in automotive repair shops and $18.77 in motor vehicle and equipment manufacturing.

Median hourly earnings of painting, coating, and decorating workers were $9.55 in 2000. The middle 50 percent earned between $7.56 and $12.48 an hour. The lowest 10 percent earned less than $6.45, and the highest 10 percent earned more than $16.07 an hour.

Many automotive painters employed by motor vehicle dealers and independent automotive repair shops receive a commission based on the labor cost charged to the customer. Under this method, earnings depend largely on the amount of work a painter does and how fast it is completed. Employers frequently guarantee commissioned painters a minimum weekly salary. Helpers and trainees usually receive an hourly rate until they become sufficiently skilled to work on commission. Trucking companies, bus lines, and other organizations that repair and refinish their own vehicles usually pay by the hour.

Many painting and coating machine operators belong to unions. Most union operators work for manufacturers and the larger motor vehicle dealers.

Related Occupations

Other occupations in which workers apply paints and coatings include painters and paperhangers, woodworkers, and machine setters, operators, and tenders—metal and plastic.

Sources of Additional Information

For more details about work opportunities, contact local manufacturers, automotive body repair shops, motor vehicle dealers, and vocational schools; locals of unions representing these workers; or the local office of the State employment service. The State employment service also may be a source of information about training programs.

Information on how to become a certified automotive painter is available from:

➤ National Institute for Automotive Service Excellence (ASE), 101 Blue Seal Dr. SE., Leesburg, VA 20175. Internet: **http://www.asecert.org**

Photographic Process Workers and Processing Machine Operators

(O*NET 51-9131.01, 51-9131.02, 51-9131.03, 51-9131.04, 51-9132.00)

Significant Points

- Employment is expected to show little or no change as digital photography becomes commonplace.
- Most receive on-the-job training from their companies, manufacturers' representatives, and experienced workers.

Nature of the Work

Both amateur and professional photographers rely heavily on photographic process workers and processing machine operators to develop film, make prints or slides, and do related tasks, such as enlarging or retouching photographs. *Photographic processing machine operators* operate various machines, such as mounting presses and motion picture film printing, photographic printing, and film developing machines. *Photographic process workers* perform more delicate tasks, such as retouching photographic negatives and prints to emphasize or correct specific features.

Photographic processing machine operators often have specialized jobs. *Film process technicians* operate machines that develop exposed photographic film or sensitized paper in a series of chemical and water baths to produce negative or positive images. First, technicians mix developing and fixing solutions, following a formula. They then load the film in the machine, which immerses the exposed film in a developer solution. This brings out the latent image. The next steps include immersing the negative in a stop-bath to halt the developer action, transferring it to a hyposolution to fix the image, and then immersing it in water to remove the chemicals. The technician then dries the film. In some cases, these steps are performed by hand.

Color printer operators control equipment that produces color prints from negatives. These workers read customer instructions to determine processing requirements. They load film into color printing equipment, examine negatives to determine equipment control settings, set controls, and produce a specified number of prints. Finally, they inspect the finished prints for defects, remove any that are found, and insert the processed negatives and prints into an envelope for return to the customer.

Photographic process workers, sometimes known as *digital imaging technicians*, use computer images of conventional negatives and specialized computer software to vary the contrast of images, remove unwanted background, or combine features from different photographs. Although computers and digital technology are replacing much manual work, some photographic process workers, especially

Photographic process workers review negatives to ensure quality photographs.

those who work in portrait studios, still perform many specialized tasks by hand directly on the photo or negative. *Airbrush artists* restore damaged and faded photographs, and may color or shade drawings to create photographic likenesses using an airbrush. *Photographic retouchers* alter photographic negatives, prints, or images to accentuate the subject. *Colorists* apply oil colors to portrait photographs to create natural, lifelike appearances. *Photographic spotters* remove imperfections on photographic prints and images.

Working Conditions

Photographic process workers and processing machine operators generally spend their work hours in clean, appropriately lighted, well-ventilated, and air-conditioned offices, photofinishing laboratories, or 1-hour minilabs. In recent years, more commercial photographic processing has been done on computers than in darkrooms; and this trend is expected to continue.

