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14 October 1983
SUPERSEDING
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(See 6.5)

MILITARY SPECIFICATION

SHIELDING HARNESES, SHIELDING ITEMS AND SHIELDING ENCLOSURES FOR USE IN THE REDUCTION OF INTERFERENCE FROM ENGINE ELECTRICAL SYSTEMS

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers requirements for interference shielding items, shielding harnesses and shielding enclosures for engine electrical systems aboard Naval ships, at advance bases, and in the vicinity of electronic installations. It includes the allowable electromagnetic interference limits for such items and the permissible limits for auxiliary devices normally installed on electrical wiring systems associated with these engines.

2. APPLICABLE DOCUMENTS

2.1 Government documents,

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

PPP-B-566 - Boxes, Folding, Paperboard.
PPP-B-576 - Boxes, Wood Cleated, Veneer, Paper Overlaid.
PPP-B-585 - Boxes, Wood, Wirebound.
PPP-B-591 - Boxes, Shipping, Fiberboard, Wood-Cleated.
PPP-B-601 - Boxes, Wood, Cleated-Plywood.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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PPP-B-621	Boxes, Wood, Nailed and Lock-Corner.
PPP-B-636	Boxes, Shipping, Fiberboard.
PPP-B-665	Boxes, Paperboard, Metal Edged and Components.
PPP-B-676	Boxes Setup.
PPP-T-76	Tape, Packaging, Paper (for Carton Sealing).

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MIL-P-116	Preservation, Methods of.
MIL-S-7886	Spark Plug, Shielded, Aircraft Reciprocating Engine, General Specification for.
MIL-L-10547	Liners, Case, and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible.

STANDARDS

FEDERAL

FED-STD-H28	Screw-Thread Standards for Federal Services.
FED-STD-H28/2	- Unified Thread Form and Thread Series for Bolts, Screws, Nuts, Tapped Holes and General Applications.

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MIL-STD-129	- Marking for Shipment and Storage.
MIL-STD-167-1	- Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
MIL-STD-461	- Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.
MIL-STD-462	- Electromagnetic Interference Characteristics, Measurement of.
MIL-STD-794	" Parts and Equipment, Procedures for Packaging of.
MIL-STD-810	- Environmental Test Methods.
MIL-STD-889	- Dissimilar Metals.

2.1.2 Government drawing. The following Government drawing forms a part of this specification to the extent specified herein.

DRAWING

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

NAVSHIPS 9000-S6202-73724	- Salt Spraying Machine.
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(Copies of specifications; standards and drawings required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein.

UNIFORM CLASSIFICATION COMMITTEE AGENT

Uniform Freight Classification Ratings, Rules and Regulations.
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(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2.1), a sample shall be subjected to first article inspection (see 4.3 and 6.3).

3.2 Composition. The shielding items directly associated with shielding engine electrical systems shall be of the following as specified (see 6.2.1). These items when assembled together comprise a shielded electrical harness.

- (a) Shielded spark plugs.
- (b) Cable shielding.
- (c) Connectors.
- (d) Enclosures.
- (e) Filters.
- (f) Cable terminal.

3.3 Materials.

3.3.1 Dissimilar metals.

3.3.1.1 Except where required for electrical reasons including grounding, contact between dissimilar metals shall be avoided. If dissimilar metals are used, they shall be selected in accordance with MIL-STD-889.

3.3.2 Where it is necessary that stationary dissimilar metals be assembled in intimate contact with each other and electrical conductivity is nonessential, an interposing material compatible to each shall be used. Insulating material will not be required between austenitic corrosion-resistant steel inserts and aluminum castings.

3.3.3 Recovered materials. Unless otherwise specified herein, all material and articles incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.4 Suitability. Shielding items shall not adversely affect the operation of the engines on which they are installed.

3.5 Protection against corrosion. Metal parts shall be of corrosion-resisting materials or other materials treated in a manner to render them resistant to corrosion when tested as specified in 4.4.6.

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3.6 Assembly and maintenance. Shielding items shall be easily assembled and maintained with a minimum of upkeep by normal maintenance personnel.

3.7 Joints. Cable shielding shall be joined to enclosures, fittings, or connectors by means of brazing, welding, or soldering. The seal when accomplished shall be mechanically secure, and electrically meet the requirements of this specification.

3.8 Shielding items.

3.8.1 Spark plugs. Spark plugs shall be shielded in accordance with MIL-S-7886 and shall withstand the torque test specified in 4.4.2. The plug shall be sealed against entrance of moisture from the cable of shielding conduit.

