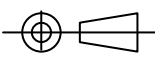


FED. SUPPLY CLASS

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FORM 09-01	THIRD ANGLE PROJECTION 	CUSTODIAN ENGINEERING MANAGEMENT COMMITTEE	REVISION 1
	PROCUREMENT SPECIFICATION NONE	TITLE MILLING MACHINE – PRECISION BED-TYPE HORIZONTAL AND VERTICAL SPINDLES	CLASSIFICATION SPECIFICATION NAS936 SHEET 1 OF 24

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1. SCOPE

- 1.1 Purpose: This specification provides a standard for the manufacture, performance, inspection, and procurement of horizontal and vertical spindle precision bed-type milling machines.
- 1.2 Classification: Bed-type Milling Machines, Horizontal and Vertical Spindle.
- 1.3 Intended Use: This specification is intended to establish the preferred relation of spindle horsepower, speeds, and feeds for the close-tolerance milling of high-tensile, thermal-resistant materials required in the aircraft and missile manufacturing industry. The requirements also provide the flexibility required in operation and set up.

2. APPLICABLE SPECIFICATIONS: Five specifications apply to this standard:

Latest revision of National Machine Tool Builders Association Code (NMTBA, Para 3.7)
 Latest revision of Joint Industries Commission Code (JIC, Para 3.8)
 American Standard Association Bulletins for small tools and machine tool elements numbers B5.1 and B5.18 (ASA, Para 3.32 and 3.3.15)
 Military Standard MIL-STD-10 Surface Roughness Waviness and Lay, where applicable
 American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, where applicable

3. REQUIREMENT:

- 3.1 Design: The dimensions and capacities for the respective types and sizes shall be as shown in Table I.

- 3.2 Type: Horizontal Spindle
 Vertical Spindle

Size: Small
 Medium
 Large

TABLE I

		Horizontal			Vertical		
		Small	Medium	Large	Small	Medium	Large
3.2.1	Work Mounting Surface (Min)						
	Width	24	48	60	24	48	60
	Length	60	96	144	60	96	144
3.2.2	Power Feed Travel						
	Table	60	96	144	60	96	144
	Cross	9 ∇	15 ∇	18 ∇	28	52	64
3.2.3	Clearance						
	Spindle	4-24	4-36	4-48	-	-	-
	Spindle Nose to Table	-	-	-	4-30	4-42	4-54
	Cutter Diameter - Maximum	18 ∇	24 ∇	30 ∇	-	-	-
3.2.4	Table Feeds IPM						
	Infinitely variable, Reading accuracy to be within $\pm 5\%$ of actual feed.	1/4-50	1/4-50	1/4-50	1/4-50	1/4-50	1/4-50
	Rapid Traverse IPM Minimum	150	150	150	150	150	150

∇ This total feed movement by carrier and spindle. Positioning accuracy to be within 0.0005.

∇ Cutter diameters around which maximum machine performance is to be designed are:

Horizontal	18	20	20
Vertical	10	12	14

Sufficient clearance to be maintained on horizontal machines for 18 inch, 24 inch and 30 inch diameter cutters.

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TABLE I

	Horizontal			Vertical		
	Small	Medium	Large	Small	Medium	Large
3.2.5 Spindle						
Power Movement Total	-	-	-	26	38	50
Power Feed Movement (Min)	-	-	-	9	15	18
Horsepower - Minimum	15/30	25/50	50/100	25/50	25/50	25/50
RPM	5-1000	5-750	5-500	13-1300	10-1000	8-850
Number Steps in Geometrical Progression - Minimum	24	24	24	24	24	24
Taper	ASA 50	ASA 60	ASA 60	ASA 50	ASA 60	ASA 60
Flange	ASA 60	ASA 60	ASA 60	ASA 60	ASA 60	ASA 60
Torque (HP/RPM)	3	4	6	2	2½	3

3 Flange diameter not specified. Layout of bolt holes and keyway pattern must conform to ASA 60 flange, with additional bolt holes and diameter to accommodate 30 inch diameter cutters.

