Computer Numerical-Control Machine Operators

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Occupational Subtitles:
- Numerical Control Tool Programmers

Work Classification Based Related D.O.T. Occupations:
- Automatic Engravers
- Balancing Machine Operators
- Production Machine Tenders
- Trim Machine Adjusters

Interests Based Related G.O.E. Occupations:
- Buffing Machine Operators
- Grinders
- Punch Press Operators
- Saw Operators

Skills Based Related O*NET Occupations:
- Coil Winders, Tapers, and Finishers
- Forging Machine Setters, Operators, and Tenders, Metal and Plastic
- Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic
- Paper Goods Machine Setters, Operators and Tenders

Noteworthy Quote:
“"The great thing about this job is that no two days are ever the same. One day, the machines might be running well and the day is easy. The next day, you may spend the whole day trying to get a machine working within product specifications. The unpredictability of the job keeps it interesting."

Computer numerical-control machine operators (com’put-er nu’mer-i-cal-con’trol ma’chine ‘op-er-a-tors) tend machines programmed by a computer to shape workpieces automatically.

In many shops and factories, machine tool setup workers and operators work with machines that cut and shape all kinds of metal and plastic parts. Usually, setup workers set up the machines to perform a series of operations. They adjust the speed, feed, and other controls, choose the coolants and lubricants, and select the instruments or tools for each operation. The operators tend the machines. They load the machines and remove the completed parts.

In 1952, scientists at the Massachusetts Institute of Technology built the first numerical-control machine tool. This device produced parts to specifications by following a computer program. Earlier versions of numerically controlled machines had controllers that read commands from a punched paper tape.

Today, many machine operators who produce metal and plastic parts work with computer numerically controlled (CNC) machines. These tools have two major parts: (1) The controller or computer is programmed to give instructions for performing a specific task. (2) The machine tool follows the instructions to complete the task. The program directs the machine tool through a series of positions and machining tasks on a workpiece. It may, for instance, move a drill bit into position and drill a hole an exact depth on the workpiece.

Many different machine tools, including milling machines, lathes, and punch presses, are computer numerically controlled. Each does a certain kind of task on the workpiece. It may shave, drill, stamp, or cut metal automatically. By changing the program and the tools, CNC machine operators can perform many different operations on a workpiece. In computer-integrated manufacturing (CIM) systems, automated material handling equipment moves workpieces through a series of work stations, each computer numerically controlled.

Although CNC machines do the machining automatically, they still must be set up and used correctly. CNC machine operators perform the set up work and observe machines to make sure that they are functioning properly.

Work Performed
The duties of CNC machine operators vary from one shop or factory to another. Some operators work on one machine all the time, others may operate more than one machine. Regardless of where they are employed, computer numerical-control machine operators are responsible for many common duties.

CNC machine operators load a program of instructions, usually contained on a disk, into the controller or computer. Sometimes, the instructions for manufacturing are saved within the hard drive of the computer. If this is the case, CNC machine operators enter commands into the computer in order to retrieve or load the information. They then clamp the metal workpiece firmly in the machine so that it does not move while it is being machined.

Computer numerical-control machine operators are responsible for selecting the appropriate tool for the task. In doing this, they check with the product specifications, usually supplied by an engineer. CNC machine operators then fasten the working tool in the machine. This tool may drill, saw, cut, shave, or mold the workpiece. If the
machine is equipped with an automatic tool changer, the operator attaches several tools to the machine in the correct sequence. They may be required to apply coolants and lubricants. CNC operators then start the machine. The machining process may take only a few minutes. In some cases the machining process may take several hours. The size of the workpiece and the complexity of the job determine the amount of time.

CNC machine operators often set up and tend more than one machine at a time. Throughout the process, they watch a screen that tells them what is happening. They may use measuring tools such as calipers and micrometers to check the accuracy of the work. They may frequently load and unload programs and change tools. Some CNC machines have sensors that inspect products as they are being machined. They automatically adjust machining operations to correct errors.

Computer numerically controlled machines simplify setup work. If a machine tool makes a wrong move during a test run, operators or tool programmers can change the program. They simply enter new commands through the keyboard of a menu-driven minicomputer. Operators can also use tested computer programs for new workpieces that are similar to one already produced.

Computer numerical-control machine operators are responsible for making sure that the finished product meets the predetermined manufacturing specifications. Using blueprints, instructions, and their general knowledge of machines, CNC machine operators monitor the machining process to ensure that everything is going according to plan.

**Numerical-control tool programmers** write computer programs that enable machine tools to perform machining tasks automatically. They analyze drawings, sketches, and designs to determine the dimension and configuration of cuts, selection of cutting tools, and machine speeds and feed rates. They determine reference points and direction of machine cutting parts.

