

Numerical Control Tool Programmers



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Work Classification Based Related

D.O.T. Occupations:

- Automotive Engineers
- Die Designers
- Drafters
- Heat Transfer Technicians
- Mechanical Engineering Technicians
- Mechanical Engineers
- Optomechanical Technicians
- Plant Engineers
- Test Engineers
- Tool Designers

Interests Based Related

G.O.E. Occupations:

- Cost Analysis Engineers
- Facilities Planners
- Forest Engineers
- Land Surveyors
- Logistics Engineers
- Management Analysts
- Materials Engineers
- Production Planners
- Time Study Engineers
- Tool Planners

Skills Based Related

O*NET Occupations:

- Computer Security Specialists
- Data Processing Equipment Repairers
- Mathematical Technicians
- Model Makers, Metal and Plastic
- Numerical Control Machine Tool Operators and Tenders, Metal and Plastic

Numerical control tool programmers (nu'mer-i-cal con'trol 'tool 'pro-gram-mers) write 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.

For many years skilled workers operated machines to make parts. In the 1940's, however, research led to the development of numerically controlled machine tools that could follow a computer program and make machine parts (pieces shaped to exact specifications) of different dimensions automatically.

Today, automobiles, aircraft, water craft, industrial machinery, construction equipment, and spacecraft require precisely machined parts. A machine tool consists of a fixture that holds the workpiece and a cutting tool that works on it. A machine tool in operation may cut, shave, grind, bore, saw, or drill the workpiece to specifications within thousandths of an inch. The machine tools for mass production include lathes, drill presses, laser cutting water jets, milling machines, grinding machines, saws, boring machines, and others. They can produce millions of parts and pieces for almost all durable goods on the market.

Industries depend on numerically controlled machine tools to produce millions of metal parts in thousands of different shapes for everything from engine blocks for cars to tiny delicate pieces for spacecraft such as the space shuttle and communications satellites. Workers who write the programs that tell the machines what to do are numerical control tool programmers.

Work Performed

There are two main parts to numerical control machine tools: an electronic controller and a machine tool. The controller, which is a computer-based work station, reads the commands of the program and then directs the tool to carry them out. To perform a machining job, each task requires a coded list (program) of steps that runs the machine tool mechanisms. Several numerical control machine tools may work on a piece before it is finished.

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.

The first task of tool programmers is to analyze the blueprint or drawing, along with other data, to learn the size, shape, and other details of the piece. Then they outline the steps to make the piece, and the sequence of these steps. They set the starting point and the path for each cut. They determine the size, position, and direction of each cut. Dimensions in metalworking are precise, often to .0001 inch.

After reviewing the thickness of the workpiece, the kind of metal, and other details, they decide which cutting tool to use for each step. A tool may mill, drill,

or bore the workpiece. Using their knowledge of machine tool processes and the properties of different metals, the programmers specify the cutting speeds of the tools and the rates at which the tools will make the cuts.

When they have made these decisions, the tool programmers write a program for the controller and store it, usually on a computer disk. The program tells the electronic controller each step to take. Usually the programmers use a computer to write the program for the controller. The computer uses programs called post processors to translate the program into the language of the controller and store it.

Programmers may do their own mathematical calculations to figure feed rates, spindle speeds, and tool numbers. A growing number of companies, however, have computer-aided manufacturing (CAM) systems the programmers can use to write programs. The CAM system calculates data on dimensions, which the programmer can use to develop the program.

Programmers also write instructions for the machine operator to set up and tend the numerical control machine. Programmers may perform the first trial of the program with a workpiece of wax or wood to be sure the program is correct in every detail. More likely, however, they use a computer simulation to perform a trial run, because a problem with the program could cause costly damage to the machining equipment. If errors show up, programmers change and retest the program until it works correctly.

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 do setups, that is, 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

Numerical control tool programmers work in comfortable, well-lighted machine shops. They usually plan and write programs in a room or office away from the noise of the metalworking machines. They work seated at a desk or table where they have a computer, drafting tools, reference manuals, and storage space for tapes and supplies. They work more with ideas, computers, and machines than with people.

Numerical control tool programmers may also assist with setups in the machine shop. The shop is usually clean, well-lighted, and well-ventilated. Since it is often noisy, workers sometimes wear ear protectors. They also wear protective equipment such as safety glasses to shield their eyes from bits of flying metal.

