

Model makers and patternmakers, metal and plastic	\$16.07
Lay-out workers, metal and plastic	14.27
Lathe and turning machine tool setters, operators, and tenders, metal and plastic	13.77
Metal-refining furnace operators and tenders	13.47
Milling and planing machine setters, operators, and tenders, metal and plastic	13.25
Tool grinders, filers, and sharpeners	13.22
Multiple machine tool setters, operators, and tenders, metal and plastic	12.96
Rolling machine setters, operators, and tenders, metal and plastic	12.85
Heat treating equipment setters, operators, and tenders, metal and plastic	12.64
Drilling and boring machine tool setters, operators, and tenders, metal and plastic	12.25
Forging machine setters, operators, and tenders, metal and plastic	12.11
Grinding, lapping, polishing, and buffing machine tool setters, operators, and tenders, metal and plastic	11.71
Extruding and drawing machine setters, operators, and tenders, metal and plastic	11.66
Plating and coating machine setters, operators, and tenders, metal and plastic	11.23
Cutting, punching, and press machine setters, operators, and tenders, metal and plastic	11.03
Molders and molding machine setters, operators, and tenders, metal and plastic	10.40
All other metal workers and plastic workers	13.26

Approximately one-third of these workers are union members, about double the rate for other workers in the economy. Metal-working industries have a higher rate of unionization than does the plastics industry.

Related Occupations

Workers in occupations closely related to machine setters, operators, and tenders—metal and plastic include machinists, tool and die makers, assemblers and fabricators, computer control programmers and operators, and woodworkers.

Sources of Additional Information

For general information about machine setters, operators, and tenders—metal and plastic, contact:

- ▶ National Tooling and Metalworking Association, 9300 Livingston Rd., Fort Washington, MD 20744. Internet: <http://www.ntma.org>
- ▶ Precision Machining Association Educational Foundation, 6363 Oak Tree Blvd., Independence, OH 44131. Internet: <http://www.pmaef.org>
- ▶ Precision Machine Products Association, 6700 West Snowville Rd., Brecksville, OH 44141-3292. Internet: <http://www.pmpa.org>
- ▶ Society of Plastics Industry, 1801 K St. NW., Suite 600K, Washington, DC 20006-1301. Internet: <http://www.socplas.org> and <http://www.certifyme.org>

Tool and Die Makers

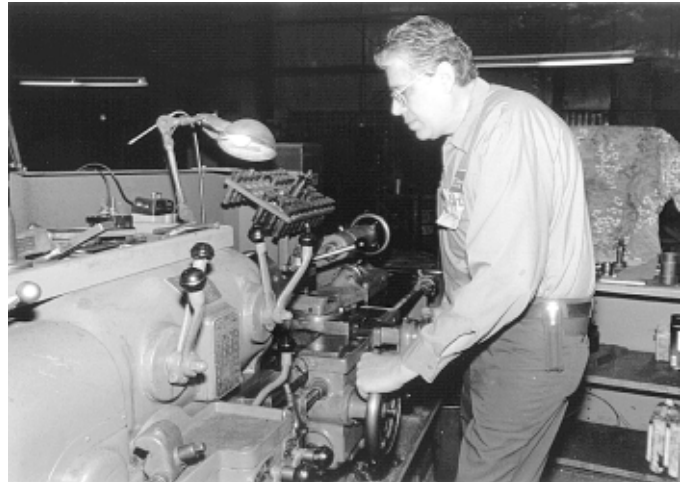
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Significant Points

- Most tool and die makers train for 4 or 5 years in apprenticeships or postsecondary programs; employers typically recommend apprenticeship training.
- Jobseekers with the appropriate skills and background should enjoy excellent opportunities.

Nature of the Work

Tool and die makers are among the most highly skilled production workers in the economy. These workers produce tools, dies, and



Tool and die makers use many types of machine tools.

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 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 (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. 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 and alloys. As a result, 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. (See the statement on machinists elsewhere in the *Handbook*.)

Working from blueprints, tool and die makers first must plan the sequence of operations necessary to manufacture the tool or die. Next, 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.

