APPENDIX D

GLOSSARY

ABSOLUTE DIMENSION: A dimension expressed with respect to a fixed point or zero origin.

ACCELERATION: Instantaneous rate of change of velocity. Acceleration is positive if the velocity is increasing.

ACCURACY: The closeness of a measured value to its true value. Accuracy is the difference between the actual target and the average from that target plus or minus three standard deviations.

ACTIVE STORAGE: Registers which hold the data which is actively being processed. In the Bridgeport Control, this consists of the interpolation registers and the N, F, S, T, M function registers.

ALIGNMENT TOLERANCE: Tolerance specified with respect to mutual perpendicularity of the machine spindle and the X and Y axes.

ALPHANUMERIC CODE: Code whose character set contains combinations of the 26 letters, 10 numerals, and/or special characters, "-", "+", "/", etc.

ANSI: American National Standards Institute

APPROACH: Manner in which an axis moves in the immediate vicinity of its destination as it nears the end of a move.

ARC CENTER OFFSET: Specification of a coordinate pair as the center of the circle segment to be machined by a circular arc move. The center coordinates are derived from the coordinates of the tool prior to the move by defining the incremental coordinates (offset) of the circle center. Offsets along the X, Y, or Z axes are given the variable names I, J, or K, respectively.

ARGUMENT: The independent variable of a function.

ASCII CODE: (American Standard Code for Information Interchange) This standardized code is used extensively in data transmission. It consists of 128 upper and lower case letters, numerals and special purpose symbols each encoded by a unique 7 bit binary number.

ASYNCHRONOUS: Describes the operation of a digital circuit in which a free running signal triggers successive instructions. The completion of one instruction triggers the next.

AUXILIARY FUNCTION: Programmable function other than the control of the machine along an axis.

AXIS: (1) A reference line of a coordinate system; for example, the X, Y and Z axis of the Cartesian coordinate system. (2) A direction along which a movement of the workpiece occurs.

AXIS OF MOTION: The Z axis is parallel to the machine spindle with +Z as the direction from the workholding means toward the toolholding means. The X axis is horizontal and parallel to the workholding surface with +X as the direction to the right, looking from the spindle toward its supporting column. The Y axis is perpendicular to both Z and X. +Y is the direction required to make a right handed Cartesian coordinate system +X, +Y, +Z.

AXIS REVERSAL: The reversal of the sign (plus or minus) of the X and Y input values on a selective basis to permit machining "left handed" parts from "right handed" part programs.

BACKLASH: Relative motion between interacting mechanical parts caused by less than absolute precision of mating surfaces.

BACKLASH TAKEUP: Correction of backlash error implemented by the control system.

BAUD RATE: Bits per second; used as a measure of serial data flow between a computer and/or communication devices.

BINARY: A number system utilizing a base of two. Binary Code is notated by 0's and 1's. For example, the number 92 is represented by 1011100. Control systems utilize binary logic because the switching components within them have two states: "ON" and "OFF". In general, X, Y, Z, I, J and K dimensions, which are input to the control in decimal notation, are converted internally to binary values so that the arithmetic functions may be more conveniently implemented.

BIT: A binary digit which can be one of the two states (0 or 1) in the binary number system. A bit is the smallest unit of data in a digital computer.

BLOCK: A command line; single line of a part program which is

sufficient to be considered as a discrete working unit of program.

BORE: To pierce with a rotary tool.

BOSS 8:   (Bridgeport Operating System Software) The binary code embedded in nonvolatile read only memory (ROM) and which is responsible for inherent control of the machine.

BUFFER: Storage device used to compensate for a difference in the rate of data flow from one device to another.

BUFFER STORAGE: Storage reigsters for X, Y, Z, I, J, K, F and M data which act as an intermediate storage area between the Tape Reader and active storage. This data is available for rapid transfer to active storage.

BYTE: A set of eight binary bits, which are operated on as a unit. A byte is a subset of a computer word.

CAD: Computer Aided Design.

CAM: Computer Aided Manufacturing.

CANNED CYCLE: A preset sequence of events initiated by a single command. For example, G84 is a tapping cycle that provides a feed in, feed out sequence.

CAPACITY, MACHINE: Specification which describes total X, Y, Z displacements.

