

MIL-F-22963B(SHIPS)  
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~~SUPERSEDING~~  
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 (See 6.4)

# MILITARY SPECIFICATION

## FILTER, AIR, ELECTROSTATIC (PRECIPITATOR) WITH POWER SUPPLY FOR ENVIRONMENTAL CONTROL SYSTEMS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

### 1. SCOPE

1.1 Scope. This specification covers the module and the wash-in-place electrostatic precipitator air filters, for use in environmental control systems onboard submarines and surface ships.

1.2 Classification. Electrostatic precipitators shall be the plate type of the following types, sizes and capacities as specified (see 6.1.1).

Type I - Electrostatic precipitator, modular (ESPM)

<u>Size</u>	<u>Capacity</u> <u>Cubic feet per minute (CFM)</u>
ESPM 11 -	340
ESPM 12 -	540
ESPM 13 -	810
ESPM 14 -	1200
ESPM 15 -	1800
ESPM 16 -	3000
ESPM 17 -	4500
ESPM 18 -	6000
ESPM XX -	(Special) as required

Type II - Wash-in-place

<u>Size</u>	<u>Capacity</u>
As required	As required

### 2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

#### SPECIFICATIONS

##### FEDERAL

QQ-P-35 - Passivation Treatments For Corrosion-Resisting Steel.  
 TT-P-645 - Primer, Paint, Zinc-Chromate, Alkyd Type.  
 TT-P-664 - Primer Coating, Synthetic, Rust-Inhibiting, Lacquer-Resisting.

##### MILITARY

MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements For.  
 MIL-E-917 - Electric Power Equipment, Basic Requirements (Naval Shipboard Use).  
 MIL-E-2036 - Enclosures for Electric and Electronic Equipment, Naval Shipboard.  
 MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.  
 MIL-P-15024/5 - Plates, Identification.  
 MIL-E-15090 - Enamel, Equipment, Light Gray (Formula No. 11).  
 MIL-P-15137 - Provisioning Technical Documentation for Repair Parts for Electrical and Mechanical Equipment (Naval Shipboard Use).  
 MIL-P-15328 - Primer (Wash) Pretreatment, Blue (Formula No. 117-B for Metals).  
 MIL-P-17545 - Primer Coating, Alkyd-Red Lead Type, Formula No. 116 and No. 116D.  
 MIL-T-55164 - Terminal Boards, Molded, Barrier, Screw and Stud Types, and Associated Accessories, General Specification For.

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## STANDARDS

### MILITARY

- MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
- MIL-STD-167 - Mechanical Vibrations of Shipboard Equipment.
- MIL-STD-242 - Electronic Equipment Parts Selected Standards.
- MIL-STD-278 - Fabrication Welding and Inspection; and Casting Inspection and Repair for Machinery, Piping and Pressure Vessels in Ships of the United States Navy.
- MIL-STD-461 - Electromagnetic Interference Characteristics Requirements for Equipment.
- MIL-STD-462 - Electromagnetic Interference Characteristics Measurements of.
- MIL-STD-750 - Test Methods for Semiconductor Devices.
- MIL-STD-1399, Section 103 - Interface Standard For Shipboard Systems, Electric Power, Alternating Current.
- MIL-STD-1472 - Human Engineering Design Criteria For Military Systems, Equipment and Facilities.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A164-71 - Electrodeposited Coatings of Zinc on Steel.
- A165-71 - Electrodeposited Coatings of Cadmium on Steel.
- A386-71 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.
- B6-70 - Zinc Metal (Slab Zinc).
- D2092-68 - Preparation of Zinc-Coated Steel Surfaces for Painting.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania, 19103.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

## 3. REQUIREMENTS

3.1 Qualification. The type I, sizes ESPM 11 through ESPM 18 precipitators shall be products which are qualified for listing on the applicable qualified products list at time set for opening of bids (see 4.3 and 6.3).

3.2 Sample for first article inspection. Prior to beginning production, one precipitator of type I, size ESPM XX and type II only shall be examined and tested as specified in 4.4.

3.3 Materials. The materials of construction shall be similar or equal to the applicable specifications specified herein and shall be of same materials and fasteners other than cast iron and self-tapping screws and sheet metal threads which have been successfully used in commercial application except cast iron shall not be used in the construction of the precipitator. Prior to construction, a list of materials and corresponding specifications shall be submitted to the Naval Ship Engineering Center (NAVSEC) for concurrence.

3.3.1 Corrosion protection. Brass, copper, 300-series corrosion-resisting steel and galvanized steel are considered corrosion-resisting materials for this application. When the corrosion-resistance of the 300-series corrosion-resisting steel is degraded by fabrication processes, it shall be restored by suitable heat treatment.

3.3.1.1 Except for the electrical portions of the power pack, ionizer section and collector section, parts fabricated from other than corrosion-resisting materials shall be protected against corrosion after fabrication with chemicals, electrolytic processes, plating or specified paints. The following methods while not restrictive are considered corrosion protection methods when properly applied.

- (a) Hot-dipped galvanized in accordance with ASTM A386-71 with the spelter conforming to grade 5 of ASTM B6-70.

