

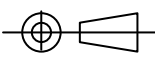
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THIRD ANGLE PROJECTION		CUSTODIAN ENGINEERING MANAGEMENT COMMITTEE	REVISION 1
PROCUREMENT SPECIFICATION	TITLE NUMERICALLY CONTROLLED MILLING MACHINES, KNEE AND BED TYPE, HORIZONTAL AND VERTICAL	①	CLASSIFICATION SPECIFICATION DIAS984
NONE			SHEET 1 OF 26



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1000 WILSON BLVD.
ARLINGTON, VA 22209

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REVISION DATE:

FORM 12-01

REVISION DATE: APRIL 30, 2013

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TABLES

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NAS984

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1. SCOPE

1.1 Purpose

This specification provides a standard for the manufacture, performance, inspection, and procurement of a series of numerically controlled, horizontal and vertical spindle, knee and bed type profilers. This standard lists minimum requirements and is not to limit design advances.

1.2 Classification

The machines shall be of the following types, sizes, and classes.

1.2.1 Type

- I Knee Type – Vertical
- II Knee Type – Horizontal
- III Bed Type – Vertical
- IV Bed Type – Horizontal

1.2.2 Size

Small, medium, and large per Section 3.2.

1.2.3 Class

Numerically controlled, three axes, AIA Class IV Contouring and Profiling.

1.3 Intended Use

The machines described by this specification are intended for use within the aerospace industry and provide the preferred characteristics for efficiently machining all aerospace materials, including aluminum, magnesium, steels, super alloys, refractories and other thermal resistant materials.

2. APPLICABLE DOCUMENTS

The latest revision of the following specifications, codes, and standards are included as a portion of this specification. Detail requirements of this specification shall override any contradictory portions of the following specifications, codes, and standards.

State and Local Safety and Electrical Codes (3.8)

Illinois Institute of Technology Research Institute

Illinois Institute of Technology Research Institute (ITTRI) Standards for APT Programming Language (3.14.3)

TechAmerica

EIA-RS-281-B Electrical and Construction Standards for Numerical Machine Control (3.3.2.21)

Copies can be obtained from TechAmerica, 601 Pennsylvania Avenue NW, North Building, Suite 600, Washington, D.C. 20004. www.techamerica.org

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ASME

- ASME B5.1M T-Slots, Their Bolts, Nuts, and Tongues (3.4.1)
- ASME B5.18 Spindle Noses and Tool Shanks for Milling Machines (3.3.1.5)
- ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay) (8.1.4)
- ASME BPVC Boiler and Pressure Vessel Code, Section VIII (3.10)

Copies can be obtained from ASME, Three Park Ave., New York, NY 10016-5990. www.asme.org

Aerospace Industries Association

- NAS938 Machine Axis and Motion Nomenclature (3.3.2.12)
- NAS953 Numerical Control System (3.13.1)
- NAS955 Interchangeable Tape Standards, Variable Block Format, Contouring and Contouring/Positioning Numerically Controlled Equipment (3.3.2.1)
- NAS968 Interchangeable Digital Magnetic Tape Standards, Variable Block, Word Address Format, Contouring and Contouring/Positioning Equipment (3.3.2.1)
- NAS969 Interchangeable Digital Magnetic Tape Cartridge for Numerically Controlled Machines (3.3.2.3)
- NAS972 Glossary of Manufacturing Equipment Terms (8.1)
- NAS979 Uniform Cutting Tests, NAS Series Metal Cutting Equipment Specifications (4.2.6, 4.3.5)

Copies can be obtained from the Aerospace Industries Association, 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209. www.aia-aerospace.org

National Fire Protection Association

- NFPA 70 National Electrical Code (3.5)
- NFPA 79 Electrical Standard for Industrial Machinery (3.5, 3.5.3, 5.8)

Copies can be obtained from NFPA, 1 Batterymarch Park, Quincy, MA 02169. www.nfpa.org

International Organization for Standardization

- ISO 4413 Hydraulic fluid power – General Rules and Safety Requirements for Systems and their Components (3.6, 5.9)
- ISO 4414 Pneumatic fluid power – General Rules and Safety Requirements for Systems and their Components (5.10)

Copies can be obtained from ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56 - CH-1211 Geneva 20, Switzerland. www.iso.org

Association of American Railroads

- AAR DPA21 Minimum Loading Standards for Machinery in Closed Cars
- AAR Open Top Loading Rules Manual

Copies can be obtained from AAR, 425 Third Street SW, Washington DC, 20024. www.aar.org

3. REQUIREMENTS

3.1 Design

The manufacturer has the choice of configuration and the functional operation of the machine, except where specifically stated in this specification. Multiple spindles may be specified as a customer option (state required center line distance).

