INCH-POUND

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MILITARY SPECIFICATION

MACHINING CENTERS, HORIZONTAL, SINGLE SPINDLE 4- and 5-AXIS, COMPUTER NUMERICAL CONTROL (CNC)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers computer numerically controlled (CNC) horizontal, single spindle type machining centers with rotary work table, automatic tool changer and equipment and accessories as specified herein. The requirements set forth in this specification and the completed ordering data (see paragraph 6.2) establish the Government's minimum requirements for each procurement.

1.2 Classification. The horizontal machining center covered by this specification shall be of the following types, classes and sizes. The specific machining center, type, class and size to be furnished shall be as specified (see 3.5 and 6.2).

Type I - Full 4-axis contouring

Type II - Full 5-axis contouring

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Industrial Plant Equipment Center, ATTN: DIPEC-SSM, 2163 Airways Boulevard, Memphis, Tennessee 38114-5051, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 3408

Class A - 10 Horsepower

Size	X - Axis Travel	Y - Axis Travel	Z - Axis Travel
1	20 inches (483mm)	15 inches (381mm)	16 inches (406mm)
2a	40 inches (1016mm)	23 inches (584mm)	18 inches (457mm)
3	60 inches (1524mm)	36 inches (914mm)	18 inches (457mm)

Class B - 15 Horsepower

Size	X - Axis Travel	Y - Axis Travel	Z - Axis Travel
1	24 inches (609mm)	20 inches (508mm)	18 inches (457mm)
2	30 inches (762mm)	22 inches (558mm)	18 inches (457mm)
3	60 inches (1524mm)	36 inches (914mm)	31 inches (762mm)
4	84 inches (2133mm)	36 inches (914mm)	31 inches (762mm)

Class C - 20 Horsepower

Size	X - Axis Travel	Y - Axis Travel	Z - Axis Travel
1	43 inches (1092mm)	35 inches (889mm)	26 inches (635mm)

Class D - 25 Horsepower

Size	X - Axis Travel	Y - Axis Travel	Z - Axis Travel
1	30 inches (762mm)	22 inches (558mm)	18 inches (457mm)
2	40 inches (1016mm)	32 inches (812mm)	26 inches (660mm)
3	72 inches (1828mm)	48 inches (1219mm)	30 inches (762mm)

Class E - 30 through 40 Horsepower

Size	X - Axis Travel	Y - Axis Travel	Z - Axis Travel
1	36 inches (914mm)	24 inches (609mm)	18 inches (475mm)
2	48 inches (1219mm)	36 inches (914mm)	28 inches (711mm)
3	72 inches (1828mm)	48 inches (1219mm)	36 inches (914mm)
4	96 inches (2438mm)	72 inches (1828mm)	36 inches (914mm)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

MILITARY

MIL-M-18058 - Machinery, Metal and Woodworking, Packaging of.

STANDARDS

FEDERAL

FED-STD-H28 - Screw Thread Standards for Federal Services.

MILITARY

MIL-STD-461 - Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interferences.

MIL-STD-462 - Electromagnetic Interference Characteristics, Measurement of.

(Unless otherwise indicated, copies of Federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

CODE OF FEDERAL REGULATIONS (CFR)

U. S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR 1910 - Occupational Safety and Health Standards.

(Application for copies should be addressed to the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402-0001.)

(Copies of specifications, standards, handbooks, drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN GEAR MANUFACTURERS' ASSOCIATION (AGMA)

AGMA 390.03a - Gear Classification, Materials and Measuring Methods for Bevel, Hypoid, Fine Pitch Wormgearing and Racks Only as Unassembled Gears. (DOD adopted)

AGMA 2000-A88 - Gear Classification and Inspection Handbook. Tolerances and Measuring methods for Unassembled Spur and Helical Gears. (Including Metric Equivalents). (DOD adopted)

AGMA 2001-B88 - Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth. (DOD adopted)

(Application for copies should be addressed to the American Gear Manufacturers' Association, Standards Department, 1500 King Street, Suite 201, Alexandria, VA 22314-2717.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B5.1 - T-Slots, Their Bolts, Nuts, and Tongues. (DOD adopted)

ANSI B5.50 - "V" Flange Tool Shanks for Machining Centers with Automatic Tool Changers. (DOD adopted)

ANSI B11.8 - Drilling, Milling, and Boring Machines, Safety Requirements for the Construction, Care, and Use. (DOD adopted)

ISO 54 - Cylindrical Gears For General Engineering and for Heavy Engineering, Modules and Diametral Pitches of. (DOD adopted)

ANSI B93.114M - Pneumatic Fluid Power Systems-Standard for Industrial Equipment and Machine Tool Applications.

ANSI/ISO 8860/1 - Dimensional, Physical and Magnetic Characteristics.

ANSI/ISO 8860/2 - Track Format.

ANSI/ISO 9293 - Volume and File Structure of Flexible Disk Cartridges for Information Interchange.

(Application for copies should be addressed to the American National Standards Institute, ATTN: Sales Dept., 1430 Broadway, New York, NY 10018-3363.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA RS-227 - One-inch perforated tape. (DOD adopted)

EIA RS-232 - Interface between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange.

EIA RS-244 - Character Code for Numerical Machine Tool Control Perforated Tape. (DOD adopted)

EIA RS-267 - Axis and Motion Nomenclature for Numerically Controlled Machines. (DOD adopted)

EIA RS-274 - Interchangeable Variable Block Data Format for Positioning and Contouring/Positioning Numerically Controlled Machines. (DOD adopted)

EIA RS-358 - Subset of American National Standard Code for Information Interchange for Numerical Machine Control Perforated Tape. (DOD adopted)

EIA RS-449 - General Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange.

EIA RS-494 - 32 Bit Binary CL Exchange (BCL) Input Format for Numerically Controlled Machines.

(Application for copies should be addressed to the Electric Industries Association, 2001 I Street, N.W., Washington. DC 20006-1899.)

JOINT INDUSTRIAL COUNCIL (JIC)

JIC H-1 - Hydraulic Standards for Industrial Equipment and General Purpose Machine Tools.

(Application for copies should be addressed to the Joint Industrial Council, c/o The National Machine Tool Builders' Association, 7901 Westpark Drive, McLean, VA 22101-4269,).

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION (NEMA)

NEMA ICS 1 - Industrial Controls and Systems. (DOD adopted)

NEMA ICS 3 - Industrial Systems. (DOD adopted)

NEMA MG 1 - Motors and Generators. (DOD adopted)

NEMA MG 7 - Motion/Position Control Motors and Controls. (DOD adopted)

(Application for copies should be addressed to the National Electrical Manufacturers' Association, 2101 L Street, N.W., Washington, DC 20037-1580.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 79 - Electrical Standard for Industrial Machinery. (DOD adopted)

(Application for copies should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269-9101.)

NATIONAL AEROSPACE STANDARD (NAS)

NAS 979 - Uniform Cutting Tests - NAS Series Metal Cutting Equipment Specifications.

(Application for copies should be addressed to the Aerospace Industries Association of America, Inc., 1725 De Sales Street, N. W., Washington, D. C. 20036.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), one complete machining center shall be subjected to first article inspection (see 6.4) in accordance with 4.4.

