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## Tool and Die Makers

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(O\*NET 51-4111.00)

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### Significant Points

- Most tool and die makers need 4 or 5 years of classroom instruction and on-the-job training to become fully qualified.
- Employment is projected to decline because of strong foreign competition and advancements in automation.
- Despite the decline in employment, excellent job opportunities are expected.

### Nature of the Work

Tool and die makers are among the most highly skilled workers in manufacturing. These workers produce and repair tools, dies, and special guiding and holding devices that enable machines to manufacture a variety of products we use daily—from clothing and furniture to heavy equipment and parts for aircraft.

Toolmakers craft precision tools and machines that are used to cut, shape, and form metal and other materials. They also produce jigs and fixtures—devices that hold metal while it is bored, stamped, or drilled—and gauges and other measuring devices. Die makers construct metal forms, called dies, that are used to shape metal in stamping and forging operations. They also make metal molds for diecasting and for molding plastics, ceramics, and composite materials. Some tool and die makers craft prototypes of parts, and then, working with engineers and designers, determine how best to manufacture the part. In addition to developing, designing, and producing new tools and dies, these workers also may repair worn or damaged tools, dies, gauges, jigs, and fixtures.

To perform these functions, tool and die makers employ many types of machine tools and precision measuring instruments. They also must be familiar with the machining properties, such as hardness and heat tolerance, of a wide variety of common metals, alloys, plastics, ceramics, and other composite materials. Tool and die makers are knowledgeable in machining operations, mathematics, and blueprint reading. In fact, tool and die makers often are considered highly specialized machinists. The main difference between tool and die makers and machinists is that machinists normally make a single part during the production process, while tool and die makers make many parts and assemble and adjust machines used in the production process. (See the section on machinists elsewhere in the *Handbook*.)

While many tools and dies are designed by engineers or tool designers, tool and die makers are also trained to design tools and often do. They may travel to a customer's plant to observe the operation and suggest ways in which a new tool could improve the manufacturing process.

Once a tool or die is designed, tool and die makers, working from blueprints, plan the sequence of operations necessary to manufacture the tool or die. They measure and mark the pieces of metal that will be cut to form parts of the final product. At this point, tool and die makers cut, drill, or bore the part as required, checking to ensure that the final product meets specifications. Finally, these workers assemble the parts and perform

finishing jobs such as filing, grinding, and polishing surfaces. While manual machining has declined, it is still used for unique or low-quantity parts that are often required in building tools and dies.

Tool and die makers use computer-aided design (CAD) to develop products and parts. Specifications entered into computer programs can be used to electronically develop blueprints for the required tools and dies. Numerical tool and process control programmers use computer-aided design or computer-aided manufacturing (CAD/CAM) programs to convert electronic drawings into CAM-based computer programs that contain instructions for a sequence of cutting tool operations. (See the section on computer control programmers and operators elsewhere in the *Handbook*.) Once these programs are developed, computer numerically controlled (CNC) machines follow the set of instructions contained in the program to produce the part. Computer-controlled machine tool operators or machinists normally operate CNC machines, but tool and die makers are trained in both operating CNC machines and writing CNC programs, and they may perform either task. CNC programs are stored electronically for future use, saving time and increasing worker productivity.

After machining the parts, tool and die makers carefully check the accuracy of the parts using many tools, including coordinate measuring machines, which use sensor arms and software to compare the dimensions of the part to electronic blueprints. Next, they assemble the different parts into a functioning machine. They file, grind, shim, and adjust the different parts to properly fit them together. Finally, tool and die makers set up a test run using the tools or dies they have made to make sure that the manufactured parts meet specifications. If problems occur, they compensate by adjusting the tools or dies.

