

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 numerically controlled multiple head printed circuit board drilling machines.
- 1.2 **Classification:** This specification will cover Class III (Positioning type) numerically controlled multiple head, high precision printed circuit board drilling machines.
- 1.3 **Intended Use:** The machine described by this specification is intended for use in the aerospace manufacturing industry and provides for precision drilling of hole patterns in printed circuit boards, within the limits specified.

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 The National Machine Tool Builders Association's (NMTBA) Electrical Standards.
- 2.2 The Joint Industries Conference (JIC) Hydraulic Standards for Industrial Equipment.
- 2.3 The American Standards Association (ASA) B5.18 Spindles.
- 2.4 Electronic Industries Association (E.I.A.) Construction Standards, Numerical Machine Tool Control.
- 2.5 State and Local Electrical and Safety Codes.
- 2.6 **National** Aerospace Standards (NAS 953) Numerical Control Systems, (Standard Practice.)

- ① INACTIVE FOR DESIGN AFTER 15 SEPT. 1975.
NO SUPERSEDING STANDARD

LIST OF CURRENT SHEETS

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

CUSTODIAN: MANUFACTURING COMMITTEE

PROCUREMENT SPECIFICATION	TITLE	CLASSIFICATION SPECIFICATION
	PRINTED CIRCUIT BOARD DRILLING MACHINE NUMERICALLY CONTROLLED	NAS 948 SHEET 1 OF 21

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- 2.7 The American Society of Mechanical Engineers' (ASME) Boiler and Pressure Vessel Code, Section VIII.
- 2.8 The Electronic Industries Association (EIA) Electrical Specification.
- 2.9 National Aerospace Standard 943, Interchangeable Perforated Tape Standard - Variable block format for positioning and straight cut numerically controlled equipment.

3.0 REQUIREMENTS

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

- 3.1 Responsibilities: An overall responsibility shall be accepted by the manufacturer for the design, manufacture, performance, reliability and packaging of the control system and the controlled equipment as defined in the specification. This responsibility shall provide for technical direction during installation and maintenance during the warranty period.
- 3.1.1 The manufacturer will in turn hold subcontractors responsible for the performance of the control sub-system and components.
- 3.1.2 The manufacturer will be responsible for the inspection, acceptance and warranty of the control system, controlled equipment and all sub-systems. The warranty period shall be for one (1) year from final machine acceptance during which time the manufacturer is responsible for replacement of all defective materials, workmanship and engineering and in turn will assure compliance of his suppliers and subcontractors to the warranty. Exceptions may be made on low cost perishable components which preventive maintenance procedures may provide for more frequent replacements than one (1) year.
- 3.1.3 At the customer's option the manufacturer will be responsible for instructions and indoctrination of the customer's personnel. The period and extent of training may vary according to the complexity of the system, and the prior training of the customer's employees. Basic and advanced training in system trouble shooting and diagnostic procedures are to be available by the manufacturer prior to and/or during the installation and checkout of equipment.
- 3.2 Design: The dimensions and capacities for the respective equipment shall be shown in Section 3.3. The manufacturer has the choice of configuration and the functional operation of the machine, except where specifically stated in this specification.

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TABLE I

TYPE, SIZE, CLASS

CLASS DESCRIPTION	MULTIPLE HEAD - MODULAR CONSTRUCTION
WORK PIECE CAPACITY	10" x 12" MAXIMUM, STACKED TO $\frac{1}{2}$ " OR LESS
SPINDLE SPEED AND FEED RANGES	800 to 45,000 RPM ---- 0 - 200 IPM INFINITELY VARIABLE
DRILL CAPACITY	# 80 (.0135) DIA. TO $\frac{1}{4}$ (.250) DIA.
MINIMUM TORQUE REQUIREMENTS MEASURED AT THE DRILL	42 IN. OZ. FOR $\frac{1}{4}$ DIA. DRILL AT 935 RPM 2 IN. OZ. FOR # 60 DIA. DRILL AT 2240 RPM
SPINDLE STROKE	0 - 2 $\frac{1}{2}$ " MAXIMUM
DRILL HOLDING DEVICE	COLLET - .0002" T.I.R. FROM NOSE
TABLE CARRIAGE RAPID TRANVERSE	60 IN./MIN. MINIMUM
JOGGING SPEEDS RAPID TRAVERSE	.001 IN./SECOND 150 IN./MINUTE
TABLE ACCURACY	POSITIONING - $\pm$.0005" *
TABLE ACCURACY	REPEATABILITY - $\pm$.0002" **
DIRECTION OF DRILLING	VERTICAL (Z AXIS) MOTION FROM +Z TO -Z OR -Z TO +Z OPTIONAL WITH MANUFACTURER. ***