3.2 Design. The machining center shall be new (not a prototype) and one of the manufacturer's current production models. Its design shall include features and components necessary for maintaining alignment and accomplishing drilling, tapping, milling and boring performance required herein. The machine shall be of a fixed base type with Y-axis vertical movements on the column ways. Longitudinal movement X axis shall be provided either by movement of the column on the base or by movement of the table on saddle ways supported by the base. Tools, toolholders, and adapters shall be inserted and removed from the spindle by an automatic tool changer with storage magazine. Tool changes, spindle operations, linear and rotary axis motion and other operations as specified herein, shall be directed by a computer numerical control (CNC) system. The machine and its numerical control system shall constitute a completely functional system with built-in operations programmed by coded punched tape and/or other devices. The machine functions shall be controlled manually by operator control devices, semi-automatically by manual data input devices, and automatically from part program data input. All parts of the machine and system that are subject to wear, breakage, or distortion shall be accessible for adjustment, replacement, and repair. The design and construction of the machine shall be in accordance with either the U.S. Customary System of Units (US) or the International System of Units (SI).

3.2.1 Reclaimed materials. The machine may contain reclaimed materials to the maximum extent possible provided such materials will not jeopardize the intended use, performance, or design life of the machine. Reclaimed materials shall have been collected or recovered from solid waste and reprocessed to become a source of

raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used, rebuilt or remanufactured products are allowed under this specification.

3.2.2 Energy efficiency. The machine and its components that directly consume energy in normal operation shall be designed and constructed for energy efficiency in accordance with the developments available within the industry.

3.2.3 Controls. All electrical, mechanical, hydraulic, and pneumatic operating controls shall be located convenient to the operator's work station(s).

3.2.4 Safety and health requirements. All parts, components, mechanisms, and assemblies furnished on the machine, whether or not specifically required herein, shall conform to all requirements of OSHA 29 CFR 1910 and ANSI B11.8. If a conflict arises between 29 CFR 1910 and ANSI B11.8, 29 CFR 1910 shall apply. Additional safety and health requirements shall be as specified (see 6.2). Covers, guards, or other safety devices normally furnished as standard on the manufacturer's commercial machining center supplied to the commercial market shall be provided for the point of operation and all other parts of the machine that present safety hazards. If point-of-operation guarding is influenced by workpiece size and configuration, the procuring activity shall provide part design data to the supplier of the machine (see 6.2). All special guarding shall meet OSHA 29 CFR 1910. The safety devices shall not interfere with the operation of the machine. All guards shall allow access to the guarded part(s).

3.2.5 Environmental protection. The machining center shall meet all applicable Environmental Protection Agency (EPA) and OSHA restrictions for materials classified as hazardous to the environment in effect on the date of the contract. During the operation of the machine at its final location, it shall comply with all applicable EPA and OSHA regulations in effect on the date of the contract regulating the emission of materials hazardous to the environment. Specific environmental protection requirements exceeding the established EPA and OSHA regulations as required herein shall be as specified by the procuring activity (see 6.2).

3.2.6 Lubrication. Means shall be provided to ensure lubrication for all moving parts. Recirculating lubrication systems shall include a cleanable or replaceable filter. Means for determining oil level in each reservoir shall be by an oil level sight gauge, a low oil level warning light, or similar device and shall be in clear view of the operator's normal work station. An automatic lubrication system shall be provided for all ways and axis screws. Each lubricant reservoir shall have at least a 24-hour capacity and means for determining fluid level. All oil holes, grease fittings, and filler caps shall be readily accessible.

3.2.6.1 Lubricants. Any greases, oils, or fluids used to initially charge the lubricant system shall be free of contaminants known to be hazardous to human health.

3.2.7 Interchangeability. All parts of the end item shall be manufactured to definite standards and tolerances that will provide for the interchangeability of respective replacement parts between end items of the same model without

modification of the part or the machine. All replacement parts shall be available domestically.

3.3 Construction. The machine shall be constructed of parts which are new, without defects, and free of repairs. The structure shall withstand all forces encountered during operation of the machine to its maximum rating and capacity without permanent distortion or failure.

3.3.1 Castings and forgings. All castings and forgings shall be free of defects, scale, and mismatching. No processes such as welding, peening, plugging, or filling with solder or paste shall be used for reclaiming any defective part. Such processes may be used only for enhancing surface finish and appearance.

3.3.2 Fastening devices. All fasteners shall be installed to prevent change of tightness. Fastening devices subject to removal or adjustment shall not be permanently installed.

3.3.3 Surfaces. All surfaces shall be clean and free of harmful or extraneous materials. All edges shall be either rounded or beveled unless sharpness is required to perform a necessary function. Except as otherwise specified herein, the condition and finish of all surfaces shall be in accordance with the manufacturer's commercial practice.

3.3.4 Welding, brazing, or soldering. Welding, brazing, or soldering shall be employed only where specified in the original design. Any material used for such operations shall be thoroughly removed from the part(s) upon completion of the operations.

3.3.5 Painting. Unless otherwise specified (see 6.2), the machine shall be painted in accordance with the manufacturer's commercial practice and color.

3.3.6 Threads. All threaded parts used on the machine and its related attachments and accessories shall conform to FED-STD-H28 and the applicable "Detailed Standard" section referenced therein.

3.3.7 Drive train gears. All gears of spindle and axis drive trains shall conform to or exceed all provisions of AGMA 390.03a, AGMA 2000-A88 and AGMA 2001-B88 for the inch-pound system of measurement or ISO 54 for the metric system of measurement. The gears shall be of proper width and size to transmit full-rated torque and horsepower throughout the speed ranges without failure for the expected service life of the machine. Gears in the drive train shall be hardened and ground steel. Working surface hardness shall be not less than Rockwell C-48.

3.3.8 Electromagnetic interference control. When specified (see 6.2), equipment furnished under this specification shall comply with MIL-STD-461. The equipment and subsystem(s) class and the emission and susceptibility requirements shall be as specified.

3.4 Components. The machining center shall consist of not less than a base, column, saddle, worktable, machining head, spindle assembly, tool changer, coolant system, electrical system, and computerized numerical control system.

3.4.1 Base. The base shall possess the mass, strength, rigidity and other load carrying characteristics necessary for supporting the column, saddle and associated components. The base shall be a casting of iron, iron alloy, or composite polymer concrete or a fabricated steel weldment, ribbed and braced to minimize distortion and deflection. The base shall form a foundation for the entire machine and be integrally constructed with the column or be separately constructed with the column machined, securely attached, and in either case, be sufficiently rigid to maintain mutual component alignment for assuring accuracy required herein. The base shall have guideways that are proportioned to fully support the saddle and/or column and worktable throughout its full range of travel. The base shall have either access doors or removable plates for servicing internal components. Fluid reservoirs shall be either housed within the base or supplied as separate external units. The base shall have means for leveling and securing the machine to a mounting surface or foundation.

