

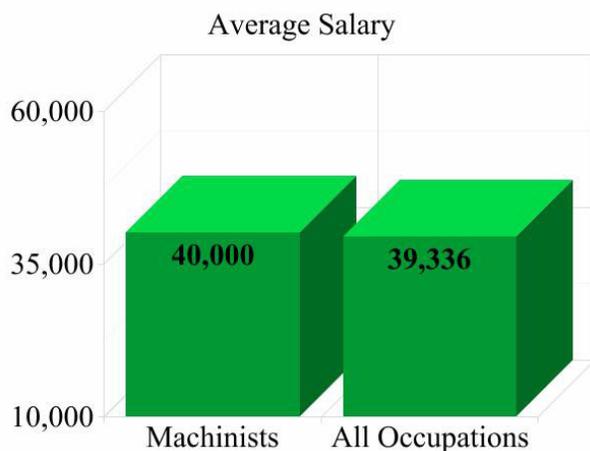
Machinists

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WHAT THEY DO

Machinists use machine tools, such as lathes, milling machines, and grinders, to produce precision metal parts. Although they may produce large quantities of one part, precision machinists often produce small batches or one-of-a-kind items. They use their knowledge of the working properties of metals and their skill with machine tools to plan and carry out the operations needed to make machined products that meet precise specifications. The parts that machinists make range from bolts to automobile pistons.

Machinists first review electronic or written blueprints or specifications for a job before they machine a part. Next, they calculate where to cut or bore into the workpiece—the piece of steel, aluminum, titanium, plastic, silicon, or any other material that is being shaped. They determine how fast to feed the workpiece into the machine and how much material to remove. They then select tools and materials for the job, plan the sequence of cutting and finishing operations, and mark the workpiece to show where cuts should be made.



After this layout work is completed, machinists perform the necessary machining operations. They position the workpiece on the machine tool—drill press, lathe, milling machine, or other type of machine—set the controls, and make the cuts. During the machining process, they must constantly monitor the feed rate and speed of the machine. Machinists also ensure that the workpiece is properly lubricated and cooled, because the machining of metal products generates a significant amount of heat. The temperature of the workpiece is a key concern, because most metals expand when heated; machinists must adjust the size of their cuts relative to the temperature.

During the cutting process, machinists detect problems by listening for specific sounds—for example, that of a dull cutting tool or excessive vibration.

Dull cutting tools are removed and replaced. Cutting speeds are adjusted to compensate for harmonic vibrations, which can decrease the accuracy of cuts, particularly on newer high-speed spindles and lathes. After the work is completed, machinists use both simple and highly sophisticated measuring tools to check the accuracy of their work against the blueprints.

Some machinists, often called production machinists, may produce large quantities of one part, especially parts requiring the use of complex operations and great precision. Many modern machine tools are computer numerically controlled (CNC). CNC machines, following a computer program, control the cutting tool speed, change dull tools, and perform all necessary cuts to create a part. Frequently, machinists work with computer control programmers to determine how the automated equipment will cut a part. The machinist determines the cutting path, speed of the cut and the feed rate, and the programmer converts path, speed, and feed information into a set of instructions for the CNC machine tool. Many machinists must be able to use both manual and computer-controlled machinery in their job.

EDUCATION REQUIRED

There are many different ways to become a skilled machinist. Many entrants previously have worked as machine setters, operators, or tenders. In high school, students should take math courses, especially trigonometry and geometry and, if available, courses in blueprint reading, metalworking, and drafting. Some advanced positions, such as those in the aircraft manufacturing industry, require the use of advanced applied calculus and physics. Due to the increasing use of computer controlled machinery, basic computer skills are needed before entering a training program. After high school, some machinists learn entirely on the job, but most acquire their skills in a mix of classroom and on-the-job training. Formal apprenticeship programs, typically sponsored by a union or manufacturer, are an excellent way to learn the job of machinist, but are often hard to get into. Apprentices usually must have a high school diploma, GED, or the equivalent; and most have taken algebra and trigonometry classes.

