Machinist/Tool and Die Maker

Snapshot

Career Cluster(s): Business, Management & Administration; Manufacturing; Science, Technology, Engineering & Mathematics

Interests: Creativity; machines; tools; manual work; technical work; mathematics

Earnings (Yearly Average): $71,160

Employment & Outlook: As Fast As Average Growth Expected

OVERVIEW

Sphere of Work

Machinists and tool and die makers set up and operate a variety of computer-controlled and mechanically controlled machine tools to produce precision metal parts, instruments, and tools for a variety of industries. They may also own their own shops.

Work Environment

Machinists and tool and die makers work in industrial settings with computer-controlled machine tools. Adhering to workplace health and safety protocols is important to avoid injury. Although many machinists and tool and die makers work full-time during regular business hours, some work evenings

A machinist at a lathe. Photo by U.S. Air Force via Wikimedia Commons. [Public Domain.]

and weekends because facilities may operate around the clock. Some work more than 40 hours a week.

Occupation Interest

Machinists and tool and die makers are good with their hands, have strong math skills, and have an interest in creating specialized parts used in an array of industries, including metalworking, automotive, aerospace, and more. They take satisfaction in knowing that their precision-cut parts play a vital role in the functioning of everything from bicycles to space shuttles. Those who own their own shops have strong business skills as well.

Profile

Interests: Things, Data, People
Working Conditions: Both Inside and Outside
Physical Strength: Medium Work, Heavy Work
Education Needs: On-the-Job Training, High School Diploma with Technical Education, Junior/Technical/Community College, Apprenticeship
Licensure/Certification: Optional
Opportunities for Experience: Internship, Apprenticeship, Part-Time Work
Interest Score: RIC

Duties and Responsibilities

Machinists

- Reading blueprints, sketches, or CAD and CAM files
- Setting up, operating, and disassembling manual, automatic, and CNC machine tools
- Aligning, securing, and adjusting cutting tools and workpieces
- Turning, milling, drilling, shaping, and grinding machine parts to specifications
- Measuring, examining, and testing completed products for defects
- Smoothing the surfaces of parts or products
- Presenting finished workpieces to customers and making modifications if needed

Tool and Die Maker

- Reading blueprints, sketches, specifications, or CAD and CAM files for making tools and dies
- Computing and verifying dimensions, sizes, shapes, and tolerances of workpieces
- Setting up, operating, and disassembling conventional, manual, and CNC machine tools
- Filing, grinding, and adjusting parts so that they fit together properly
- Testing completed tools and dies to ensure that they meet specifications
- Smoothing and polishing the surfaces of tools and dies

A Day in the Life—Duties and Responsibilities

Machinists use machine tools, such as lathes, milling machines, and grinders, to produce precision metal parts. Many machinists must be able to use both manual and computer numerically controlled (CNC) machinery. CNC machines control the cutting tool speed and do all necessary cuts to create a part. The machinist determines the cutting path, the speed of the cut, and the feed rate by programming instructions into the CNC machine.

Although workers may produce large quantities of one part, precision machinists often fabricate small batches or one-of-a-kind items. The parts that machinists make range from simple steel bolts to titanium bone screws for orthopedic implants. Hydraulic parts, antilock brakes, and automobile pistons are other widely known products that machinists make.

Some machinists repair or make new parts for existing machinery. After an industrial machinery mechanic discovers a broken part in a machine, a machinist remanufactures the part. The machinist refers to blueprints and performs the same machining operations that were used to create the original part in order to create the replacement.

Some manufacturing processes use lasers, water jets, and electrified wires to cut the workpiece. As engineers design and build new types of machine tools, machinists must learn new machining properties and techniques.

On the other hand, tool and die makers construct precision tools or metal forms, called dies, that are used to cut, shape, and form metal and other materials. They produce jigs and fixtures—devices that hold metal while it is bored, stamped, or drilled—and gauges and other measuring devices.

Dies are used to shape metal in stamping and forging operations. They also make metal molds for die casting and for molding plastics, ceramics, and composite materials.

