



NATIONAL AEROSPACE STANDARD

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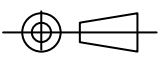


INACTIVE DESIGN AFTER 31 JULY 2012

FED. SUPPLY CLASS

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FORM 09-01	THIRD ANGLE PROJECTION 	CUSTODIAN ENGINEERING MANAGEMENT COMMITTEE	REVISION 5
	PROCUREMENT SPECIFICATION NONE	TITLE ELECTRON BEAM WELDING MACHINE – HIGH VACUUM	CLASSIFICATION SPECIFICATION NAS976 SHEET 1 OF 24



1.0 SCOPE INACTIVE DESIGN AFTER 31 JULY 2012

1.1 Purpose

This specification provides a standard for manufacture, performance, inspection, reliability and procurement of an Electron Beam high-vacuum welding system exclusive of weld positioners, weld manipulators and other mechanical tooling devices. This standard lists minimum requirements and is not limited to design advancements.

1.2 Classification

This machine is a completely self-contained general-purpose Electron Beam welding facility.

1.2.1 Type

- I. Electron Beam - High Vacuum
- II. Movable Gun
- III. Fixed Gun
- IV. Movable Gun and Workpiece

1.2.2 Size

Chamber size and power ratings shall be that which is applicable to customer requirements.

1.2.3 Class

Precision

LIST OF CURRENT SHEETS

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

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CUSTODIAN: MANUFACTURING COMMITTEE

PROCUREMENT
SPECIFICATION

NONE

TITLE

ELECTRON BEAM WELDING MACHINE - HIGH VACUUM

CLASSIFICATION

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1.3 Intended Use INACTIVE DESIGN AFTER 31 JULY 2012

The welding systems described by this specification are intended for use in the aerospace manufacturing industry and provides a means for joining together a wide range of materials and material thickness. These include, but are not limited to, refractory and reactive metals, ceramics, dissimilar materials, steels, and non-ferrous metal alloys.

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 Electrical Manufacturers Association (NEMA) Standards for Electrical Apparatus and Equipment. (3.5)
- 2.2 The Electronic Industries Association (EIA) Construction Standards, RS281.
- 2.3 National Aerospace Standard 938, Machine Axis and Motion Nomenclature, as applicable.
- 2.4 National Aerospace Standard 953, Numerical Control System (standard practice), as applicable.
- 2.5 National Aerospace Standard 955, Interchangeable Perforated Tape Standards, Variable Block Format, Numerically Controlled Equipment, as applicable.
- 2.6 National Aerospace Standard 968, Interchangeable Digital Magnetic Tape Standards, Variable Block, Word Address Format, Contouring and Contouring/Positioning Equipment, as applicable.
- 2.7 National Aerospace Standard 969, Interchangeable Digital Magnetic Tape Cartridge - for Numerically Controlled Machines, as applicable.
- 2.8 MIL-C-45662, Calibration of Standards.
- 2.9 Federal, State, and Local regulations and codes pertaining to radio interference and safety.
- 2.10 State and Local Safety and Electrical Codes.

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APPROVAL DATE Aug. 1965 REVISION ① 15 July 1971 ② 30 Nov. 1974

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- 2.12 "National Bureau of Standards: Handbook #59 - Permissible Dose from External Sources of Ionizing Radiation, and National Bureau of Standards Handbook #93 - Safety Standard for Non-Medical X-Ray and Sealed Gamma-Ray Sources". (3.8.3)
- 2.13 Joint Industrial Council (J.I.C.) Standard for Air and Hydraulics.
- 2.14 Glossary of Manufacturing Equipment Terms, NAS 972. (8.1)
- 2.15 Occupational Safety & Health Standard Part 1910 of Chapter XVII of Title 29 of the Code of Federal Regulations (Occupational Safety & Health Act (OSHA) - 1970). (3.8).

3.0 REQUIREMENTS

3.1 Design

The general shape and arrangement of the Electron Beam welding machine, control cabinets and associated components shall provide the necessary functions with accessibility, minimum space and neatness. The manufacturer has the choice of configuration and the functional operation of the machine, except where specifically stated in this specification.