Numerical-control tool programmers help transform specifications on a blueprint or a drawing into a workpiece. The order may be for several thousand copies of a simple device with a few angles and curves and perhaps some holes or slots. Or the order may be for a single complex piece two feet square and six inches thick with contoured curves, hollowed-out wells, tapped holes, and ridges made from a rare metal alloy worth several thousand dollars. Numerical-control tool programmers may plan and write programs only, or they may perform other tasks. In small to mid-size machine shops they may spend only part of their time planning and writing programs. Programming for some numerical-control machine tools is rather routine. Programmers may also assemble the cutting tools and get them ready for use, clamp the workpiece in place, and do other tasks to prepare for the automatic machining of parts.

**Working Conditions**
Most machine shops are relatively clean, well-lighted, and well-ventilated. Many shops are air-conditioned. Workers must wear safety shoes, safety glasses, and earplugs. They may not wear loose clothing that might get caught in the machinery. Machines are equipped with shields and guards to protect workers from flying chips of metal or plastic.

CNC machine operators stand by their machines and lift workpieces into place. Generally, the metal pieces weigh less than fifty pounds. For heavier pieces, chain hoists or other material handling equipment is available. Some firms make only small items like computer or automobile parts. Others make large gears for heavy equipment.

**Hours and Earnings**
CNC machine operators and programmers work year-round and about forty hours a week. Sometimes they work overtime, for which they get time and a half or double pay. Since many plants have more than one shift a day, some operators work nights or weekends.

According to the Bureau of Labor Statistics, in 2007, numerical-control machine operators earned an average of $33,690 a year. Wages ranged from a high of more than $48,050 a year to a low of less than $21,370 a year. Numerical-control tool programmers earned slightly more, averaging $44,800 a year, with a high of more than $65,400 a year and a low of less than $27,790 a year. Wages vary depending on employer and years of experience. Earnings also vary with geographic region. Earnings in large cities are often higher than the rates in rural regions.

Computer numerical-control machine operators and numerical-control tool programmers usually receive fringe benefits. They may include paid sick leave and vacations, life and health insurance, and pensions.

**Education and Training**
CNC machine operators should have a high school or a technical school education. Courses should include plane geometry, shop mathematics, physics, blueprint reading, and machine shop. Courses in computer operations are valuable as preparation for this work.

Employers seldom hire students straight out of high school for this work. CNC machine tool operators usually have had experience in other machine tool operation. With experience, workers can move into CNC work. Those already working in the shop in other jobs often get this job.

Trainees learn how to become CNC machine operators on the job. They work under the direction of supervisors or skilled operators. Trainees learn the basics within a few months. They may also attend courses lasting one or two weeks offered by machine tool manufacturers. Employees who want to upgrade their skills and advance often enroll in formal courses of study.

Trade and technical colleges offer students courses in machining, which include studies in computer numerical-control. Some of these students may move directly into CNC machine operator jobs.

Most numerical-control tool programmers receive formal training from a two-year college or technical school. Classroom studies include an introduction to
numerical-control and the basics of programming. Further study covers computer-aided design. Trainees begin writing simple programs under experienced programmers. Students also learn drafting, mechanical drawing, shop practices, and the use of CAD/CAM systems. They learn the working properties of different metals, metal cutting and forming, cutting speeds and feeds, and so on.

Machinery manufacturers are beginning to standardize programming languages but there are still many languages in use. Therefore, it is helpful for numerical-control tool programmers to learn several programming languages.

Since programming methods vary with different makes of numerical-control machine tools, programmers usually receive further training when a company buys new equipment. A representative of the company that makes the equipment conducts the training. To keep up with developments in the field, numerical-control tool programmers periodically upgrade their skills by attending courses at a local community college. Employers usually reimburse the programmers for the cost of successfully completed study.

Unions and Professional Societies

Many CNC machine operators and numerical-control tool programmers are members of a union. Unions for these workers include the International Association of Machinists and Aerospace Workers (IAM), the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW), the International Union of Electronic, Electrical, Salaried Machine and Furniture Workers (IUE-CWA), the International Brotherhood of Electrical Workers (IBEW), and the United Steelworkers of America (USW). Labor-management contracts cover working conditions and terms for life and health insurance, pension plans, and other benefits.

There are also associations and organizations that represent the interests of those working in manufacturing. These organizations offer educational seminars and programs for workers to help advance the field of manufacturing technology. Some of these associations include the Association for Manufacturing Excellence (AME), the Association for Manufacturing Technology (AMT), the National Association of Manufacturers (NAM), the National Tooling and Metalworking Association (NTMA), the Precision Machine Products Association (PMPA), and the Precision Metalforming Association Educational Foundation (PMAEF). These organizations provide members with networking opportunities, conferences, publications, and education and training.