**Work environment.** Tool and die makers usually work in toolrooms that are normally quieter than typical manufacturing production floors because there are fewer machines running at once. Toolrooms also are generally kept clean and cool to minimize heat-related expansion of metal workpieces. To minimize the exposure of workers to moving parts, machines have guards and shields. Most computer-controlled machines are totally enclosed, minimizing workers' exposure to noise, dust, and the lubricants used to cool workpieces during machining. Tool and die makers also must follow safety rules and wear protective equipment, such as safety glasses to shield against bits of flying metal, earplugs to protect against noise, and gloves and masks



*Tool and die makers use manual lathes to make custom parts or small batches of parts.*

## Projections data from the National Employment Matrix

Occupational Title	SOC Code	Employment, 2006	Projected employment, 2016	Change, 2006-16	
				Number	Percent
Tool and die makers .....	51-4111	101,000	91,000	-9,700	-10

NOTE: Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook*.

to reduce exposure to hazardous lubricants and cleaners. These workers also need stamina because they often spend much of the day on their feet and may do moderately heavy lifting. Companies employing tool and die makers have traditionally operated only one shift per day. Overtime and weekend work are common, especially during peak production periods.

### Training, Other Qualifications, and Advancement

It usually takes 4 or 5 years of classroom and paid on-the-job training to become a fully trained tool and die maker. Good math, problem-solving, and computer skills are important requirements for these workers.

**Education and training.** Most tool and die makers learn their trade through 4 or 5 years of education and training in formal apprenticeships or in other postsecondary programs offered at local community colleges or technical schools. These programs often include a mix of classroom instruction and paid hands-on experience. According to most employers, apprenticeship programs are the best way to learn all aspects of tool and die making. Most apprentices must have a high school diploma, GED, or equivalent, and high school mathematics and shop classes make it easier to get into an apprenticeship program.

Traditional apprenticeships usually require that the apprentice complete a specific number of work and classroom hours to complete the program, which typically takes 4 or 5 years. Some companies and State apprenticeship programs, however, are now shifting from time-based programs to competency-based programs. Under competency-based programs, apprentices can move ahead more quickly by passing a series of exams and demonstrating competency in a particular job skill.

While formal apprenticeship programs may be the best way to learn the job, many tool and die makers receive most of their formal classroom training from community and technical colleges while working for a company that often supports the employee's training goals and provides the needed on-the-job training less formally. These trainees often begin as machine operators and gradually take on more difficult assignments. Many machinists become tool and die makers.

During their training, tool and die maker trainees learn to operate milling machines, lathes, grinders, laser and water cutting machines, wire electrical discharge machines, and other machine tools. They also learn to use handtools for fitting and assembling gauges and other mechanical and metal-forming equipment. In addition, they study metalworking processes, such as heat treating and plating. Classroom training usually consists of tool designing, tool programming, blueprint reading, and, if needed, mathematics courses, including algebra, geometry, trigonometry, and basic statistics. Tool and die makers must have good computer skills to work with CAD/CAM technology, CNC machine tools, and computerized measuring machines.

Even after completing a formal training program, tool and die makers still need years of experience to become highly skilled. Most specialize in making certain types of tools, molds, or dies.

**Certification and other qualifications.** State apprenticeship boards certify tool and die makers as journey workers after they have completed a licensed program. While a State certification is not necessary to work as a tool and die maker, it gives workers more flexibility in employment and is required by some employers. Apprentices usually must be at least 18 years old, in addition to having a high school education and high school mathematics classes.

Because tools and dies must meet strict specifications—precision to one ten-thousandth of an inch is common—the work of tool and die makers requires skill with precision measuring devices and a high degree of patience and attention to detail. Good eyesight is essential. People entering this occupation also should be mechanically inclined, able to work and solve problems independently, have strong mathematical skills, and be capable of doing work that requires concentration and physical effort. Tool and die makers who visit customers' plants need good interpersonal and sales skills.

Employers generally look for someone with a strong educational background as an indication that the person can more easily adapt to change, which is a constant in this occupation. As automation continues to change the way tools and dies are made, workers regularly need to update their skills to learn how to operate new equipment. Also, as materials such as alloys, ceramics, polymers, and plastics are increasingly used, tool and die makers need to learn new machining techniques to deal with the new materials.

**Advancement.** There are several ways for skilled workers to advance. Some move into supervisory and administrative positions in their firms or they may start their own shop. Others may take computer courses and become computer-controlled machine tool programmers. With a college degree, a tool and die maker can go into engineering or tool design.

