



NATIONAL AEROSPACE STANDARD

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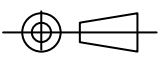


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FORM 09-01	THIRD ANGLE PROJECTION 	CUSTODIAN ENGINEERING MANAGEMENT COMMITTEE	REVISION 1
	PROCUREMENT SPECIFICATION NONE	TITLE MILLING MACHINE, CONTOUR, NUMERICAL CONTROL, MULTIAXIS, TRAVELING GANTRY/TABLE, COMBINATION HIGH AND LOW SPEED	CLASSIFICATION SPECIFICATION NAS977 SHEET 1 OF 23

IN NATIONAL AEROSPACE STANDARD

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON 6, D. C.

1.0 SCOPE

- 1.1 **Purpose:** This specification provides a standard for the manufacture, performance, inspection and procurement of a numerically controlled, wide bed, contour milling machine. This standard lists minimum requirements and is not to limit design changes.
- 1.2 **Classification:** This equipment shall be classified as a combination high and low speed range, numerically controlled, contouring, wide bed, vertical milling machine in the following styles, types and sizes.
- 1.2.1 **Style I** - Traveling gantry.
Style II - Traveling table.
Type I - Single spindle.
Type II - Multiple spindle.
Size I - Working surface width - 96".
Size II - Working surface width - 120".
Size III - Working surface width - 144".

Note: The recommended minimum working length to be 30', and to be field extensible.

- 1.3 **Intended Use:** The machine described by this specification is intended for use in the aerospace manufacturing industry. It shall provide adequate capacity to perform machining operations (stock removal) on ferrous and non-ferrous materials. It shall be capable of utilizing all commonly used milling cutters for operations such as pocketing, sculpturing, slabbing, detailing, facing, etc.

All numerically controlled axes of motion shall be automatically controlled by programmed numerical data media or manually controlled by suitable controls. (Automatic control by means of manual input of numerical data shall be optional.)

2.0 APPLICABLE SPECIFICATIONS, CODES AND STANDARDS

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

- 2.1 The National Machine Tool Builders Association's (NMTBA) Electrical Standards.
- 2.2 The Joint Industries Conference (JIC) Hydraulic and Pneumatic Standards for Industrial Equipment.
- 2.3 The American Standards Association (ASA) for small tools and machine tool elements, numbers B5.1, B5.18 and B5.28.

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- 2.4 The American Society of Mechanical Engineers' (ASME) Boiler and Pressure Vessel Code, Section VIII.
- 2.5 National Aerospace Standard 938, Machine Axis and Motion Nomenclature.
- 2.6 National Aerospace Standard 953, Numerical Control Systems (standard practice).
- 2.7 National Aerospace Standard 955, Interchangeable Tape Standards - Variable block format, contouring and contouring/positioning, numerically controlled equipment.
- 2.8 Electronics Industries Association (EIA) Construction Standards, Numerical Machine Tool Control, #RS-281.
- 2.9 National Aerospace Standard 968, Interchangeable Digital Magnetic Tape Standards, Variable Block, Word Address Format, Contouring and Contouring/Positioning Equipment.
- 2.10 National Aerospace Standard 969, Interchangeable Digital Magnetic Tape Cartridge - for Numerically Controlled Machines.
- 2.11 The American Standards Association (ASA) for Surface Texture, B46.1 1962.
- 2.12 All components, equipment and sub-systems whose design and construction are not covered by this specification or the above standards, shall be in accordance with accepted commercial standards.

3.0 REQUIREMENTS

The manufacturer's contractual obligations for the design and function of the machine shall be specified in this section.

- 3.1 **Design:** The manufacturer has the choice of configuration and the functional operation of the machine, except where specifically stated in this specification. The dimensions and capacities for the respective styles, types and sizes shall be shown in Section 3.2, and the controls in Section 3.
- 3.2 **Style:** Traveling gantry or traveling table - to be manufacturer's option.
Type: Single or multiple spindle, with or without manual tilt - to be customer's option.
Size: Per Table I - to be customer's option.

TABLE I

	I	II	III
Working Surface			
Width	96"	120"	144"
Length (recommended)	30'	30'	45'
Work Height, Standard - spindle nose to table top			
Maximum (24" power rail adjustment and 24" vertical carrier movement)	48"	48"	48"
Minimum	4"	4"	4"
T-slot Width, spaced 5" center-to-center	.812"	.812"	.812"
Spindle Carrier - quantity	Customer Option		
Manual Tilt (Customer Option)	- longitudinal	+15°	+15°
	- transverse	+15°	+15°

