

NATIONAL AEROSPACE STANDARD

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC., 1725 DE SALES STREET, N. W., WASHINGTON, D. C. 20036

1.0 SCOPE

- 1.1 Purpose: This specification provides a standard for the manufacture, performance, inspection, and procurement of a series of numerically controlled measuring inspection machines. Machines shall have the capability of automatically probing, measuring and recording the required digital information.
- 1.2 Classification: The machines shall be of the following type, size and class as specified by the procurement agency.
- 1.2.1 Type:
- I - Vertical
 - II - Horizontal
- 1.2.2 Sizes:
- Small
 - Medium
 - Medium Large
 - Large
- 1.2.3 Classes:
- 1.2.3.1 Machine
- Class I - 3-axis
 - Class II - 3-axis with 4th axis mode (rotary positioning)
- 1.2.3.2 Control
- AIA Class III Positioning Numerical Control Systems, NAS 943 Punched Tape Standards.
- 1.3 Intended Use: The machines described by this specification are intended for use in the aerospace manufacturing industry and provide a means for the inspection of parts or tools where the inspection requires verification of the physical geometry or where the determination of an unknown geometry is required.

LIST OF CURRENT SHEETS

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CUSTODIAN: MANUFACTURING COMMITTEE

PROCUREMENT SPECIFICATION	TITLE	CLASSIFICATION
		SPECIFICATION
	MEASURING INSPECTION MACHINE - PRECISION - NUMERICALLY CONTROLLED	NAS 971 SHEET 1 OF 18

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THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THIS PROJECT. IT SHALL BE THE RESPONSIBILITY OF THE USER TO DETERMINE THE DATE OF APPROVAL SHOWN HEREON. AIA AND ITS COMMITTEES WILL NOT INVESTIGATE THE APPLICABILITY OF PATENTS TO THE SUBJECT MATTER OF THIS STANDARD AND IN RESPECT THEREOF DO NOT ASSUME ANY LIABILITY TO PATENT OWNERS OR TO PROSPECTIVE USERS.

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 of this specification shall preclude any contradictory portions of the following specifications, codes and standards.

- 2.1 Joint Industries Conference Hydraulic & Pneumatic Standards for Industrial Equipment. (JIC)
- 2.2 National Machine Tool Builders Association Electrical Code. (NMTBA)
- 2.3 American Standards Association. (ASA)
- 2.4 American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII. (ASME)
- 2.5 National Aerospace Standard 938, Machine Axis and Motion Nomenclature.
- 2.6 No conflict shall exist with National Aerospace Standard 943, Interchangeable Perforated Tape Standards Variable Block Format for Positioning and Straight Cut Numerically Controlled Equipment.
- 2.7 National Aerospace Standard 953, Numerical Control System. Only specific paragraphs as specified by the customer shall apply.
- 2.8 The Electronic Industries Association Electrical Specifications and Construction Standard, Numerical Machine Tool Control. (EIA-RS281) Where conflict exists between National Machine Tool Builders Association and Electronic Industries Association Specifications, customer shall specify preference.
- 2.9 State and Local Safety Codes that are more exacting shall apply.

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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 dimensions and capacities for the respective types and sizes shall be as shown in Section 3.2 and the control in Section 3.3.1. The general shape and arrangement of machine, control cabinets, and associated components shall combine necessary functions with accessibility, minimum space, and neatness. The manufacturer has the choice of configuration and functional operation of the machine, except where specifically stated in this specification.

3.2 Types, Sizes, Class:

Table I

	Small	Medium	Med. Large	Large
Work Mounting Surface				
Length (X)	48	72	96	120
Width (Y)	24	48	60	60
Work Height (Z)	24	36	48	60
Work Surface to Floor				
Minimum	31	31	31	31
Maximum	33	33	33	33
Tee Slots 5" O. C.	13/16	13/16	13/16	13/16
Minimum Distributed Workload Lbs.	1500	3000	5000	5000
Minimum Loading Capacity Lbs. per	1000	1000	1000	1000
Square Inch				
Class II Rotary Table	24" dia.	36" dia.	48" dia.	60" dia.
Rotary table to have center locating hole 1.0004" dia.				
1.000"				
with protective center plug				
Movements (X axis)	56	80	104	128
(Operating Range) (Y axis)	32	56	68	68
(Z axis)	24	36	48	60
Rates				
Traverse-IPM	200	200	200	200
Rotary table-RPM	2	2	1-1/2	1
Final approach not-to-exceed	4 sec.	4 sec.	4 sec.	4 sec.
All dimensions in inches except where otherwise shown				

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3.3 Machine Sub-Assemblies:3.3.1 Machine Controls:

3.3.1.1 Numerical Control System: The machine shall be equipped with a numerical control system for controlling all movements as specified in Section 3.2 and shall be arranged for operation in modes described in this section. The systems shall comply with the requirements set forth in NAS 953 Numerical Control System specification. (Specify applicable paragraphs.)