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3.2 Type and Size

TABLE I – TYPES & SIZES

		SMALL			MEDIUM		LARGE	
		No. 2	No. 3	No. 4	No. 5	No. 6	Bed Type Only	
WORK MOUNTING SURFACE	Length	50	72	86	94	104	116	
	Width	10	16	18	18	18	20	
	T-Slot Size	11/16	13/16	13/16	13/16	13/16	13/16	
	T-Slot Spacing	3	5	5	5	5	5	
MOVEMENTS: MANUAL AND NUMERIC	TYPES I AND III							
	Longitudinal	28	34	42	50	60	72	
	Transverse	10	16	18	18	18	18	
	Vertical	12	16	16	16	16	—	
	Multiple Head Adjustment	1"	1"	1"	1"	1"	1"	
	TYPES II AND IV							
	Longitudinal	28	34	42	50	60	72	
	Transverse	10	12	12	14	16	18	
	Vertical	17	18	20	20	20	24	
	Multiple Head Adjustment	1"	1"	1"	1"	1"	1"	
CLEARANCES	TYPES I AND III							
	Spindle Nose to Table	Max	15	20	22	22	22	26
		Min	3	4	6	6	6	2
	Throat Distance	Min	11	14	17	17	17	22
	TYPES II AND IV							
	Spindle C/L to Table	Max	17	18	20	20	20	24
		Min	0	0	0	0	0	0
	Cutter Diameter	Max	12	14	16	16	16	16
	Table C/L to Column	Min	10	12	14	14	14	14
		Max	20	24	26	28	30	32
FEED RATES IPM (ALL TYPES) /a/	Longitudinal	0–75	0–75	0–100	0–100	0–100	0–150	
	Transverse	0–75	0–75	0–100	0–100	0–100	0–150	
	Vertical	0–75	0–75	0–100	0–100	0–100	0–150	
	Steps	INFINITE			INFINITE		INFINITE	
SPINDLE	Horsepower	10	15	20	25	25	30	
	RPM	36 to 3,600			36 to 3,600		36 to 3,600	
	RPM – Alternate No. 1	24 to 2,400			24 to 2,400		24 to 2,400	
	Number of Steps	Min	24	24	24	24	24	
	Taper and Flange	ANSI #50			ANSI #50		ANSI #50	
	Spindle Horsepower/RPM							
	36–3,600	—	—	—	1/4	1/4	1/4	
	24–2,400	—	—	—	1/4	1/4	1/2	

Notes:

- /a/ FEED RATES refers to individual axes rates. Vector rate may be reduced accordingly.
- (b) The specifications for small and medium machines apply to both knee and bed types. Minimum vertical head travels for these machines shall be as listed in vertical-knee heading.
- (c) Movements and clearances apply to single spindle profilers and are not to be reduced through addition of multiple spindles.
- (d) Vertical head travel manual on knee type profilers.
- (e) All units are in inches unless otherwise specified.

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3.3 Machine Subassemblies

3.3.1 Tool Holder Head Assemblies

Spindle head assemblies shall consist of spindle assembly (spindle and bearings), drive motor where applicable and other necessary devices for providing variation in speeds within the stipulated range of speeds, integral housing, and such saddle and slide mechanisms as necessary to satisfy the requirements of Table I, Section 3.2.

3.3.1.1 The spindle bearings shall be of adequate design to carry the axial and radial load components which will result when using a high helix cutter at maximum horsepower and also provide optimum bearing life at high rpm and light loads.

3.3.1.2 An automatic spindle brake shall be provided to stop spindle and prevent cutter rotation during cutter change. Braking device shall be interlocked to prevent power rotation of spindle until brake has been released. A manual release, if necessary, shall be provided conveniently located on the head to release brake for indicating purpose. Activation of spindle off button shall cause the spindle to stop in 10 seconds maximum (Ref. 3.8.5).

3.3.1.3 The direction of spindle rotation shall be reversible.

3.3.1.4 Housings shall provide pads for mounting cutter guards.

3.3.1.5 The spindle nose shall be of an alloy steel suitably hardened and shall conform to ASME B5.18.

3.3.1.6 The spindle shall be provided with a power operated drawbar (Customer option).

3.3.1.7 Provisions shall be made on multiple spindle machines for 1" independent fine adjustment parallel to spindle center line.

3.3.1.8 Speed control tolerance shall not exceed $\pm 3\%$ of indicated spindle speed.

3.3.2 Machine Controls

The machine shall be equipped with an AIA Class IV solid state, including IC, numerical control system for controlling all movements specified in Paragraph 3.2, Table I, and shall be arranged for operation in manual and automatic modes.

3.3.2.1 The system shall accept a control input medium which conforms to NAS955 or NAS968 as specified by the customer. Input data shall be Binary Coded Decimal Form.

3.3.2.2 The least significant digit of dimensional data shall be .0002 inch or smaller for linear movements.

3.3.2.3 The tape reader shall be capable of reading 300 lines per second. Tape reels shall be Ø8" minimum or tape cartridge to NAS969 as specified by the customer.

3.3.2.4 The interpolation function shall be an integral part of the MCU and, as specified by the customer, shall be linear, circular or parabolic, or a combination of two.

3.3.2.5 The entire system, including accessory devices, shall be provided with protection from the surrounding environment. Adequate seals and filters shall be provided to prevent entry of foreign matter.

