



Machinist/Tool & Die

Cluster Overview: Planning, managing, and providing scientific research and professional and technical services including laboratory and testing services, and research and development services.

Career Goal (O*NET Code): (51-4041) - Machinists and tools and die makers set up and operate a variety of computer-controlled or mechanically-controlled machine tools to produce precision metal parts, instruments, and tools.

Student Name: _____

Grade: _____

School: _____

SUGGESTED COURSEWORK

EXTENDED LEARNING EXPERIENCES

Middle School	8th	HS Courses:	(Local districts may list high school credit courses here)		<p>Curricular Experiences***:</p> <ul style="list-style-type: none"> BEST Robotics, Inc. FIRST Robotics Competition Project Lead the Way Skills USA Technology Student Association The Infinity Project <p>Career Learning Experiences:</p> <ul style="list-style-type: none"> Career Preparation Job Shadowing Internship 	<p>Extracurricular Experiences:</p> <ul style="list-style-type: none"> Destination ImagiNation International Bridge Building Contest Marine Advanced Technology Education Center National Engineering Design Competition UIL Academic Competitions VEX Robotics Competition <p>Service Learning Experiences:</p> <ul style="list-style-type: none"> Campus Service Organizations Community Service Volunteer Peer Mentoring/Peer Tutoring 		
High School	9th	Courses*:	English I Algebra I or Geometry Biology	World Geography Foreign Language I Physical Education or Athletics			<p>COLLEGE CREDIT OPPORTUNITIES -- High School</p> <p>Students should take Advanced Placement (AP), International Baccalaureate (IB), dual credit, Advanced Technical Credit (ATC), or locally articulated courses (Tech Prep), if possible. List those courses that count for college credit on your campus.</p>	
		Career-Related Electives:	Concepts of Engineering & Technology					
	10th	Courses:	English II Geometry or Algebra II Chemistry	World History Foreign Language II Elective				
		Career-Related Electives:	Engineering Design & Presentation					
	11th	Core Courses:	English III Algebra II or Pre-Calculus Physics	United States History Foreign Language III ** Professional Communications or Speech				
		Career-Related Electives:	Advanced Engineering Design & Presentation					
12th	Core Courses:	English IV Pre-Calculus or Calculus 4th Science	Government/Economics Elective Elective					
	Career-Related Electives:	Practicum in STEM						

Postsecondary	<p>How to Become a Machinist and Tool & Die Maker</p> <p>Machinists train in apprenticeship programs, vocational schools, or community or technical colleges, or informally on the job. To become a fully trained tool and die maker takes 4 or 5 years of technical instruction and on-the-job training. Good math, problem-solving, and computer skills are important.</p>			<p>Carrer Options (Sample of reported job titles)</p>	<p>Professional Associations:</p> <ul style="list-style-type: none"> Fabricators & Manufacturers Association International National Institute for Metalworking Skills American Mold Builders Association Association for Manufacturing Technology National Tooling and Machining Association Precision Machined Products Association
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Postsecondary	<p>Texas Southmost College South Texas College Texas State Technical College</p>			<ul style="list-style-type: none"> Machinist Automation Technician Tool Room Machinist Gear Machinist Machine Operator Maintenance Specialist Machine Repair Person Set-Up Machinist Machinist Tool and Die Unity Operator Tool and Die Maker Tool Repairer Toolmaker Trim Die Maker Jig and Fixture Repairer Die Maker Tool and Die Machinist 	
	<p>Machining Technology Machinist (CERT)</p>				
	<p>Machining Technology Toolmaker (CERT)</p>				
	<p>Machining Technology – Tool & Die/Mold Making (AAS)</p>				
	<p>The University of Texas at Brownsville The University of Texas - Pan American</p>				

* Students must meet local & state high school graduation requirements. ** Required course for the Distinguished Graduation Plan (in addition to other measures). *** Based on campus availability. Students may select other elective courses for personal enrichment purposes.

This plan of study serves as a guide, along with other career planning materials, for pursuing a career path and is based on the most recent information as of 2009. All plans meet high school graduation requirements as well as college entrance requirements.



Machinist/Tool & Die

TEA Industry Cluster	STEM
SOC Code	51-4041
Identified by	TWC LMCI; Tech Prep Occupations
Projected Growth (2018)	0 %
BISD Magnet School Available	No

Source: Demand Occupations by Cluster, updated *June 27, 2012*

Description

What Machinist and Tool & Die Makers Do

Machinists and tools and die makers set up and operate a variety of computer-controlled or mechanically-controlled machine tools to produce precision metal parts, instruments, and tools.