3.3 Construction

- 3.3.1 Machine shall be constructed to comply with the requirements of section 3 and the Inspection and Acceptance test of section 4. Choice of configuration and actual moving elements shall be the prerogative of the builder.
- 3.3.2 T-Slots - 1-1/16" T-Slots shall be ASA B5.1 Standard.
- 3.3.3 T-Slots and Keyways - Center T-Slot or keyway shall be on centerline of work mounting surface within ±0.030 inch.
- 3.3.4 Clearance from retracted spindle nose to table edge shall be 5 inches minimum on horizontal machine.
- 3.3.5 All moving parts and ways shall be protected to eliminate the possibility of foreign material getting into moving parts of the machine. Telescoping or following bed way covers with drop sides sturdy enough to support a man's weight shall be provided.
- 3.3.6 The machines shall be provided with hardened replaceable ways and replaceable mating surfaces for all power-driven machine member motions.
- 3.3.7 The horizontal mill shall be provided with outboard arbor support having accurately adjustable bearings and outer arm braces.
- 3.3.8 Power feed shall be provided by independent motors (not to be actuated by spindle motors).
- 3.3.9 Accurate indicators for both feed rate and spindle horsepower shall be provided. A horsepower indicator with at least a 4 inch dial face shall be located in plain view of the operator.
- 3.3.10 Adjustable automatic spindle jam and thermal overload power feed cutoff shall be provided. After time delay, spindle power shall be disconnected. Spindle and all feeds shall be interlocked to prevent feed without spindle rotation.
- 3.3.11 Selection of spindle speeds and feeds shall be made by quick-change methods.
- 3.3.12 Anti-backlash devices shall be provided for all feed elements.
- 3.3.13 Pads shall be provided for the installation of cutter guards.
- 3.3.14 Spindle bearings shall meet the radial and axial load components resulting from the use of 45 degree helix angle cutters. Provisions shall be made for adjustment of spindle bearings for maintenance without major disassembly.
- 3.3.15 The spindle nose shall be of suitable hardened alloy steel and shall conform to the ASA B5.18 standards.
- 3.3.16 Machines shall be provided with 110 volt transformer, light, and one service outlet.
- 3.3.17 Spindle rotation shall be reversible and shall include a neutral position.
- 3.3.18 Power-operated draw bar with safety interlock to spindle motor shall be provided.

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THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THE SAME TITLE AND DATE OF APPROVAL. IT IS THE LATEST DATE OF APPROVAL SHOWN.

- 3.3.19 A power-actuated device to secure any/all slides in selected position without movement is required. An interlock shall be provided so that no slide can be engaged before release of its clamping device.
- 3.3.20 A high-capacity, screened flood coolant system with readily accessible settling basin is required. Other coolant systems are to be quoted extra. Provision shall be made to prevent contamination and/or intermix of coolant and lubricant.
- 3.3.21 The manufacturer shall anticipate in the design of the machine provisions for future field installation of continuous path, 3-axes numerical control.
- 3.3.22 All ways and moving parts shall be automatically force-lubricated. The machine shall operate only when suitable oil pressure is established. Provisions shall be made to prevent the oil from entering the bearings and gears without being filtered. A sight oil level gage and oil pressure indicator shall be provided. An oil sump with freedom of access shall be required.
- 3.3.23 Fine adjustment - Dials or scales shall be legibly marked with readings to 0.001 inch. Provisions shall be made to permit 0.0005 inch adjustment and locking of dials.
- 3.3.24 Optional Features:
- 3.3.24.1 Number and spacing of T-Slots.
- 3.3.24.2 Pendant Station.
- 3.3.24.3 Single Controls.
- 3.3.24.4 Semi-automatic table cycle in both directions consisting of rapid advance, feed, and rapid return.
- 3.3.24.5 Coolant refrigeration.
- 3.3.24.6 Temperature control of lubricant.
- 3.3.24.7 Temperature control of hydraulic power fluid.
- 3.3.24.8 Synchronized, powered outer arm brace with anti-friction bearings.
- 3.4 Spindle Head Assemblies: Shall consist of spindle nose, spindle, provisions for altering the stipulated range of speeds, integral housing and such saddle and slide mechanism as may be necessary to satisfy the requirements of Table I.
- 3.5 Control Systems: (Manual - See 3.3.21)
- 3.6 Controls: All primary operator's control buttons, switches, levers, gages and regulating devices shall be grouped and mounted in a location affording the operator (when in his normal, established work position) maximum visibility of the machine, tooling, and work. When other than pendant control is provided, secondary controls consisting of start, stop, reverse, and jog are required in opposite area.
- 3.7 Electrical Equipment: All electrical equipment and its installation shall conform to the latest revision of NMTBA "Machine Tool Electrical Standards." All machines shall be equipped to operate on 220/440 volt, 3-phase, 60-cycle alternating current unless otherwise specified.
- 3.8 Hydraulic Equipment: All hydraulic equipment and its installation shall conform to the latest JIC Standards, where they apply.
- 3.9 Lubrication: Automatic lubrication of all sliding and rotating parts [1] shall be actuated by the cycling of the machine. Such lubrication shall be adequate for the purpose but not excessive. All points of adjustment [2] shall have provisions for periodic lubrication. Lubricating system shall be equipped with a low-level and system failure alarm.
- [1] Excluding motors or pumps with non-additive pack seal bearings.
- [2] Defined as motions independent of machine cycling.
- 3.10 Safety: Each machine shall be furnished with safety devices of the latest approved type. Moving parts which are hazardous to personnel shall be guarded.
- 3.11 Interchangeability: All replaceable parts, with the exception of adjustable gibs shall be manufactured to definite standards for tolerance, clearance, and finish so that any such part may be field installed without further machining. All parts shall be permanently and legibly marked with the manufacturer's part number.
4. INSPECTION AND ACCEPTANCE
- 4.1 Inspection: (Customer's Option) The erection of each machine shall be supervised by the manufacturer at the installation point designated by the customer and shall be inspected and tested for compliance with the customer's specifications.

