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AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.
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THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THE SAME
PRODUCT AND SHALL BECOME EFFECTIVE NO LATER THAN SIX MONTHS FROM THE LAST
REVISION DATE.

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THIRD ANGLE PROJECTION	CUSTODIAN ENGINEERING MANAGEMENT COMMITTEE	REVISION 4
PROCUREMENT SPECIFICATION NONE	TITLE MILLING MACHINE - TRACER CONTROLLED PROFILING & CONTOURING-VERTICAL	CLASSIFICATION SPECIFICATION NAS914 SHEET 1 OF 27

INACTIVE FOR DESIGN AFTER 29 JUNE 2012

1.0 SCOPE

1.1 Purpose:

This specification provides a standard for the manufacture, performance, reliability, inspection, and procurement of a series of rectangular table profile and contour milling machines having multiple axes of tracer controlled motion. This standard lists minimum requirements and is not to limit design advances.

1.2 Classification

The machines shall be of the following type, size, and class as specified by the procuring agency.

1.2.1 Type

Vertical - Single or Multiple Spindle

I - Two Axes of Motion

II - Three Axes of Motion

III - Four Axes of Motion

1.2.2 Size

A - Small

B - Medium

C - Large

D - Extra Large

1.2.3 Class

I - Aluminum and Steel Milling Machine (less than 230 KSI)

II - Super Alloy Milling Machine (including steel over 230 KSI)

LIST OF CURRENT SHEETS

NO.	REV.	NO.	REV.	NO.	REV.	NO.	REV.
1	3	8	3	15	3	22	3
2	3	9	3	16	3	23	3
3	3	10	3	17	3	24	3
4	3	11	3	18	3	25	3
5	3	12	3	19	3	26	3
6	3	13	3	20	3		
7	3	14	3	21	3		

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CUSTODIAN: MANUFACTURING COMMITTEE

PROCUREMENT SPECIFICATION

NONE

TITLE

MILLING MACHINE - TRACER CONTROLLED
PROFILING & CONTOURING-VERTICAL

CLASSIFICATION
SPECIFICATION

Documents
AS 914
SHEET 1 OF 26

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INACTIVE FOR DESIGN AFTER 29 JUNE 2012

1.3 Intended Use

The machines described by this specification are intended for use within the aerospace manufacturing industry to provide high rigidity characteristics and appropriate speed and feed ranges for use in machining the entire spectrum of aerospace materials including aluminum, magnesium, steels, titanium, super alloys, refractories, and other thermal resistant materials.

2.0 APPLICABLE SPECIFICATIONS, CODES, AND STANDARDS

The latest revision of the following specifications, codes, and standards is 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 Joint Industrial Council (JIC) Electrical Standards for General Purpose Machine Tools, ECP.1.1967. (3.5 & 3.5.9)
- 2.2 The Joint Industrial Council (JIC) Hydraulic and Pneumatic Standards for Industrial Equipment. (3.6)
- 2.3 The American National Standards Institute (ANSI) B5.1 T-slots, B5.18 Spindle Nose, B46.1 Surface Texture. (3.2, 3.3.2.1 & 3.4.1)
- 2.4 The American Society of Mechanical Engineers' (ASME) Boiler and Pressure Vessel Code, Section VIII. (3.10)
- 2.5 National Electrical Code (NEC). (3.6)
- 2.6 National Aerospace Standard 938 and Machine Axis and Motion Nomenclature. (3.3.2)
- 2.7 National Aerospace Standard 972, Glossary of Manufacturing Equipment Terms. (8.1)
- 2.8 National Aerospace Standard 979, Uniform Cutting Tests - NAS Series Metal Cutting Equipment Specifications. (4.2.6 & 4.3.3.4)
- 2.9 National Aerospace Standard 985, Uniform Alignment Tests - NAS 900 Series Equipment Specifications. (4.3.2.1)
- 2.10 Occupational Safety and Health Standards, Part 1910 of Chapter XVII of Title 29 of the Code of Federal Regulations. (Occupational Safety and Health Act (OSHA) - 1970.) (3.8)
- 2.11 State and Local Safety and Electrical Codes. (3.8)

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INACTIVE FOR DESIGN AFTER 29 JUNE 2012

3.0 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.

3.1.1 The design of the machine saddle and rail should anticipate the use of more than one spindle and/or head with the various spindle and/or head combinations being interchangeable in the field, and installation shall not exceed eight (8) hours total.