Duties

Machinists typically do the following:

- Work from blueprints, sketches, or computer-aided design (CAD) or computer-aided manufacturing (CAM) files
- Set up, operate, and tear down manual, automatic, or computer numeric controlled (CNC) machine tools
- Calculate dimensions using measuring instruments
- Install, align, secure, and adjust cutting tools and workpieces
- Monitor the feed and speed of machines
- Turn, mill, drill, shape, and grind machine parts to specifications
- Measure, examine, and test completed products for defects
- Deburr all surfaces of parts or products to ensure that they conform to specifications

Tool and die makers typically do the following:

- Study blueprints, sketches, specifications, or CAD or CAM files for making tools and dies
- Compute and verify dimensions, sizes, shapes, and tolerances of workpieces
- Set up, operate, and tear down conventional, manual, or computer numeric controlled (CNC) machine tools
- File, grind, and adjust parts so that they fit together properly
- Test completed tools or dies to ensure that they meet specifications
- Inspect for proper dimensions and defects
- Smooth and polish surfaces of tools and dies

Machinists use machine tools that are either conventionally controlled or computer numerically controlled, 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. The parts that machinists make range from simple bolts of steel or brass to titanium bone screws for orthopedic implants. Hydraulic parts, anti-lock brakes and automobile pistons are other widely known products that machinists make.

Machinists may further be classified by specialty:

- **Production machinists** 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 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. Many machinists must be able to use both manual and computer-controlled machinery in their job.
- **Maintenance machinists** repair or make new parts for existing machinery. After an industrial machinery mechanic discovers the broken part of a machine, the machinist gets the broken part. For more information, see the profile on [industrial machinery mechanics and maintenance workers](#). To replace or remanufacture broken parts, maintenance machinists refer to blueprints and do the same machining operations that were needed to create the original part.

Although production machinists are concentrated in a few industries, maintenance machinists work in many manufacturing industries.

Because the technology of machining is changing rapidly, machinists must learn to operate a wide range of machines. Some newer manufacturing processes use lasers, water jets, electrical discharge machines (EDM), or electrified wires to cut the workpiece. Although some of the computer controls are similar to those of other machine tools, machinists must understand the unique capabilities of these different machines. As engineers create new types of machine tools, machinists must constantly learn new machining properties and techniques.

Toolmakers craft precision tools and toolholders 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. Many 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. Computer numeric control programmers use CAD and computer-aided manufacturing (CAM) programs to convert electronic drawings into CAM-based computer 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 are often trained to both operate CNC machines and write CNC programs, and they may do either task.

Training Opportunities Linked to Those Jobs (Degree Types and Colleges/Universities)

How to Become a Machinist and Tool & Die Maker

Machinists train in apprenticeship programs, vocational schools, or community or technical colleges, or informally on the job. To become a fully trained tool and die maker takes 4 or 5 years of technical instruction and on-the-job training. Good math, problem-solving, and computer skills are important.

Education

There are many different ways to become a skilled machinist or tool and die maker. In high school, students should take math courses, especially trigonometry and geometry. They should also take courses in blueprint reading, metalworking, and drafting, if available.

Some advanced positions, such as those in the aircraft manufacturing industry, require the use of advanced applied calculus and physics. The increasing use of computer controlled machinery requires machinists and tool and die makers to have basic computer skills before entering a training program.

Training

Formal apprenticeship programs, typically sponsored by a union or manufacturer, are an excellent way to become a machinist or tool and die maker, but they are often hard to get into. Apprentices usually must have a high school diploma or equivalent, and most have taken algebra and trigonometry classes.

Apprenticeship programs consist of paid shop training and related technical instruction lasting between 4 and 5 years. Apprenticeship classes are often taught in cooperation with local community colleges or vocational–technical schools.

Although apprenticeship programs may be the best way to learn the job, a growing number of machinists and tool and die makers receive their formal technical training from community and technical colleges. These employees often learn while employed by a manufacturer that supports the employee's training goals and gives the needed on-the-job training less formally.

Apprentices usually work 40 hours per week and get technical instruction at night. Trainees often begin as machine operators and gradually take on more difficult assignments. Machinists and tool and die makers must have good computer skills to work with CAD/CAM technology, CNC machine tools, and computerized measuring machines. Many machinists become tool and die makers.

Even after completing a formal training program, tool and die makers still need years of experience to become highly skilled.

Certification

To boost the skill level of machinists and tool and die makers 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 machinists and tool and die makers with better job opportunities and helps employers judge the abilities of new hires. Journey-level certification is available from state apprenticeship boards after completing an apprenticeship. Many employers recognize this certification, and it often leads to better job opportunities.

Important Qualities

Analytical skills. Machinists and tool and die makers must understand highly technical electronic or written blueprints, models, and specifications so they can craft precision tools and metal parts.