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- (b) Electroplating with zinc in accordance with type LS of ASTM A164-71 followed by a phosphate treatment conforming to method A of ASTM D2092-68.
- (c) Electroplating with cadmium in accordance with type NS of ASTM A165-71 followed by a phosphate treatment conforming to method A of ASTM D2092-68.
- (d) Hot phosphoric or chromic acid treatment, or a coating of primer in accordance with MIL-P-15328 followed by two coats of primer conforming to TT-P-664.

3.3.1.2 Bolts, nuts, studs, screws and such fastenings or fittings as may be used shall be of corrosion-resisting material passivated in accordance with QQ-P-35, or of a material treated in a manner to render it adequately resistant to corrosion.

3.3.2 Dissimilar metals. To prevent destructive electrolysis, direct contact of electrolytically dissimilar materials shall be avoided. Where dissimilar metal contacts can not be avoided, care shall be exercised in material selection to prevent possible galvanic corrosion of the anodic material during operation or cleaning of the precipitator.

### 3.4 Design and construction.

3.4.1 Reliability and maintainability. The principle of maximum reliability is paramount and no compromise of this principle shall be made with any other basic requirement of design. It is the intention of this specification to obtain equipment of such design that it will have an operating life of at least 175,200 hours. The basis for design of replaceable parts shall be an equivalent of 3 years of ship operation (approximately 21,000 hours) before replacement is necessary.

3.4.1.1 The designer shall take cognizance of the conditions under which the equipment will be maintained and repaired on shipboard, and of the fact that the personnel responsible for maintenance and repair may not be a seasoned mechanics. Human engineering design criteria and principles shall be applied in the design of the precipitator so as to achieve safe, reliable and effective performance by the operator and maintenance personnel, and to optimize personnel skill requirements. MIL-STD-1472 shall be utilized as guidelines in applying human engineering design criteria for the precipitator.

3.4.1.2 The contractor shall establish and maintain an effective reliability and maintainability assurance program including the following:

- (a) Design reviews. The reliability assurance program shall include provisions for the reliability review and evaluation of design as an integral part of the contractor's engineering design procedures. Design or engineering change occurring during development or production shall be subjected to comparable review procedures.
- (b) Production control and monitoring. The reliability assurance program shall provide an economical and effective system of production control and monitoring to assure that reliability achieved in design is maintained during production (see 4.1.1).
- (c) Subcontractor and vendor reliability. The reliability assurance program shall include provisions to assure subcontractor and vendor selection and performance consistent with the reliability requirements of the contract and applicable portions of this specification.
- (d) Reliability analysis. The contractor shall analyze those factors affecting reliability. The reliability analysis shall include, but shall not be limited to the following:
  - (1) List of those parts which experience and judgment show are subject to wear, material deterioration, and service failures.
  - (2) Specific design features employed to attain the required service life of the parts with due consideration of shipboard environment and resultant conditions. Some suggested design features are choice of materials, hardness surface finishes, fits, clearances, fastenings, equipment protection fail-safe features, reparability and accessibility.
  - (3) Show by calculation or other means that the design does in fact fulfill the design requirements with the criteria chosen.
  - (4) Preventive maintenance and servicing requirements necessary to the achievement of reliable equipment. Any unusual steps or precautions necessary in carrying out maintenance and servicing requirements shall be pointed out.
- (e) Failure reporting, analysis, and feedback. The reliability assurance program shall incorporate a formalized system for recording, collecting, and analyzing all failures that occur during all testing, installation and operation through the tenure of the contract. Analysis shall be fed back to

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the contractor's engineering management, and production activities on a timely basis. Failure reports received from using activity shall be integrated into this program for trouble analysis and for experience consideration for future design review.

3.4.1.3 Maintainability. The construction of the power pack unit (see 3.4.2) shall be such that all wiring, terminals and electrical connections shall be accessible for servicing and for test purposes without requiring the removal of a part or an assembly from the unit enclosure. The ionizer, the collector and the screen modules of the type I precipitator shall be cleanable in an ultrasonic cleaner. The modules shall be designed to facilitate handling by one person.

3.4.2 General design. The precipitator shall consist of an ionizing section, a collecting section and electro-magnetic interference (EMI) screens as an integral unit, provided with safety devices, designed for deck and for overhead mounting, and incorporating provisions to enable the connection of a discharge duct, and shall consist of a remote power pack (power supply) for converting alternating current (a.c.) input to high voltage direct current (d.c.). The remote power pack shall be provided with safety devices and designed for bulkhead and for overhead mounting.

3.4.2.1 Shock. The precipitator shall be designed such that it is capable of passing the high-impact shock tests specified in MIL-S-901 for grade A, class 1 equipment.

3.4.2.2 Vibration. The precipitator shall be designed such that no damage will occur or malfunction be caused either by internally excited vibrations, or by the environmental vibrations specified in MIL-STD-167 for frequencies up to and including 33 hertz (Hz).

3.4.2.3 Resistance to air flow. The maximum resistance to air flow through the precipitator ionizing-collection section with EMI screens installed shall be 0.5 inch of water at rated air flow.

3.4.2.4 DOP smoke penetration. The maximum permissible penetration of the precipitator by DOP (dioclyphthalate) smoke of 1.0 micrometre particle size shall be 10.0 percent of upstream concentration at rated air flow.

