws in metal castings and welds. Radioisotop instruments monitor production processes and activate mechanisms which automatically control the thickness of products manufactured in sheet form and the level of liquids in closed containers.

How Atomic Energy Is Produced

Atomic energy, or more accurately nuclear energy, may be produced through several processes, the two most important of which are fission and fusion. In fission, the nucleus of a heavy atom is split, releasing energy in the form of heat and radiation, and producing two or more lighter elements. In fusion, energy is released by combining the nuclei of two light atoms. The detonation of atomic bombs is an application of the explosive release of enormous amounts of atomic energy. Nonweapon applications require that release of this energy be carefully controlled and regulated so that it proceeds at a manageable rate. Scientists have developed practical methods of controlling the fission reaction, but have not yet mastered control of the fusion (or thermonuclear) reaction.

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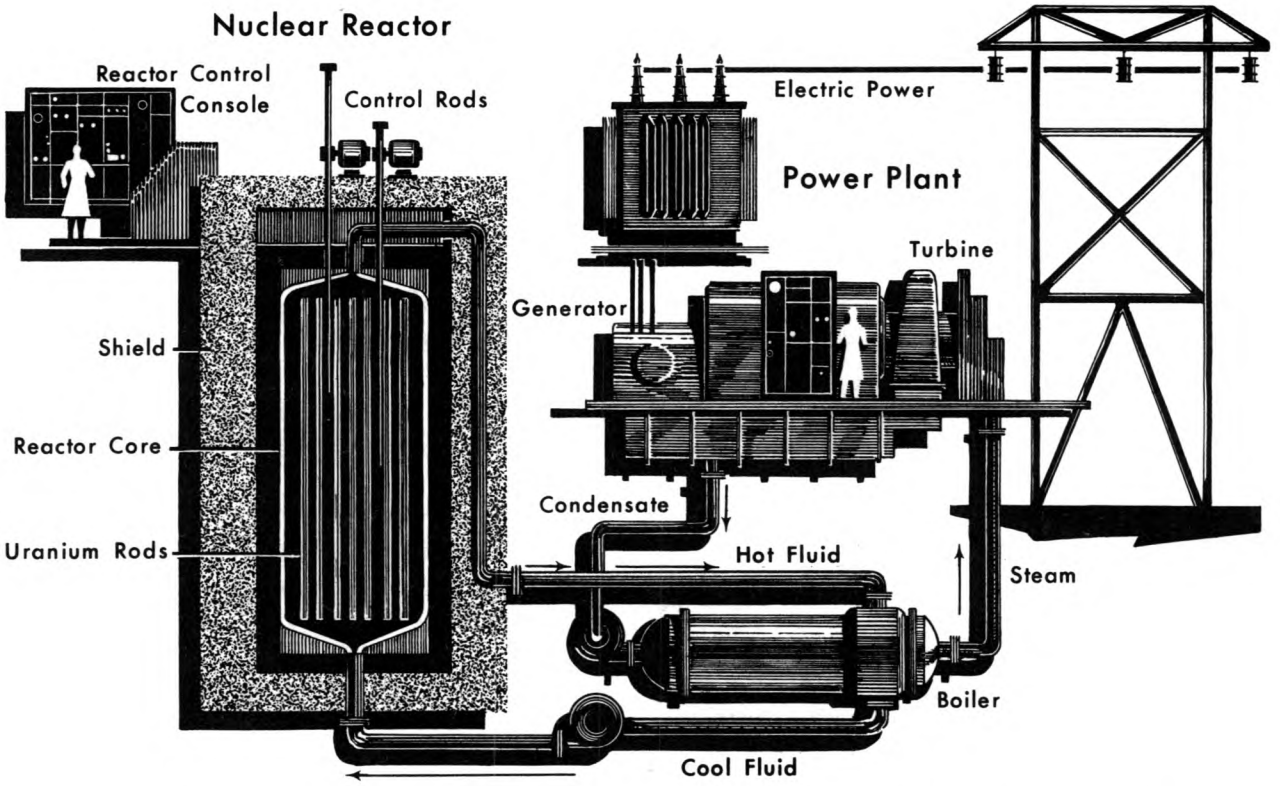
CHART 31

NUCLEAR REACTOR GENERATING ELECTRICITY .....



Controlled fission is the essential feature of a nuclear reactor. The reactor, being a kind of furnace, needs fuel to operate. The principal source material for reactor fuel is uranium, which in its natural state contains less than 1 percent of readily fissionable material, uranium U–235. Although natural uranium is used as reactor fuel, a more concentrated and enriched fuel can be produced and used by increasing the proportion of U–235 isotope through a process called gaseous diffusion. U–235 is the most usable material that occurs naturally and undergoes fission readily, but two manmade fissionable materials (plutonium and uranium U–233) also can be used as reactor fuel.

Fissionable fuel is placed in the nuclear reactor in a particular arrangement with certain other elements. Under proper conditions, the fuel will sustain a "chain reaction"—the continuous fissioning (or splitting) of the nuclei of atoms—resulting in the release of energy in the form of heat and radiation. When the fissionable atoms in the fuel split, they release neutrons (so-called "atomic bullets") which cause other fissionable atoms to split. These, in turn, release additional neutrons which similarly split more atoms. This is how the fission process is maintained. The level of the chain reaction is carefully controlled, usually by inserting special neutron-absorbing rods into the fuel chamber, or "core," of the reactor. In this way, the rate of the fission reaction and of the energy produced can be regulated or stopped completely.

Thus, harnessed atomic energy is produced in a nuclear reactor in the form of heat and radiation. However, if reactors are to be used for power, the heat must be removed from the reactor and put to work. This is done by converting the heat to electricity through the use of conventional equipment. The major difference between nuclear and conventional thermal electric power stations is that the heat needed to generate steam to drive

turbines comes from a nuclear reactor rather than from a conventional steam-generating boiler fueled with coal, gas, or oil.