* = AS DEFINED ON SHEET # 17

** = AS DEFINED ON SHEET # 18 & # 19

*** = TESTS CONTAINED HEREIN SHOW A
SPINDLE DRILLING FROM + Z TO -Z
FOR ILLUSTRATION PURPOSES ONLY.

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- 3.3 Type, Size, Class: See Table I for all data.
- 3.4 Construction: The machine shall be constructed to comply with the requirements of section 3.0 and inspection and acceptance tests of section 4.0.
- 3.4.1 The table shall be of sufficient size and have adequate travel to permit the simultaneous drilling of a minimum of four (4) separate stacks of 10" x 12" printed circuit boards utilizing four (4) independent heads.
- 3.4.2 The installation shall permit the use of from one (1) to four (4) drill head assemblies at any one time, on a horizontal support structure. The latter shall be movable in the plus or minus "x" direction within the noted range.
- 3.4.2.1 In operation the support structure shall be raised or lowered and the spindle of the drill motor advanced under controlled conditions under power.
- 3.4.2.2 Each head shall be capable of individual adjustment along the Z axis to accommodate variations in drill length.
- 3.4.2.2.1 Provisions shall be made for manual override of the system.
- 3.4.2.3 Each drill head shall be mounted to the support structure by means of quick change devices. A pressure foot shall also be provided. Drill heads shall be equipped for collets.
- 3.4.2.3.1 The machine shall be capable of performing a minimum of 50 (drilling cycles) per minute, per head through (1) 1/16 glass bonded material, on 0.100" centers using a # 54 (.055) diameter drill.
- 3.4.2.4 The hold down device shall be a power controlled pressure foot assembly. It shall maintain a constant pressure on circuit boards during the drilling cycle. The pressure applied by the pressure foot shall be variable within the range from 0 to 100 lbs. force.
- 3.4.2.4.1 The pressure foot for each spindle to include a removable drill bushing. The bushing is to extend below the pressure pad to localize compression at point of drilling.
- 3.4.3 Provisions shall be made for a chip removal system which will keep the table or bearing surface dust free.

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AIA AND ITS COMMITTEES WILL NOT INVESTIGATE THE APPLICABILITY OF PATENTS TO THE SUBJECT MATTER OF NAS STANDARDS AND IN RESPECT THEREOF DO NOT ASSUME ANY LIABILITY TO PATENT OWNERS OR TO PROSPECTIVE USERS

THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THE SAME PRODUCT AND SHALL BECOME EFFECTIVE NO LATER THAN SIX MONTHS FROM THE LAST DATE OF APPROVAL SHOWN HEREON

- 3.4.4 Any point within the working area of the table shall be capable of being positioned on the axis of a given drill motor, plus or minus 0.0005" measured with respect to a point of origin. Direct reading indications shall show the ultimate position of table in terms of X and Y coordinates.
- 3.5 Head Assemblies: Head assemblies shall consist of a spindle, drive motor, feed mechanism, and other necessary devices for providing a variation in speed within the stipulated range, an integral housing and associated components as is necessary to satisfy the requirements of table I Section 3.2
- 3.5.1 The spindle shall be of quality, hardened and ground alloy steel.
- 3.6 Control System: The machine shall be equipped with a numerical control system for controlling all movements specified. However, the system shall be designed to permit manual and semi-automatic operation as well as full numerical control.
- 3.6.1 The numerical control system shall be Class III, point to point positioning. The input media shall conform to NAS 943 specification for punched tape.
- 3.6.1.1 The numerical control system shall provide controlled motion in three (3) normal axes.
- 3.6.1.2 The positioning table longitudinal movement is defined as the (X) axis, the positioning table motions normal to this axis is defined as the (Y) axis and the spindle movements is defined as the (Z) axis.
- 3.6.1.3 When the Class III, 3-axis control is ordered the positioning table longitudinal movement (X), the positioning table cross movement (Y) and the spindle movement (Z) shall be controlled.
- 3.6.2 The control system shall be complete. The control console shall contain all the necessary electronics for control of the table and spindle, tape transport mechanism, tape reader, operation selector, dials and power supply, and may include tape punch equipment if required. All units and circuitry to be properly installed within the control console.
- 3.6.3 The system shall have built in capability so that programming of "stops" can be provided for drill changes, drill and part inspection, spindle speed changes, program changes, program checks, etc. Resumption of automatic operation shall not cause any loss of positional information.