3.4.2.5 Ozone and oxides of nitrogen production. The maximum permissible ozone and oxides of nitrogen concentration produced by the precipitator shall be 0.05 parts per million (ppm) at rated air flow when relative humidity at the precipitator air outlet is not less than 35 percent nor more than 45 percent, and the ionizer is operating at design voltage.

3.4.2.6 EMI. The EMI requirements for the precipitators shall conform to MIL-STD-461.

3.4.3 Type I (modular). The type I precipitator shall be of the modular design and construction. The ionizing section, the collecting section and EMI screens, each shall be a separate module that is removable for cleaning and for maintenance.

3.4.3.1 Standard modules. The number of standard size modules for each of the component sections and screens shall not exceed three in number. The standard component modules shall be used either singularly or in multiples as required to meet the requirements of this specification for a specific size precipitator.

3.4.3.2 Air flow (size ESPM 11 through ESPM 18). The rated air flow in CFM of a specific size precipitator shall be at least equal to that specified in table I, based on 70°F. dry bulb temperature and 40 percent relative humidity air entering the precipitator.

Table I - Air flow and physical data.

Size	Air flow (CFM)	Dimensions (inches, maximum)		
		Width	Height	Depth (direction of air flow)
11	340	14	12	26
12	540	20	12	26
13	810	31	12	26
14	1200	20	22	26
15	1800	31	22	26
16	3000	47	22	26
17	4500	53	32	26
18	6000	47	42	26

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- 3.4.3.2.1 Air flow (size ESPM XX). The rated air flow in CFM for the size ESPM XX precipitator shall be as specified (see 6.1.1).
- 3.4.3.3 Physical dimensions (size ESPM 11 through ESPM 18). The overall dimensions of each precipitator assembly shall be not greater than those specified in table I.
- 3.4.3.3.1 Physical dimensions (size ESPM XX). The overall physical dimensions for the size ESPM XX precipitator assembly shall be as specified (see 6.1.1).
- 3.4.3.4 Housing. The precipitator housing shall be constructed of steel and shall be of continuously welded construction. The housing frame shall be rigid and of adequate strength to support and maintain alignment of the assembled parts. Provisions shall be made to permit access for maintenance and removal of the ionizers, the collectors, and EMI screens upon removal of a side panel and the prevention of electrical shock (see 3.7). Unless otherwise specified (see 6.1.1) the removable panel shall be located on the right hand side of the precipitator housing.
- 3.4.3.4.1 Right-hand side. The right-hand side of the precipitator assembly shall be the side on the right when facing the precipitator air inlet connection and direction of air flow.
- 3.4.3.4.2 Removable side panel. The removable side panel shall be flanged. The flanged surfaces shall be gasketed and air tight. The removable side panel shall be secured by the use of captive hexagon head machine screws threaded into the mating flanged surface, or into pressed-in-nuts or welded nuts.
- 3.4.3.4.3 Connections for duct work. The precipitator air inlet and the air outlet shall have smooth flat surfaces for flanged duct connections. Unless otherwise specified (see 6.1.1), the surfaces for the connecting flanges shall be drilled with 13/32 inch diameter holes on 3 inch centers, working from the flange corners towards the air inlet and air outlet center-lines. When the space between the center-line and the adjacent hole exceeds 2 inches, there shall be a hole on the center-line. The center of the corner holes shall be located 1/2 inch from the corner edges of the flange. Tolerances for the drilled holes, the distance between hole centers and location of the corner holes shall be plus or minus 1/64 inch.
- 3.4.3.4.4 Mounting dimensions. Unless otherwise specified (see 6.1.1), the precipitator assembly mounting dimensions and tolerances shall be in accordance with figure 1.
- 3.4.3.4.5 Gaskets. All gaskets shall be fabricated of neoprene.
- 3.4.4 Type II (wash-in-place). The type II precipitator shall be of the wash-in-place design and water-tight construction. The wash-in-place design shall utilize a solution of detergent and hot water for scouring foreign matter from the ionizer and collector cells. Full coverage of the ionizer and collector cells by the cleaning solution, without emitting the cleaning solution from the precipitator air inlet and air outlet, shall be achieved through design and positioning of the wash-in-place system. On each side of the precipitator housing, a quick disconnect fitting shall be installed for supplying the cleaning solution to the cleaning system of the precipitator from an external source. The cleaning solution shall drain from the ionizer and collector cells into a drain pan(s) which shall be an integral part of the precipitator assembly.
- 3.4.4.1 Cleaning solution pressure and temperature. The wash-in-place system shall be designed for a cleaning solution delivered to the precipitator at a pressure of at least 40 pounds per square inch gage (psig) and at a temperature of 130° +5°F.
- 3.4.4.2 Disconnect fitting. The quick disconnect fitting shall be 1/2 inch and shall be similar to Hansen Company model number B4K26, or equal.
- 3.4.4.3 Detergent dispenser. When specified (see 6.1.1), a detergent dispenser shall be provided and shall consist of a stowage tank for a concentrated detergent, valves and two 25 foot hoses which shall have a quick disconnect fitting on each end of the hoses. The concentrated detergent shall be drawn from the stowage tank and injected into the hot water by a venturi effect resulting from the flow of the hot water.
- 3.4.4.4 Drain pan. Each drain pan shall be provided with a flanged drain connection. Each drain connection shall be sized for a removal rate of the cleaning solution equal to at least the inflow spray rate plus 10 percent. At no time shall any accumulation of the cleaning solution in the drain pan be such that it will come in contact with the collector plates. The assembly shall be constructed to prevent water leakage at any time during the cleaning process.