CARTESIAN COORDINATES: A dimensioning system whereby the position of a point can be defined with reference to a set of axes at right angles to each other.

CHARACTER: One of a set of letters, numerals or symbols which may be combined to represent information in a program. In the Bridgeport system, the characters used are: letters N, G, XYZ, etc.; decimal digits 0 to 9; and the characters "-", "tab", "end of block", and "rewind stop". The characters are used to address specific registers.

CHATTER: Vibration caused by harmonic vibration of a tool in contact with the work piece during a move.

CIRCULAR INTERPOLATION: A mode of contouring control which uses the information contained in a single block to produce an arc of a circle.

CLOCKWISE: Spindle rotation direction such that a right handed screw installed in the tool holder would drive into the work piece. Counterclockwise is the reverse of clockwise.

CLOSED LOOP SYSTEM: A feedback system whereby a signal from the machine control is acted upon by the machine tool and a monitoring unit then returns the acted upon signal for comparison. The difference between the two signals is the rate loop error or "following error" which is amplified and compared with a velocity (tachometer) signal and output to the power amplifier. The power amplifier accepts the error signal and supplies the necessary output for the servo drive which then attempts to reduce the error to zero.

CNC: (Computer Numerical Control) A numerical control system wherein a dedicated, stored program computer is used to perform some or all of the basic numerical control functions.

COMPENSATION, CUTTER: The ability of a control to accept differences between a programmed tool diameter and the actual tool diameter. This compensation generates an entirely new milling path parallel with the old and equidistant from it by the compensation amount at all times.

COMPUTER: A device capable of accepting information, operating on the information according to preprogrammed instructions and supplying the results ot these operations. A typical computer consists of a CPU (central processing unit containing control, arithmetic and logic, and register elements), main memory and I/O (Input/Output) devices.

COORDINATE SYSTEM, STANDARD: Coordinate system which defines the coordinates of a moving tool (or draftsman's pencil) with respect to a stationary workpiece. (Ref. EIA 267 definition of Standard Coordinate System.) COORDINATES, ABSOLUTE: The values of the X, Y, Z coordinates with respect to the origin.

COORDINATES, CONTROL: The absolute tool coordinate values currently stored in the control system memory.

COORDINATES, INCREMENTAL: Values of X, Y, Z coordinates as a measurement from the preceeding coordinate value, resulting in the coordinates of a new point being specified as if the previous point were the origin.

COORDINATES, MACHINE: Values of X, Y, Z coordinates referenced to the Home position to an origin which is the specified origin of the physical part.

COUNTERCLOCKWISE: See CLOCKWISE.

CURRENT LOOP: A communication line on which the presence or absence of electrical current is used to represent transmitted data.

CUTTER COMPENSATION: See COMPENSATION, CUTTER

CUTTER PATH: The path described by the cutter in order to generate the desired part configuration.

CYCLE: A sequence of operations that is repeated regularly. Examples: bore mill, canned, facing, pocket, quill, Z.

DECELERATION: Instantaneous rate of change of decreasing velocity in the direction of tool motion.

DEFLECTION: Error in tool tip XY position caused by excessive sideloading of the tool during a cut.

DEPARTURE: Characteristics of the motion of a tool as it initiates a move from the current location to a new one.

DIAMETER, NOMINAL TOOL: Diameter specified by the tool manufacturer and subject to manufacturer's tolerance specification.

DISTANCE: Length of a line segment connecting two points.

DISTANCE, PECK: Incremental -Z travel of a drill motion specified in a deep hole or chip break cycle.

DOWNFEED: The motion of the tool in the -Z direction.

DOWNLINE LOADER: See LOADER

DRIFT: Motion of the tool which occurs without directive from the control system.

DWELL: The time delay programmed during a canned cycle.

EDITOR: A program which permits a user to create new files or to modify existing files.

EIA STANDARD CODE: (Electrical Industries Association) two EIA Standards for N/C character coding are: RS-244-A Character code for Numerical Machine Control Perforated Tape, commonly called EIA code; and RS-358 Subset of the USA Standard Code for Information Interchange for Numerical Machine Control Perforated Tape, commonly called ASCII Code. Bridgeport Controls conform to both code character sets.

