INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Název projektu: **Automatizace výrobních procesů ve strojírenství a řemeslech**
Registrační číslo: **CZ.1.07/1.1.30/01.0038**
Příjemce: **SPŠ strojnická a SOŠ profesora Švejcara Plzeň, Klatovská 109**
Tento projekt je spolufinancován Evropskou unií a státním rozpočtem České republiky

Produkt:

Zavádění cizojazyčné terminologie do výuky odborných předmětů a do laboratorních cvičení

NC and CNC machines

Návod v anglickém jazyce

Číslo tématu: **8b**

Monitorovací indikátor: **06.43.10**

INSTRUCTIONS FOR TOPIC: 8b

Created in school year: 2012/2013

Branch: 26-41-M/01 Electrical Engineering - Mechatronics

Subject: Programming of NC Machines

Year: 3.

Prepared by: Ing. Pavel Steininger; translated by: Bc. Veronika Mádlová

NC and CNC machines

Numerical Control (NC) and Computerised Numerical Control (CNC) machines provide automatic or semi-automatic operation of machine tools which cut metal and other materials – the degree of automation varying to suit specific requirements.
In conventional machine tools the slides are moved along their slideways by the operator-manually or by engaging the automatic feed mechanism – or, as in the case of automatic lathes,by means of special cams. The operator also performs the other actions necessary for machining a component(eg.starting/stopping rotation of the spindle,changing speed of feed rates,turning on cutting fluid).Each of these actions requires the operator to exercise judgement and make a decision.These decisions must be repeated each time a component is produced,when even the parts are identical to one another.
In contrast,the use of numerical control for machine tools means that the decisions which govern the operation of the machine are made only once-at the planning and programming stage in the preparation of machine control tape.With numerically controlled machine tools all the necessary movements required to machine a component are performed automatically by the machine itself in response to numerical information fed to it in coded form from a tape or control system.

The advantages include:
1. The rate at which metal can be removed from a workpiece on an NC machine tool is not, in general, greater than that achieved on the equivalent manual machine tool. In fact, it is often appreciably less because,as there will often not be an operator to adjust machining conditions, the part programmer will tend to specify machining conditions- feeds, speeds, etc.-which are conservative. In this way he avoids difficulties which may arise when for example, the workpiece material turns out in

practice to be harder than was expected. NC does, however,eliminate marking out and the time that the craftsman would require to measure and position the cutting tool so that,overall machining times are often reduced.

2. Much of the cost of designing,making and storing jigs,fixtures and templates is eliminated.

3. Design changes and modifications can be introduced easily.

4. Better accuracy and consistency, and lower scrap rate are achieved.

5. Tool turrets or carousels which reduce the number of times the machine has to stop to wait for an operater to change tools

6. Pallet loading devices, interchangeable or remotely controlled tables which eliminate
production delays while on operator unloads finished components and loads blanks.

The disadvantage of NC

The main disadvantage of NC is the high initial cost of the NC machine tool as compared with that of the equivalent manual machine tool. The high capital costs make it necessary to achieve high utilisation and a high standard of machine maintenance to ensure reliability. The efficiency of the part programmer is critical to the success of NC.

CNC machine characteristics

These machines are similar to NC machines in that they receive their commands from magnetic tape punch card or punched tape. They can also receive input signals direct from a Teletype or Line Printer. They have the advantage that, all part program information introduced into the machine control system through the reader can be stored in a mini-computer memory and executed from there. The stored information is normally retained within the computer memory until removed or changed by the programmer/operator. The information is retained although power from control may be removed for a period of time by standby batteries. A NC and CNC machine comprises a metal cutting unit and a control console.

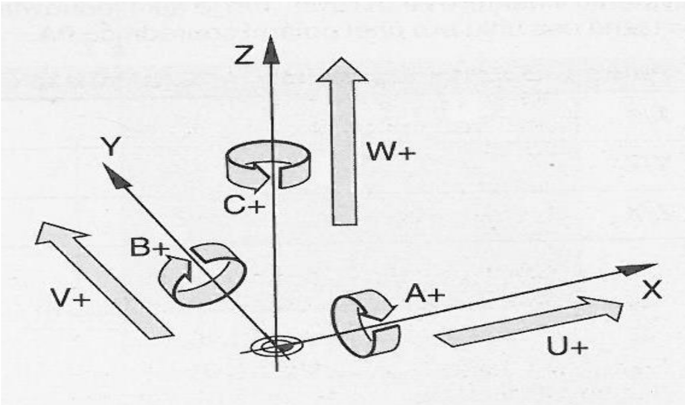
Fundamentals of numerical control

The data obtained from engineering information is converted into a coded numerical input on a program to which the electronic control circuits of the machine tool will respond.The command signals read by the tape reader from the input tape are converted into electric signals and these signals are fed into a network of logic circuits. This directs them by means of logic circuits to the servo-mechanisms which operate the moving parts to take up the position required.The positioning system is the basic and major feature of the NC machine tool to which all other features are added. Most NC machine tools can position the slides to within 0,025mm of repeatable accuracy within their scope of movement.When an NC machine is seen the first time, its apparent complexity varies with the number of special features built into it. It is necessary therefore to eliminate all these special features in order to see and understand the basic NC machine.