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INACTIVE DESIGN AFTER 31 JULY 2012 NATIONAL AEROSPACE STANDARD

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	I	II	III
Spindle			
Horsepower	50/100	50/100	50/100
Horsepower/revolution - minimum	1/2	1/2	1/2
Speed Range	20-3600	20-3600	20-3600
Speed Changes	See Note 1		
Taper	50A	50A	50A
Quill Travel (adjustment only)	1-1/2"	1-1/2"	1-1/2"
Numerically controlled movements			
Longitudinal (gantry or table)	30'	30'	45'
Transverse, spindle carrier	See Note 2		
Vertical (depth) spindle carrier	24"	24"	24"
Feed rates, infinite, N/C and Manual			
Longitudinal	per min. 0-150"	0-150"	0-150"
Transverse	per min. 0-150"	0-150"	0-150"
Vertical (depth)	per min. 0-60"	0-60"	0-60"
Rapid traverse rates, N/C and Manual			
Longitudinal	per min. 240"	240"	240"
Transverse	per min. 240"	240"	240"
Vertical (depth)	per min. 60"	60"	60"

- NOTE: 1. To have geometric progression (24 steps) or to be infinitely variable.
 2. If more than one spindle, each to clear table when using an 8" diameter cutter, with both spindles vertical and at 0° tilt.
 3. Feed rates to be vectorial.

3.3 Machine Sub-Assemblies:

- 3.3.1 Tool Holder Head Assemblies: Spindle head assemblies shall consist of spindle nose, spindle, drive motor and other necessary devices for providing variations in speed within the stipulated range, integral housing, and such saddle, slide and tilting mechanisms as necessary to satisfy the requirements of Table 1, Section 3.2.
- 3.3.1.1 The quantity of spindle head assemblies required will be the prerogative of the customer.
- 3.3.1.2 The spindle carrier(s) shall traverse along the carriage cross rail on adequate antifriction ways.
- 3.3.1.3 At the option of the customer, the spindle head assembly may be of the tilt type or plain type.
- 3.3.1.3.1 The tilt type shall be capable of being tilted in either of the two planes, or both, one parallel with, and the other perpendicular to the longitudinal travel of the machine.
- 3.3.1.3.2 The angle of tilt shall be on each side of the vertical position in each plane as specified in 3.3.1.3.1.

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- 3.3.1.3.3 The angle of tilt required, within the limits specified, shall be accomplished manually; power actuation to be a customer option.
- 3.3.1.3.4 When a tilt spindle is selected, numerically controlled axial spindle movement shall be provided.
- 3.3.1.3.5 Adequate clamping of the tilt type spindle head shall be provided.
- 3.3.1.4 A spindle brake shall be provided for each spindle.
- 3.3.1.5 The spindle shall be hardened and ground alloy steel mounted in antifriction type bearings designed to withstand the axial and radial loads resulting from the low and high horsepower and speeds specified.
- 3.3.1.6 Spindle is to be reversible type.
- 3.3.1.7 Power actuated draw-in bar shall be provided to facilitate cutter changes.
- 3.3.1.8 No. 50A taper, as specified, is to be provided (with 4" and 7" diameter bolt circles) for securing face mounted cutters.
- 3.3.2 Machine Controls:
- 3.3.2.1 Numerical Control System: The machine shall be equipped with a numerical control system at the machine for controlling the movements specified in Table I. This system does not include the machine control media preparation equipment.
- 3.3.2.2 The numerical control system shall, at the option of the procuring agency, be Class IV/III Combination or Class IV.
 - 3.3.2.2.1 The machine shall be complete with control system including control media transport mechanism and necessary control circuitry properly installed within the control cabinet. The data media reader to be high speed type capable of reading 300 lines per second with 1000 characters per second search and rewind.
 - 3.3.2.2.2 The system shall be capable of controlling axes movements individually and/or simultaneously in any combination.
 - 3.3.2.2.3 The system provided shall be such that programing can be accomplished with a general purpose computer, if computation apart from the machine unit is required.
 - 3.3.2.2.4 The system shall provide for machining right hand or left hand parts from the same tape. Reversing switches shall be provided for each axis of movement.
 - 3.3.2.2.5 The system shall be such that programmed and non-programmed stops can be effected for such purposes as cutter change, cutter and part inspection, spindle speed change, program checks, etc. Resumption of automatic operation shall not cause position error.
 - 3.3.2.2.6 The system shall be such that control of auxiliary functions such as coolant flow, spindle on-off, part clamping, or others as specified, can be programmed as desired.
 - 3.3.2.2.7 The system shall provide automatic parity error check.
 - 3.3.2.2.8 Whenever and wherever practical, fail-safe design should be employed, e.g., power failure device, air conditioning failure, etc.
 - 3.3.2.2.9 The system shall be such that in the event of a malfunction, the machine will stop without deviation to the programmed cutter path.