During the fission process, neutrons and other forms of nuclear radiation are released. Nuclear radiation, identifiable only by sensitive instruments, can be ruinous to equipment and highly dangerous to personnel. Therefore, special materials, resistant to damage by radiation, are used in reactors and great care is taken to protect personnel. For example, the nuclear reactor is housed in a special container and surrounded by shielding materials, such as concrete, water, and lead.

A valuable byproduct of reactor operation is the production of radioisotopes. The major method of producing radioisotopes is to expose stable atoms of various elements to the neutrons emitted from the reactor core. Radioisotopes can also be produced by bombarding materials placed in a particle accelerator (also known as an "atom smasher"), a machine which accelerates electrically charged particles to speeds of thousands of miles per second.

Nature of the Atomic Energy Field

Many different kinds of research and industrial activities are required for the production and application of nuclear energy. These include the mining, milling, and refining of uranium-bearing ores; the production of nuclear fuels; the manufacture of nuclear reactors, reactor components, and nuclear instruments; the production of special materials for use in reactors; the designing, engineering, and construction of nuclear facilities; the operation and maintenance of nuclear reactors; the disposal of radioactive wastes; the processing and packaging of radioisotopes; the production of nuclear weapons; and research and development work.

These activities are performed in plants in several different industries, as well as in laboratories and other types of facilities. Much of this work, such as ore mining and milling, manufacture of heat transfer equipment, and construction of facilities, differs little from similar nonatomic energy work. Other activities, such as manufacture of the fuels needed to run reactors, are unique to the atomic energy field.

The Federal Government supports most of the basic atomic energy activities. The U.S. Atomic Energy Commission (AEC) directs the Federal Government's atomic energy program and regulates the use of nuclear materials by private organizations. Almost all of the AEC's work program, including the operation of Commission-owned facilities, is contracted out to private organizations. The AEC-owned facilities include laboratories, uranium processing plants, nuclear reactors, and weapon manufacturing plants. More than half of all workers in the atomic energy field are employed in these facilities. Private firms in their own installations are engaged in many types of atomic energy activity except development and production of military weapons and certain nuclear fuel-processing operations.

A large amount of research and development work is done in the atomic energy field. Much of this work is carried on by the AEC-owned laboratories and by university and college laboratories, other nonprofit institutions, and industrial organizations under Commission contracts. Additional research and development is carried on by private industry.

Jobs in the atomic energy field are found in every State, although employment is most heavily concentrated in California, New Mexico, Tennessee, Pennsylvania, and New York.

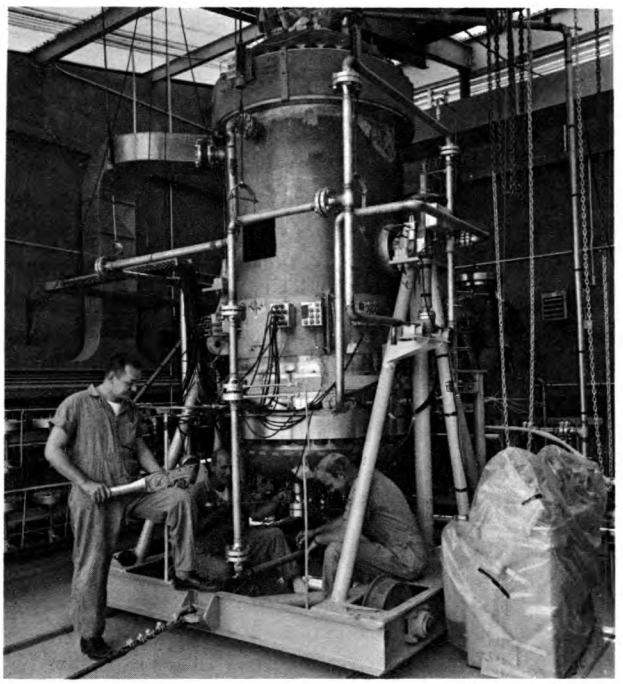
Occupations in the Atomic Energy Field

Engineers, scientists, technicians, and craftsmen accounted for a large proportion of the nearly 200,000 workers in the atomic energy field in 1964. A higher proportion of professional and technical workers is found in this field than in most other fields of work, largely because of the concentration on research and development. Office personnel in administrative and clerical jobs represent another large group. Most of the remaining employment consists of semiskilled and unskilled workers in production work, and plant protection and other service workers. The following tabulation shows the distribution of employment among major occupational groups based primarily on a 1964 Bureau of Labor Statistics survey covering about two-thirds of the estimated employment in the atomic energy field. (These percents may not apply to atomic energy employment not covered by the survey.)

	Percent
Total employment	100
Engineers	15
Scientists	8
Administrative and other professional workers	8
Clerical and other office workers	15
Technicians	16
Skilled workers	21
All others	17

Although some engineers in the atomic energy field are highly trained in nuclear technology, engineers in all major engineering fields are employed. Mechanical engineer is probably the largest single engineering occupation, but large numbers of electrical and electronics, chemical, reactor, civil, and metallurgical engineers are also employed. Many of these engineers do research and development work, while others are engaged in designing nuclear reactors, nuclear instruments, and other equipment used in the atomic energy field, and in the supervision of construction activities or the operation of production plants.

Mainly because of the emphasis given to basic and applied nuclear research, a large number of scientists are employed by research laboratories and other organizations engaged in atomic energy work. Physicists and chemists predominate, but many types of scientists are included, such as mathematicians, metallurgists, biological scientists, and health physicists.



Instrument technicians make connections on a test reactor.

A large number of technicians are employed to assist engineers and scientists in research and development work and in the designing and testing of equipment and materials. These include draftsmen; electronics, instrument, chemical, and other engineering and physical science technicians; and radiation monitors.