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3.4.4.5 Air flow and physical data requirements. The rated air flow in CFM, the overall physical dimensions of the precipitator assembly, the mounting dimension, tolerances and the requirements for connection for mating ductwork shall be as specified (see 6.1.1).

3.4.4.5.1 Physical dimension limitations. The assembly shall be designed and constructed for passage through a standard 25 inch diameter submarine hatch either as an assembled unit or in sections for re-assembly within the submarine. Disassembly to pass through a hatch shall be held to a minimum.

### 3.5 Electrical requirements.

3.5.1 Power requirements. The precipitators shall be designed to operate on an input of 115 volts, single-phase 60 Hz type I power of MIL-STD-1399, section 103.

3.5.2 Ambient temperature. Components shall be designed for continuous operation in a maximum of 50°C. ambient temperature.

### 3.5.3 Power pack (see 3.4.2).

3.5.3.1 Power supply. The power supply shall incorporate the following features:

- (a) Variable adjustment of the primary input for control of output voltages.
- (b) Visual means of reading the variable secondary input voltage with an on-off switch in the line to control the meter.
- (c) Input circuit transformer which isolates the input and output circuits and ensures input circuit is ungrounded.
- (d) Visual means of reading the ionizer and collector current and voltages, as an indicator for malfunction, with an on-off switch in the line to control the meter.
- (e) Accessible circuit breaker(s) for manual reset without entering the power supply enclosure.
- (f) Manual on-off switch operable without entering the power supply enclosure.
- (g) Electrical-mechanical interlocks as safety devices.

3.5.3.2 Output power. Rectification of output power shall be accomplished by semiconductor components as the preferred method. As an alternate method, rectification may be accomplished by electron tubes. Semi-conductor components shall meet the tests of MIL-STD-750. Electronic tubes shall be selected from MIL-STD-242.

3.5.3.3 Equipment above 2.5 kilovoltampere (KVA) containing rectifiers, silicon controlled rectifiers, power transistor, saturable reactors, magnetic amplifiers or other non-linear devices in the main power circuit shall be designed to minimize harmonic distortion effects on the ship's electrical power distribution system. The measured magnitude of each of the individual phase harmonic currents from the 2nd through the 23rd expressed as a percentage of the full load fundamental root mean square (rms) phase current shall not exceed 3 percent for any input current between zero and rated full load value. Similarly, no individual harmonic phase current from the 24th through 20 kilohertz (kHz) shall exceed a magnitude in percent equal to  $1700/N^2$  where N is the harmonic multiple number. Harmonics generated by equipments with full load current ratings in excess of two amperes but with power ratings less than those specified above shall be current amplitude limited as follows:

- (a) No individual harmonic phase current shall exceed a magnitude in percent equal to  $1700/N^2$  where N is the harmonic multiple number.
- (b) The upper frequency limit of this requirement is 20 kHz.

Applicable power consuming and conversion equipment shall be tested to determine compliance with the limitations in allowable magnitude of harmonic line current specified above. The equipment under test shall be connected to a 60 hertz (Hz) power source as applicable having a voltage drop less than 2 percent at full load of equipment under test due to its passive (i.e. not due to the reaction of a regulator) impedance as a source. Under the conditions of test, the power source shall not have a harmonic voltage content at any frequency in percent rms which is greater than 25 percent of the allowable percentage harmonic current at that frequency as stated above. Fundamental and harmonic currents shall be measured by determining the voltage developed across a noninductive line resistor in each phase. The resistance value of the line resistor shall be such that the potential drop at fundamental frequency will be approximately 1 percent of line voltage. The accuracy of measurement of harmonic currents shall be 5 percent.

3.5.4 Enclosures for electrical components. Enclosures for electrical components shall be in accordance with the general requirements of MIL-E-2036. The enclosure for the power pack shall be of drip-proof construction in accordance with MIL-E-2036 and MIL-STD-108.

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3.5.5 Electrical connections. Wiring shall be neat and shall be tied or clamped in a manner that provides support and prevents chafing of the wire insulation due to vibration and shock. There shall be no splices in the wire and all connections shall be at the terminals of the devices or terminal blocks.

3.5.5.1 External cable connections. Provision shall be made for the connection of the power source cables and high voltage cables to terminals within the power pack. Provision shall be made for the connection of the high voltage to terminals within the precipitator assembly. All terminal boards within the power pack shall be accessible from the front, and the terminal boards within the precipitator assembly shall be accessible from the removal access panel side for electrical connection box.

3.5.6 Cable entrance. Blank gasketed plates shall be provided in the top and bottom of the power pack and precipitator assembly enclosures to permit the drilling of a cable entrance by the installing activity.

3.5.7 Insulation materials. Insulation materials and the application techniques thereof for the electrical system components and wires shall be in accordance with class A or B insulation system of MIL-E-917. The insulation material shall be flame and arc resistant and non-toxic.

3.5.8 Plastics. Plastics utilized in the construction of the electrical components shall conform to the requirements of MIL-E-917.