3.3.1.2 For automatic inspection repetitive cycle, the machine under tape control shall execute a programmed sequence of motions. When a cycle is completed and a particular point located and the relevant information recorded, the system shall automatically initiate the next cycle.

3.3.1.3 For single inspection cycle operation a selector switch setting is to be provided. In this mode the machine shall perform under tape control the programmed sequence of motions to locate and record one point only. Upon completion of any such cycle the machine will automatically stop. The operator may then initiate the next cycle by actuating the start button.

3.3.1.4 For manual inspection cycle, the system shall be capable of moving the probe to any position within the range from X, Y and Z commands set in dial or push buttons on the operator's console. These motions shall be initiated by actuating the start button after which the cycle will be completed as in the "single inspection cycle" mode.

3.3.1.5 For manual measuring cycle, the system shall be capable of allowing the operator to move the probe in all three axes under pendant control to any position. At that point, the cycle will be continuous under probe control to locate and record one point only. Upon completion of this cycle, the machine will automatically stop.

3.3.1.6 The system shall be capable of jog control, allowing the operator to move the probe in all three axes under pendant control.

3.3.1.7 The system shall be capable of simultaneous positioning in three axes or sequential in each axis as programmed.

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- 3.3.1.8 It shall be possible to interrupt any tape controlled program at the conclusion of any cycle in order to execute non-programmed motions using manual numeric or jog control modes of operation and return to tape control without loss of program continuity. When returning to tape control after manual insertion of information or a power failure and where previous tape information is required, a tape scan to update the control system shall be permitted, provided that machine movements are not required during this process.
- 3.3.1.9 Axis reversing switches shall be provided so that right and left hand parts can be measured or inspected from the same tape.
- 3.3.1.10 Control system shall operate from standard punched tape (NAS 943).
- 3.3.1.11 The least significant digit of linear dimensional data shall be 0.0001" or smaller for linear movements and 0.0001 of a revolution for angular movements.
- 3.3.1.12 Decimal display output shall include continuous visual display in all mode of operation of the following:
- (a) Inspection point number.
 - (b) Actual digital position of the probe in the probe axis referenced to any zero point.
 - (c) Actual digital position of probe in all other axes referenced to any zero point.
 - (d) Nominal position of probe in probe axis.
 - (e) *Error, that is (d) from (b).
- 3.3.1.13 System controlled electric printer print-out to include
- (a) Inspection point number.
 - (b) Nominal position of probe in probe axis.
 - (c) Actual position of probe in probe axis.
 - (d) *Error, that is (c) from (b).
- Format shall be in accordance with paragraph 3.3.1.14.
System shall be capable of recording on NAS 943 punched tape all of the output data.
- * (See 8.1.2 for definition)

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- 3.3.1.14 Suggested format for printout (See paragraph 6.1 for additional options).

Printout capability, 80 characters minimum at a rate which will not limit performance.

Inspection Point Number	Axis and Nominal Dimension	Axis and Actual Dimension	Error
001	X-12.3456	X-12.3471	/.0015
002	Y-12.3456	Y-12.3456	.0000
003	Z-12.3456	Z-12.3440	-.0016

- 3.3.1.15 The system shall be capable of establishing a zero reference at any point within the system range upon a zero shift command from the tape or manual input. The normal fixed established machine zero reference point must not be lost when zero shifting.

- 3.3.1.16 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 position.

- 3.3.1.17 Operator's controls shall be mounted in a console and shall include start and stop buttons, power on/off, mode select, three 6-digit for the small and medium machines and two 6-digit and one 7-digit for the medium large and large machine actual position displays with numerals a minimum of 3/4" high, three sets of zero offset switches, null meters or error indicators, three sets of manual input switches, button or dials, in-position lights, and inspection point (operation display).

- 3.3.1.18 Pendant control shall be provided and shall be accessible to the operator from all sides of the machine. Pendant shall include jog control for each axis, a program start button, a cycle stop button and a mode selection switch.

- 3.4 Construction: The machine shall be constructed to comply with the requirements of this specification and other specifications as noted.

- 3.4.1 The three axes of motion are as defined in NAS 938. Movements of probe in each axis shall be as shown in Section 3.2.

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