Tool and die makers use computer-aided design (CAD) programs to develop products and parts. They enter designs into computer programs that produce blueprints for the required tools and dies. Computer numeric control programmers, described in the metal and plastic machine workers profile, convert CAD designs into computer-aided manufacturing (CAM) programs that contain instructions for a sequence of cutting-tool operations. Once these programs are developed, CNC machines follow the set of instructions contained in the program to produce the part. Machinists normally operate CNC machines, but tool and die makers often are trained to both operate CNC machines and write CNC programs and, thus, may do either task.

WORK ENVIRONMENT

Immediate Physical Environment

Because machinists and tool and die makers work around machine tools that may present hazards, these workers must follow precautions to avoid injuries. For example, workers must wear protective equipment, such as safety glasses, to shield against bits of flying metal, earplugs to dampen the noise produced by machinery, and masks to limit their exposure to fumes.

Human Environment

Human interaction depends on the size of the shop and the nature of the machinist's or tool and die maker's job. A shop with numerous employees might work on larger-scale projects requiring regular collaboration and teamwork, while a smaller shop might do more solitary, small-batch jobs. In all cases, employees must interact with their employer on assignments, and vice versa. Shop owners have the added responsibility of managing staffing and employment matters, as well as meeting with clients, including resolving disputes. Some machinists may also test their products in the field.

Technological Environment

Machinists and tool and die makers must be extremely familiar with all the necessary tools of their trade, including manual and CNC machinery. They must be able to create and read blueprints, commonly using CAD and CAM software. As engineers design and build new types of machine tools, machinists must learn new machining properties and techniques.

EDUCATION, TRAINING, AND ADVANCEMENT

High School/Secondary

Machinists typically have a high school diploma or equivalent, whereas tool and die makers may need to complete courses beyond high school. High school courses in math, blueprint reading, metalworking, and drafting are considered useful.

Suggested High School Subjects

- Algebra
- Biology
- Chemistry
- Civics
- Earth or Life or Physical Science
- Economics
- English
- Entrepreneurship
- Geometry
- History
- Physics
- Pre-Calculus

- Psychology
- Statistics
- Trigonometry

Related Career Pathways/Majors

Business, Management & Administration Career Cluster

- General Management Pathway

Manufacturing Career Cluster

- Manufacturing Production Process Development Pathway
- Production Pathway

Science, Technology, Engineering & Mathematics Career Cluster

- Engineering & Technology Pathway
- Science & Mathematics Pathway

Postsecondary

Some community colleges and technical schools have 2-year programs that train students to become machinists or tool and die makers. These programs usually teach design and blueprint reading, the use of a variety of welding and cutting tools, and the programming and function of CNC machines.

Related College Majors

- Machine Shop Technology/Assistant
- Machine Tool Technology/Machinist
- Tool & Die Technology

Transferable Skills and Abilities

Analytical Skills

- Understanding technical blueprints, models, and specifications in order to craft precision tools and metal parts

Manual Dexterity

- Machining parts may demand accuracy to within .0001 of an inch, a level of accuracy that requires workers' concentration and dexterity

Math Skills and Computer Application Experience

- Using computers to work with CAD/CAM technology, CNC machine tools, and computerized measuring machines

Mechanical Skills

- Operating milling machines, lathes, grinders, laser and water cutting machines, wire electrical discharge machines, and other machine tools

Physical Stamina

- Standing for extended periods and performing repetitious movements

Technical Skills

- Understanding computerized measuring machines and metalworking processes, such as stock removal, chip control, and heat treating and plating

Adult Job Seekers

Adults with a high school diploma and who have related work experience, such as sheet metal workers, mechanics, and machinery maintenance workers, stand a good chance of becoming machinists or tool and die makers if they undergo the required training.

Professional Certification and Licensure

A number of organizations and colleges offer certification programs. The Skills Certification System, for example, is an industry-driven program that aims to align education pathways with career pathways. In addition, journey-level certification is available from state apprenticeship boards after the completion of an apprenticeship.