Apprenticeship programs consist of paid shop training and related classroom instruction lasting up to 4 years. In shop training, apprentices work almost full time and are supervised by an experienced machinist, while learning to operate various machine tools. Classroom instruction includes math, physics, materials science, blueprint reading, mechanical drawing, and quality and safety practices. In addition, as machine shops have increased their use of computer-controlled equipment, training in the operation and programming of CNC machine tools has become essential. Apprenticeship classes are often taught in cooperation with local community colleges or vocational-technical schools. A growing number of machinists are learning the trade through 2-year associate degree programs at community or technical colleges. Graduates of these programs still need significant on-the-job experience as machinists' assistants before they are fully qualified.

Machinists - Continued

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OTHER USEFUL SKILLS

People interested in becoming machinists should be mechanically inclined, have good problem-solving abilities, be able to work independently, and be able to do highly accurate work (tolerances may reach 50/1,000,000ths of an inch) that requires concentration and physical effort. Experience working with machine tools is helpful. In fact, many entrants have worked as machine setters, operators, or tenders.

To boost the skill level of machinists and to create a more uniform standard of competency, a number of training facilities, State apprenticeship boards, and colleges offer certification programs. Completing a recognized certification program provides a machinist with better career opportunities and helps employers better judge the abilities of new hires. Journeyworker certification can be obtained from State apprenticeship boards after completing an apprenticeship; this certification is recognized by many employers and often leads to better career opportunities.

As new automation is introduced, machinists normally receive additional training to update their skills. This training usually is provided by a representative of the equipment manufacturer or a local technical school. Some employers offer tuition reimbursement for job-related courses.

HOW TO ADVANCE

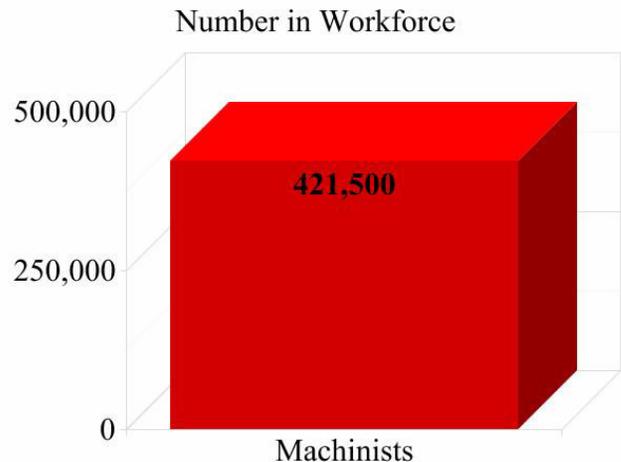
Machinists can advance in several ways. Experienced machinists may become CNC programmers, tool and die makers, or mold makers, or be promoted to supervisory or administrative positions in their firms. A few open their own machine shops.

WORK ENVIRONMENT

Today, many machine shops are relatively clean, well lit, and ventilated. Computer-controlled machines often are partially or totally enclosed, minimizing the exposure of workers to noise, debris, and the lubricants used to cool workpieces during machining. Nevertheless, working around machine tools presents certain dangers, and workers must follow safety precautions. Machinists wear protective equipment, such as safety glasses to shield against bits of flying metal, and earplugs to dampen machinery noise. They also must exercise caution when handling hazardous coolants and lubricants, although many common water-based lubricants present little hazard. The job requires stamina, because machinists stand most of the day and, at times, may need to lift moderately heavy workpieces. Modern factories use

JOB GROWTH

Employment of machinists is projected to decline by 5 percent over the 2008–18 decade, due to rising productivity among these workers and strong foreign competition in the manufacture of goods. Machinists are becoming more efficient as a result of the expanded use of and improvements in technologies such as CNC machine tools, autoloaders, high-speed machining, and lights out manufacturing. This allows fewer machinists to accomplish the same amount of work. Technology is not expected to affect the employment of machinists as significantly as that of some other production workers, however, because machinists monitor and maintain many automated systems. Due to modern production techniques, employers prefer workers, such as machinists, who have a wide range of skills and are capable of performing almost any task in a machine shop.



Despite the projected decline in employment, job opportunities for machinists should continue to be good, as employers value the wide-ranging skills of these workers. Also, many young people with the necessary educational and personal qualifications needed to become machinists prefer to attend college or may not wish to enter production occupations. Therefore, the number of workers learning to be machinists is expected to be less than the number of job openings arising each year from the need to replace experienced machinists who retire or transfer to other occupations. Employment levels in this occupation are influenced by economic cycles—as the demand for machined goods falls, machinists involved in production may be laid off or forced to work fewer hours.