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- 4.2 Classification of Tests:
- 4.2.1 Requirement verifications.
- 4.2.2 Tolerance tests.
- 4.2.3 Performance tests.
- 4.3 Test Conditions
- 4.3.1 At manufacturer's plant.
- 4.3.2 By manufacturer and customer.
- 4.3.3 Inspection at completion. Progressive inspection at customer's option.
- 4.3.4 Test shall be performed as shown in Sections 4.4.2, 4.4.3 and 4.4.4 unless approval is obtained from customer.
- 4.3.5 The specific measuring instruments and methods shown on the various test illustrations do not preclude the use of other acceptable means of measurement such as optical, electronic, or air gaging.
- 4.4 Test Details
- 4.4.1 Check required items specified in Section 3 not covered by Section 4.
- 4.4.2 Tolerance tests per following descriptive drawings.
- 4.4.2.1 Test for table flatness.
- 4.4.2.2 Test for spindle runout.
- 4.4.2.3 Test for runout of spindle internal taper.
- 4.4.2.4 Test for spindle and arbor support alignment.
- 4.4.2.5 Test for spindle and overarm parallelism.
- 4.4.2.6 Test for quill and table parallelism.
- 4.4.2.7 Test for squareness of column and table top.
- 4.4.2.8 Test for rise and fall of table.
- 4.4.2.9 Test for parallelism of center T-slot and table top.
- 4.4.2.10 Test for squareness of center T-slot and spindle.
- 4.4.2.11 Test for squareness of spindle and column ways.
- 4.4.2.12 Test for lost motion - backlash.
- 4.4.2.13 Test for lead error.
- 4.4.2.14 Test for straightness of keyways.
- 4.4.2.15 Test for table flatness.
- 4.4.2.16 Test for spindle runout.
- 4.4.2.17 Test for runout of spindle internal taper.
- 4.4.2.18 Test for squareness of table top and spindle.
- 4.4.2.19 Test for rise and fall of table.
- 4.4.2.20 Test for rise and fall of head in cross movement.
- 4.4.2.21 Test for parallelism of center T-slot and table ways.
- 4.4.2.22 Test for squareness of cross movement and center T-slot.
- 4.4.2.23 Test for squareness of vertical movement and table top.
- 4.4.2.24 Test for lost motion - backlash.
- 4.4.2.25 Test for lead error.
- 4.4.2.26 Test for straightness of keyways.

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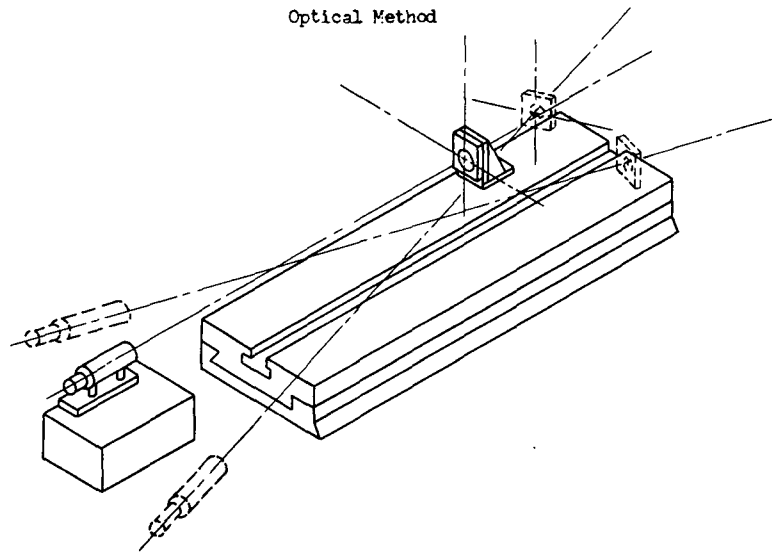
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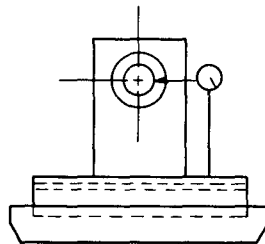
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4.4.2.1 TEST FOR TABLE FLATNESS