The atomic energy field employs many highly skilled workers because of the need to fabricate special parts and equipment for use in experimental and pilot work and the need for large maintenance forces to care for the considerable amount of complex equipment and machinery. Maintenance mechanics (e.g., machinery repairmen and millwrights) and all-round machinists are employed extensively in most atomic energy activities, as are electricians, carpenters, plumbers, pipefitters, sheet-metal workers, and instrument repairmen. A large number of chemical process operators work in the production of defense materials and reactor fuel materials. The following tabulation shows the occupational distribution of skilled workers in the atomic energy field in 1964.

	Percent
Total skilled workers	100
Chemical process operators	12
All-round machinists	12
Maintenance mechanics	13
Electricians	10
Plumbers and pipefitters	6
Instrument repairmen	7
Carpenters	3
Tool and die makers	2
Sheet-metal workers	3
Instrument makers	3
Other skilled workers	29

Activities in the Atomic Energy Field

A brief description of some important atomic energy activities and the types of workers employed in them follows. In several of these activities, such as uranium mining, the percent distribution of employment by occupation is similar to that in comparable nonatomic work.

Uranium Mining. The 4,200 miners and supporting personnel employed at about 700 uranium

mines in 1964 had jobs similar to those in the mining of other metallic ores. Their jobs were largely concentrated in the Colorado Plateau area of the Far West, in the States of New Mexico, Wyoming, Utah, Colorado, and Arizona. A relatively few mines account for the bulk of production and employment. Most workers in uranium mines are in production jobs, such as miners and drillers in underground mines, and truckdrivers, bulldozer operators, and machine loaders in open pit mines. A small proportion of the employees in uranium mining are in professional jobs, such as mining engineer and geologist.

Uranium Ore Milling. In uranium mills, metallurgical and chemical processes are used to extract uranium from mined ore. The basic steps included are ore preparation (primarily crushing and grinding), leaching to extract uranium, and product recovery—operations similar to those used in the milling of other metallic ores. The 21 uranium mills in operation in 1964, most of them located in the Colorado Plateau, employed about 2,000 workers. These workers were distributed among major occupational groups in the following proportions:

	Percent
Total employment	100
Engineers and scientists	7
Administrative and other professional workers	9
Clerical and other office workers	7
Technicians	6
Skilled workers	24
Other workers	47

More than a third of the skilled workers were chemical process operators, and many skilled machinery repairmen, millwrights, pipefitters, carpenters, and electricians were also employed. Chemists, chemical engineers, metallurgists, and metallurgical engineers accounted for about three-fifths of the engineers and scientists employed in these mills.

Uranium Refining and Enriching. Milled uranium is chemically processed to remove impurities and then converted to metal or intermediate chemical products for reactor fuel preparation. Conventional chemical and metallurgical processes are used, but they must meet more exacting standards than in most other industries. The output of refining plants may be further processed to obtain enriched uranium.

Activity in this segment of the atomic energy field is centered in Ohio, Tennessee, Kentucky, and Illinois. In 1964, uranium was refined and enriched at 14 plants. More than 8,500 workers were distributed among major occupational groups in the following proportions:

	Percent
Total employment	100
Engineers and scientists	12
Administrative and other professional workers	11
Clerical and other office workers	14
Technicians	7
Skilled workers	37
Other workers	19

Among skilled workers, the largest single occupation was chemical operator in processing operations. Maintenance craftsmen, particularly in the highly automatic uranium enriching plants, accounted for a large proportion of skilled workers. Chemical engineers and chemists accounted for about half of the engineers and scientists employed in refining and enriching operations. Many of the technicians worked in chemical analytical laboratories associated with production processes.

Reactor Manufacturing. More than 15,000 workers are estimated to have been employed in 1964 in the design and manufacture of nuclear reactors and unique reactor components. Reactor manufacturers do extensive research and development work on reactors and auxiliary equipment, design the reactor, and generally fabricate some of the intricate components, such as fuel elements, control rods, and reactor cores. Many components of reactor plants are similar to components of conventional power plants and are purchased from plants manufacturing such products.

More than half of the employees in firms that design and manufacture reactors are scientists, engineers, and technicians. Engineers alone represent about 30 percent of the employment, with mechanical engineers and reactor engineers, who are specialists in reactor technology, predominating. Among scientists, the largest group are physicists, but many chemists, mathematicians, and metallurgists are also employed. Assisting these engineers and scientists are many draftsmen, engineering aids, and physical science technicians.

Skilled workers are employed by reactor manufacturers in experimental, production, and maintenance work. All-round machinists and sheet-metal workers account for a large proportion of these craftsmen. Other craftsmen, such as instrument makers, machinery repairmen, instrument repairmen, and electricians, are also employed. Reactor manufacturers employ nuclear reactor operators to operate experimental and test reactors.

Fuel elements and other unique components are fabricated not only by reactor manufacturers but in specialized fuel-processing plants as well. Many mechanical and metallurgical engineers, technicians, and chemical process operators are employed in these plants.

Reactor Operation and Maintenance. About 600 workers were engaged in the operation and maintenance of nuclear reactors producing commerical electricity in 1964. Prinicipal types of occupations found in the operation of a nuclear power station are mechanical engineer, electrical and electronics engineer, chemist, instrument technician, electronics technician, radiation monitor, reactor operator, and other power plant operators and attendants. Among the employees needed to maintain and repair reactors are machinery repairmen, instrument repairmen, electricians, and pipefitters.