3.3.2.6 Components sensitive to vibration shall be protected from vibrations.

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- 3.3.2.7 Control media installation, removal, and normal operating control functions shall not disrupt or affect continuation of normal environment protection and control.
- 3.3.2.8 The MCU shall have manual controls for rewinding the tape to the last end of block reference point.
- 3.3.2.9 A separate manual resolver or equivalent device shall be provided for each axis. The operator must be able to locate the cutter to set-points using feeler gauges while manipulating the resolvers.
- 3.3.2.10 The machine control unit shall be equipped with an accumulative running hour recorder to allow maintenance logging of component replacement. The recorder shall be connected to the main control circuit of the system.
- 3.3.2.11 It shall be possible to interrupt the automatic cycle without loss of information.
- 3.3.2.12 The axis designation shall conform to NAS938.
- 3.3.2.13 The system shall have built-in capability so that programmed and non-programmed "stops" can be provided for cutter changes, cutter and part inspections, spindle speed changes, program checks, etc. Resumption of automatic or manual operation shall not cause any loss of accuracy on the work piece.
- 3.3.2.14 The system shall control auxiliary functions such as coolant on-off, spindle on-off, part clamping, or other functions as specified by the customer.
- 3.3.2.15 Loss of synchronization, for any reason, shall stop the system. The loss of synchronization, as well as the particular axis involved, shall be indicated by appropriate signals, e.g., lights.
- 3.3.2.16 Maintenance and testing aids shall be incorporated as practical to expedite the correction of malfunctions of the equipment.
 - 3.3.2.16.1 Indicator lights shall be employed throughout the system at points of probable failure to expedite location of faulty components.
 - 3.3.2.16.2 Where practical, testing circuits shall be incorporated to indicate marginal conditions.
 - 3.3.2.16.3 A test procedure and test tape shall be furnished with each machine for maintenance personnel's use in checking and adjusting the electronic system and machine tool.
- 3.3.2.17 A full floating zero reference system for all axis movements shall be provided to allow the location of the start point of the part at any point on the working surface.
- 3.3.2.18 The machine shall be capable of producing right and left hand pieces (mirror image) from the same tape through the use of inversion switches for each axis except "Z". Indicator lights showing normal and reverse settings shall be clearly visible to the operator. Switch locations are to be customer option.
- 3.3.2.19 The system shall be capable of controlling the movements of all machine axes individually, simultaneously, or in any combination, at all feed rates.
- 3.3.2.20 The system shall have the ability of locating the original set-point automatically after the machine axes are manually positioned by means of visual indicators to within $\pm .040$ inch of the set-point.
- 3.3.2.21 All construction, wiring and electronic equipment shall be in accordance with EIA-RS-281-B
- 3.3.2.22 The machine controls shall not hunt more than one pulse.

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- 3.3.2.23 For those controls that are dependent upon the presence of a sprocket hole in each tape character for proper reading of that character, the loss of a sprocket hole signal in the control shall stop the tape reader and may be considered as part of the tape parity error check.
- 3.3.2.24 A sequence number readout, three-digit display, or equivalent block counter shall be provided on the control panel (Customer option).
- 3.3.2.25 An incremental feed system shall be provided to permit the operator to jog the tool precise, pre-determined distances by touching a pushbutton. A selector switch shall provide specific increment of jog of .0001", .0010", .0100", .1000" and 1.0000" (Customer option).
- 3.3.3 Operator's Controls
- All operating control switches or levers shall be located convenient to the operator when he is in the normal and established operating positions.
- 3.3.3.1 The control console shall contain the necessary controls for manual and automatic tape operation. In addition, manual controls shall be provided for the auxiliary functions, spindle speed selection, spindle on-off, spindle direction with a neutral position, emergency stop to completely stop all machine movements including spindle.
- 3.3.3.2 There shall be a manual override for all feed rates to permit operating in the range of 10% to 100%, with an off position.
- 3.3.3.3 A visible readout for each axis, capable of indicating input commands to within .0002 inch for linear movement, shall be provided (Customer option).
- 3.3.3.4 The panel shall be provided with controls for clearing temporary and active storage.
- 3.3.3.5 The following visual indicators shall be included on the panel:
- 3.3.3.5.1 Parity error.
- 3.3.3.5.2 Program stop.
- 3.3.3.5.3 Cycle start.
- 3.3.3.5.4 Optional stop.
- 3.3.3.5.5 A wattmeter type spindle horsepower meter with a Ø3 inch dial, minimum, or approved equal for each spindle motor.
- 3.3.3.5.6 Feed rate indicators, calibrated in inches per minute, for all power feed movements (Customer option).
- 3.4 Construction
- The machine shall be constructed to comply with requirements of this specification and other specifications as noted.
- 3.4.1 Work mounting surface shall be provided with longitudinal T-slots per Table I conforming to ASME B5.1M. One T-slot shall be located on the center line of the work mounting surface.
- 3.4.2 The machine shall be provided with hardened and ground replaceable ways or approved equivalent, for all power driven machine motions.

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