Modern technology is changing the ways in which tool and die makers perform their jobs. Today, for example, these workers often use computer-aided design (CAD) to develop products and parts. Specifications entered into computer programs can be used to electronically develop drawings for the required tools and dies. Numerical tool and process control programmers use computer-aided manufacturing (CAM) programs to convert electronic drawings into computer programs that contain a sequence of cutting tool operations. (See the statement 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; however, 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.) Next, tool and die makers assemble the different parts into a functioning machine. They file, grind, shim, and adjust the different parts to properly fit them together. Finally, the 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, tool and die makers compensate by adjusting the tools or dies.

Working Conditions

Tool and die makers usually work in toolrooms. These areas are quieter than the production floor because there are fewer machines in use at one time. They also are generally clean and cool to minimize heat-related expansion of metal workpieces and to accommodate the growing number of computer-operated machines. To minimize the exposure of workers to moving parts, machines have guards and shields. Many computer-controlled machines are totally enclosed, minimizing the exposure of workers 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 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.

Employment

Tool and die makers held about 130,000 jobs in 2000. Most worked in industries that manufacture metalworking machinery and equipment, metal forgings and stampings, motor vehicles, miscellaneous plastics products, and aircraft and parts. Although they are found throughout the country, jobs are most plentiful in the Midwest, Northeast, and West, where many of the metalworking industries are located.

Training, Other Qualifications, and Advancement

Most tool and die makers learn their trade through 4 or 5 years of education and training in formal apprenticeships or postsecondary programs. The best way to learn all aspects of tool and die making, according to most employers, is a formal apprenticeship program that combines classroom instruction and job experience. A growing number of tool and die makers receive most of their formal classroom training from community and technical colleges, sometimes in conjunction with an apprenticeship program.

Tool and die maker trainees learn to operate milling machines, lathes, grinders, spindles, 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 mechanical drawing, tool designing, tool programming, blueprint reading, and mathematics courses, including algebra, geometry, trigonometry, and basic statistics. Tool and die makers increasingly must have good computer skills to work with CAD technology and CNC machine tools.

Workers who become tool and die makers without completing formal apprenticeships generally acquire their skills through a combination of informal on-the-job training and classroom instruction at a vocational school or community college. They often begin as machine operators and gradually take on more difficult assignments. Many machinists become tool and die makers.

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 a high degree of patience and attention to detail. Good eyesight is essential. Persons entering this occupation also should be mechanically inclined, able to work and solve problems independently, and capable of doing work that requires concentration and physical effort.

There are several ways for skilled workers to advance. Some move into supervisory and administrative positions in their firms; many obtain their college degree and go into engineering or tool design; and some may start their own shops.

Job Outlook

Applicants with the appropriate skills and background should enjoy excellent opportunities for tool and die maker jobs. 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. As more of these highly skilled workers retire, employers in certain parts of the country report difficulty attracting well-trained applicants. 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 may prefer to attend college or may not wish to enter production-related occupations.

Despite expected excellent employment opportunities, little or no change in employment of tool and die makers is projected over the 2000-10 period because advancements in automation, including CNC machine tools and computer-aided design, should improve worker productivity, thus limiting employment. On the other hand, tool and die makers play a key role in the operation of many firms. 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.

Earnings

Median hourly earnings of tool and die makers were \$19.76 in 2000. The middle 50 percent earned between \$15.67 and \$24.45. The lowest 10 percent had earnings of less than \$12.44, while the top 10 percent earned more than \$28.88. Median hourly earnings in the manufacturing industries employing the largest number of tool and die makers in 2000 are shown below.

Motor vehicles and equipment	\$25.76
Aircraft and parts	22.17
Metal forgings and stampings	21.52
Metalworking machinery	18.99
Miscellaneous plastics products, not elsewhere classified	18.92

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.

Sources of Additional Information

For information about careers in tool and die making, contact:

- Precision Machine Products Association, 6700 West Snowville Rd., Brecksville, OH 44141-3292. Internet: <http://www.pmpa.org>
- National Tooling and Metalworking Association, 9300 Livingston Rd., Ft. Washington, MD 20744. Internet: <http://www.ntma.org>
- PMA Educational Foundation, 6363 Oak Tree Blvd., Independence, OH 44131-2500. Internet: <http://www.pmaef.org>