3.4.2 Column. The column shall be a casting of iron, iron alloy, or composite polymer concrete or a fabricated steel weldment. The column shall be of a box-like construction with adequate strength and proportions to sustain without distortion or deflection all dynamic forces imposed by full load machining operations. The machine shall be structured with either a stationary or sliding type column. If column movement is used to provide either X or Z axis movement, it shall be precision fitted to the guideways of the base. The X or Z axis movement shall be independently driven by a solid-state servo drive, with either a direct current (DC) permanent magnet or an alternating current (AC) servo motor coupled to a precision ground ball screw. The column shall be arranged to support and accommodate the machining head and spindle drive mechanism. Column slides and screws shall be shielded and protected from foreign contamination by either telescoping or curtain type way covers and way wipers.

3.4.3 Z axis. Transverse movement (Z axis) shall be accomplished by either a saddle supported by ways attached to the bed, machining head mounted in a saddle attached to a moving column, or a traversing spindle/quill assembly mounted in the machining head. The Z axis movement shall be capable of being secured in place, at any point over the entire travel range, by electrically locking the servo devices or another comparable means as directed by the numerical control unit.

3.4.4 Machine ways. Machine ways shall be hardened and ground with a minimum hardness of 60 Rockwell "C". When specified (see 6.2), ways shall be either integral to the machine or replaceable. The ways shall be of a type suitable for high grade precision numerically controlled machines covered by this specification. Movement of the slides on the way surfaces shall be through adjustable preloaded, recirculating roller bearing cartridges or nonmetallic way liners having a low coefficient of friction, with excellent slip-stick and damping properties. Protection of the machine ways shall be either telescoping or curtain type way covers and way wipers.

3.4.5 Pallet shuttle system. When specified (see 6.2), the machine shall have a pallet shuttle system arranged for the mechanized removal and precise reattachment of worktable tops. Unless otherwise specified (see 6.2), the system shall be comprised of a minimum of two duplicate pallets and a workchange mechanism which is functional for automatically transferring a pallet from the machine's work zone area to a workpiece load area while either simultaneously or

consecutively transferring and attaching the other pallet in the reverse process. The system shall be operated by the numerical control to accomplish automatic pallet change for the intervention except to start the cycle between programs. The complete automatic programmable pallet change shall be accomplished within 72 seconds. Control shall be included for automatic pallet change, inhibit, and manual cycle. Automatic pallet changes shall be preceded by an audio type warning signal for a period of not less than five seconds. A pallet change inhibit switch shall be provided in a location readily accessible by an operator who is at the off-line pallet.

3.4.6 Spindle assembly. Unless otherwise specified (see 6.2), the spindle shall be either fixed or tilting. When a tilting spindle is provided, it shall replace the vertical rotary milling table as the fifth axis of control for type II machines. The spindle shall be supported and held in axial and radial alignment by ball or roller bearings. The spindle shall be mounted in the machining head with its bearings designed and arranged to compensate for thermal expansion. The spindle shall have positive means for accepting, retaining and releasing tools and tool holders inserted by the automatic tool changer or operator. When specified (see 6.2), the spindle nose taper shall accept either size 40, 45 or 50 flange tool shanks complying with ANSI B5.50. The tool holder shall be held in the spindle by means of a retention knob and automatic drawbar. The spindle shall automatically stop rotation for tool changes, and shall be equipped to automatically orient to a preprogrammed position enabling the automatic tool changer to insert preprogrammed tools from the tool magazine. The spindle shall be capable of both clockwise and counterclockwise directions of rotation for accomplishing the full range of spindle speeds specified herein and shall be driven by a variable speed electric motor. The machine shall have overload protection which automatically stops the movement of all slides and the rotation of the spindle should it stall from overload. When specified (see 6.2), a high/low pressure (low pressure where applicable) coolant through the spindle shall be provided for deep hole drilling or operations where the cutting tool can not be reached with the standard coolant system. All spindle bearings, gears, shafts, and clutches shall be constantly flooded by temperature controlled lubricating oil or another proven suitable means to stabilize the machine and control spindle growth due to machine operation or changes in ambient temperature-when required to attain and ensure the dimensional accuracy stated within this specification.

3.4.7 Saddle. The saddle slide shall be a casting of iron, iron alloy or a fabricated steel weldment, rigidly constructed and precision fitted to the guideways of the base. The saddle shall also have guideways for supporting and traversing the worktable throughout its full range of travel. Guideways of the saddle and all other components of the machine shall be designed with friction characteristics that will permit precise control of slide movement without sticking or overshooting. Mating ways shall have means for holding them in alignment to prevent cutting forces from separating slide surfaces or distorting feed screws. The saddle shall be independently driven by a solid-state servo drive, with either a DC permanent magnet or an AC servo motor coupled to a precision ground ball screw. Means such as servo locks shall be provided that automatically secure slide surfaces in place immediately upon completing numerical control directed moves.

3.4.8 Rotary table. Types I and II machines shall be furnished with a horizontal rotary milling table. In addition the type II machines, unless otherwise specified (see 6.2), shall have for the fifth axis either a vertical rotary milling table, tilting rotary table or tilting spindle. When a vertical rotary milling table or tilting rotary table is furnished on type II machines, for the fifth axis, the table shall be equipped with quick disconnect electrical and hydraulic connections. Unless otherwise specified (see 6.2), the number, size and configuration of T-slots in the tables shall conform to the requirements of ANSI B5.1. The top of the worktables shall be machine finished for a work mounting surface. The table shall have coolant troughs or similar means for draining spent coolant into its reservoir. Edge block locators shall be provided on two adjacent sides of the table. The rotary tables for types I and II machines shall be capable of positioning as specified in table I at variable feedrates provided by the numerical control unit. The tables shall be independently driven by solid-state drives and servo motors. The rotary table shall be provided with an anti-backlash drive system and independent position feedback. The table and all slides shall be provided with an automatic positive means of securing machine components in place to permit accurate cuts under full horsepower without drifting.

3.4.9 Automatic tool changer. The machine shall be equipped with an automatic tool changer and storage magazine with, unless otherwise specified (see 6.2), a storage capacity as specified in table I. Tool change shall be accomplished automatically by a power activated arm which will interchange the tool in the spindle with a tool selected from the tool storage magazine. The storage magazine shall permit convenient loading and unloading of tool holders during operational setup. Random access tool selection capability shall be provided. The machine shall have the capability of reusing a tool that has been returned to the storage magazine after a programmed operation. The storage magazine shall be of the closed loop recirculating configuration.

3.4.10 Chip conveyor system. Unless otherwise specified (see 6.2), a chip conveyor system shall be provided to automatically remove chips from the work area and dump them into a container.

3.4.11 Coolant system. The coolant system shall include a sump or reservoir, a power driven pump, and all necessary piping. The sump or reservoir shall have sufficient capacity to permit full flow of coolant. The system shall have means for draining and cleaning and shall include a baffle or a strainer which is easily removable for cleaning. Means shall be provided to permit the operator to direct and control the amount of coolant over the entire work area.

3.4.12 Pneumatic system. The pneumatic system when required, shall conform to the requirements of ANSI B93.114M.

3.4.13 Hydraulic system. The hydraulic system shall conform to or exceed the requirements of JIC H-1. The hydraulic system shall be complete including all pumps, valves, piping, cylinders, and pressure controls. Overpressure protection shall be provided in the high pressure line to prevent damage to components. A filter system shall be provided to ensure delivery of clean fluid. The hydraulic reservoir shall have means for determining fluid level, a provision for draining, and a cleanout access plate if the reservoir is not removable.