Axis and motion nomenclature

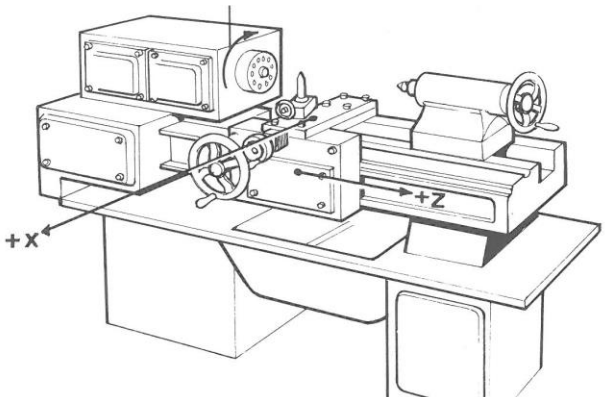
A reference system is required to define positions in a plane or in space. The position date are always referenced to a predetermine point and are described througt coordinates.The cartesian coordinate system(a rectangular coordinate system) is based on three coordinate axes X,Y and Z. The axes are mutually perpendicular and intersect at one point called the datum. A coordinate identifies the distance from the datum in one of these directions. A position in a plane is thus described througt two coordinates and a position in space througt three coordinates.

The Z axis of an NC machine is always in line with the axis of the practical spindle of the machine, whether the spindle is horizontal or vertical, and the axis is positive in a direction from the workpiece to the tool. The other axes are disposed accordingly, with the provision that the X axis is horizontal and parallel to the work-holding surface. The Y axis is perpendicular to the X and Z axes. If more than one spindle impart cutting power, that which is most perpendicular to the workpiece is designated the principal spindle. Where the work- table or tool head are capable of rotation, the codes A, B and C are used. These are rotary motions arounds axes X, Y and Z. These motions have positive direction that would advance right-handed screws in the positive X, Y and Z direction.



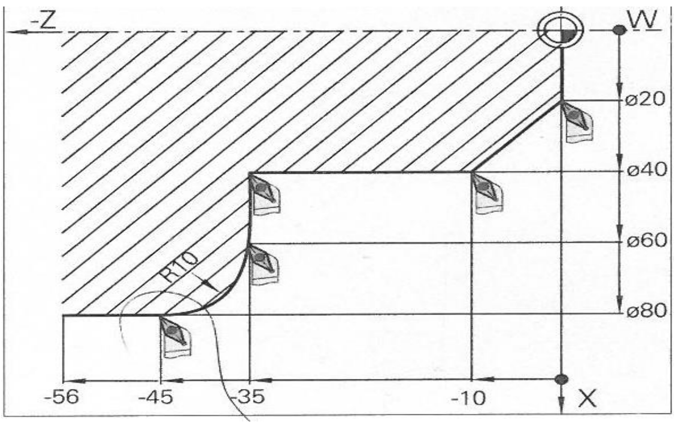
Coordinates that are referenced to the datum are referenced to as absolute coordinates. Relative coordinates are referenced to any other known position (datum) you define within the coordinate system. Relative coordinate values are also referend to as incremental coordinate values. The illustration at left shows the assignment of secondary axes and rotary axes to the main axes.

Reference systems on lathe machine



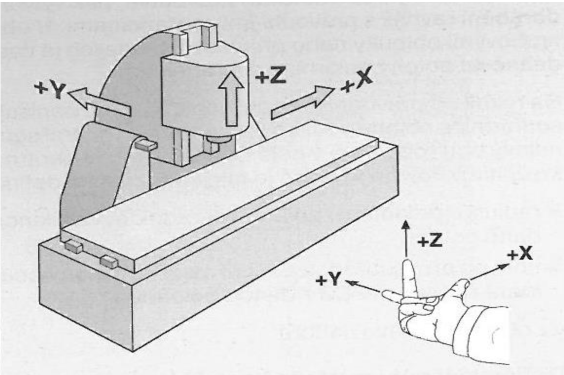
The cross slide is referred to as the X axis and the saddle as the Z axis. All X axis values that are displayed or entered are regarded as diameters. When programming paths of traverse remember to: Program a positive valve to depart the workpiece. Program a negative valve to approach the workpiece

The axis designations X and Z describe positions in two dimensiond coordinate system.As you can see from the figure to the right the position of the tool tip is clearly defined by its X and Z coordinates. CNC machine can connect points by linear and circule paths of traverse (interpolations)



.Workpiece machining is programmed by entering the coordinates for a succession of points and connecting the points by linear or circular paths of traverse. Like the paths of traverse you can also describe the complete contour of a workpiece by defining single points through their coordinates and connecting them by linear or circular paths of traverse. The coordinates entered for the axes X and Z are referenced to the workpiece datum.