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- 3.3.2.2.10 The control circuitry shall be such that replaceable plug-in units or modules are used for electronic system components.
- 3.3.2.2.11 Program synchronization adjustment controls for the programmed start position of the various controlled motions shall be located on the operator's pendant control.
- 3.3.2.2.12 At customer option, the numerical control system shall conform to the following NAS Specification: 955, or 968 and 969.
- 3.3.2.2.13 Test Program - A test program shall be furnished with each machine for maintenance personnel's use in checking and adjusting the electronic system and cutting characteristics of the machine. The program shall be for a minimum of one (1) hour running time.
- 3.3.2.2.14 All construction, wiring and electronic equipment shall be in accordance with the EIA Electrical Standards RS-281, where applicable.
- 3.3.2.2.15 The fundamental measuring system (feedback system) to be either absolute or incremental, a manufacturer's option.
- 3.3.2.2.16 The system shall provide for switching from programmed to manual mode without losing established relationship between work piece and program.
- 3.3.2.2.17 The system shall be applicable to APT and ADAPT.
- 3.3.2.2.18 The manufacturer shall supply the post-processor applicable to the numerical control system.
- 3.3.2.2.19 Zero Offset - The system shall be such that the zero or reference point can be offset the full range of any axis, and proceed without any physical back travel to a fixed point.
- 3.3.2.2.20 The control system shall be designed and constructed to operate in a normal factory environment defined as follows:
- Room ambient temperature, 50°F to 125°F
 - Room ambient relative humidity, 10% to 95%
 - Line voltage fluctuation, $\pm 10\%$ of rated voltage
- 3.3.2.3 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.
- 3.3.2.3.1 Horsepower indicators shall be provided for each spindle head.
- 3.3.2.3.2 Longitudinal, transverse and axial movements and vertical rail adjustment, shall be manually operated, power actuated. Power tilt of the spindle(s) to be a customer's option.
- 3.3.2.3.3 Automatic control by means of programmed numerical data media shall be provided for the longitudinal movement of the gantry (or table), transverse movement of the spindle carriers (on the cross rail) and the vertical movement of the spindle heads.
- 3.3.2.3.4 If specified by the customer, indicators shall be provided within the control panel to show direction and rate of feed of the longitudinal and transverse movements.
- 3.3.2.3.5 If specified by the customer, position indicators in cumulative inches for "x", "y" and "z" axis shall be provided. Indicators must read to four (4) places to the right of the decimal point. This function may be switchable.
- 3.3.2.3.6 A portable station shall be provided containing a feed rate over-ride control and emergency stop controls.

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- 3.3.2.3.7 "Z" axis limit switches which are capable of adjustment shall be provided for use with a vertical spindle attachment or right angle attachment.
- 3.3.2.3.8 Each movement not numerically controlled shall be provided with a readily accessible locking device.
- 3.3.2.3.9 Provisions for fine adjustment for all movements shall be provided. Dials or scales showing location of machine element shall be legibly marked, reading to .001", or degrees and minutes.
- 3.4 Construction: The machine shall be constructed to comply with the requirements of this specification.
- 3.4.1 Bed and Table Unit:
 - 3.4.1.1 At the manufacturer's option, to be supplied in sections of convenient lengths, preferably 15' and 30' lengths.
 - 3.4.1.2 To be machined to tolerances to permit the addition of sections for conformance with the customer's requirements.
 - 3.4.1.3 Suitable tie-downs and leveling wedges shall be provided for each section.
 - 3.4.1.4 The addition of sections may be made at any time and shall not require removal from location for machining or alterations of existing sections.
 - 3.4.1.5 The bed sections shall have hardened and ground replaceable ways for the gantry carriage travel (Style I), or for the table travel (Style II).
 - 3.4.1.6 A rack and pinion drive shall provide the gantry carriage movement (Style I) or table movement (Style II).
 - 3.4.1.7 The surface of the table top shall be finished in accordance with 4.3.2.1, and have T-slots per ASA B5.1 as specified in Section 3.3.
 - 3.4.1.8 Provisions shall be made for the recovery of coolant.
 - 3.4.1.9 Provisions shall be made for the addition of a chip removal mechanism.
 - 3.4.1.10 The bed shall be provided with leveling jacks (or other devices) which are to be accessible for maintaining proper level at all times.
 - 3.4.1.11 Two accurately bored and bushed holes, one on each side of the table, are to be provided, to facilitate squareness alignment of gantry (transverse axis) to table (longitudinal axis).
 - 3.4.1.12 All castings and fabrications shall be of uniform quality, free from blow holes, porosity, hard spots, shrinkage defects, cracks or other injurious defects. Strength or other essential properties of the castings and fabrications shall be of adequate size throughout for the purpose intended.
 - 3.4.1.13 Welding, brazing and soldering processes shall be performed in accordance with accepted industrial practices. Unless by customer authorization, these processes, and including peening and plugging, are not to be used on castings or forgings for purposes of reclaiming any portion of the equipment.
 - 3.4.1.14 All screws, pins, bolts and other similar fastening devices shall be installed with adequate means for preventing loss of proper tightness and adjustment. All such parts subject to removal or adjustment, shall not be swaged, peened, staked or otherwise permanently deformed.

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