3.4.14 Electrical requirements. The machine shall be wired to conform to NFPA 79. Each machine shall be wired to draw all of its electrical power from a single circuit. Unless otherwise specified (see 6.2), the machine shall be designed to operate on 230/460-volt, 3-phase, 60-Hertz (Hz) input power. The machine shall be initially wired for operation on the voltage (230 or 460 volts) specified by the procuring activity (see 6.2).

3.4.14.1 Motors. Motors shall be rated for continuous duty and shall have ball or roller bearings of the sealed and permanently lubricated type. All motors (except axis motors, see 3.4.14.2) shall conform to the requirements of NEMA MG 1. Unless otherwise specified (see 6.2), motors shall be AC, 60-Hz, or DC industrial-type motors with dripproof enclosures. Each motor control shall conform to the requirements of NEMA ICS 1 and NEMA ICS 3.

3.4.14.2 Axis motor(s) and motor controls. Unless otherwise specified (see 6.2), axis motors shall be DC or AC, permanent magnet, servo-type motors with ball or roller bearings of the sealed and permanently lubricated type. The motor enclosures shall be totally enclosed, nonventilated (TENV) with provision for mounting a cooling fan and motor. Unless otherwise specified (see 6.2), the axis motor controls shall be silicon controlled rectifier (SCR) or pulse-width modulated (PWM) solid-state type controls. Each motor and control shall conform to the requirements of NEMA MG-7.

3.4.15 Worklight. When specified (see 6.2), a worklight shall be provided. The light shall have a protective shield, an on-off switch, and shall be adjustable to reflect maximum light on the work area. If a built-in lighting system is provided, the adjustable light described above shall not be required.

3.4.16 Hour meter. When specified (see 6.2), the machine shall be equipped with an hour meter. The hour meter shall be installed to display accumulated operating time for the main drive motor. The meter shall be of the nonresetting type and shall have a range of 0 to 99,999 hours in increments of not greater than 1 hour. The meter shall be sealed to prevent the entrance of dust and moisture and shall be mounted to withstand shock and vibration generated by the machine.

3.4.17 Computer numerical control (CNC). The machining center shall have a fully automatic solid-state soft-wired, integrated circuit, microprocessor-based type computer numerical control. The machine control unit (MCU) shall provide automatic control of machine functions, operating modes, 4 axes movement for type I machines and 5 axes movement for type II machines, spindle operation, tool change, and other part program directed functions for machining centers of the type specified herein. Controlled axes shall be identified in accordance with EIA Standard RS-267. The control shall have linear and circular interpolation and be capable of simultaneous control of 4 axes for type I machines and 5 axes for type II machines. Control features shall include manual data input (MDI), programmable interface, buffer storage, fixed cycles, part program storage, part program and buffer edit capability, and control diagnostics. The MCU shall direct machine functions from command data stored in memory. The data stored in memory shall be input by the media specified herein or MDI from a full ASCII keyboard. The control shall initiate a halt or an error signal should a fault condition occur in the control. All necessary executive program routines shall be furnished in the form of 1-inch, eigth-channel binary-coded decimal punched tape in conformance

with EIA Standard RS-227 or 3-1/2-inch diskettes for controls having volatile memories or erasable programmable read only memory (EPROM) chips. When executive programs are supplied in the form of EPROM, complete documentation sufficient to interpret and duplicate shall be provided or one additional EPROM chip shall be provided by the manufacturer. A line voltage of $\pm$10 percent from normal shall not adversely affect the numerical control system function. The control shall be capable of functioning in ambient temperatures ranging from 50^{0} to 120^{0} Fahrenheit (F) and humidity ranging from 5 to 95 percent noncondensing. The control shall automatically shut down when internal operating temperature exceeds safe operating temperature. Control resolution shall be 0.0001 inch or 0.001mm for each linear axis and not more than 0.001 of a degree for each rotary axis. The control shall also provide the following:

a. A 9-, 12- or 14-inch monochrome or multi-color Cathode Ray Tube (CRT) shall be provided.

b. Unless otherwise specified (see 6.2), a photoelectric tape reader shall be provided that is capable of reading a minimum of 300 characters per second with standard feed and take up spools 5 1/4 inches in diameter.

c. Automatic tape code recognition, in conformance with EIA Standards RS-244 and RS-358.

d. Decimal point programming.

e. Preparatory functions (G-codes) and miscellaneous functions (M-codes) in accordance with EIA Standard RS-274

f. Programmable software travel limits.

g. Direct revolutions per minute (RPM) programming.

h. Programmable dwell.

i. Absolute/Incremental input.

j. Inch/Metric switchable data input.

k. Mirror image.

l. Plane selection.

m. Feedrate programming - inches per minute(IPM)/millimeters per minute (MMPM)

n. Fixed cycles, G80 series.

o. Dry run, no motion test with graphics.

p. Spindle speed override (50 to 120 percent) and axis feedrate override (0 to 120 percent).

q. Peripheral equipment interface complying with EIA Standards RS-232 and RS-449, unless otherwise specified (see 6.2).

r. Cutter diameter compensation and tool length offsets.

s. Automatic acceleration/deceleration all axes.

t. Parametric programming.

u. Linear axis jog for each axis, continuous and incremental modes.

v. Leadscrew pitch error compensation.

w. Reversal error compensation.

x. Axis error compensation.

y. Fixture error compensation.

z. Multi-quadrant circular interpolation.

aa. Standby battery power for controls with volatile memories shall be a minimum of 72 hours, unless otherwise specified (see 6.2).

bb. Unless otherwise specified (see 6.2), the control shall be capable of storing in memory not less than 100 feet of part programs. Part program storage shall be either solid-state, magnetic bubble memory, Winchester hard disk/flexible disk drive combination units or single/or double flexible disk drive units as specified (see 6.2).

cc. Buffer storage: The buffer shall store transferred command data from the specified input media to internal storage without delaying the next incoming command and without interrupting the machine functions.

dd. Graphics software shall be provided which shall allow for on-screen display of part geometry and tool path verification. Software functions shall be menu driven with interactive conversational prompting to allow for programming at the MCU through the MDI keyboard.

ee. Cycle start/feed hold.

ff. Program edit, change, add and block delete. The control shall be capable of performing editing functions while simultaneously running another part program.

gg. Sequence number search forward and reverse.

hh. Reference zero (all axes home position).

ii. Floating zero.

jj. Plus and minus programming.

kk. Programmable macros.

ll. Threading cutting capabilities.

3.4.17.1 Additional (CNC) features. The following options are available for computerized numerical controls. Additional features shall be as specified and fully described (see 6.2).

a. Tool life management.
b. Programmable tool retract.
c. Adaptive control.
d. Parabolic interpolation.
e. Helical interpolation.
f. Cubic interpolation.
g. Digitizing.
h. Scanning.
i. Zone inhibit programming.
j. Axis inhibit.
k. Probe interface.
l. Polar coordinate programming.
m. Inverse time feedrate programming.