Completing a certification program provides machinists and tool and die makers with better job opportunities and helps employers judge the abilities of new hires.

Additional Requirements

There are multiple ways for workers to gain competency in the job as a machinist or tool or die maker. One common way is through long-term on-the-job training, which lasts 1 year or longer.

Trainees usually work 40 hours per week and take additional technical instruction during evenings. Trainees often begin as machine operators and gradually take on more difficult assignments. Machinists and tool and die makers must be experienced in using computers to work with CAD/CAM technology, CNC machine tools, and computerized measuring machines. Some machinists become tool and die makers.

Some new workers may enter apprenticeship programs, which are typically sponsored by a manufacturer. Apprenticeship programs often consist of paid shop training and related technical instruction lasting several years. The technical instruction usually is provided in cooperation with local community colleges and vocational-technical schools. Workers typically enter apprenticeships with a high school diploma or equivalent.

EARNINGS AND ADVANCEMENT

Earnings depend on the size of the machine shop, the scale of projects, industries served, and whether the machinist or tool and die maker owns the business.

Median annual earnings of machinists were $44,420 in 2019. The lowest 10 percent earned less than $27,940, and the highest 10 percent earned more than $66,610.

Median annual earnings of tool and die makers were $53,920 in 2019. The lowest 10 percent earned less than $33,820, and the highest 10 percent earned more than $77,940.

Machinists and tool and die makers may receive paid vacations, holidays, and sick days; life and health insurance; and retirement benefits. These are usually paid by an employer if the business is not self-owned.

EMPLOYMENT AND OUTLOOK

Machinists and tool and die makers held 460,600 jobs in 2019. Employment is expected to grow as fast as average for all occupations through the year 2029, at a rate of 3 percent, with employment growth varying by specialty.

Employment of machinists is projected to grow 4 percent through the year 2029. With improvements in technologies, such as CNC machine tools, autoloaders, high-speed machining, and lights-out manufacturing, machinists will still be required to set up, monitor, and maintain these systems.

Employment of tool and die makers is projected to decline 5 percent through the year 2029. Advances in automation, including CNC machine tools, should reduce demand for tool and die makers to perform tasks, such as programming how parts fit together that computer software can perform.

Many job openings for machinists and tool and die makers are expected to arise each year from the need to replace workers who transfer to other occupations or leave the labor force, such as to retire.

Related Occupations

- Boilermaker
- Industrial Machinery Mechanic/Machinery Maintenance Worker/Millwright
- Metal/Plastic Machine Worker
- Sheet Metal Worker
- Welder/Cutter/Solderer/Brazer

MORE INFORMATION

American Mold Builders Association (AMBA)
7321 Shadeland Station Way, #285
Indianapolis, IN 46256
317.436.3102
info@amba.org
amba.org

Association for Manufacturing Technology (AMT)
7901 Jones Branch Drive, Suite 900
McLean, VA 22102-4206
800.524.0475
AMT@AMTonline.org
www.amtonline.org

Fabricators and Manufacturers Association (FMA)
2135 Point Boulevard
Elgin, IL 60123
888.394.4362
info@fmanet.org
www.fmamfg.org

Manufacturing Institute (MI)
733 10th Street NW, Suite 700
Washington, DC 20001
202.637.3426
Institute@nam.org
www.themanufacturinginstitute.org

National Institute for Metalworking Skills (NIMS)
10565 Fairfax Boulevard, Suite 10
Fairfax, VA 22030
844.839.6467
www.nims-skills.org

National Tooling & Machining Association (NTMA)
1357 Rockside Road
Cleveland OH 44134
800.248.6862
ntma.org

Precision Machined Products Association (PMPA)
6880 W Snowville Road
Brecksville, OH 44141
440.526.0300
gro.apmp@ofni
www.pmpa-national.com

Precision Metalforming Association (PMA)
6363 Oak Tree Boulevard
Independence, OH 44131-2500
216.901.8800
www.pma.org

Stuart Paterson