3.2 Size

The vacuum chamber configuration and size shall be indicated by the manufacturer. The usable working area shall be specified by the customer.

3.3. Machine Sub-Assemblies

3.3.1 Positioning Mechanism

- 3.3.1.1 When the gun and/or the workpiece are movable for the purpose of positioning and welding, the positioning mechanisms shall be controlled from outside the chamber. These controls shall be mounted in a location easily accessible to the operator while observing the welding.
- 3.3.1.2 When a movable gun is specified it shall provide sufficient cable and accessory for using the gun in a 90° tilt about the axis of travel up to the horizontal position. This adjustment shall be applicable over the entire span of travel.
- 3.3.1.3 Positioning mechanism for gun or workpiece shall be zero backlash type and shall be capable of manual or mechanized movement for alignment of beam center line to weld position.

3.3.2 Machine Controls

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- 3.3.2.1 The machine shall have the necessary devices and designs so that it can be converted with a minimum of rework for operation by numerical control or by some other programming means as specified by the customer.
- 3.3.2.2 Data input for numerical control systems shall be in accordance with either National Aerospace Standards 955, 968 or 969 when numerical control is specified by the customer.
- 3.3.2.3 Control System design shall be in accordance with National Aerospace Standard 953 when numerical control is specified by the customer.
- 3.3.3 Operator's Controls
- 3.3.3.1 The controls necessary for welding are to be contained in the operator's control station, or stations. The operator's control station, or stations, shall be located convenient to the operator when he is in a normal operating position. The minimum control elements of the operator's control station, or stations, shall include, but not limited to, the following:
- 3.3.3.1.1 Beam switch "on-off".
- 3.3.3.1.2 Mushroom head, red "Emergency Stop" button for arresting the welding operation.
- 3.3.3.1.3 "On and Off" switches for gun filament and for chamber light.
- 3.3.3.1.4 Directional switches for constant and variable speed motors, fixture drives and movable gun.
- 3.3.3.1.5 Jogging switches for initial positioning of the gun or workpiece.
- 3.3.3.1.6 Direct reading digital beam current control and indicating meter.
- 3.3.3.1.7 Automatic sequence "On-Off" switch.
- 3.3.3.1.8 Direct reading digital accelerating voltage controls and indicating meter.
- 3.3.3.1.9 Digital focusing controls and indicating meter.
- 3.3.3.1.10 Adjustment for gun filament current and indicating meter.
- 3.3.3.1.11 Power "On-Off" switch.
- 3.3.3.1.12 High Voltage "On" indicator light.

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3.3.3.1.13 Direct reading digital adjustment devices for speed setting of power-driven elements.

3.3.3.1.14 Vacuum controls and meters.

3.3.3.1.15 Three (3) vacuum gages shall be provided: One (1) ionization gage with a direct reading meter registering for 1×10^{-3} Torr to 1×10^{-5} Torr or better, and two (2) thermocouple gages with direct reading meters for one (1) Torr to 1×10^{-3} Torr.

3.4 Construction

The machine shall be constructed to comply with the requirements of this specification.

3.4.1 Consideration shall be given to the prevention of degradation of functional mechanism from weld spatter and vapor plating.

3.4.2 Work table motion and/or gun carriage motion shall be straight within .001" per foot in any plane of movement, not to exceed .010" in any 10 feet, and have machined "T" slots as specified by the customer.

3.4.3 All wiring, plumbing, and functional elements shall be located for maximum accessibility and for ease of servicing.

3.4.4 Machine components and modules shall be arranged in a neat, compact, and efficient manner such as to facilitate accessibility, operation, and maintenance, and to conserve floor space.

3.4.5 The entire system shall be capable of being certified to meet the FCC regulation. (Ref. 2.10)

3.4.6 Vacuum Chamber

3.4.6.1 The chamber shall be constructed of a material thickness adequate for design consideration and shall be of such material, thicknesses, and construction as to sufficiently attenuate and prevent the leakage of harmful radiation and assure adequate strength at 1×10^{-6} Torr internal pressure. (Ref. 3.8.3)

3.4.6.2 The chamber shall have provisions for the addition or extensions to increase the working capacity of the evacuated portion without further machining.