Hours and Earnings

Numerical control tool programmers normally work eight hours a day, five days a week. In the tool and die and

mold making industry they may work forty-five to fifty-five hours a week. Some machine shops run two shifts, or even three a day. Others may run weekend shifts to justify their investment in more expensive equipment. Programmers may work the swing shift or the night shift. They may work overtime in peak periods if there is a shortage of skilled workers.

According to the Bureau of Labor Statistics, in 2000, numerical control tool programmers earned an average of \$13.17 an hour. Earnings ranged from a high of \$ 20.25 an hour to a low of \$8.80 an hour. Earnings vary depending on geographic location, employer, and years of experience.

Education and Training

Employers often prefer skilled machinists or tool and die makers with technical school training in tool programming. High school students who wish to become numerical control tool programmers should take mathematics, physics, chemistry, blueprint reading, metalworking, drafting, and computer courses. Summer work in a machine shop is beneficial, because experience with machine tools is extremely important. Few shop managers, however, allow inexperienced workers to handle the most critical parts of their computer numerically controlled equipment. Therefore, most numerical control tool programmers have had extensive experience as machine tool operators or setters.

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.

Employers may choose candidates from their work force for training as numerical control tool programmers. For some kinds of programming, such as complex parts for the aerospace or shipbuilding industries, employers may require programmers with a degree in engineering or related technical field. A few programmers still learn their skills through apprenticeships and on-the-job training.

Although machinery manufacturers are beginning to standardize programming languages, there are still many languages still 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 conduct 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.

Licensing, Certification, Unions, and Professional Societies

Numerical control tool programmers need no license or certification. Certification as a manufacturing technologist by the Society of Manufacturing Engineers may be helpful in getting employment. Very few belong to a union. Some may join if their shop has a union.

Personal Qualifications

Numerical control tool programmers must be able to work with little or no supervision. They must also be able to work well with others and communicate well both in speech and in writing. They must be logical, analytical, and detail-oriented. They must be able to do highly accurate work requiring keen concentration. An interest in mechanical processes, machines, and production is an asset. Ingenuity will help numerical control tool programmers develop creative methods of numerical control.

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

Most numerical control tool programmers are employed in metal processing industries throughout the United States. The largest employers are the aerospace and automobile industries and other manufacturers of durable goods. These firms are mostly in or near large cities of New England and the Midwest, and on the West Coast. Some are in the South. These large factories also contract with smaller factories (called job shops) to make special parts. They also work in plants that make telecommunications and plastics products. They write the programs to make the injection molds.

Small machine shops with ten workers or less also employ numerical control tool programmers. Science laboratories and similar establishments employ numerical control tool programmers. They may work for agencies such as the National Aeronautics and Space Administration (NASA).

Employment Outlook

According to the Bureau of Labor Statistics, employment of numerical control tool programmers is expected

to increase steadily through the year 2010. The increasing use of computer numerically controlled machine tools and advances in technology will reflect job growth. However, advances in computer software require fewer numerical control tool programmers to translate part and product designs into computer numerically controlled machine tool instructions. Most openings will occur as programmers transfer to other work or retire.

This occupation is also sensitive to the economy. When manufacturing orders drop, tool programmers may face layoffs or shorter workweeks.

Entry Methods

Tool programming is not considered an entry job. Nearly all numerical control tool programmers have worked as machinists or tool and die makers, or as similar workers before becoming numerical control tool programmers. Some individuals 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 metropolitan newspapers have classified advertisements for numerical control tool programmers. The Yellow Pages of telephone books list machine shops and other plants that may employ numerical control tool programmers. The Internet is also helpful for people searching for a numerical control tool programming position. Job seekers should write resumes and send them to the employers for whom they might like to work.

Advancement

Skilled 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

Delmar Publications, P.O. Box 15015, Albany, NY 12212-5015.

Computer Numerical Control: Concepts and Programming. Warren S. Seames. 447 pages. \$57.95.

National Tooling and Machining Association, 9300 Livingston Road, Fort Washington, MD 20744.

Machine Tools and Manufacturing Technology. 770 pages. \$65.95.

Prentice Hall, Division of Simon and Schuster, Inc., 240 Frisch Court, Paramus, NJ 07652-5240.

Numerical Control Programming Manual CNC Apt-Compact II. George Stanton. \$39.85.
Computer Numerical Control Programming.
Peter J. Amic. 350 pages. \$70.00 hardbound.

Springer-Verlag New York, Inc., 175 Fifth Avenue, New York, NY 10010.

CNC Machining Technology: Part Programming Techniques. Graham T. Smith. \$38.95 softbound.

VGM Career Horizons, NTC Publishing Group, 4255 West Touhy Avenue, Lincolnwood, IL 60646.

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