EMERGENCY STOP - A button that cuts off power to the three axes.

END OF BLOCK CHARACTER (EOB): A character that represents the end of a line or block of information contained on a machine control tape. (See EIA STANDARD CODE).

END OF PROGRAM: An 'M02' code indicating completion of the workpiece. Stops spindle, coolant and feed after completion of all commands in the block. The tape is rewound back to the

rewind stop code at the beginning of the program.

EQUIVALENT PAPER TAPE LENGTH: One foot of paper tape contains 120 characters or bytes of data.

EXECUTE: To perform a specified computer instruction; to run a program.

FEED FUNCTION: The relative motion between the tool or instrument and the work piece. It is caused by motion of the axis or axes.

FEEDBACK: The control signal derived as the result of an output action which is used to modify the input creating that action.

FEEDRATE OVERRIDE: A variable manual control function used to reduce or increase the programmed feedrate.

FLOATING ZERO: A characteristic of a machine tool controller permitting the zero reference point on any axis to be easily established at any point in the travel. (Refer to G92)

FOLLOWING ERROR: See CLOSED LOOP SYSTEM.

INITIALIZE: To set the system logic (counters, switches, registers) to zero or other starting values at the beginning of a computer program.

INTEGRATED CIRCUIT (IC): A solid state microcircuit consisting of interconnected active and passive semiconductor devices diffused into a single silicon chip.

INTERFACE: The portion of the machine tool controller that connects the control system to the outside world. This can include a data link to a remote computer or connection to peripheral machine tool equipment. Special consideration has to be given in the interface design so that the control system is effectively isolated from externally generated electrical "noise" transients.

INTERPOLATION: A function of a control whereby data points are generated between given coordinate positions to allow simultaneous movement of two or more axes of motion in a defined geometric pattern, linear, circular and parabolic.

JOG: Fixed incremental tool position change along a single axis (X, Y or Z) executed by the machine as a result of operator input.

MACRO: A subroutine consisting of a group of instructions which can be stored and then recalled as a group to avoid reprogramming the subroutine in a new location. The macro call statement may assign values to the variables, if any, in the macro.

MANUAL FEEDRATE OVERRIDE: A control that enables the operator to increase or to reduce the feedrate if the tape programmed rate is not optimal for the material being machined.

MDI: Manual Data Input, a method of operation in which data is entered manually by keyboard or other means instead of by program.

MISCELLANEOUS FUNCTION: A one or two digit "M" code which sets a particular auxiliary machine function such as spindle/on-off, coolant/on-off, etc.

MODAL: Remains in effect until changed.

NONVOLATILE MEMORY: A type of computer system memory offering preservation of data storage during power loss or system shutdown.

NUMERICAL CONTROL (NC): A method of controlling moving machine parts and auxiliary equipment using an input medium which consists of coded alphanumeric characters.

OVERRIDE: To manually or otherwise deliberately override an automatic control system or circuit and thereby render it ineffective.

PARITY CHECK: A method of checking the correctness of binary data after that data has been transferred. The single digit sum of all the binary digits in the word or character and its logical state represents either an even or an odd number of 1's making up the binary word.

PART PROGRAM: Specific and complete set of data and instructions written for the operation of a numerically controlled machine tool.

PECK: A canned cycle for deep hole drilling whereby the Z axis feed is reversed at regular intervals for chip relieving.

POINT, CLEARANCE: Program point for tool changing or other operator activity. It has a distance reference to the part, and therefore to program zero.

POINT, PART PROGRAM ZERO: The absolute zero about which all programmed absolute coordinates originate. These coordinates usually match the part coordinates for simplicity. However, the turn on state is such that program zero must be shifted. Further, the turn on state is such that the control coordinate must be synchronized with the machine and part.

POINT, PART REFERENCE: A point which may be referred to by the dial indicator or edge finder. This reference point may have coordinates other than part zero. This is usually displayed in

machine coordinates.

POINT TO POINT CONTROL: A positioning system that controls the discrete positions at which a machine operation is performed. The path and rate of movement between points is not under continuous control in every system. The most common application of point to point control is drilling.