3.8.1.1 Cable terminal assembly sleeve. The sleeve of the cable terminal assembly, if ceramic, shall be of fired glazed aluminum oxide type ceramic. If other materials are used, they shall withstand the tests specified herein.

3.8.1.2 Rubber materials of the cable terminal assembly shall be one of the following types as specified (see 6.2.1), and shall withstand without deterioration, the temperature tests specified in 4.4.5.3.

(a) Type NT - 120 degrees Celsius (°C).

(b) Type HT - 204°C.

3.8.2 Cable shielding conduit. Cable shielding flexible conduit utilized with engines or interconnections with associated equipment shall be double braid over sealed bellows conduit. Brass bellows-type inner cores shall contain a minimum of 80 percent copper in copper-zinc alloy. Additional corrosion-resistant treatment of conduit, such as Iridite 17P, may be used when specified (see 6.2.1). (A metal band identifying the manufacturer of the shielding conduit shall be permanently installed on the shielded ignition harness.)

3.8.3 Cable connectors. Connectors, except the spark plug connector shall be of the spherical seat type. Connectors shall withstand the tests specified in 4.4.1 to 4.4.6.1 inclusive. The spark plug connector shall incorporate a flat seat ferrule and shall fit the plug as specified in MIL-S-7886.

3.8.4 Shielding enclosures. Shielding enclosures, other than hermetically sealed units, shall utilize one of the following types of joints, as applicable, between base and cap:

(a) Type SC- Spherical-cone seating.

(b) Type MF - Multiple face joint.

(c) Type F - Flat joint - the minimum width of face shall be 5/16 inch.

(d) Type WT - Watertight - when specified (see 6.2.1), type WT shall be watertight, constructed of Naval brass and any one type of joint as specified in items (a), (b) or (c).

3.8.4.1 Gaskets. Gaskets shall be of metallic construction. The gasket shall remain firmly in place on the joint face of either base or cap during disassembly and reassembly.

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3.8.4.2 Shielding enclosures. Shielding enclosures shall withstand the tests specified in 4.4.1 to 4.4.6.1 inclusive.

3.8.4.3 Fittings. Fittings for the joining of shielding conduit to enclosures shall be of the spherical cone seating type and shall withstand a tightening or twisting torque of 325 inch-pounds (in-lb) as specified in 4.4.2.

3.8.4.4 Fastening devices. Cover hold-down fasteners or machine screws shall conform to the thread configuration as Specified in FED-STD-H28 and FED-STD-H28/2 and shall be held captive on the removable cover.

3.8.4.5 Ventilation. Enclosures containing electrical contacts shall be provided with means for ventilation where needed to prevent corrosion due to products of the sparking. Proof that ventilation would not be required shall be submitted by the manufacturer, and such proof shall be furnished with a sample unventilated enclosure submitted for first article tests specified in 4.2.

3.8.4.6 Condensation. Enclosures shall be provided with appropriate means for the drainage of condensation. Enclosures shall be such that engine starting and operation shall not be adversely affected by their use.

3.8.4.7 Test lead connection. Distributor enclosures shall incorporate one additional tower, similar to that provided for spark plug leads, for connecting test leads expeditiously.

3.9 Temperature. The shielding effectiveness of shielding items or harness shall not deteriorate under temperature conditions between minus 54°C and plus 75°C and the interference values specified in 4.4.4.1 shall not exceed the original values specified in 3.12.1 by more than 20 decibels (dB).

3.10 Salt fog and solar radiation. The shielding items shall withstand the salt fog and solar radiation test of 4.4.6.1 Following this test, the items shall show no appreciable corrosion or other damage to parts due to salt fog or solar radiation and the interference values specified in 4.4.4.1 shall not exceed those specified in 4.4.4 by more than 20 dB.

3.11 Vibration. The shielding items shall conform to the vibration requirements of MIL-STD-167-1.

3.12 Interference.

3.12.1 Shielded items and shielded harnesses. Shielded items shall conform to the interference limits of MIL-STD-461 when tested in accordance with 4.4.4 except that, where no electronic equipment is associated with the wiring of the engine electrical system, radiated limits only shall apply in determining acceptability of the shielding.

3.12.2 Marking. Engine ignition shielding harnesses shall be marked "IF16165" in a conspicuous and durable manner after inspection.

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3.13 Engines in noncritical naval areas. Ignition interference from internal combustion engines, in areas 1000 feet distance from electronic devices and installations, shall conform to the requirements for such engines as specified in MIL-STD-461. Components other than engines, tested separately therefrom shall conform to the interference limits specified in 3.12.

3.14 Workmanship- Workmanship and material shall be of such quality that the shielding has electrical characteristics as specified herein, shall be sturdy, of excellent appearance, and of high standard with respect to tolerances and mechanical fit (see 4.4.1).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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.