Research and Development Facilities. Nineteen research and development laboratories and other research facilities are owned by the Atomic Energy Commission and are operated for the AEC by universities and industrial concerns. These facilities are major centers for basic and applied nuclear research in the physical, engineering, and life sciences and in the development of nuclear reactors and other nuclear equipment. In 1964, they employed nearly 47,000 workers, distributed among major occupational groups in the following proportions:

	Percent
Total employment	100
Engineers	17
Scientists	14
Administrative and other professional workers	8
Clerical and other office workers	16
Technicians	20
Skilled workers	13
Other workers	12

This occupational distribution indicates that more than half of the employees in AEC research and development facilities are engineers, scientists, and supporting technicians. Among the engineers and scientists are physicists, mechanical engineers, electrical and electronics engineers, chemists and chemical engineers, mathematicians, reactor engineers, metallurgists and metallurgical engineers, biological scientists, and health physicists. Assisting scientists and engineers are many physical science and engineering aids; draftsmen; electronics, instrument, and biological technicians; and radiation monitors.

Administrative and clerical workers together account for another large proportion of employment. The skilled worker group includes large numbers of all-round machinists, electricians, machinery repairmen, and millwrights, as well as substantial numbers of tool and die makers, instrument makers, and pipefitters. Nuclear reactor operators are employed to operate research and test reactors and many service workers are employed in plant protection and security operations.

Although most nuclear energy research is performed by the AEC research and development facilities, additional atomic energy research is performed in the privately owned research laboratories of educational institutions, other nonprofit institutions, and industrial concerns. Like the AEC facilities, these labortories employ a high proportion of workers in scientific, engineering, and other technical jobs.

Production of Nuclear Weapons and Other Defense Materials. An estimated 40,000 to 45,000 workers were employed in 1964 in establishments producing nuclear weapons and weapon components, plutonium, and other defense materials. These workers were distributed among major occupational groups in the following proportions:

	Percent
Total employment	100
Engineers and scientists	13
Administrative and other professional workers	12
Clerical and other office workers	12
Technicians	10
Skilled workers	27
Other workers	26

About 1 out of every 4 workers in these defense production facilities is a skilled worker in a pro-

duction or maintenance job. Included among these skilled workers are large numbers of machinery repairmen and millwrights, chemical process operators, all-round machinists, electricians, instrument repairmen, pipefitters, tool and die makers, and instrument makers.

Among the large number of scientists and engineers employed at these facilities are many chemists, physicists, and mechanical, chemical, and electrical and electronics engineers. Many engineering and physical science aids, draftsmen, radiation monitors, and electronics technicians are employed to assist scientists and engineers.

Other Atomic Energy Activities. Nearly 1,800 workers were employed in 1964 to produce special materials such as beryllium, zirconium, and hafnium for use in reactors. Nearly three-fifths of these workers are in production, maintenance, and service jobs. Chemical process operators, all-round machinists, and machinery repairmen are numerically important groups of skilled workers. Among scientists and engineers, principal occupations include metallurgist, metallurgical engineer, chemist, and chemical engineer.

Many thousands of workers are engaged in designing and constructing nuclear reactor housing and other atomic energy facilities. Civil and mechanical engineers and draftsmen are among those employed in the design of these facilities. Pipefitters, electricians, carpenters, boilermakers, operating engineers, and other building trades craftsmen are employed in the construction of these facilities.

Almost 4,000 workers were employed in 1964 by companies that manufacture reactor control instrumentation, radiation detection and monitoring devices, and other instruments for the atomic energy field. Production of these instruments involves work similar to that in instrument manufacturing in general. Among engineers and technicians, who represent a substantial proportion of employment in such companies, numerically important occupations include electrical and electronics engineer, mechanical engineer, electronics technician, instrument technician, and draftsman.

Nine companies, which employed over 1,300 workers in 1964 specialize in the manufacture of particle accelerators—machines which enable scientists to study the structure and properties of the elementary particles that make up the nucleus of an atom. Workers typically employed in the design and manufacture of these machines include electrical and electronics engineers, mechanical engineers, physicists, draftsmen, electronics technicians, and machinists.

Other workers in the atomic energy field in 1964 were engaged in such activities as processing and packaging radioisotopes, manufacturing radiography units and radiation gages, packaging and disposing of radioactive wastes, and industrial radiography. Among the workers in these activities are engineers, chemists, biological technicians, radiographic equipment operators (radiographers), remote handlers and packagers of radioisotopes, and mechanics and other workers who repair equipment containing radioisotopes.

Government Employment. The Atomic Energy Commission, which directs the Federal Government's atomic energy program, employed nearly 7,200 workers in its national and field offices in 1964. Over 1,300 engineers and scientists were employed by the Commission, including personnel in nearly every major engineering and scientific occupation, such as reactor, civil,

One technician monitors the radiation level while another lifts radioisotope source holder from lead "can."

and electrical and electronics engineers, chemists, health physicists, and physicists. Since the AEC is primarily an administrative and regulatory agency, approximately two-thirds of Commission employees were in administrative and other professional positions and in clerical and other office jobs. This proportion of administrative and clerical personnel is much larger than in most other activities in the atomic energy field. Another large group of AEC employees were engaged in protective and security activities.

In addition to those employed by the Atomic Energy Commission, a few thousand government employees are engaged in atomic energy work in other Federal agencies and in regulatory and promotional activities of State and local governments. Their duties involve atomic energy research and application, and preparing and carrying out radiation health and safety measures. Outside the AEC, most of the scientists, engineers, and other professional and supporting workers in atomic energy work in Federal Government agencies are employed by the Departments of Defense, the Interior (Geological Survey), Agriculture, and Health, Education, and Welfare, and by the National Aeronautics and Space Administration. The Department of Health, Education, and Welfare, in cooperation with the AEC, aids States in establishing measures to meet radiation health hazard problems.

Unique Atomic Energy Occupations. Most of the occupations discussed in the preceding sections are similar to those found in other industrial activities, although they may have job titles unique to the atomic energy field (such as nuclear engineer, radiation chemist, and nuclear reactor operator) and may require some specialized knowledge of atomic energy. A detailed discussion of the duties, training, and employment outlook for most of these occupations appears elsewhere in the *Handbook*. (See index for page numbers.)