3.5.9 Electrical insulation. Where required for electrical insulation of such parts as panels, spacers and barriers the following materials, while not restrictive, are acceptable as insulators, separators, and supports when properly utilized:

- (a) Polytetrafluoroethylene, polyester glass, or alumina steatite for disc, cookie and stand-off type insulators, for separators and for supports.

3.6 Creepage and clearance distances. Creepage and clearance distance (between electrical circuits and between any circuit and ground) used in construction of the power supply and connecting devices between the precipitator and the power supply shall conform to the requirements of MIL-E-917.

3.7 Warning and safety devices. Electrical circuits shall be arranged and warning and safety device shall be provided to insure full protection of the operator, maintenance personnel and the equipment. In particular the following shall be provided in addition to any other protection and safety device which may be necessary:

- (a) Prevent injury to personnel or damage to equipment while removing or replacing the ionizing, collecting and screen modules or units incident to maintenance.
- (b) Protect personnel from injury and the equipment from damage, due to malfunction of or damage incurred by the unit, or due to change of voltage.
- (c) Minimize any danger of fire due to arc-over.
- (d) Indicate malfunction of the unit.

The safety device shall consist of an electrical-mechanical interlock. The device shall be located such that the removal of any part of the precipitator which, when removed, exposes high-voltage or hazardous electrical connections, shall de-energize the precipitator and simultaneously discharge hazardous capacitance. Generally the interlock shall be located on all access panels, the EMI screen or screens and the power pack access cover.

3.8 Screens. Unless otherwise specified (see 6.1.1), screens shall be provided on the air inlet and on the air outlet of the precipitator assembly to reduce EMI radiation, and as a safety feature. Screens shall be safety interlocked in accordance with 3.7.

3.9 Welding. Welding procedures and materials shall be in accordance with MIL-STD-278, except that only visual examination of welds is required.

3.10 Painting. Exterior surfaces of the precipitator assembly and the power pack, except those surfaces constructed of brass, copper or corrosion-resisting steel shall be thoroughly cleaned and coated as follows:

- (a) One coat of pretreatment coating conforming to MIL-P-15328.
- (b) One coat of zinc chromate primer conforming to TT-P-645, or one coat of red lead primer conforming to MIL-P-17545.
- (c) One final coat of gray enamel conforming to class 2 of MIL-E-15090.

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3.11 Identification, information and label plates. Identification and label plates shall be style II and shall conform to types A, B, D, F or H of MIL-P-15024 and MIL-P-15024/5. Information plates shall be style VI and shall conform to types F or H of MIL-P-15024. The physical dimensions of the identification and the information plates be equal to or less than the dimensions of a size number ten plate of MIL-P-15024.

3.11.1 Identification plates. Each precipitator assembly (screens, ionizer and collector unit) and each power pack shall be provided an identification plate, and the plates shall contain the following information:

- (a) Nomenclature.
- (b) Type and size (assembly only).
- (c) National stock number (NSN).
- (d) Component identification number (CID).
- (e) Contract or order number.
- (f) Electrical characteristics.
- (g) Manufacturer's serial number.
- (h) Manufacturer's name and address.

3.11.2 Information plates. Each precipitator assembly and each power pack shall be provided with an information plate which warns personnel as to the potential danger of the high voltage and specifies the safety precautions that must be observed while operating the equipment. The proposed information plates design shall be submitted to the the procuring activity for review.

3.11.3 Label plates. Each precipitator shall be provided with a label plate which indicates the direction of air flow through the assembly. Each power pack shall be provided with a label plate for the following:

- (a) On-off switch.
- (b) Primary input adjustment.
- (c) Variable secondary input indicator.
- (d) Circuit breaker.
- (e) Variable ionizer and collector current and voltage indicator.
- (f) Malfunction indicator.

3.11.3.1 The size of each label plate shall be equal to or less than 3 inches by 2 inches.

3.11.4 Marking of terminal boards. Terminal boards shall be marked in accordance with MIL-T-55164.

3.12 Technical data. The supplier shall prepare a system safety check list, microfilm aperture and labeling checks, drawings inspection system plan, first article test report in accordance with the data ordering documents included in the contract or order (see 6.1.2).

3.12.1 Drawings. In addition to the drawing content required by the data ordering document the following unique technical features shall be included:

- (a) Methods and sizes of fastenings and clearances for installation and servicing.
- (b) Supplementary data necessary to permit shipyard installation without suppliers assistance.
- (c) Performance data and curves. Curves to show how efficiency varies with air flow power input.
- (d) Specify serial number(s) in lieu of model number (for type III drawings only).
- (e) Specify weight and center of gravity for each size assembly (for type IV drawing only).

3.12.2 Technical manual. In addition to the requirements covered by the data ordering document, the following unique technical features shall be included:

- (a) The manual shall cover only one type of precipitator.
- (b) Include photo views of the equipment as part of the general description.
- (c) Include reduced size copies of all diagrams, assembly drawings and detail drawings of repair parts.

3.13 Repair parts. Unless otherwise specified (see 6.1.1), repair parts shall be furnished in accordance with MIL-P-15137 (see 6.2).

3.14 Workmanship. Sharp edges, burrs and other imperfections shall be removed from parts subject to contact with personnel to prevent cuts during repair and maintenance. Face of meters shall not be scratched or broken. All fasteners shall be in place and tight.