4.2 Classification of inspections. The inspections specified herein are classified as follows:

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.5).

4.3 First article inspection. First article inspection shall consist of the tests specified in 4.4.

4.3.1 First article inspection report. The contractor shall furnish a first article inspection report in accordance with the data ordering document specified in 6.2.2.

4.3.2 Samples. The minimum number of units of each type of model or shielding items subjected to first article inspection shall be as follows:

- (a) Shielded spark plugs - eight.
- (b) Connectors - 12.
- (c) Cable shielding conduit - sufficient for a particular engine harness and one extra 3-foot length.
- (d) Enclosures - one of each type (see 3.8.4).
- (e) Shielding harness - one complete harness and such shielding items as may be required.
- (f) Sleeves - 12.
- (g) Rubber seals associated with sleeve - 12.

Each item shall incorporate identification markings.

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4.4 Inspection.

4.4.1 Examination of test sample. The test sample shall be examined for material, workmanship, finish, internal parts and mechanical fits to determine conformance with this specification. Items may be rejected on the basis of this examination (see 3.13).

4.4.2 Torque test. The shielding items shall be assembled in a harness and installed on an appropriate engine or test block. Using a torque wrench capable of measuring above 325 in-lb, a tightening torque of 325 in-lb shall be applied to coupling nuts, towers and fittings under test. Any cracking, breaking or deformation shall be cause for rejection. The extent of any cracking, breaking or deformation shall be determined. Prior to testing, all oil, burrs and other non-uniformities shall be removed from the threads and mating surfaces.

4.4.3 Vibration. Vibration tests shall be performed in accordance with type I of MIL-STD-167-1 or in preparation for this test, the shielding item shall be assembled in harness form and installed on a test block or engine. The block with harness shall be mounted on the vibration machine. During and upon completion of the test, a visual examination of the shielding item or harness under test shall be made to detect any loosening or deformation.

4.4.4 Interference tests. Interference tests shall be performed in accordance with the measurement techniques of MIL-STD-462. The tests shall be conducted following the torque and vibration tests.

4.4.4.1 Interference check tests, Interference check tests shall be performed following the temperature and salt fog tests. The test shall be at frequencies at which maximum Interference was obtained in the test specified in 4.4.4. Interference values shall not exceed those obtained in the test specified in 4.4.4 by more than 20 decibels (dB).

4.4.5 Temperature test.

4.4.5.1 Low. Shielding items shall be assembled in a standard harness mounted on an appropriate test block or engine and shall be subjected to an ambient temperature of minus 54°C for a period of 4 hours. Following this test the interference limits shall conform to the interference limits specified in 3.9.

4.4.5.2 High. Shielding items assembled as specified in 4.4.5.1 shall be subjected to an ambient temperature of 75°C for a period of 4 hours. following this test, the interference limits shall conform to the interference limits specified in 3.9.

4.4.5.3 Cable terminal assembly (rubber material) temperature test. The rubber material of the cable terminal assembly shall be placed within a tightly closed container and subjected to the degrees of temperatures specified herein after for a period of 6 hours. No deterioration in form or sealing properties shall occur:

- (a) Type NT - 120°C.
- (b) Type HT - 204°C.

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4.4.6 Corrosion resistance. Unless otherwise specified in the contract, the test sample shall be subjected to the salt fog test of 4.4.6.1. This test shall be performed after all other tests specified herein are completed. Items tested separately shall have all openings closed which are not normally exposed. Nonwatertight enclosures shall be fitted with special gaskets to preclude leakage to the interior.

4.4.6.1 Salt fog and solar radiation test. This test shall consist of the solar radiation and salt fog tests in MIL-STD-810 conducted simultaneously, except as modified herein. Shielding items shall be subjected, under continuous ultra-violet light, to a 20 percent hot salt fog at 54°C for a period of 3 minutes, followed by a hot air blast at 54°C for a period of 3 minutes. The cycle shall be repeated continuously for 100 hours. Upon completion of the test, the unit shall be washed with fresh water, dried and examined. Examination after the salt fog test shall show no appreciable corrosion in or on the test sample or other damage to parts due to the salt fog and interference limits shall conform to 3.12. During test, all shielding shall be mounted in its normal installed position. Test equipment shall be equivalent to the Navy standard salt spraying machine as shown on Drawing 9000-S6202-73724.

4.5 Quality conformance inspection. Quality conformance inspection of shielding items and shielding harnesses shall consist of the following:

- (a) Examination of test sample (see 4.4.1).
- (b) Interference measurement tests (see 4.4.4 and 4.5.2).