Personal Qualifications

Employers look for workers with good work habits. The work demands mental effort, alertness, and attentiveness. The operators not only run the machines but also must understand the principles by which they work. CNC workers should have good communications skills, flexibility, and the willingness to learn new tasks. Since they spend their day surrounded by potentially dangerous machinery, CNC operators should also be safety conscious.

Occupations can be adapted for workers with disabilities. Persons should contact their school or employment counselors, their state office of vocational rehabilitation, or their state department of labor to explore fully their individual needs and requirements as well as the requirements of the occupation.

Where Employed

According to the Bureau of Labor Statistics, in 2007, about 140,380 computer numerical-control machine operators and 17,280 numerical-control tool programmers were employed throughout the United States. Many work in industries that produce fabricated metal products, industrial machinery and equipment, transportation equipment, and primary metals. CNC machine operators work throughout the United States. Large numbers work in metropolitan regions in the Northeast and Midwest where manufacturing is concentrated.

Employment Outlook

The many advantages of CNC machines are causing many firms to adopt this technology. Computer-driven equipment is more productive and less expensive in the long run. It allows one operator to tend several machines at the same time. Setup is much easier, thereby reducing the amount of time setup workers spend on each machine. Improvements in CNC machine tools, such as adaptive controls and sensors make the operators more productive. To some extent, the increased use of CNC machine tools will boost employment of these operators. A continuing trend of substituting plastics parts for metal parts may create a demand for CNC machine operators by firms that manufacture plastics products.

On the other hand, the productivity of CNC machines cuts down on the number of workers required to operate them. Competition from foreign imports may limit employment. To counter this competition, producers in the United States are moving production operations to other countries. This practice reduces employment opportunities for CNC machine operators. Most openings will occur as workers retire or transfer to other fields of work.

Entry Methods

Most CNC machine operators learn on the job. New workers in machine shop programs usually begin with less-skilled jobs. Later, as they demonstrate good work habits, they move to more complex machines and operations. Under supervision, new operators learn on the job. They can learn many basic machine operations in a few months. Manufacturers offer instruction on new models and new processes.

Tool programming is not considered an entry job. Nearly all programmers have worked as machinists or tool and die makers, or as similar workers before becoming numerical-control tool programmers. Some workers wishing to become numerical-control tool programmers already have computer and programming skills. Employers and shop supervisors may train these workers in their own plant or send them to school to learn tool programming. Community colleges and technical schools have a placement service to help students find a job when they complete their studies.
Many newspapers have classified advertisements for numerical-control tool programmers. The Yellow Pages of telephone books list machine shops and other plants that may employ CNC machine operators and numerical-control tool programmers. Professional organizations and the Internet are also helpful for people searching for a machining position. Job seekers should write resumes and send them to the employers for whom they might like to work.

**Advancement**

Skilled CNC machine operators may advance to work in CNC machine programming and CNC maintenance. These workers should continue to study in order to improve their knowledge and skills, and keep up-to-date with advancing technology. They may also, by serving an apprenticeship, become journeyworker machinists or tool and die makers. They may move up to become CNC machine programmers, CNC program coordinators, or department heads.

Numerical-control tool programmers may advance to supervisory work. They may move up to work in tool designing, process planning, or part designing. They may transfer to a better paying job with a larger firm or a science laboratory. Some experienced numerical-control tool programmers go into business for themselves. They may do freelance programming for several machine shops, or they may set up their own shop.

**For Further Research**

Association for Manufacturing Excellence, 3115 North Wilke Road, Suite G, Arlington, Heights, IL 60004. Web site: www.ame.org

Association for Manufacturing Technology, 7901 Westpark Drive, McLean, VA 22102-4206. Web site: www.amtonline.org

International Association of Machinists and Aerospace Workers, 9000 Machinists Place, Upper Marlboro, MD 20772-2687. Web site: www.goiam.org

International Brotherhood of Electrical Workers, 900 Seventh Street, NW, Washington, DC 20001. Web site: www.ibew.org


National Tooling and Machining Association, 9300 Livingston Road, Fort Washington, MD 20744-4998. Web site: www.ntma.org

Precision Machined Products Association, 6700 West Snowville Road, Brecksville, OH 44141. Web site: www.pmpa.org

**Precision Metalforming Association Educational Foundation**, 6363 Oak Tree Boulevard, Independence, OH 44131-2500. Web site: www.pma.org or www.metalforming.com

United Automobile, Aerospace and Agricultural Implement Workers of America, Solidarity House, 8000 East Jefferson Avenue, Detroit, MI 48214. Web site: www.uaw.org

United Steelworkers, Five Gateway Center, Pittsburgh, PA 15222. Web site: www.usw.org

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