3.4.17.2 Postprocessor. When specified (see 6.2), the system shall be furnished with a postprocessor program(s) to be utilized in off-line computer-assisted preparation of part programs. The postprocessor shall be provided for converting specified programming language (see 6.2) to the form and format required to operate the machine tool and control. The postprocessor shall be written for use on the type computer specified (see 6.2). Documentation sufficient to implement and utilize the postprocessor shall be provided for computer compatibility verification and validation at least 30 days prior to delivery of the machining center.

3.4.17.3 Punched tape data input. Unless otherwise specified (see 6.2), the input media for the control shall be 1-inch, eight-channel punched-tape conforming to EIA Standard RS-227. The data input format and codes shall comply with EIA Standard RS-274 and both EIA Standards RS-244 and RS-358.

3.4.17.3.1 Tape punch unit. When specified (see 6.2), the system shall have a tape punch unit for producing punched tapes from edited programs of tape being input and for programs stored in data memory. The unit shall have a plug receptacle and circuitry that is compatible with the tape punch output of the system, punching both paper and mylar tapes of dimensions, characteristics, and code in accordance with 3.4.17.3.

3.4.17.4 Diskette input. When specified (see 6.2), a portable diskette reader/writer shall be provided with all the hardware and software necessary and interface between the control and the reader/writer. The reader/writer shall receive and store part program data from the control unit and be capable of loading stored programs to the memory of the control unit. Part program storage shall be on a 3-1/2-inch diskette. The diskette shall meet the requirements of

ANSI/ISO 8860/1, ANSI/ISO 8860/2, and ANSI/ISO 9293. The communication between the reader/writer shall be by means of EIA RS-232 communication ports.

3.4.17.5 Binary Cutter Location (BCL). When 32 Bit Binary Cutter Location (BCL) Exchange Input for Numerically Controlled Machines is specified (see 6.2), the input media shall be a 3-1/2-inch diskette and shall meet the requirements of ANSI/ISO 8860/1, ANSI/ISO 8860/2, and ANSI/ISO 9293. The input data format shall comply with EIA Standard RS-494. Functions 10.1, 10.2 and 10.3 of Section 10, EIA-RS-494 shall apply. Manufacturers providing functions or features that can not be addressed by command codes currently covered by EIA-RS-494 shall apply to the Electronic Industries Association, IE-31 Committee on Numerical Control Systems and Equipment for an extension of the standard codes to cover the new features or functions. A diskette reader/writer shall be provided with all the hardware and software necessary and interface between the control and the reader/writer. The reader/writer shall receive and store part program data from the control unit and be capable of loading stored programs to the memory of the control unit. The communication between the reader/writer shall be by means of EIA-RS-232 communication ports.

3.4.17.6 Programmable interface. A software program for accommodating the softwired interface between the numerical control and machine shall be provided either in the control as nonvolatile memory or as a separate program that is compatible with the input media specified herein by the procuring activity.

3.4.17.7 Maintenance diagnostics system. Maintenance diagnostics software shall be furnished either in the control as nonvolatile memory or as a separate program that is compatible with the input media specified herein by the procuring activity. The diagnostic software shall test, exercise, and display failures, at least to board level.

3.4.17.8 Operator control panel. Unless otherwise specified (see 6.2), the control unit shall have a control panel which provides at least the following control functions: Emergency Stop; Cycle Start; Optional Stop; Mode Selection; Feed Hold; Feedrate Override; Spindle Speed Override; Jog; Jog Direction; and EOB Stop.

3.4.17.8.1 Pendant control. When specified (see 6.2), a pendant control shall be furnished as an operator control panel. The pendant control shall be connected to the machine to enable the operator to control machine functions while in a close observation position. Unless otherwise specified (see 6.2), the pendant control shall be capable of the same functions as stated for the operator control panel in paragraph 3.4.17.8.

3.5 Size and capacity. Unless otherwise specified (see 6.2), the size and capacity of the machine shall meet the requirements of table I for the machine specified. Machine size and capacity shall be not less than the stated requirements of the size ordered. When a range is given, the required performance shall be from the stated minimum or less to the stated maximum or greater.

3.5.1 Physical size limitations. When specified (see 6.2), the physical size of the machine shall not exceed the height, width, and length restrictions

specified by the procuring activity to ensure the machine will fit in its future operating location.

3.6 Alignment tolerances. Each machine shall meet the alignment tolerances specified in table III.

3.7 Performance. The machine and numerical control system combination shall be capable of performing as specified herein. In addition, the machine shall be capable of performing drilling, tapping, milling and boring to accomplish the capacities of table I while meeting the accuracies of Table II.

3.7.1 Additional performance requirements. Performance features required in addition to, or in lieu of, the requirements herein shall be as specified and fully described (see 6.2).

3.8 Standard equipment. All standard equipment normally provided with the manufacturer's commercial machine shall be furnished.

3.9 Optional and accessory equipment. Optional and accessory equipment shall be furnished as specified and fully described (see 6.2). The equipment provided shall be functional without requiring modification of the equipment or machine.

3.10 Marking on instruments, control panels, charts, and plates. All words on instruments, control panels, charts, and plates shall be in the English language. Characters shall be permanently marked in boldface on a contrasting background. All plates shall be corrosion resistant.

3.10.1 Lubrication plate. When specified (see 6.2), a lubrication plate shall be attached to each machine. Unless otherwise specified (see 6.2), the information provided on the plate shall be as listed below.

Points of lubricant application
Type of lubricant
Servicing interval
Military or Federal specification for each lubricant (if applicable)

3.10.2 Nameplate. A nameplate shall be securely attached to each machine. Unless otherwise specified (see 6.2), the nameplate shall contain the information listed below.

Nomenclature
Manufacturer's name
Manufacturer's model designation
Manufacturer's serial number
Power input (volts, total amps, phase, frequency)
Amp rating of largest motor
Short circuit/over-current protection rating
Contract Number or Order Number
National Stock Number or Plant Equipment Code
Date of manufacture

3.10.3 Hydraulic fluid requirements plate. When specified (see 6.2), a hydraulic fluid requirements plate shall be attached to the machine at the hydraulic reservoir fill point. Unless otherwise specified (see 6.2), the plate shall contain the following information.

Type of fluid (SAE or Military or Federal specification number)
Type of filter

3.11 Workmanship. Workmanship of the machine and its accessories shall meet all requirements specified herein and shall be of a quality equal to that prevailing among manufacturers producing equipment of the type covered by this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspections set forth in this specification shall become a part of the contractors overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submissions of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.4).

b. Quality conformance inspection (see 4.5).

c. Acceptance test (see 4.6).

4.3 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be performed in accordance with the test conditions specified in 4.8.1.

4.4 First article inspection. When a first article inspection is required, it shall be applied to the first article submitted in accordance with 3.1. Unless otherwise specified (see 6.2), first article inspection shall consist of the

examination in 4.7 and all tests in 4.8. The machine shall pass the examination and all tests to be accepted.

4.5 Quality conformance inspection. Quality conformance inspection shall be applied to each item prior to being offered for acceptance under the contract. Unless otherwise specified (see 6.2), quality conformance inspection shall consist of the examination in 4.7, the tests in 4.8, and the inspection in 4.9. The machine shall pass the examination, all tests, and the inspection to be accepted.