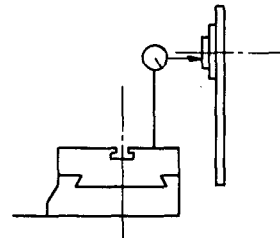


The table must be flat within 0.0005 inch maximum per foot and 0.001 inch maximum over-all

4.4.2.2 TEST FOR SPINDLE RUNOUT



Spindle periphery runout
0.0002 inch maximum



Spindle face runout
0.0002 inch maximum

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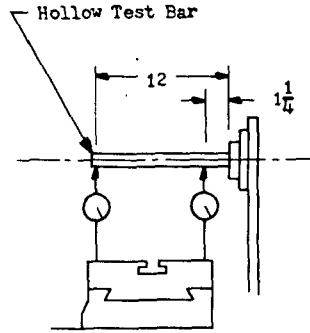
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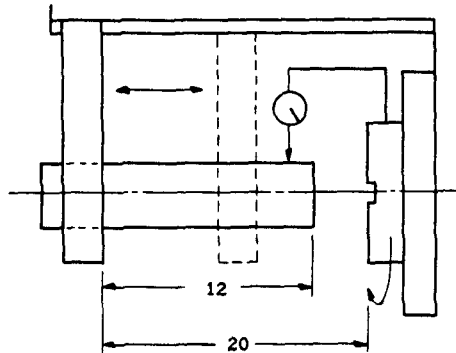
4.4.2.3 TEST FOR RUNOUT OF SPINDLE INTERNAL TAPER



Spindle taper runout (1-1/4 inches from face) 0.0002 inch maximum

Spindle taper runout (12 inches from face) 0.0005 inch maximum

4.4.2.4 TEST FOR SPINDLE AND ARBOR SUPPORT ALIGNMENT



Arbor support (in clamped position) to be aligned with spindle with 0.0005 inch maximum runout

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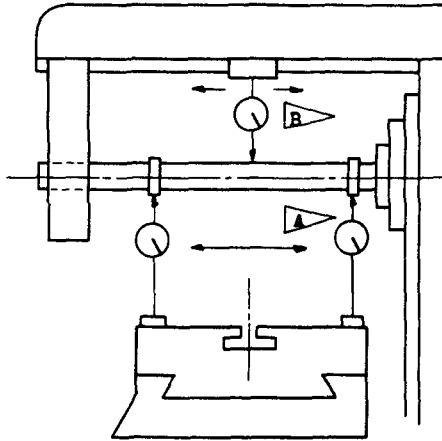
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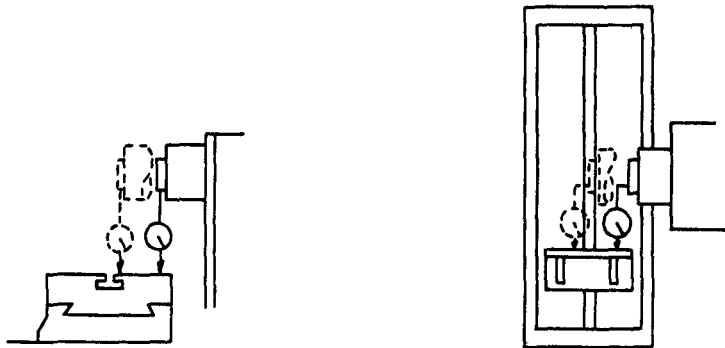
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4.4.2.5 TEST FOR SPINDLE AND OVERARM PARALLELISM



- A** Spindle (in unlocked position) to be parallel to table top within 0.0002 inch maximum per foot
- B** Overarm (in clamped position) to be parallel to spindle within 0.0002 inch maximum per foot

4.4.2.6 TEST FOR SPINDLE AND TABLE PARALLELISM



Spindle to be parallel to table top within 0.0002 inch maximum over its full travel

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