Some photographic process workers and processing machine operators are exposed to the chemicals and fumes associated with developing and printing. These workers must wear rubber gloves and aprons and take precautions against these hazards. Those who use computers for extended periods may experience back pain, eye strain, or fatigue.

Photographic processing machine operators must do repetitive work at a rapid pace without any loss of accuracy. Photographic process workers do detailed tasks, such as airbrushing and spotting, which can contribute to eye fatigue.

Many photo laboratory employees work a 40-hour week, including evenings and weekends, and may work overtime during peak seasons.

Employment

Photographic process workers held about 26,000 jobs in 2000. Nearly one-third of photographic process workers were employed in photofinishing laboratories and 1-hour minilabs. About one-fourth worked for portrait studios or commercial laboratories that specialize in processing the work of professional photographers for advertising and other industries.

Photographic processing machine operators held about 50,000 jobs in 2000. One-half worked in retail establishments, such as department stores and drug stores. About one-quarter worked in photofinishing laboratories and 1-hour minilabs. A small number were self-employed.

Employment fluctuates somewhat over the course of the year. Typically, employment peaks during school graduation and summer vacation periods, and again during the winter holiday season.

Training, Other Qualifications, and Advancement

Most photographic process workers and processing machine operators receive on-the-job training from their companies, manufacturers' representatives, and experienced workers. New employees gradually learn to use the machines and chemicals that develop and print film.

Employers prefer applicants who are high school graduates or those who have some experience in the field. Familiarity with computers is essential for photographic processing machine operators. The ability to perform simple mathematical calculations also is helpful. Photography courses that include instruction in film processing are valuable preparation. Such courses are available through high schools, vocational-technical institutes, private trade schools, and colleges and universities.

On-the-job training in photographic processing occupations can range from just a few hours for print machine operators to several months for photographic processing workers like airbrush artists and colorists. Some workers attend periodic training seminars to maintain a high level of skill. Manual dexterity, good hand-eye coordination, and good vision, including normal color perception, are important qualifications for photographic process workers.

Photographic process machine workers can sometimes advance from jobs as machine operators to supervisory positions in laboratories or to management positions within retail stores.

Job Outlook

Overall employment of photographic process workers and processing machine operators is expected to show little or no change through the year 2010. Employment of processing machine operators will grow slower than average, while employment of photographic process workers will decline. Most openings will result from replacement needs, which are higher for machine operators than for photographic process workers.

In recent years, the use of digital cameras, which use electronic memory rather than film to record images, has grown rapidly among professional photographers and advanced amateurs. As the cost of digital photography drops, the use of such cameras will become more widespread among amateur photographers, reducing the demand for traditional photographic processing machine operators. However, conventional cameras, which use film to record images, are expected to continue to be the camera of choice among most casual photographers. Population growth and the popularity of amateur and family photography will contribute to an ongoing need for photographic processing machine operators to process the film used in conventional cameras, including increasingly sophisticated disposable cameras. This need will prevent what otherwise would be even slower growth in the numbers of these workers.

Employment of photographic process workers is expected to decline, as digital cameras and imaging become more commonplace. Using digital cameras and technology, consumers who have a personal computer and the proper software will be able to download and view pictures on their computer, as well as manipulate, correct, and retouch their own photographs. No matter what improvements occur in camera technology though, there will be some photographic processing tasks that require skillful manual treatment.

Earnings

Earnings of photographic process workers vary greatly depending on skill level, experience, and geographic location. Median hourly earnings for photographic process workers were $9.44 in 2000. The middle 50 percent earned between $7.56 and $12.54. The lowest 10 percent earned less than $6.44, and the highest 10 percent earned more than $16.61. Median hourly earnings were $9.55 in miscellaneous business services, including photofinishing laboratories.