3.2 Type, Size, Class

TABLE I

<u>Work Mounting Surface</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
Width	24	48	72	over 72
Length	48	120	168	over 168

Movements (manually & tracer controlled)

Type I, II, III

Transverse (y)	28	52	72	W+4
Longitudinal (x)	52	124	172	L+4
Depth (z) (tracer)	12	12	12	16
Depth (type III - tracer)	8	8	8	12
Transverse (y) multiple spindle-		1/2(y)movement	+2	

Type I, II

Work surface to spindle nose	6-18	6-24	6-30	6-30
Spindle quill adjustment (for multiple spindle)	-	1	1	2

Type III

Work surface to pivot point	2-8	4-14	4-20	4-20
Pivot point to spindle nose	2-10	2-10	2-10	2-10
Tilt, transverse (in degrees)	+ 15	+22.5	+22.5	+22.5
Pivot point adjustment (for cutter dia.)	+ 2	+ 2	+ 2	+ 2
Spindle quill and/or depth slide adjustment	2	2	2	2

Type I & II - See Fig. I, Sheet 25

Type III - See Fig. II, Sheet 25

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INACTIVE FOR DESIGN AFTER 29 JUNE 2012

TABLE I (Cont'd.)

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
<u>Feed Rates</u>				
Tracing x & y axes - I.P.M.		1/4 to 25		
Positioning rate		100		
Tracing z axis - I.P.M.		1/4 to 25		
Positioning rate		80		
Alternate #1 x, y, z axes		1/4 to 40		
Alternate #2 x, y, z axes		0 to 60		
Tilt axes - degree/minute		0 to 45		
<u>Spindle Data</u>				
Horsepower per spindle (minimum)	10	15	20	30
Alt. #1			25/50	25/50
Multiple Spindle	10	10	15	20
	(A&B)		(C&D)	
RPM - Class I	24-1800		36-3600	
Alt. #1	16-1600		1800/3600	
	(a l l s i z e s)			
- Class II		9-1800		
Alt. #1		16-1200		
Torque per spindle (HP/RPM)				
Class I		.25		
Class II		.5		
No. of Steps (Minimum in Geometric Progression or Infinitely Variable)		12 min.		
Spindle Taper (per ANSI B5.18)		#50		
Distance between spindles, multiple spindle machines				
Size B, C & D		10 or 20 or 30		

3.3 Machine Sub-Assemblies

3.3.1 Tool Holder Head Assemblies

Spindle head assemblies shall consist of spindle nose, spindle assembly (including bearings), 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 I, Section 3.2.

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- 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 maximum bearing life at high RPM and light loads and stipulated torque requirements at low speeds.
- 3.3.1.2 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 shall be provided conveniently located on the head to release brake for indicating purpose.
- 3.3.1.3 The direction of spindle rotation shall be reversible.
- 3.3.1.4 The spindle shall be provided with a power-operated drawbar to hold the tool in the spindle nose. (Customer option)
- 3.3.1.5 A suitable means of maintaining a controlled temperature level in the spindle head shall be provided. If the spindles are liquid-cooled, an over-temperature thermal warning device shall be provided to alert the operator to an over-temperature condition. Spindle coolant source shall be independent from cutter coolant source.
- 3.3.1.6 All gearing and drive shafts, etc., shall be designed to rotate the cutter at constant angular velocity at all spindle speeds and under maximum spindle load.
- 3.3.1.7 Provisions for the installation of cutter guards are required.

3.3.2 Machine Controls

All tracer controlled axes of motion shall be automatically controlled by a hydraulic, electrohydraulic, or electronic tracer control unit and manually controlled by suitable manual controls. Designation of all controlled axes shall conform to NAS 938.

3.3.2.1 Template Mounting Area

A template mounting area is to be provided with the machine so that the entire working surface is available for mounting work. If the template table is not to be provided as noted in the Ordering Data, then the tracer shall be located so that either half of the work mounting area is available for tracing with the template mounted on the other half of the work mounting area. Machine to be designed so that field conversion and installation of a separate template table can be made if not ordered with the machine originally. The template table shall be provided with longitudinal tee slots, 3/8" wide, spaced on 10" centers with one on the center line of the table.

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INACTIVE FOR DESIGN AFTER 29 JUNE 2012

3.3.2.2 Tracing System

The tracing unit shall be provided to perform the distinct functions from a common tracer stylus. Micrometer dials shall be provided to facilitate positioning of the longitudinal, transverse, and vertical adjustments of the tracer stylus in relation to the cutter. The tracing stylus shall be sensitive to even the slightest variation of surface, and the contact pressure necessary to actuate the tracing mechanism shall be sufficiently light to permit use of master pattern shapes made of wood, compound, and other easily worked materials. The tracer mechanism shall be so arranged that it will automatically disengage itself when the tracer stylus is not in contact with the guiding surface. The tracer mechanism shall also have a selector valve that will permit automatic disengagement of the tracer to be bypassed so that when the tracer stylus is hanging freely the spindle carrier will continue downward until the stylus again contacts some surface.