4.6 Acceptance test. Acceptance test shall be performed on each machine to ensure conformance with this specification. Unless otherwise specified (see 6.2), the acceptance test shall be performed only after the machine is installed at its final location. The acceptance test shall consist of the examination in 4.7 and all tests in 4.8. The machine shall pass the examination and all tests to be accepted.

4.7 Examination. The machine shall be examined to determine compliance with all requirements of this specification.

4.8 Tests.

4.8.1 Test conditions. All tests shall be performed in an indoor facility with ambient conditions of 41° to 104° F and 20 to 95 percent relative humidity.

4.8.2 Operational test. Each machine shall be operated under numerical control for a period of 8 hours without load. The numerical control program shall cycle each axis through its entire range, addressing all speeds, feeds, direction of rotation, standard and optional control functions specified in this document. Proper operation of all machine functions, controls, motors, adjusting mechanisms, tool changes and accessories shall be verified during the test period. The numerical control system shall be further tested to verify proper operation of MDI, program edit, graphics and system diagnostics. Should a malfunction occur, it shall be corrected and the operational test repeated until a full 8 hours of running time is completed without failure.

4.8.3 Alignment tolerance test. Each machine shall be tested to determine compliance with the alignment tolerance requirements of 3.6. The alignment tolerance test shall be performed prior to and subsequent to the performance test(s) given in 4.8.4 through 4.8.4.10. Any machine adjustments required to comply with 3.6 during or after the performance test shall be cause for rejection.

4.8.4 Performance test. While using either one or more test setups devised by the supplier, the machine shall be tested to verify its ability to perform machining operations under numerical control for meeting the accuracy tolerances of table II. The test piece(s) shall be, at the supplier's option, steel, cast iron or aluminum and the tool(s), spindle speed and feed rate for each test shall be selected by the supplier as the most suitable for the particular operation being performed. The test piece(s) shall present a work surface normal to the tool point and approximately centered with reference to the work area in the X Y plane. In milling and contouring test(s), successive cuts may be made inside the outlines of previous cuts and roughing cuts may be made in the various cuts with excess metal removed as desired to make measurements convenient.

4.8.4.1 Tapping test. Eight holes shall be pilot drilled and tapped at programmed locations; four with finished threads to accept 8-32 screws and four with finished threads to accept 3/4-10 screws. Finished threads shall meet Class 3 standards for internal threads as set forth in Handbook H28.

4.8.4.2 Boring test. A minimum of 10 holes shall be pilot drilled, semi-finish bored, and finish bored in a selected pattern covering an area not less than 14-inch in diameter. Four of the holes shall be spaced on 14-inch centers. Different tools shall be used for semi-finish and finish boring operations. Each address shall be to the fourth decimal place with digits other than zero. Finished hole size may range from 1.125 to 2.750 inches. The resulting hole location and hole size errors shall not exceed the permissible tolerance of table II for boring.

4.8.4.3 Straight-line milling test. The straight-line milling test shall be a programmed square or rectangle, not less than 6 inches in length per side with sides parallel to the travel along X and Y axis. Machine angle shall be not less than 2^{0}. The resulting cuts shall be checked for dimensional accuracy, squareness, parallelism, flatness, angularity, and corner locations to verify the accuracy required in table II for straight-line milling.

4.8.4.4 Circle contouring test. A circle shall be programmed and milled within the outline of the square cut required in 4.8.4.3. The cut shall be made at constant Z-axis depth of 0.500 inches and by using the MCU resolution. The resulting cut shall be checked for dimensional accuracy, roundness, surface finish, and angularity to verify the accuracy required in table II for circle contouring.

4.8.4.5 Straight-line contouring test. Either a square or an equilateral triangle shall be programmed and milled within the circle cut and described by 4.8.4.4 at constant depth of 0.500 inch. The reference line for one side of the square or triangle shall be 10 to 20 angular degrees slanted to the Y axis. The resulting cut shall be checked for dimensional accuracy, squareness and angularity to verify the accuracy required in table II for straight-line contouring.

4.8.4.6 Transverse tilt cutting test. A transverse tilt cutting test shall be performed in accordance with NAS-979 April 1966 Revision 1, 15 January 1969, paragraph 4.3.3.6.

4.8.4.7 Longitudinal tilt cutting test. A longitudinal tilt cutting test shall be performed in accordance with NAS-979 April 1966 Revision 1, 15 January 1969, paragraph 4.3.3.7.

4.8.4.8 Profile-cone frustum cutting test. A profile-cone frustum cutting test shall be performed on type II machines only in accordance with NAS-979 1966 Revision 1, 15 January 1969, paragraph 4.3.3.8.

4.8.4.9 Maximum horsepower test. Using a workpiece of SAE 1020 steel, a straight cut of not less than 12 inches in length shall be made with either a face mill or shell end mill. Diameter of the cutter and spindle speed shall be determined by the supplier to be suitable for making the cut with specified chip

load and peripheral cutter speeds. The depth of the cut shall be as required to load the spindle motor to its maximum rated horsepower. Chip load shall be 0.010 ±0.01 inches and peripheral cutter speed shall not exceed 300 feet per minute. The cutting action shall be smooth and even and the finished workpiece shall show no evidence of tool chatter. In addition there shall be no evidence of overheating of the spindle drive motor or the applicable feed motor.

4.8.4.10 Test program verification. Unless otherwise specified (see 6.2), while using one or more test setups devised by the supplier, the machining test program (tape) required under postprocessor validation (see 3.4.17.2), shall be run on the machining center to verify its ability to receive and perform all program functions without malfunction or error. The test piece(s) shall be either steel, cast iron, or aluminum, while the tooling shall be selected by the supplier as the most suitable for the particular operation performed.

4.8.4.11 Additional performance tests. Performance tests required in addition to or in lieu of the requirements given in 4.8.4 shall be as specified and fully described (see 6.2).

4.8.5 Environmental protection certification of conformance. The contractor shall certify and maintain substantiating evidence that the product offered complies with all environmental protection restrictions as required in 3.2.6. The Government reserves the right to require proof of such conformance prior to first delivery and thereafter as may be otherwise provided for under the provisions of the contract.

4.8.6 Electromagnetic interference control test. Equipment requiring electromagnetic interference control shall be tested for compliance with 3.3.8 using the procedures given in MIL-STD-462.