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## 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection system. The supplier shall provide and maintain an inspection system in accordance with the data ordering document included in the contract or order (see 6.1.2).

4.2 Maintainability inspection. Maintainability inspection shall be in accordance with 4.2.1.

4.2.1 Maintainability demonstration. The first production unit shall be examined after testing, and the capability to maintain, disassemble and repair the unit shall be demonstrated to a Government representative. The demonstration shall be conducted utilizing the recommended tools and with other than expert mechanics. The maintainability demonstration shall include but not be limited to the following:

- (a) Ionizer(s), collector(s) and screen(s) modules of the type I precipitator assembly are removable for cleaning and repair.
- (b) The modules of the type I precipitator assembly can be cleaned in an ultrasonic cleaner.
- (c) Full coverage of the ionizer and collector cells by the detergent solution is achieved, and the adherent foreign matter is removed and flushed away through the drain system.
- (d) All wiring, terminals and electrical connections of the type I and type II precipitator assemblies and of the power packs are accessible for servicing and testing without requiring the removal of a part or assembly from the enclosure.

4.3 Qualification tests.<sup>1/</sup> Qualification tests shall be conducted on sizes ESPM 11 through ESPM 18 inclusive type I precipitator assembly and its accompanying power pack at a laboratory satisfactory to NAVSLC. Qualification tests shall consist of the examination in 4.6.1 and the tests specified in 4.3.3 and 4.6.2. In addition to these tests, the type I, size ESPM 13 and the size ESPM 18 precipitator assemblies and accompanying power packs shall be tested as specified in 4.3.1 and 4.3.2.

4.3.1 High impact shock test. The type I, size ESPM 13 precipitator assembly and its accompanying power pack shall be shock tested on the light-weight machine as prescribed for type A shock of MIL-S-901. The type I, size ESPM 18 precipitator assembly and its accompanying power pack shall be tested on the medium weight machine as prescribed for type A shock of MIL-S-901. The precipitator shall be operated at rated voltage and current during shock test. The tests shall be conducted prior to tests specified in 4.3.2 and 4.3.3. The correction of damage which may have occurred during shock test shall not be performed prior to these tests. Evidence of fragmentation or missile effect of parts, deformation that will cause interference between parts or failure to operate shall be cause for rejection.

4.3.1.1 Upon completion of shock test and specified post-shock tests, the sample precipitator assembly and accompanying power pack shall be returned to the supplier for his examination and disposition.

4.3.2 Vibration tests. The type I, size ESPM 13 and ESPM 18 precipitator assemblies and accompanying power packs shall be subjected to the type I environmental vibration tests specified in MIL-STD-167.

4.3.3 Performance tests.

4.3.3.1 DOP smoke penetration. DOP smoke penetration of the precipitator assembly shall be determined at rated air flow plus or minus 5 percent using the Naval Research Laboratory (NRL) E-3 smoke penetration meter. Particle size of DOP smoke aerosol shall be equal or less than 1.0 micrometre.

<sup>1/</sup> Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3).

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4.3.3.1.1 Measurement of aerosol procedures. Measurement of aerosol penetration shall be performed using the following procedures:

- (a) Samples of the concentrated aerosol at the center point of the test duct located at least 1 foot, but not more than 2 feet, upstream of the assembly air inlet. A perforated distribution plate shall be located in the test duct at least 2 feet upstream of the sample point.
- (b) Samples of the concentrated aerosol at the center point of the test duct 8 feet + 3 inches downstream of the assembly air outlet. A baffle made of two 3-inch wide slots shall be located in the test duct 3-1/2 feet + 3 inches downstream of the assembly air outlet to intermix the air discharged from the air outlet.

4.3.3.2 Air flow resistance. The resistance to air flow of the precipitator assembly (ionizer, collector, screens) shall be determined at rated air flow.

4.3.3.3 Ozone and oxides of nitrogen production. The production of ozone and oxides of nitrogen shall be determined at ambient relative humidity and at rated air flow with a Mast Ozone Monitor, Model 724-2, or equal. The sampling tube(s) shall be located at least 4 feet but not more than 6 feet downstream of the assembly air outlet. The effect of reducing agents in the atmosphere shall be accounted for when determining concentrations. The production of ozone and oxides of nitrogen shall be corrected to a relative humidity of 40 percent.

4.3.3.4 Electromagnetic interference. The electromagnetic interference characteristics of the precipitator assembly and its accompanying power pack shall be determined by method CE01, CE03, RE01, and RE02 in accordance with MIL-STD-462. For these tests, the assembly shall be installed in a test duct, and the ionizer(s) and collector(s) in the assembly shall be operating at rated voltages.

4.3.3.4.1 Test duct arrangement. The test duct arrangement shall be as follows:

- (a) The test duct upstream of the assembly shall be at least 1 foot in length and shall be sized for an air velocity of at least 600 feet per minute (fpm).
- (b) In the upstream section of the test duct at a distance of approximately 6 inches from the air inlet of the assembly, a Navy standard air filter(s) shall be installed.
- (c) The test duct downstream of the assembly shall be at least 10 feet in length and shall be sized for an air velocity of at least 2000 FPM.