POINT, XYZ HOME: A fixed mechanical point in three dimensional space, which defines the active travel limits of the machine and is referenced to a right handed Cartesian coordinate system centered about the table (X,Y) and quill (Z). With respect to table motion, the X, Y home position is table extreme right (X), table extreme in (Y). With respect to tool motion, the X,Y home is tool left (X), tool out (Y). Z home position is quill up.

POLAR COORDINATES: A mathematical system for locating a point in a plane by the length of its radius vector and the angle this vector makes with a fixed line.

PRECISION: Measure of repeatability of a series of measurements of the same true value without regard to the difference from the true value.

PROGRAM STOP: Miscellaneous function command that stops the feed after completion of other commands in the block. It may also electromagnetically disconnect line power from other machine tool auxiliary functions.

PUNCHED TAPE: A tape with holes produced in such a manner so as to represent a particular set of data. The standard geometry is specified in EIA RS-227.

QUADRANT: One of the four quarters of the rectangular coordinate dimensioning system.

R2E3: Acronym for the Rigid RAM, 2 horsepower spindle motor, E type control, 3 axes milling machine.

RANGE OF TRAVEL: Absolute distance between the XYZ HOME POINT and the X,Y, or Z limit switch design trip point.

RANDOM ACCESS MEMORY (RAM): A storage unit in which direct access is provided to data, independent of memory location.

RAPID TRAVERSE: Maximum rate of travel of tool with respect to the workpiece achievable with the tool not in contact with the part.

READ ONLY MEMORY (ROM): A storage unit generally used for control programs whose contents are not alterable (cannot be erased or changed).

REALTIME: Control system operations in which the system is controlling a process while that process is actually occurring.

REPEATABILITY: Worse case steady state condition between commanded X, Y, Z tool position and true X, Y, Z tool position, achievable with the machine. Repeatability is measured in terms of plus or minus three standard deviations from the average position of a statistically significant number of identical machine moves without regard to the target.

RESET: Occurs under the following conditions: 1) power ON 2) Reset Switch activated 3) power OFF for more than 100 seconds. At Reset, the screen clears and the system reads, writes and verifies the system RAM and reads and verifies the system ROM.

RESOLUTION: Smallest increment of output action obtainable from the smallest increment of input.

RESOLUTION, CONTROL LOGIC: Smallest measure of numeric data achievable in the control system hardware.

RESOLUTION, DISPLAY: Smallest significant digit increment of a numeric value displayable with the display hardware.

RESOLUTION, INPUT: Smallest unit of numeric data input achievable with the input hardware.

RESOLUTION, OUTPUT: Smallest X, Y, or Z move possible under program control.

RS-358: (Commonly called EIA code) Subset of the USA Standard Code for Information Interchange for Numerical Machine Control Perforated Tape (commonly called ASCII).

SEQUENCE NUMBER: A multidigit "N" number identifying the block or group of blocks on the NC tape. This sequence number is displayed on the operator's console.

SIGN REVERSAL: Inversion of the current direction (sign) of an axis under program control.

SPEED, SPINDLE: Angular velocity of the spindle, specified in RPM.

SYNCHRONOUS COMMUNICATION: A method of transferring serial binary data, transmitted at a fixed rate, with the transmitter and receiver synchronized by characters located at the beginning of each block of data.

TOLERANCE: The largest difference between a specified value and the true value which permits treating the two values as if they were identical.

TOOL ASSEMBLY: A complete assembly usually consisting of the tool holder with collet, etc. where necessary, the cutter, and if applicable, the tool insert. The tool holder fits directly into the spindle nose of the machine.

TOOL LENGTH OFFSET: The numeric value of an error correction to compensate for less than absoutely accurate tool length specification.

TRAVEL: The tool motion.

VECTOR VELOCITY: The resulting speed of a particular combination of axes motion. The individual axes move slower than the programmed rate, but the resultant rate, or vector, is equal to the programmed rate.

ZERO SHIFT: A characteristic of a machine tool controller permitting the zero point on an axis to be shifted readily over a specified range.

ZERO SUPRESSION: The elimination of nonsignificant zeroes to the left of the decimal point or nonsignificant zeroes to the right of the first digit after the decimal point. The Bridgeport control permits both modes provided that the decimal point appears in the word.