Detail oriented. The work of machinists and tool and die makers must be highly accurate. For example, tolerances may reach 50/1,000,000ths of an inch, which requires workers' precision, concentration, and attention to detail.

Math and computer skills. These workers must have good math and computer skills to work with CAD/CAM technology, CNC machine tools, and computerized measuring machines.

Mechanical skills. Machinists and tool and die makers must be mechanically inclined. They operate milling machines, lathes, grinders, laser and water cutting machines, wire electrical discharge machines, and other machine tools. They also may use a variety of hand tools and power tools.

Stamina. The ability to endure long periods of standing and doing repetitious movements is important for machinists and tool and die makers.

Technical skills. Machinists and tool and die makers must understand computerized measuring machines and metalworking processes, such as stock removal, chip control, and heat treating and plating.

Texas Southmost College	South Texas College	Texas State Technical College	University of Texas at Brownsville	University of Texas - Pan American
		Machining Technology Machinist (CERT)		
		Machining Technology Toolmaker (CERT)		
		Machining Technology – Tool & Die/Mold Making (AAS)		

Local Employers

A-1 Truck Svc	Harlingen	Internationalsales & Mfg	Harlingen
Bemar Industrial Supply Inc	Brownsville	Materiales Triple AAA Inc	Brownsville
Concord Marshall Elevators Inc	Harlingen	Rio Grande Steel Inc	San Benito
Filtration Plus	Brownsville	Twin Diesel Svc	Port Isabel
Industrial Technology Supplies	Brownsville	Webb Saw & Tool Inc	Harlingen

Career Options

(Specific Job Types)

- Machinist
- Tool Room Machinist
- Machine Operator
- Machine Repair Person
- Machinist Tool and Die
- Automation Technician
- Gear Machinist
- Maintenance Specialist
- Set-Up Machinist
- Unity Operator
- Tool and Die Maker
- Toolmaker
- Jig and Fixture Repairer
- Tool and Die Machinist
- Tool Repairer
- Trim Die Maker
- Die Maker

Salary Ranges

Wages for Machinists

Location	Pay Period	2011				
		10%	25%	Median	75%	90%
United States	Hourly	\$11.73	\$14.99	\$18.86	\$23.17	\$28.49
	Yearly	\$24,400	\$31,200	\$39,200	\$48,200	\$59,300
Texas	Hourly	\$10.83	\$14.08	\$18.19	\$22.62	\$27.88
	Yearly	\$22,500	\$29,300	\$37,800	\$47,000	\$58,000
Brownsville-Harlingen, TX MSA	Hourly	\$8.65	\$10.34	\$13.27	\$16.61	\$19.47

Location	Pay Period	2011				
		10%	25%	Median	75%	90%
	Yearly	\$18,000	\$21,500	\$27,600	\$34,500	\$40,500
McAllen-Edinburg-Mission, TX MSA	Hourly	\$8.12	\$9.24	\$11.79	\$17.64	\$24.21
	Yearly	\$16,900	\$19,200	\$24,500	\$36,700	\$50,400

Wages for Tool and Die Makers

Location	Pay Period	2011				
		10%	25%	Median	75%	90%
United States	Hourly	\$15.22	\$18.75	\$22.43	\$27.94	\$33.22
	Yearly	\$31,700	\$39,000	\$46,700	\$58,100	\$69,100
Texas	Hourly	\$12.98	\$15.97	\$20.36	\$25.71	\$30.22
	Yearly	\$27,000	\$33,200	\$42,300	\$53,500	\$62,900
Brownsville-Harlingen, TX MSA	Hourly	—	—	—	—	—
	Yearly	—	—	—	—	—
McAllen-Edinburg-Mission, TX MSA	Hourly	\$7.99	\$9.00	\$12.86	\$16.61	\$19.03
	Yearly	\$16,600	\$18,700	\$26,700	\$34,500	\$39,600

Professional Associations linked to the Careers

For more information about machinists and tool and die makers, including training and certification, visit [Fabricators & Manufacturers Association International](#) [National Institute for Metalworking Skills](#) (NIMS)

For general information about manufacturing careers, including machinery and tool and die makers, visit [American Mold Builders Association](#) (AMBA) [Association for Manufacturing Technology](#) (AMT) [National Tooling and Machining Association](#) (NTMA) [Precision Machined Products Association](#) (PMPA)

Sources

The information provided in this document was collected from the following sources:

- Occupational Outlook Handbook (<http://www.bls.gov/ooh/>)
- O*NET OnLine (<http://www.onetonline.org/>)
- Texas CARES (<http://www.texascaresonline.com/>)
- CareerOneStop (<http://www.careeronestop.org/>)