4.4 First article inspection (type I, size ESPM XX and type II only). One sample of the type I, size ESPM XX and one sample of the type II precipitator assembly and its accompanying power pack covered in the contract or order shall be submitted for first article inspection. First article inspection shall consist of the examination of 4.6.1 and the tests of 4.3.1, 4.3.2, 4.3.3 and 4.6.2. In addition to these tests, the type II precipitator shall be tested as specified in 4.4.2.

4.4.1 Test reports. The supplier shall prepare a first article test report in accordance with the data ordering documents included in the contract or order (see 6.1.2).

4.4.2 Unless otherwise specified (see 6.1.1), first article inspection shall not be conducted on precipitator assemblies and accompanying power packs that are identical to those which have successfully passed the first article tests within a period of 3 years of the date of the contract or order. Certified reports on such first article tests shall be submitted in triplicate to the command or agency concerned to substantiate the fact that the tests have been conducted and specification requirements met (see 6.1.2).

4.4.3 Drain pan test. Prior to subjecting the type II precipitator assembly to this test, the drain pan that will be supplied with the assembly shall be installed and the spray manifold shall be checked for correct orientation. The air inlet and air outlet flanges shall be blanked and the insulator compartment access covers removed. Water at ambient temperature shall be supplied to the spray manifold at a pressure of at least 40 psig for at least 1 hour. Cause for rejection shall be water leakage through any boundaries, joints, between cells, into any insulator compartments or the accumulation of water in the drain pan such that the water contacts the collector plates.

4.5 Sampling for quality conformance inspection.

4.5.1 Lot. All precipitator assemblies and their accompanying power packs of the same type and size offered for delivery at one time, shall be considered a lot for the purpose of sampling.

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4.5.2 Sampling for visual and dimensional examination. A random sample of precipitator assemblies and their accompanying power packs shall be selected from each lot in accordance with table II and shall be examined as specified in 4.6.1. Failure of any precipitator assembly and its power pack in the sample to pass the examination specified in 4.6.1 shall be cause for rejection of the lot.

Table II - Sampling for examination.

Lot size	Sample quantity
2 to 10	1
11 to 25	2
26 to 40	3
Over 40	4

#### 4.6 Quality conformance inspection.

4.6.1 Examination. A visual and dimensional examination shall be made on the sample precipitator assemblies and their power packs selected in accordance with 4.5.2 to verify conformance to the requirements of this specification not involving tests.

4.6.2 Operational test. Each precipitator assembly and its power pack furnished under a contract or order shall be energized to demonstrate proper construction. Safety devices shall be checked to insure proper construction, to insure proper performance, and insulation resistance and dielectric strength measurements shall be made to demonstrate that no personnel hazard exists. The precipitator and its power pack shall be operated continuously for at least a 3 hour period and the measurement of ozone production made to determine whether ozone production exceeds specification limit (see 3.4.2.5), or prior to being installed into the assembly, each ionizing and collecting module shall be operated continuously at operating voltage and current until the ozone production does not exceed specification limit. Electrical metering equipment shall be connected in the circuitry to demonstrate that the ionizing and collecting current and voltage does not vary more than 10 percent from the values determined under qualification or first article approval. Evidence of improper construction, unsatisfactory performance of the safety devices, personnel hazards, ozone production exceeds specification limit or variation of more than 10 percent in ionizing and collecting current and voltage, shall be cause for rejection.

4.7 Inspection of preparation for delivery. The packaging, packing and marking shall be inspected for compliance with section 5 of this document.

#### 5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing and marking. The requirements and levels of preservation, packaging, packing and marking shall be specified by the procuring activity (see 6.1.1).

#### 6. NOTES

##### 6.1 Ordering data.

6.1.1 Procurement requirements. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type, size and capacity (see 1.2).
- (c) Air flow and physical dimensions for type I, size XX requirements (see 1.2, 3.4.3.2.1 and 3.4.3.3.1).
- (d) Removable side panel, if other than as specified (see 3.4.3.4).
- (e) Connections for ductwork if other than as specified (see 3.4.3.4.3).
- (f) Mounting dimensions, if other than as specified (see 3.4.3.4.4).
- (g) Detergent dispenser required (see 3.4.4.3).
- (h) Air flow and physical data requirements for type II (see 3.4.4.5).
- (i) Screens, if other than as specified (see 3.8).
- (j) Repair parts required (see 3.13).
- (k) Inspection system requirements (see 4.1.1).
- (l) First article requirements if other than as specified (see 4.4.2).
- (m) Preservation, packaging, packing and marking requirements (see 5.1).

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6.1.2 Contract data requirements. When this specification is used in a procurement invoking the provisions of Armed Service Procurement Regulations (ASPR) paragraph 7-104.9(n) and which incorporates a DD Form 1423 Contract Data Requirements List (CDRL), the following data requirements should be specified for delivery on the cited Data Item Description (DID) and delivered in accordance with such CDRL. When the ASPR provision are not invoked, the following data should be specified for delivery in accordance with the contract or order.

<u>Spec paragraph</u>	<u>Data requirement</u>	<u>Service</u>	<u>Applicable DID</u>	<u>Options</u>
(a) 3.12	System safety check list	SH	UDI-H-26378	-----
(b) 3.12	Microfilm, aperture and tabulating cards	SH	UDI-E-23140	-----
(c) 3.12.1	Drawings	SH	UDI-E-23174	Categories A, B, G and H, Types II and III or type IV
(d) 3.12.2	Technical manual	SH	UDI-M-23455	Type I, MIL-M-15071
(e) 4.1.1	Inspection system plan	SH	UDI-R-23574	-----
(f) 4.4.1	Test report first article	SH	UDI-T-23450	-----

(Copies of DID's required by the contractor in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

6.2 Management control system documents. The following management control system documents should be included on DD Form 1660:

(a) MIL-P-15137 (see 3.13).