4.9 Packaging inspection. Packaging of each item shall be inspected to determine compliance with the requirements of section 5.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-18058.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The numerically controlled machines covered by this specification are intended for use in any production shop where drilling, boring, tapping, reaming, and milling operations by numerical control of the machine are required. The machine may be used to produce prototype parts from a taped process or to produce production items repetitively from a proven process, to accuracies within the capabilities of the machine.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Type, class, and size required (see 1.2).

c. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).

d. First article, if required (see 3.1).

e. Additional safety and health requirements, if required (see 3.2.4).

f. Specify configuration of additional point-of-operation guarding, if required (see 3.2.4).

g. Specify environmental protection requirements, if required (see 3.2.5).

h. Painting, if different (see 3.3.5).

i. If electromagnetic interference control is required, specify the equipment and subsystem class and the emission and susceptibility requirements (see 3.3.8).

j. Specify type of machine ways, integral or replacable, (see 3.4.4).

k. Specify and fully described pallet shuttle system, if required (3.4.5).

l. Specify spindle type, if different (see 3.4.6).

m. Specify spindle taper, if different (see 3.4.6).

n. Coolant through the spindle, if required (3.4.6)

o. Specify the desired type of fifth axis, if required (3.4.8).

p. Specify the number, size and configuration of T-slots, if different (see 3.4.8).

q. Specify the desired number of tools, if different (see 3.4.9).

r. Chip conveyor system, if required (see 3.4.10).

s. Electrical system, electrical supply, and voltage for initial wiring, if different (see 3.4.14).

t. Motors, if different (see 3.4.14.1).

u. Axis motors, if different (3.4.14.2).

v. Axis motor controls, if different (see 3.4.14.2).

w. Worklight, if required (see 3.4.15).

x. Hour meter, if required (3.4.16).

y. Photoelectric tape reader, if different (see 3.4.17b).

z. Peripheral equipment interface, if different (see 3.4.17q).

aa. Specify the number of hours of standby battery power needed, if different (see 3.4.17aa).

bb. Specify part program storage capacity (in feet), if different (see 3.4.17bb).

cc. Specify and fully described type of part program storage media required (see 3.4.17bb).

dd. Specify and fully describe additional CNC features, when required (see 3.4.17.1).

ee. Postprocessor, specify computer name and model, form and format, if required (see 3.4.17.2).

ff. Specify data input media, if different,(see 3.4.17.3).

gg. Specify tape punch unit, if required (see 3.4.17.3.1).

hh. Specify diskette input, if required (see 3.4.17.4).

ii. Specify EIA Standard RS-494 Binary Cutter Location, if required (see 3.4.17.5).

jj. Operator control panel functions, if different (see 3.4.17.8).

kk Specify pendant control, if required (see 3.4.17.8.1)

ll. Pendant control panel functions, if required (see 3.4.17.8.1).

mm. Size and capacity, if different (see 3.5).

nn. Specify physical size limitation, if required (see 3.5.1).

oo. Additional performance requirements, if required (see 3.7.1).

pp. Specify and fully describe optional and accessory equipment, if required (see 3.9).

qq. Lubrication plate, if required (see 3.10.1)

rr. Lubrication plate information, if different (see 3.10.1).

ss. Nameplate information, if different (3.10.2).

tt. Hydraulic plate, if different (see 3.10.3).

uu. Hydraulic plate information, if different (see 3.10.3).

vv. Inspection conditions, if different (see 4.3).

ww. First article inspection, if different (see 4.4).

xx. Quality conformance inspection, if different (4.5).

yy. Acceptance test, if different (see 4.6).

zz. Test program verification, if different (see 4.8.4.10)

aaa. Additional performance tests, if required (see 4.8.4.11).

bbb. Electromagnetic interference control test requirements, if different (see 4.8.6).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Description (DIDs) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/ provided and that the DIDs are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
N/A	DI-TMSS-80527	Commercial Off-The-Shelf (COTS) Manuals	Require all data be in the English language
N/A	DI-TMSS-80528	Supplemental Data for Commercial Off-The-Shelf (COTS) Manuals	Require all data be in the English language

The above DIDs were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DIDs are cited on the DD Formal 1423.

6.4 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a first article sample, a first production item, or a standard production item from the contractor's current inventory and the number of items to be tested as specified in 4.4. The contracting officer should include specific instructions in

acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.5 Definitions.

6.5.1 Inch-pound units. Inch-pound units are a system of measures based on the yard and pound commonly used in the United States of America and defined by the National Institute of Standards and Technology. Inch-pound units having the same names in other countries may differ in magnitude.

6.5.2 Metric units. Metric units are a system of basic measures defined by the International System of Units based on "Le System International D'Units (SI)," of the International Bureau of Weights and Measures. These units are described in ASTM E 380 and IEEE 268 (MIL-STD-961).

6.6 Measurement system. In this specification, all measurements, dimensions, sizes, and capacities are given in inch-pound units. These measurements may be converted to metric units through the use of the conversion factors and methods specified in FED-STD-376.

6.7 Cross-reference of classification changes. Classification changes from the previous issue of this specification are as follows:

MIL-M-80263	MIL-M-80263A
Class A, Size 2, 30 inches (Y - Axis)	Delete Class A, Size 2a (New) Class E, Size 4 (New)

6.8 Changes from previous issues. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

6.9 Safety and health requirements. OSHA 29 CFR 1910 limits only the total hazard level (noise, radiation, electromagnetic emissions, noxious vapors, air contaminants, and heat) of the environment in which a machine will operate. It does not limit the hazard level of individual machines in an operating environment. The procuring activity should analyze the existing hazard level in the proposed operating environment and specify additional requirements necessary to integrate this new machine into its future environment.

6.10 Hazardous materials minimization. The manufacturer should minimize the use, generation, or emission of materials known hazardous to the environment during the manufacturing processes employed at his facilities. During the production of an end item, the manufacturer should comply with all applicable Federal, state, and local statutes in effect at the point of production which

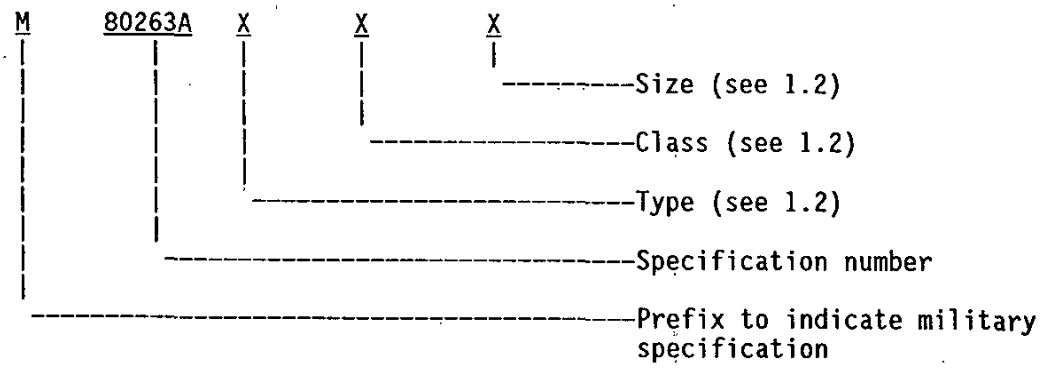
regulate the use of hazardous materials. Where practical, alternative materials or processes should be employed in lieu of known hazardous materials or processes to minimize the threat to the environment.

6.11 Training. Training required by the procuring activity should be provided as specified in the contract.

6.12 Warranty. Warranty requirements should be as specified by the procuring activity in the contract.

6.13 Inspection location. The contractor should identify in his response to the solicitation the location where inspection and tests are to be performed.

6.14 Part or Identifying Number (PIN). The PIN to be used for machines acquired to this specification are created as follows:



6.15 Subject term (keyword) listing.

Axis
Chip conveyor
Diagnostics
Flexible diskette
Postprocessor
Rotary table
Software
Tool changer

Table I - Sizes and capacities.