Median hourly earning for photographic processing machine operators were $8.39 in 2000. The middle 50 percent earned between $7.06 and $10.56. The lowest 10 percent earned less than $6.06, and the highest 10 percent earned more than $14.48. Median hourly earnings in the industries employing the largest numbers of photographic processing machine operators were as follows:

Miscellaneous business services	$9.03
Department stores	7.97
Drug stores and proprietary stores	6.89

Related Occupations

Photographic process workers and processing machine operators need specialized knowledge of the photodeveloping process. Other workers who apply specialized technical knowledge include clinical laboratory technologists and technicians, computer operators, jewelers and precious stone and metal workers, prepress technicians and workers; printing machine operators; and science technicians.

Sources of Additional Information

For information about employment opportunities in photographic laboratories and schools that offer degrees in photographic technology, contact:

➤ Photo Marketing Association International, 3000 Picture Place, Jackson, MI 49201.

Semiconductor Processors

(O*NET 51-9141.00)

Significant Points

- Semiconductor processors is the only production occupation whose employment expected to grow much is expected to grow faster than the average for all occupations.
- An associate degree in a relevant curriculum is increasingly required.

Nature of the Work

Electronic semiconductors—also known as computer chips, microchips, or integrated chips—are the miniature but powerful brains of high technology equipment. They are comprised of a myriad of tiny aluminum wires and electric switches, which manipulate the flow of electrical current. Semiconductor processors are responsible for many of the steps necessary to manufacture each semiconductor that goes into a personal computer, missile guidance system, and a host of other electronic equipment.

Semiconductor processors manufacture semiconductors in disks about the size of dinner plates. These disks, called wafers, are thin slices of silicon on which the circuitry of the microchips is layered. Each wafer is eventually cut into dozens of individual chips.

Semiconductor processors make wafers using photolithography, a printing process for creating plates from photographic images. Operating automated equipment, workers imprint precise microscopic patterns of the circuitry on the wafers, etch out the patterns with acids, and replace the patterns with metals that conduct electricity. Then the wafers receive a chemical bath to make them smooth, and the imprint process begins again on a new layer with the next pattern. Wafers usually have from 8 to 20 such layers of microscopic, three-dimensional circuitry.

Semiconductors are produced in semiconductor fabricating plants, or "fabs." Within fabs, the manufacture and cutting of wafers to create semiconductors takes place in "clean rooms." Clean rooms are production areas that must be kept free of any airborne matter, because the least bit of dust can damage a semiconductor. All semiconductor processors working in clean rooms—both operators and technicians—must wear special lightweight outer garments known as "bunny suits." Bunny suits fit over clothing to prevent lint and other particles from contaminating semiconductor processing worksites.

Operators, who make up the majority of the workers in clean rooms, start and monitor the sophisticated equipment that performs the various tasks during the many steps of the semiconductor production sequence. They spend a great deal of time at computer terminals, monitoring the operation of the equipment to ensure that each of the tasks in the production of the wafer is performed correctly. They also may transfer wafer carriers from one development station to the next; in newer fabs, the lifting of heavy wafer carriers and the constant monitoring for quality control are increasingly being automated, however.

Semiconductor processing technicians use microscopes to check for flaws in semiconductor wafers.

Once begun, production of semiconductor wafers is continuous. Operators work to the pace of the machinery that has largely automated the production process. Operators are responsible for keeping the automated machinery within proper operating parameters.

Technicians account for a smaller percentage of the workers in clean rooms, but they troubleshoot production problems and make equipment adjustments and repairs. They also take the lead in assuring quality control and in maintaining equipment. In order to prevent the need for repairs, technicians perform diagnostic analyses and run computations. For example, technicians may determine if a flaw in a chip is due to contamination and peculiar to that wafer, or if the flaw is inherent in the manufacturing process.

Working Conditions

The work pace in cleanrooms is deliberately slow. Limited movement keeps the air in cleanrooms as free as possible of dust and other particles, which can destroy semiconductors during production. Because the machinery sets operators' rate of work in the largely automated production process, workers keep an easy-going pace. Although workers spend some time alone monitoring equipment, operators and technicians spend much of their time working in teams.

Technicians are on their feet most of the day, walking through the clean room to oversee production activities. Operators spend a great deal of time sitting or standing at workstations, monitoring