The health physics occupations, which are unique to the atomic energy field, and some other occupations that are unique in that they require training in the handling and use of radioactive materials or radiation-producing equipment, are discussed briefly in the following sections.

Health physicists (also called radiological physicists) are concerned with the problem of radiation safety for workers in atomic energy installations and for people in surrounding communities. They have the responsible job of protecting individuals and property from the hazards of radiation by detecting radiation, and applying pertinent safety standards to control exposure to it. In 1964, about 800 health physicists were employed in radiation protection work, research, or teaching.

Health physicists are responsible for planning and organizing radiological health programs at atomic energy facilities. For example, they set up standards of inspection and establish procedures for protecting employees and eliminating radiological hazards. They supervise the inspection of work areas with potential radiation hazards and prepare instructions covering safe work procedures in these areas. Health physicists also inspect shipments of equipment and materials and radioactive waste disposal activities, to insure compliance with Government standards and regulations. Another duty involves the preparation of reports on radioactive contamination, radiation levels, and radiation exposure.

Health physicists may also plan and supervise training programs dealing with radiation hazards at private and public facilities, and may advise authorities on methods of dealing with such hazards. In some cases, they are employed on research projects dealing with the effects of human exposure to radiation and may develop procedures to be followed in using radioactive materials. Finally, they assist in the development of better methods and equipment for the detection and control of radiation hazards.

Radiation monitors (also called health-physics technicians) generally work under the supervision of health physicists. An estimated 1,800 radiation monitors were employed in the atomic energy field in 1964. They use special instruments to monitor (check) work areas, tools, and equipment to detect radioactive contamination. They monitor incoming and outgoing shipments of equipment and materials for radiation levels and contamination. Soil, water, and air samples are taken to determine radiation levels. Monitors may also collect and analyze radiation monitoring equipment worn by workers, such as film

badges and pocket detection chambers, to measure each worker's exposure to radiation.

Radiation monitors inform their supervisors when a worker's exposure to radiation or the level of radiation in a work area approaches specified maximum permissible limits and they recommend work stoppage in potentially unsafe areas. They may calculate the amount of time that personnel may work in contaminated areas, considering maximum radiation exposure limits for workers and the radiation level in the area. Monitors may also prescribe clothing requirements and other safety precautions to be followed by workers entering radiation zones.

Other duties may include instructing workers in radiation safety procedures, checking and servicing radiation detection instruments, and maintaining records on individual radiation exposures and the location and intensity of radioactivity in contaminated areas.

In addition to health physicists and radiation monitors, other occupations require training which is unique to the atomic energy field. For example, although a *nuclear reactor operator's* job in a nuclear power station is similar to a boiler operator's job in a conventional power station, he must learn to operate the controls of a nuclear reactor rather than the controls of a conventional steam-generating boiler. He may also control the operation of other equipment such as turbines and generators. In addition, reactor operators may perform work in connection with reactor fuel handling operations, such as the loading and unloading of reactor cores.

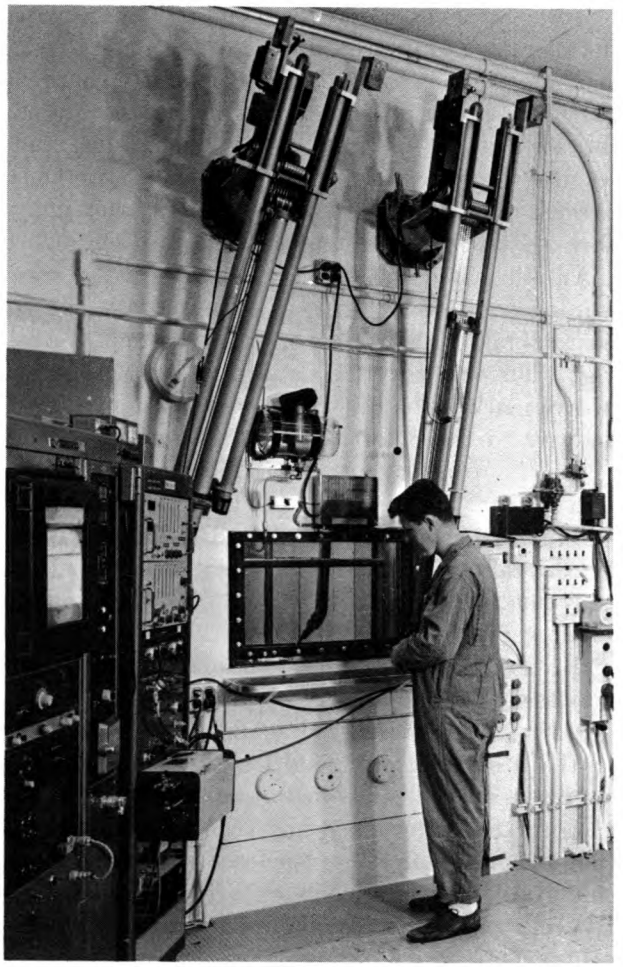
Nuclear reactor operators who work with research and test reactors check reactor control panels and adjust controls to maintain specified operating conditions within the reactor, such as power and radiation levels. They also assist in setting up and conducting tests and experiments; for example, they may insert objects into the reactor core for exposure to radiation. They work under the direction of scientists and engineers in charge of the tests and experiments.

An estimated 1,300 nuclear reactor operators were employed in atomic energy activities in 1964. More than half were engaged in the production of plutonium and other special defense materials, and many of the remainder worked in research and development laboratories.

Accelerator operators set up and coordinate the operation of particle accelerators. They adjust machine controls to accelerate electrically charged particles, in accordance with instructions from the scientist in charge of the experiment, and set up target materials which are to be bombarded by the accelerated particles. They may also assist in the maintenance of equipment.