Characteristics	Class A			Class B			
	Size 1	Size 2a	Size 3	Size 1	Size 2	Size 3	Size 4
Spindle horsepower	10	10	10	15	15	15	15
NC Axis Range:							
X - travel	20	40	60	24	30	60	84
Y - travel	15	23	36	20	22	36	36
Z - travel	16	18	18	18	18	31	31
Spindle carrier:							
No. speeds	Infinite						
Range (rpm)	10-3750	10-2000	40-3000	4-2400	10-3150	30-3000	30-3000
Axis drives:							
Feedrate-X-Y-(ipm)	.1-150	.1-150	.5-100	.1-100	.1-150	.1-150	.1-150
Feedrate-Z-(ipm)	.1-150	.1-150	.5-100	.1-100	.1-150	.1-150	.1-150
Rapid traverse (ipm)	400	400	400	400	400	400	400
Tool changer/storage:							
Storage capacity	24	30	40	24	24	30	30
Tool Dia. (inch)	4-1/4	5	5	4-1/4	6	4-1/2	4-1/2
Tool length (inch)	11	16	16	12	12	15	15
Tool weight (lbs)	17	20	20	16	26	30	30
4-Axis machines only							
Horiz. rotary table							
Size (inch)	17	20	22	16	22	24	24
No. of positions	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Feedrate (rpm)	4	4	4	2.5	4	3	3
Load capacity (lbs)	750	2000	2200	1400	2200	2200	2200
5-axis machines only							
Horiz. rotary table							
Size (inch)	17	20	22	16	22	24	24
Degree of Rotation	110	255	255	110	110	110	110
Feedrate (rpm)	4	4	4	2.5	4	3	3
Load capacity (lbs)	750	2000	2200	1400	2200	2200	2200
Vertical rotary table							
Size (inch)	12	14	24	13	24	24	24
No. of positions	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Feedrate (rpm)	4	4	4	2.5	4	3	3
Load capacity (lbs)	500	500	500	500	500	1000	1000

TABLE I. - Sizes and capacities. (Continued)

Characteristics	Class C	Class D			Class E			
	Size 1	Size 1	Size 2	Size 3	Size 1	Size 2	Size 3	Size 4
Spindle horsepower	20	25	25	25	30	30	40	40
NC Axis range:								
X - travel	43	30	40	72	36	48	72	96
Y - travel	35	22	32	48	24	36	48	72
Z - travel	26	18	26	30	18	28	36	36
Spindle carrier:								
No. Speeds	Infinite							
Range (rpm)	10-3000	20-3000	15-3000	10-2500	20-3000	20-3000	10-2000	20-2000
Axis drives:								
Feedrate-X-Y-(ipm)	.1-150	.1-100	.1-100	.1-100	.1-100	1-100	.1-100	.1-100
Feedrate-Z-(ipm)	1-150	.1-100	.1-100	.1-100	.1-100	1-100	.1-100	.1-100
Rapid traverse (ipm)	300	300	300	200	300	300	200	200
Tool changer/storage:								
Storage capacity	25	24	30	36	28	36	40	40
Tool Dia. (inch)	4	4-1/4	5-1/2	8	5-1/2	5-1/2	5-1/2	7-3/4
Tool length (inch)	15	16	16	18	18	18	18	18
Tool weight (lbs)	40	50	50	50	50	50	50	50
4-Axis machines only								
Horiz. rotary table								
Size (inch)	20	20	24	40	20	28	32	40
No. of positions	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Feedrate (rpm)	4	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Load capacity (lbs.	2000	2000	2200	5000	2000	5000	5000	5000
5-Axis machines only								
Horiz. rotary table								
Size (inch)	20	22	24	40	20	28	32	40
Degree of rotation	255	110	150	255	255	255	255	255
Feedrate (rpm)	4	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Load capacity (lbs)	2000	3000	2200	5000	2000	5000	5000	5000
Vertical rotary table								
Size (inch)	24	13	14	30	18	24	30	40
No. of positions	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Feedrate (rpm)	4	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Load capacity (lbs)	700	700	700	700	700	700	700	700
Substitutes for vertical rotary table								
Fifth axis on applicable machines								
Tilting table:								
(degrees)				90		90	90	90
Tilting spindle:								
(degrees)			150	150		150	150	150

TABLE II - Performance accuracy.

Machining Operation	Accuracy (permissible Tolerance)
Drilling:	
Hole size	±0.005"
Hole depth	±0.005"
Tapping:	
Threaded holes shall be Class III fit in accordance with FED-STD-H28	
Boring and counterboring:	
Hole location, based on centerline distance of bored holes, 2 holes 18" apart	±0.0015"
Hole size, maximum speed, hole to hole	±0.0005"
Depth of counterbore	±0.0005"
Milling (straight-line):	
Squareness of sides	±0.0015"/ft
Parallelism of opposing sides	±0.0015"/ft
Flatness	±0.001"/ft
Angularity of ramp cuts	±0.0024"/ft
Corner location, deviation from programmed points	±0.001"
Surface finish, maximum roughness	64 rms
Contouring (circle):	
Roundness	
Diameters measured at 30 degree intervals	±0.003"
Angularity, difference between programmed and actual points of Tangency of circles to straight surfaces	0.001"
Contouring (straight-line):	
Squareness of sides	0.0015"/ft
Angularity of sides	0.0015"/ft

TABLE III - Alignment and accuracy.

Component characteristics	Permissible tolerance
Spindle axial runout	0.0002"TIR
Spindle radial runout:	
1" from spindle nose	0.0005" TIR
8" from spindle nose	0.001" TIR
Spindle centerline to X and Y axis	0.0005"/FT
All linear axis travel square to each other	0.0006/FT and 0.001"TIR
Key slots/edge locators parallel with longitudinal axes movement	0.0005"/FT
Key slots/Edge locators on rotary tables shall be located in relation to the center of rotation within	0.001" TIR
Worktable/Pallet working surface parallel with ZX plane checked at a point 8" from center of rotation at four positions; and 0^{o},90^{o}, 180^{o} and 270^{o} index (4 point check)	0.001" TIR (not to exceed 0.002" when multiple number furnished)
Worktable working surface rise-fall checked over full range of travel	0.001"/FT
Accuracies over full travel, bidirectional:	
Longitudinal (X-axis)	accuracy ±0.0005"in 30"
	repeatability ±0.0003"in 30"
Vertical (Y-axis)	accuracy ±0.0005"in 30"
	repeatability ±0.0003"in 30"
Traverse (Z-axis)	accuracy ±0.0005"in 30"
	repeatability ±0.0003"in 30"
Contouring table:	
360,000 positions	accuracy ± 10 sec
	repeatability ±5 sec

Custodians:
Army - AL
Navy - SH
Air Force - 99

Review activities:
Army - AL
Navy - SH, AS
Air Force - 84
DLA - GS

Preparing activity:
DLA - IP

Project (3408-0027)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-M-80263A	2. DOCUMENT DATE (YYMMDD) 901019

3. DOCUMENT TITLE
Machining Centers, Horizontal, Single Spindle 4- and 5-Axis, Computer Numerical Control (CNC)

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME Defense Industrial Plant Equipment Center	b. TELEPHONE (Include Area Code) (1) Commercial 901-775-4790 (2) AUTOVON 683-4790
c. ADDRESS (Include Zip Code) ATTN: DIPEC-SSM 2163 Airways Blvd, Memphis, TN 38114-5051	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340