The action of the mechanism shall be completely automatic once the tracer stylus has engaged the master profile template and shall be suitable for duplication of either internal or external profiles with the cutter traveling in either selected direction. The mechanism shall also have a selector valve to disengage the automatic tracer for hand control of the table and cross-slide movements for starting and clearing operations. Tracer controlled feed rates shall be infinitely variable.

3.3.2.2.1 Single Stylus System for Machine Type I - This system shall be capable of simultaneously controlling longitudinal and transverse 360° motions.

3.3.2.2.2 Selective Stylus System for Machine Type II - One stylus capable of simultaneous 360° plus depth control from a model, or 360° from a template, or 180° depth from a template. At customer's option a second stylus shall be provided, arranged for template control of depth, while the first stylus is controlling 360° motion. Either mode of operation to be available to the operator by simple switching or valving.

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INACTIVE FOR DESIGN AFTER 29 JUNE 2012

- 3.3.2.2.3 Simultaneous Stylus System for Machine Type III - One stylus for simultaneous 360° plus depth, a second stylus for tilt control. The unit shall be capable of depth control tracing in the vertical plane while simultaneously performing 360° profiling in the horizontal plane. It shall be possible to trace the combination of a curve in a sloping surface with a slope of at least $\pm 30^\circ$ with the horizontal.
- 3.3.2.2.4 Steering Provisions - Manual steering shall be provided for all machine types.
- 3.3.2.2.5 Provisions shall be made to allow positioning the tracer controlled range within any desired position of the manually controlled power operated range in the event the latter is greater. All tracer controlled movements are to be arranged for manual control.
- 3.3.2.2.6 A safety device shall be provided so that if the tracer finger is overdeflected, the tracer unit will be automatically retracted.
- 3.3.2.2.7 The tracer unit shall contain the feed rate selector knob.
- 3.3.2.2.8 Depth Stop - A depth stop, having a minimum of six quickly selected positions, each capable of adjustment to within .001 inches, shall be provided.
- 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 tracer control unit shall be so located as to be readily accessible to the operator at all times.
- 3.3.3.2 Suitable indicators shall be provided for spindle horsepower, spindle RPM, and feed rate. All indicators to have an accuracy of $\pm 5\%$.
- 3.4 Construction
- The machine shall be constructed to comply with requirements of this specification and other specifications as noted.
- 3.4.1 Work holding surface shall be provided with T-slots 13/16 inches wide, conforming to ANSI B5.1 running longitudinally and spaced on 5 inch centers with one on the center line of the work holding surface.

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- 3.4.2 The machine shall be provided with hardened and ground replaceable ways for all power driven machine motions. (Customer option)
- 3.4.3 All way surfaces shall be protected from grit and chips by suitable way covers, wipers, and seals. Way covers, used on horizontal surface, shall be capable of supporting a 200 lb. operator.
- 3.4.4 Anti-backlash devices shall be provided for all feed elements.
- 3.4.5 All pumps shall be provided with mechanical seals; packing gland seals are not acceptable.
- 3.4.6 Provisions shall be made for the addition of a chip removal mechanism. (Customer option)
- 3.4.7 The machine shall be provided with 115 volt transformer, work light, and one service outlet, accessible to the operator.
- 3.4.8 The machine shall be provided with tie down and leveling devices. Leveling devices to be accessible for maintaining proper level at all times.
- 3.4.9 Provisions shall be made for standard lifting eyes and/or similar devices which may be required for servicing, maintenance, and installation.
- 3.4.10 Reference scales with pointers shall be fitted to all axes. Scales to be graduated in 1/16" increments.
- 3.4.11 One complete set of machine wrenches, special tools, and/or other required equipment necessary for normal operation of machine shall be supplied.
- 3.5 Electrical Equipment
- All electrical equipment and its installation shall conform to the latest revision of Joint Industrial Council Electrical Standards for General Purpose Machine Tools and the National Electric Code.
- 3.5.1 Power supply shall be from one source, 460 volts, 3 phase, 60 cycle, A.C. with a maximum line voltage fluctuation of $\pm 10\%$ of rated voltage unless otherwise specified.

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