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- 3.6.4 The system shall also control auxiliary functions such as spindle on-off, part clamping, automatic final position clamping of table during drilling cycle, or other functions as specified by programming.
- 3.6.5 The control circuitry shall be modular with solid state printed circuit logic. The systems shall also be maintenance oriented with adequate provisions for maintenance checkout devices.
- 3.6.6 Up to date wiring diagrams shall be provided in a pocket on inside wall or doors of control console and be clearly visible.
- 3.6.7 The machine must be capable of programming from a previously punched tape, prepared on a general purpose computer.
- 3.6.8 Zero Offset: The system shall be such that full floating zero capability can be achieved at any point within the entire working area of the table.
- 3.6.9 Test Tape: A test tape shall be furnished with each machine for maintenance personnel's use in checking and adjusting the electronic system for all motion characteristic of the machine.
- 3.6.10 The system shall be designed and constructed to operate continuously in a normal factory environment defined as follows:
 Room ambient temperature - from 60°F to 125°F.
 Room ambient relative humidity - from 10% to 95%
 Line voltage fluctuation - $\pm$ 10% of rated voltage
- 3.6.11 Components sensitive to vibration shall be protected from vibrations generated by the equipment while it is in operation.
- 3.6.12 The reading speed of the tape reader shall be such that the machine is not input limited.
- 3.7 Operators Controls: All operating control switches or levers, shall be convenient to the operator when he is in the normal and established operating positions.
- 3.7.1 Emergency stop button shall be readily available to operator at operator's control station to immediately stop machine.
- 3.8 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 volts, 3 phase, 60 cycle alternating current, unless otherwise specified, and include circuit breaker or fuse interrupter.

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THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THE SUBJECT MATTER OF THIS STANDARD AND SHALL BE USED FOR THE DESIGN OF THE MACHINE FROM THE DATE OF APPROVAL SHOWN HEREON

APPROVAL DATE Oct. 1964 REVISION ① 15 Sept. 1975

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- 3.8.1 Electronic components shall be arranged into convenient plug-in or quick disconnect module type units. These units shall be standardized, and interchangeable whenever practical. Functional identification shall be permanently marked on each module.
- 3.8.2 All components (resistors, capacitors, etc.) shall be protected from electrical damage caused by power surges, transients, failures, and signals in the air, such as those generated by radio transmitter, welders, and x-ray machines.
- 3.8.3 Identification of all replaceable parts shall be permanently marked: Transistors, diodes, capacitors, resistors, and other components shall be identified or coded and marked adjacent to their location.
- 3.8.4 Terminal strips shall have each terminal permanently marked in sequence.
- 3.8.5 All electrical cabinet doors are to be provided with locks.
- 3.8.6 Machine shall be provided with a 110 volt transformer, work light, and one 110 volt service outlet.
- 3.9 Hydraulic Equipment:
- 3.9.1 All hydraulic equipment and its installation shall conform to the latest Joint Industries Conference Standards, where they apply.
- 3.9.2 Suitable over-temperature thermal switches and signaling devices shall be provided to alert the operator to an over-temperature condition and to shut off electrical motors at the end of the cycle in event hydraulic fluid temperature exceeds the top limit specified by the supplier.
- 3.9.3 The use of fire resistant hydraulic fluids shall be the customer's option.
- 3.10 Lubrication:
- 3.10.1 Automatic and adequate lubrication of all sliding and rotating parts, except motor or pump with non additive pack seal bearings, shall be provided.
- 3.10.2 All points of adjustment shall have provisions for periodic lubrication.

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