3.4.6.3 The chamber shall be arranged to accommodate the driving mechanisms (external or internal) for internally-mounted fixturing such as carriages and tables.

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- 3.4.6.4 Suitable viewing ports shall be provided in the chamber as specified by the customer. Viewing ports shall be constructed with a suitable radiation shielding glass mounted so as to prevent the escape of harmful radiation. Viewing ports shall be provided with interior removable cover glass or some equivalent protection.
- 3.4.6.5 The chamber shall be equipped with a minimum of one (1) full access door equal to interior cross section of the chamber. Additional doors will be provided when specified by the customer.
- 3.4.6.6 Chamber doors and/or gun access port shall be provided with safety devices to interrupt the power to the electron gun whenever the door or port is opened.
- 3.4.6.7 Suitable power feed-throughs for driving fixtures, feed-throughs for coolants, back-fill gas, and multiple electrical connectors shall be provided as specified by the customer.
- 3.4.6.8 Suitable lighting fixtures shall be provided to illuminate the work area. Additional lighting outlets may be required as specified by the customer.
- 3.4.6.9 Vacuum-exposed chamber surfaces that are not epoxy coated shall have a surface finish equal to, or better than a 40 microinch.
- 3.4.6.10 Valve(s) shall be provided to equalize pressure by admitting either air or other gases, within 5 minutes or as specified by the customer. Valve(s) shall be equipped with a filter/silencer.
- 3.4.7 Vacuum System
- 3.4.7.1 The vacuum pumping system shall be of sufficient capacity to evacuate a clean bare chamber to an operating pressure level of 1×10^{-4} Torr or better. Evacuation time to be specified by the customer.
- 3.4.7.2 Mechanical pumps shall be located in such a manner as to minimize or eliminate the transmission of vibration to the rest of the machine.
- 3.4.7.3 An air lubricator and filter shall be provided in conjunction with the air supply used to actuate any pneumatically-operated valves.
- 3.4.7.4 All cold traps, diffusion pumps, baffles and all vacuum-exposed surfaces shall be readily accessible and easily cleaned. They shall be of such materials and construction as will minimize contamination.

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3.4.7.5 Operation of the pumping equipment shall be sequenced automatically or by a single manual switching device as defined by the customer, to evacuate the chamber to the desired welding pressure level.

3.4.7.5.1 The welding sequence control shall be interlocked so that it cannot be initiated, or maintained, until the desired pressure for welding is present in the chamber.

3.4.7.5.2 Manual override controls of the pumping sequence shall be provided.

3.4.7.6 In the event of the loss of cooling water a vacuum system alarm and an adjustable preset timer shall be initiated for selective system shutdown.

3.4.7.7 Electrical power shall be brought to the vacuum system equipment in such a manner that the other equipment in the machine may be shut down without shutting down the vacuum system.

3.4.7.8 In a multivacuum pumping system provisions shall be made to shut down individual pumping groups.

3.4.7.9 Cooling water supply in multivacuum pumping systems shall be individual parallel systems fed from a master manifold.

3.4.7.10 Each pumping group shall have an individual water filter.

3.4.8 Viewing System

An optical viewing system in addition to 3.4.6.4 and/or a closed circuit television system either in line with the beam center line or oblique to the beam center line shall be provided with magnification to assure adequate viewing of beam spot and workpiece relative to the position on weld area. This system shall be shielded from deposition of metallic vapors.

3.5 Electrical Equipment

All electrical equipment and its installation shall conform to the applicable specification noted in Section 2.0. All machines shall be equipped to operate on 460 volts, 3 phase, 60 hertz alternating current unless otherwise specified. (Ref. 2.1 and 2.2)

3.5.1 Power supply shall be from one source, 460 volts, 3 phase, 60 hertz A.C. with a maximum line voltage fluctuation of + 10% of rated voltage unless otherwise specified.

3.5.2 All inter-connecting wiring, conduit and wireways shall be furnished by the manufacturer.

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