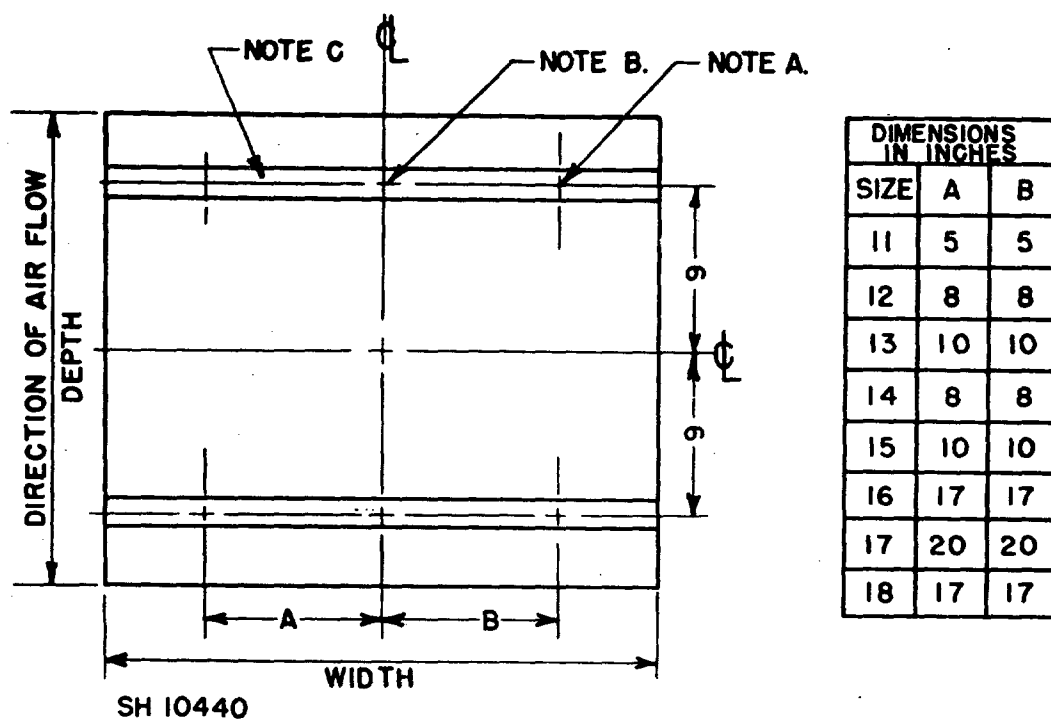
6.3 With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in applicable Qualified Products List QPL 22963, whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Ship Engineering Center, Prince George's Center, Center Building, Hyattsville, Maryland 20782, and information pertaining to qualification of products may be obtained from that activity.

6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

6.4 THE MARGINS OF THIS SPECIFICATION ARE MARKED "\*" TO INDICATE WHERE CHANGES (ADDITIONS, MODIFICATIONS, CORRECTIONS, DELETIONS) FROM THE PREVIOUS ISSUE WERE MADE. THIS WAS DONE AS A CONVENIENCE ONLY AND THE GOVERNMENT ASSUMES NO LIABILITY WHATSOEVER FOR ANY INACCURACIES IN THESE NOTATIONS. BIDDERS AND CONTRACTORS ARE CAUTIONED TO EVALUATE THE REQUIREMENTS OF THIS DOCUMENT BASED ON THE ENTIRE CONTENT IRRESPECTIVE OF THE MARGINAL NOTATIONS AND RELATIONSHIP TO THE LAST PREVIOUS ISSUE.

Preparing activity:  
Navy - SH  
(Project 4460-N018)

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## NOTES:

- A. Bolt holes:  
3/4-10 UNC by 1 inch deep.
- B. Provide bolt holes on centerline for sizes 13, 15, 16, 17 and 18.
- C. Mounting bars on top and bottom - 2 inches wide by 1 inch thick.
- D. Dimension tolerances -  $\pm 1/32$ .

Figure 1 - Mounting dimensions.



STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL		OMB Approval No. 22-R255	
<b>INSTRUCTIONS:</b> The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.			
<b>DOCUMENT IDENTIFIER AND TITLE</b>			
<b>NAME OF ORGANIZATION AND ADDRESS</b>		<b>CONTRACT NUMBER</b>	
		<b>MATERIAL PROCURED UNDER A</b> <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT	
<b>1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?</b> <b>A. GIVE PARAGRAPH NUMBER AND WORDING.</b>          <b>B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES</b>			
<b>2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID</b>			
<b>3. IS THE DOCUMENT RESTRICTIVE?</b> <input type="checkbox"/> YES <input type="checkbox"/> NO (If "Yes", in what way?)			
<b>4. REMARKS</b>			
<b>SUBMITTED BY</b> (Printed or typed name and address - Optional)		<b>TELEPHONE NO.</b>	
		<b>DATE</b>	