### Employment

Tool and die makers held about 101,000 jobs in 2006. Most worked in industries that manufacture metalworking machinery, transportation equipment such as motor vehicle parts, fabricated metal products, and plastics products. Although they are found throughout the country, jobs are most plentiful in the Midwest and the Northeast, where many of metalworking companies are located.

### Job Outlook

Employment of tool and die makers is projected to decline rapidly. However, excellent job opportunities are expected as many employers report difficulty finding qualified applicants.

**Employment change.** Employment of tool and die makers is projected to decline rapidly by 10 percent over the 2006-16 decade because of strong foreign competition in manufacturing and advances in automation, including CNC machine tools and computer-aided design, that should improve worker productivity. On the other hand, tool and die makers play a key role in building and maintaining advanced automated manufacturing equipment, which makes them less susceptible to lay-offs than other less-skilled production workers. As firms invest in new equipment, modify production techniques, and implement product design changes more rapidly, they will continue to rely heavily on skilled tool and die makers for retooling.

**Job prospects.** Despite declining employment, excellent job opportunities are expected. Employers in certain parts of the country report difficulty attracting skilled workers and apprenticeship candidates with the necessary abilities to replace retiring workers and fill other openings. The number of workers receiving training in this occupation is expected to continue to be fewer than the number of openings created each year by tool and die makers who retire or transfer to other occupations. A major factor limiting the number of people entering the occupation is that many young people who have the educational and personal qualifications necessary to learn tool and die making usually prefer to attend college or do not wish to enter production occupations.

**Earnings**

Median hourly wage-and-salary earnings of tool and die makers were \$21.29 in May 2006. The middle 50 percent earned between \$17.29 and \$26.77. The lowest 10 percent had earnings of less than \$13.85, while the top 10 percent earned more than \$32.41. Median hourly wage-and-salary earnings in the manufacturing industries employing the largest numbers of tool and die makers were as follows:

Motor vehicle parts manufacturing .....	\$26.45
Plastics product manufacturing .....	20.79
Forging and stamping .....	20.24
Metalworking machinery manufacturing .....	20.08
Machine shops; turned product; and screw, nut, and bolt manufacturing .....	19.41

The pay of apprentices is tied to their skill level. As they gain more skills and reach specific levels of performance and experience, their pay increases.

**Related Occupations**

The occupations most closely related to the work of tool and die makers are other machining occupations. These include machinists; computer control programmers and operators; and machine setters, operators, and tenders—metal and plastic. Another occupation that requires precision and skill in working with metal is welding, soldering, and brazing workers.

Like tool and die makers, assemblers and fabricators assemble and repair complex machinery. Millwrights and industrial machinery mechanics also repair and assemble manufacturing equipment. When measuring parts, tool and die makers use some of the same tools and equipment that inspectors, testers, sorters, samplers, and weighers use in their jobs.

**Sources of Additional Information**

For career information and to have inquiries on training and employment referred to member companies, contact:

➤ PrecisionMachineProductsAssociation, 6700 West Snowville Rd., Brecksville, OH 44141. Internet: <http://www.pmpa.org>

For lists of schools and employers with tool and die apprenticeship and training programs, contact:

➤ National Tooling and Machining Association, 9300 Livingston Rd., Ft. Washington, MD 20744.

Internet: <http://www.ntma.org>

For information on careers, education and training, earnings, and apprenticeship opportunities in metalworking, contact:

➤ Precision Metalforming Association Educational Foundation, 6363 Oak Tree Blvd., Independence, OH 44131.

Internet: <http://www.pmaef.org>

➤ The National Institute for Metalworking Skills, 10565 Fairfax Boulevard, Suite 203, Fairfax, VA 22030.

Internet: <http://www.nims-skills.org>

Information on the registered apprenticeship system with links to State apprenticeship programs can be found on the U.S. Department of Labor’s Web site: [http://www.doleta.gov/atels\\_bat](http://www.doleta.gov/atels_bat) Apprenticeship information is also available from the U.S. Department of Labor’s toll free helpline: (877) 872-5627.