An estimated 5,000–6,000 *radiographers* were employed in atomic energy work in 1964. These workers take radiographs of metal castings, welds, and other objects by adjusting the controls of an X-ray machine or by exposing a source of radioactivity to the object to be radiographed. They select the proper type of radiation source and film to use and apply standard mathematical formulas to determine exposure distance and time. While taking radiographs, they use radiation detection instruments to monitor the work area for potential radiation hazards. Radiographers may also remove and develop the film or plate and may assist in its analysis.

Many other specialized workers are employed in the atomic energy field. *Hot-cell technicians* operate remote-controlled equipment to test radioactive materials which are placed in hot cells—rooms which are enclosed with radiation shielding materials, such as lead and concrete. By controlling "slave manipulators" (mechanical devices which act as a pair of arms and hands) from outside the cell and observing their actions through the cell window, these technicians perform standard chemical and metallurgical operations involving radioactive materials. Hot-cell technicians may also enter the cell wearing protective clothing (after clearance by a radiation monitor) to set up experiments or to decontaminate the cell and equipment. *Decontamination men* have the primary duty of decontaminating equipment, plant areas, and materials exposed to radioactive contaminants. They use radiation-detection instruments to locate the contamination; eliminate it by the use of special equipment, detergents, and chemicals; and then verify the effectiveness of the decontamination measures. *Waste-treatment operators* operate heat exchange units, pumps, compressors, and other equipment to decontaminate and dispose of radioactive waste liquids. *Waste-disposal men* seal contaminated wastes in concrete containers and transport the



Hot-cell technicians operate remote controls to manipulate irradiated material.

containers to a burial ground or arrange for sea burial. *Radioisotope-production operators* use remote control manipulators and other equipment to prepare radioisotopes for shipping and to perform chemical analyses to ensure that radioisotopes conform to specifications. The tasks performed by employees in the above five jobs may also be done by chemical process operators.

Training, Other Qualifications, and Advancement

Training and educational requirements and advancement opportunities for most workers in atomic energy activities are generally similar to those for comparable jobs in other fields and are discussed elsewhere in the Handbook under the specific occupation. (See index for page numbers.) However, specialized training is required for many workers because the atomic energy field is a relatively new field of work, requires rigorous work standards in both its research and production activities, and has unique health and safety problems.

Engineers and scientists at all levels of professional training are employed in the atomic energy field. Many of them have had advanced training, particularly those engaged in research, development, and design work. Of the scientists and engineers employed in research and development by major AEC contractors in 1963, over 1 in 5 had a Ph. D. degree. The proportion of engineers with Ph. D. degrees is smaller than the proportion of scientists with such degrees. However, graduate training is preferred for an increasing number of engineering jobs, and training in nuclear engineering is available almost exclusively at the graduate level.

Although many scientific and engineering positions in the atomic energy field, do not require specialized knowledge of nuclear energy it is essential for some others. For example, health physicists must be specially trained in health physics, and other positions may require chemists with special training in radiochemistry or engineers specially trained in nuclear engineering. This specialized training may be obtained by taking graduate work at a university or through-on-the-job training. It emphasizes problems dealing with the properties and control of radiation and its effects on materials or living systems.

Colleges and universities have expanded their facilities and curriculums to provide training in nuclear energy. Engineers and scientists who plan to specialize in the atomic energy field generally take graduate work in nuclear energy, although introductory or background courses may be taken at the undergraduate level. Some colleges and universities award graduate degrees in nuclear engineering or nuclear science. Others offer graduate training in these fields, but award degrees only in the traditional engineering or scientific fields.

Craftsmen in some atomic energy jobs may need more training than most craftsmen in comparable nonatomic jobs. Stricter performance requirements may be needed because of the extreme precision usually required to insure efficient operation

of equipment and because complex equipment and machinery must be maintained. For example, pipefitters may have to fit pipe to tolerances of less than one ten-thousandth of an inch and work with pipe made from rare metals costing more than $1,000 a foot. In addition, if the equipment is contaminated with radioactivity, the worker on repair or rebuilding jobs may be allowed only limited working time and must do the work quickly. Welding, also, may have to meet higher reliability standards than in most nonatomic fields. Craftsmen in the atomic energy field generally obtain the required special skills through on-the-job training. Most AEC installations have apprentice training programs to develop craft skills. Some union craft training programs give particular attention to the special work requirements of the atomic energy field.

The following discussion of training, education, and other qualifications relates to jobs which are unique to the field of atomic energy or which require specialized training which is unique to the field. Such training mainly gives workers an understanding of radiation, methods of handling radioactive materials or radiation-producing equipment, and procedures to follow when working in radioactive areas.

Employers prefer that health physicists have a bachelor's degree in physics, chemistry, or engineering, and a year or more of graduate work in health physics. At a university, the prospective health physicists attend classes during the academic year to obtain a fundamental knowledge of radiation physics and biophysics, instrumentation, the interaction of radiation with matter and living systems, and the principles of permissible radiation exposure and prevention of undesirable exposure. During the summer months, they work at Commission installations on problems of monitoring (measurement of radiation level), shielding, waste disposal associated with the operation of nuclear reactors, the processing of nuclear fuels, and the handling of radioisotopes.

To qualify for on-the-job training as a radiation monitor, a high school education with courses in mathematics, physics, and chemistry usually is sufficient. Completion of some college courses in the physical or biological sciences is preferred and experience in working with laboratory equipment is desirable. Radiation monitors must become familiar with characteristics of radiation, maximum permissible radiation exposure levels, and methods of calculating exposure periods. They must also learn how to use radiation detection instruments.

