

HISTORY OF NUMERICAL CONTROL

Numerical Control Defined:

The simplest definition for numerical control is to control by numbers. It is a process of controlling machine tools and manufacturing processes by tape commands, electrical impulse commands, or commands from a computer system.

History of Numerical Control:

As early as 1807 punched cards were used to control textile looms. Other early forerunners were the petroleum and chemical industries who used this concept for process control. The old fashioned player piano used the same control unit principle as N/C. As the holes in the player roll passed over a sensing bar, air was drawn into tubes which in turn activated mechanisms controlling the individual piano keys.

The metal working equipment industry was slow to catch on. In 1949 the first tape controlled toolmakers lathe was demonstrated, but there was no interest. It was the computation and measurement of the curved surface of a helicopter rotor blade that sparked the original N/C concept. Between 1949 and 1952 The Parsons Corporation and M.I.T., under the sponsorship of the Air Force, constructed an experimental milling machine to prove the possibility of contour milling. In order for N/C to be made practical it was necessary for the electronics industry to expand, and it did at a rapid rate. In 1952 the first successful 3 axis demonstration was made, and by 1964, 35,000 N/C units were in use.

In years past, flexowriters, much like typewriters were used to punch tape or cards which would later be read by the large control unit adjacent to the mill. Today many changes have taken place in numerical, electronic or computer controlled machines.

Controller Evolution - We have gone from vacuum tubes and mechanical relays to high density integrated circuits. The ability of the controller to generate three dimensional shapes has vastly improved. Controllers were point to point locators usually in two axes. Today, microprocessor/controllers (CNC) are capable of nearly every shape imaginable. Also; they can make decisions, store and analyze programs and communicate with the user. They can monitor the quality of the product, change to sharper tools when needed and communicate with other computers and robots that load and unload the parts. These CNC machines can even analyze internal problems and tell the user what may be wrong. These controllers are called fourth generation, because of the density and sophistication of the electronics within. The big difference between NC and CNC is the ability of the controller to think. NC machines blindly follow instructions while CNC machines analyze data.

Software Evolution - Microprocessors, added computer capability. Today's software is capable of two way communication. Programming languages are "user friendly" and may lessen the chance of errors for the programmer. The logic of the program is more easily understood and learning time is less. Modern software adds capabilities, prevents errors, speeds learning, simplifies programming and completes the package for a fourth generation

machine. Today more and more manufactures of computer hardware are employing software programmers to increase the problem solving capacity of the computer in its software instead of increasing the capability in the computer hardware.

ADVANTAGES OF COMPUTER NUMERICAL CONTROL

- Many fixtures have been replaced with simple clamps. It is the program tape or the computer that positions the cutting tool right down to the final dimension. Fixtures are then so much equipment that is not needed. Large industries save money by eliminating storage of large fixtures.
- Complex operations can often be done more quickly with a program and precise electronics or computers instead of physical effort. This also helps to simplify inspection and make quality control much easier.
- As less time is spent in setting up a machine, it means that machine utilization is higher and the required number of machines is reduced.
- It is useful when the need exists to shorten lead time. If tooling, fixturing, and template requirements are greatly reduced, the savings are obvious. The potential is shown in the automobile industry. Thanks to the lead time reduction made possible by programmed machines, the Big Three American automobile manufacturers have been able on various occasions to introduce models ahead of schedule. The roof, rear deck, lower back and other sheet metal parts were stamped by N/C made dies. Robotics have become influential in American industry. These most often are machines with arms capable of doing various tasks in nearly any environment. They do not need heat, light or paid vacations to function. They can work in hazardous fume or dangerous environmental areas. Some robots manufactured today are totally autonomous appearing self governing as they can move about from work station to work station doing various tasks and delivering payloads in random predetermined orders. They do not depend on a line of sight or any mechanical guidance system, but instead are guided by infrared ray systems that are binary coded. Thousands of robotics are in existence in our country today with hundreds of thousands planned in the next few years.
- It is useful where a part is complex but must be made in short runs with variations. It is much easier to modify a program than to make new or modified tooling and fixturing accessories. If a program is contained in memory, modifications can be made by inserting or deleting changes only when and where necessary.
- It is useful in situations where a part is so complex that human error is likely to occur. Once a program is made and checked to insure its accuracy, it will work without error indefinitely, barring a malfunction of the machine tool or machine control unit. In many units, should a malfunction occur, the machine will sense a problem and stop before damage takes place.
- One great advantage of N/C is that there is no allowance for scrap. If the program has been checked before inserting into the machine control unit, and it is found to be correct, then there is no need for trial runs.