Reference systems on milling machines



When using a milling machine you orient tool movements to the cartesian coordinate system. The illustration at right shows how the cartesian coordinate system describes the machine axes. The figure at right illustrates the right-hand rule for remembering the three axis directions the middle finger is pointing in the positive direction of the tool axis from the workpiece toward the tool (the Z axis) the thumb is pointing in the positive X direction and the index finger in the positive Y direction.

Selecting the datum

A production drawing identifies a certain form element of the on the workpiece usually a corner as the absolute datum. Before setting the datum you align the workpiece with the machine axes and move the tool in each axis to a known position relative to the workpiece. You then set zero or a predetermind position valve.This establishes the reference system for the workpiece which will be used for your part program. If the production drawing is not dimensioned for NC set the datum at a position or corner on the workpiece, which is the most suitable for deducing the dimensions of the remaining workpiece positions.

Machine datum

The point of intersection of the X and Z axes is called the machine datum. On a lathe the machine datum is usually the point of intersection of the spindle axis and the spindle surface. The machine datum is designated with the letter M.

Workpiece datum

For machining a workpiece it is easier to reference all input data to a datum located on the workpiece.By programming the datum used in the workpiece drawing you can take the dimensions directly from the drawing without further calculation.This point is the workpiece datum. The workpiece datum is designated with the letter W.

Reference points

When the control is switched off, it forgets the positions of the machine axes. Your machine therefore has a fixed reference mark on each axis.The control knows the exact distance between these reference marks and the machine datum and can re-establish the assignment of displayed positions to machine axis positions when you traverse the reference marks after switch-on.

Zdroj:

HEIDENHAIN *Firemní dokumentace iTNC530*. Praha: Heidenhain, 2000.

NC a CNC stroje - NC and CNC machines - slovníček odborných termínů

Vocabulary	Slovníček
Břit (ostří)	cutting edge
Břitová destička	tip, bit
Brusič	grinder
Čelo nástr.	face
Číselník (děl.k.)	dial
Deska upínací	face plate
Díra ve vřeteni	bore of the spindl
Dělicí hlava	dividing head
Dílenské měřidlo	gauge
Drobivá tříska	tear type of chip
Dělená tříska	shear type of chip
Fréza čelní	face cutter
Fréza stopková	shank cutter
Fréza tvarová	form milling cutter
Fréza odvalovací	hobbing cutter
Frézka universální	universal milling cutter
Frézka vodorovná	horizontal milling mach.
Frézka svislá	vertical milling mach.
Hlavní části	main parts of
Hrotový soustruh	centr lathe
Hrot otočný	live centre
Hřbet nástroje	ridge
Hloubka záběru	depth of cut
Chyba	error
Kalibr s dobrou	go gauge
Kalibr se špatnou	not go gauge
Kladivo	hamer
Klika	crank
Kopírovací soustruh	repetition lathe
Koník	tailstock
Kontrola	inspection

Konzola	knee
Kolečko ruční	handwheel
Matice vodicího šroubu	clasp nut
Míra	measurement
Mikrometr	micrometer
Měření	gauging
Nástroj z jed. kusu	soolid tool
Nástroj hrubovací	roughing tool
Nástroj hladicí	finishing tool
Nástroj jedno.	single point tool
Nástroj upichovací	cutting off tool
Nástroj závitový	screw cutting tool
Nonius	vernier
Páka	lever
Páka spouštěcí	starting lever
Příkon	power
Příčné saně	cross slide rest
Přímočarý	linear
Pohyb	motion
Posuv	feed
Posuv podélný	longitudinel feed
Posuv příčný	cross feed
Posuv svislý	vertical feed
Počet posuvů	number of feed
Posuvné měř.	vernie calliper
Přesnost	accuracy
Pracovní stůl	work table
Řezná rychlost	cutting speed
Rukojeť	handle
Sekáč	chisel
Sevřít	to grip
Spínač	switch
Sklíčidlo	chuck
Stopka	shank

Strojní svěrák	parrallel machine vice
Soustruh	lathe
Soustružit	to turn
Soustružnický nůž	turning tool
Šroub vodicí	lead screw
Šířka třísky	widt of chip
Upnout	to locate
Upínací zařízení	fixture
Tříska	cutting
Ostřit	to sharpen
Vedení	guide
Vřeteno	spindle
Vřeteno konec	spindle nose
Vřeteník	headstok