Nuclear power reactor operators need a basic understanding of reactor theory and a working knowledge of reactor controls. The minimum requirement for an operator trainee usually is a high school education, although college-level training may be required by some employers. To become a fully qualified operator of a reactor in an electric power station, the trainee must get experience in power station operation and complete 6 months to 1 year of intensive on-the-job training in reactor theory and operation. Power reactor operators usually are selected from conventional power plant personnel having experience as boiler or turbine operators. Operators of research and test reactors must also be high school graduates. Preference is given to those who have completed courses in science and engineering at a college level. They need from 2 to 4 years of on-the-job training, covering all phases of reactor operations, before being considered fully qualified. Workers who operate the controls of private nuclear reactors must be licensed by the AEC. To qualify for a license, the trainee must pass an operating test, a written test given by the Commission, and a medical examination.

To qualify for on-the-job training as an accelerator operator, a high school education, including courses in mathematics and physics, is usually required. Extensive training in electronics or a bachelor's degree in engineering or physics may be required for operators of these very high-energy machines. Accelerator operators receive on-the-job training covering operating, repair, and safety procedures. Such training may last from 2 to 7 months or more, depending on the type of accelerator. To qualify for on-the-job training as radiographers, a high school education, including courses in mathematics, chemistry, and physics is usually sufficient.

High school graduates with some mechanical experience usually can qualify for on-the-job training as hot-cell technicians. They are given about 1 to 2 years of in-plant training. High school graduates can become decontamination men after receiving 3 to 15 months of formal technical instruction and on-the-job training. For

the job of radioisotope-production operator, a high school education, with courses in chemistry, is usually required. One or two years of on-the-job training may be necessary to become fully qualified. High school graduates can qualify as waste-treatment operators, but experience in reading electronic instruments or in a chemical laboratory is desirable. After 15 to 18 months of on-the-job training in the operation of equipment and use of instruments, they are fully qualified. High school graduates can also qualify for employment as waste-disposal men. They receive on-the-job training in the operation of equipment and the avoidance of radiation hazards.

Many other workers in the atomic energy field also need special training because of the presence of potential radiation hazards. Employees who work in the vicinity of such hazards should have some training in the nature of radiation and the procedures to follow in case of its accidental release. Workers who handle radioisotopes or maintain radioisotope gages need a basic knowledge of health physics in addition to specific training related to their particular jobs. Technicians, chemical process operators, and maintenance craftsmen in nuclear power plants and fuel-processing facilities also require some health physics training if they work with radioactive materials or perform work in radiation-contaminated areas. Such training is generally provided through in-plant programs—for example, through apprentice training programs for craftsmen—and may range from less than an hour to several weeks or more, depending largely on the degree of potential exposure to radiation. In some States, workers may obtain such training through adult vocational educational programs.

Individuals who handle classified data (restricted for reasons of national security) or who work on classified projects in the atomic energy field must have a security clearance. This is a finding based on an investigation of a person's character, loyalty, and associations. All employees of the Atomic Energy Commission must have such clearance.

The Atomic Energy Commission, at its contractor-operated facilities, supports certain on-the-job and specialized training programs to help prepare scientists, engineers, technicians, and other workers for the atomic energy field. The AEC also offers graduate fellowships in specialized fields, and provides uranium and other materials to educational institutions.

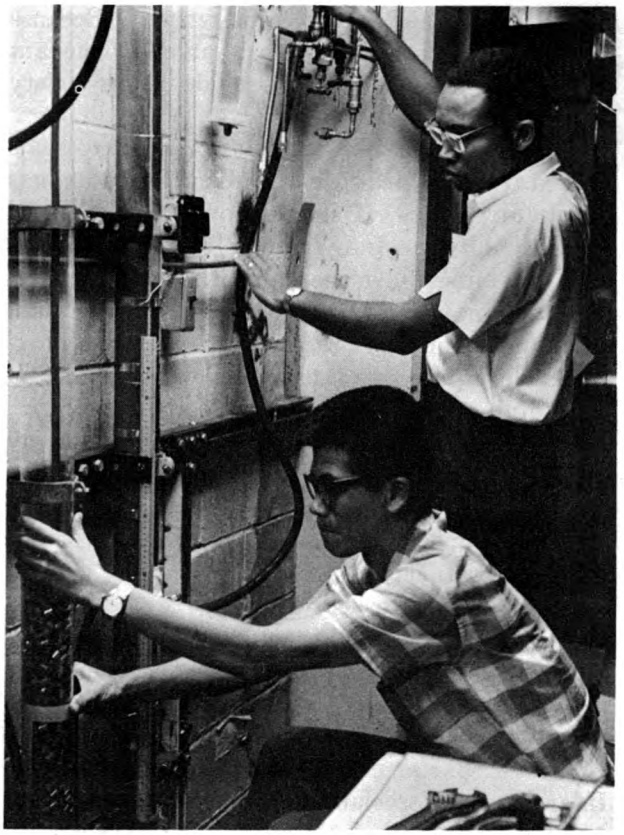
Several kinds of graduate fellowships are offered by the AEC. A large number of fellowships, about 375 for the 1965–66 academic year, will be granted for the study of nuclear science and engineering. These fellowships are available for first, intermediate, and final years of graduate work at participating universities. The prerequisite is a bachelor's degree in engineering or physical science, with courses in mathematics through differential equations.

Fellowships in health physics provide for 9 months' training at 1 of 10 universities, followed by 3 months' training at a Commission laboratory. Approximately 70 such fellowships are available each year to students with bachelor's degrees in biology, chemistry, engineering, or physics with courses in mathematics through calculus. About 15 additional fellowships of 3-year maximum duration are available for advanced training in health physics leading to a doctorate.

Additional educational and training opportunities are offered in cooperative programs arranged by AEC laboratories with colleges and universities. Temporary employment at AEC-owned laboratories is available to faculty members and students. Engineering undergraduates may work at laboratories and other Commission facilities on a rotation basis with classroom studies, and graduate students may do their thesis work at such laboratories.

The AEC sponsors institutes at which college and high school faculty members can obtain training in the latest developments in nuclear energy technology, radiation biology, and the use and safe handling of radioisotopes. Courses in health physics are sponsored by the AEC to State and local government employees concerned with licensing and inspecting functions in the atomic energy field. The AEC also sponsors the Oak Ridge Institute of Nuclear Studies, which conducts a school to train physicians, scientists, and engineers in radioisotope technology.

Many Commission contractors offer technical and graduate instruction at their own plants or at nearby colleges to prepare new employees for work in their organizations or to give further training to experienced personnel. Some contractors send employees outside the immediate area



Nuclear engineers adjust equipment used in reprocessing nuclear fuels.

to receive graduate-level instruction, and pay their transportation, tuition, and other expenses. Contractors often give tuition assistance to employees desiring to attend college and university courses on their own time.

Employment Outlook

Total employment in the atomic energy field during the remainder of the 1960's is expected to remain relatively stable. On the other hand, total employment during the first half of the 1970's is expected to increase as commercial activities in atomic energy expand and new applications develop. Among individual atomic energy activities, however, the prospects for employment differ.

The increasing expenditures for atomic energy research by both government and private industry should lead to further employment growth in research and development laboratories. Employment is also expected to continue to increase in the design and manufacture of nuclear power reactors, in the manufacture of nuclear instruments, and in the processing and packaging of radioisotopes. As more nuclear reactors are built and put into operation, employment will increase both in the operation and maintenance of reactors, and in such related activities as the fabrication and reprocessing of reactor fuel elements and the disposal of radioactive wastes. In contrast, employment in mining, milling, refining, and enrichment of uranium probably will decrease during the remainder of the 1960's but begin to show improvement in the early 1970's.

Many different applications of atomic energy are expected. There is excellent promise for growing uses of atomic power in the Nation's space program for propulsion and for auxiliary power for space vehicles. The use of nuclear reactors in electric power stations is expected to become increasingly widespread. Additional areas of expansion include the Nation's reactor program for naval and maritime uses; the further development of radioisotope technology in industry, medicine, and food preservation; and the application of nuclear explosives for nonmilitary use.

Expansion of these areas of atomic energy activities will create especially good employment opportunities for trained professional and technical workers and skilled craftsmen. Particular need will exist for scientists (such as physicists, chemists, mathematicians, metallurgists, biological scientists, and health physicists); engineers (such as mechanical, electrical and electronics, chemical, reactor, and metallurgical); technicians (such as engineering and physical science aids, draftsmen, electronics technicians, instrument technicians, and radiation monitors); and craftsmen (such as machinery repairmen, machinists, electricians, plumbers and pipefitters, and instrument repairmen).

In addition to the employment opportunities created by expansion in some atomic energy activities, other job openings will occur because of the need to replace workers who retire, die, or transfer to other industries.

Earnings and Working Conditions

Detailed information on earnings in individual occupations in atomic energy activities is not available. However, indications are that earnings in some nuclear energy activities are higher than

in non-nuclear energy activities. For example, in mid-1965, blue-collar workers employed by contractors at AEC laboratories and other installations had average straight-time hourly earnings of $3.34, while blue-collar workers in all manufacturing industries had average earnings of $2.62 an hour.

Professional workers employed at AEC installations averaged $989 a month in base pay in mid-1965, and other white-collar workers (largely clerical and other office personnel) averaged $3.02 an hour. (Earnings data for many of the occupations found in the atomic energy field are included in the statements on these occupations elsewhere in the *Handbook*. See index for page numbers.)

Most workers in the atomic energy field receive 2 or 3 weeks' vacation with pay, depending on their length of service. In addition, most firms in this field have group life, health, and accident insurance coverage and retirement plans.

Working conditions in uranium mining and milling, instrument and auxiliary equipment manufacturing, and facilities construction are similar to those in comparable nonatomic energy activities, except for radioactive safety precautions. In other atomic energy activities, in which the major proportion of workers in the field are employed, working conditions generally are unusually good. Buildings and plants are well lighted and ventilated. Equipment, tools, and machines are modern and sometimes the most advanced of their type. The surroundings are also pleasant because the buildings are often spread out over wide land areas. In some cases, plants are located in remote areas.

Extensive safeguards ensure the health and safety of workers in the atomic energy field. However, only a small proportion of employees in the atomic energy field work in areas where direct radiation dangers exist.

The AEC regulates the possession and use of radioactive materials, and AEC personnel inspect nuclear facilities to insure compliance with the AEC's health and safety requirements. Because the hazards of radiation are unique, constant efforts are being made to provide better safety standards and regulations.

Workers in uranium mines are subject to some hazard from the presence of radioactive radon gas in the air, which, if inhaled over a number of years, could cause lung injury. However, practically all mines have mechanical ventilation systems to reduce concentrations of this gas. Uranium mills and other fuel-processing facilities employing modern processes usually have no difficulty in maintaining safe working levels of radioactivity.

The AEC and its contractors, who employ more than half of all atomic energy workers, have maintained a very good safety record. In 1964, the average number of disabling injuries for all AEC operations was 1.96 for each million employee hours worked, compared with an average of 12.7 for all manufacturing industries.

Most plant hourly paid workers belong to unions. Among unions which have members in the atomic energy field are unions in the Metal Trades Department, AFL–CIO, such as The International Association of Machinists and Aerospace Workers; the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers; the International Brotherhood of Electrical Workers; the International Chemical Workers Union; and the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada. The Oil, Chemical and Atomic Workers International Union also represents workers in this field.

Where To Go for More Information

Additional information about employment in the atomic energy field may be obtained by writing to the Division of Labor Relations, U.S. Atomic Energy Commission, Washington, D.C., 20545.