4.5.1 When assemblies are too large to make the tests specified in 4.5(b), practical consideration shall be given to requiring the testing of interference producing components separately.

4.5.2 Interference tests shall be performed to the fullest extent necessary to determine conformance with MIL-STD-461. Testing, however, shall be minimized. To this end, prior test reports on identical equipment of the same manufacturer with identical shielding may be accepted in lieu of further testing.

4.5.3 Quality conformance inspection report. The contractor shall prepare a quality conformance inspection report in accordance with the data ordering documents specified (see 6.2.2).

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisitions. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.4.)

5.1 Preservation. preservation shall be level A or C, as specified (see 6.2.1).

5.1.1 Level A. The shielding shall be unit protected in accordance with method III of MIL-P-116. Unit containers shall conform to PPP-B-566, PPP-B-636, PPP-B-665, or PPP-B-676 with container selection at the option of the contractor. Box closure shall be as specified in the applicable box specification or appendix thereto with method I closure applicable to PPP-B-636 boxes.

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5.1.2 Level C. Preservation shall afford adequate protection against deterioration and physical damage during shipment from the supply source to the first receiving activity for immediate use. The contractors retail or wholesale preservation methods may be used when such meets the requirements of this level.

5.2 Packing. Packing shall be level A, B or C, as specified (see 6.2.1).

5.2.1 General requirements. When specified (see 6.2.1), containers for the packing level required shall conform to the exterior shipping container requirements of MIL-STD-794. When the acquisition or order does not specify MIL-STD-794, exterior containers for packing shall conform to the level specified herein.

5.2.2 Level A. Shielding items shall be packed in containers conforming to any one of the following specifications at the option of the contractor:

<u>Specifications</u>	<u>Type or class</u>
PPP-B-576	Class 2
PPP-B-585	Class 3
PPP-B-591	Class 2, weather resistant
PPP-B-601	Overseas type
PPP-B-621	Class 2, overseas
PPP-B-635	Weather resistant

Shipping containers shall have caseliners conforming to MIL-L-10547. Caseliners shall be closed and sealed in accordance with the appendix to MIL-L-10547. Caseliners for weather resistant fiberboard boxes conforming to PPP-B-636 may be omitted provided all corners and edge seams and manufacturer's joints are sealed with minimum 2-inch wide tape conforming to PPP-T-76. Boxes shall be closed and banded in accordance with the applicable box specification or appendix thereto with method V closure applicable to PPP-B-636 boxes. The gross weight of wood or wood-cleated boxes shall not exceed 200 pounds.

5.2.3 Level B. Shielding items shall be packed in boxes conforming to any one of the following specifications at the option of the contractor:

<u>Specifications</u>	<u>Type or class</u>
PPP-B-576	Class 1
PPP-B-585	Class 1 or 2
PPP-B-591	Class 1, domestic
PPP-B-601	Domestic type
PPP-B-621	Class 1, domestic
PPP-B-636	Domestic type

Box closure shall be as specified in the applicable box specification or appendix thereto with method I closure applicable to PPP-B-636 boxes. The gross weight of wood or wood-cleated boxes shall not exceed 200 pounds.

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5.3 Marking. In addition to any special marking required (see 6.2.1), interior packages and-exterior shipping containers shall be marked in accordance with MIL-STD-129, and in addition shall include the electrical and mechanical operational characteristics or ratings (as applicable).

60 NOTES

6.1 Intended use. The items described herein are intended to shield engine spark plug electrical systems to prevent electromagnetic interference to nearby electronic systems.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number and date of this specification.
- (b) First article sample, if required (see 3.1).
- (c) Shielding items required (see 3.2).
- (d) Type of rubber material required (see 3.8.1.2).
- (e) If additional corrosion resistant treatment of conduit is required (see 3.8.2).
- (f) Whether a watertight type WT joint is required (see 3.8.4(d)).
- (g) Level of preservation required (see 5.1).
- (h) Level of packing required (see 5.2).
- (i) When MIL-STD-794 packing level and containers are applicable (see 5.2.1).
- (j) Special marking required (see 5.3).

6.2.2 Data requirements. When this specification is used in an acquisition which incorporate a DD Form 1423, Contract Data Requirements List (CDRL) the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated in the contract. When the provisions of DAR 7-104.9 (n)(2) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraphs.

<u>Paragraph no.</u>	<u>Data requirements title</u>	<u>Applicable DID no.</u>
4.3.1, 4.5.3	Test reports	DI-T-2072

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5000.19L., Vol. II, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

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6.2.2.1 The data requirements of 6.2.2 and any task in section 3, 4 or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 First article inspection. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection as to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.5 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 2920-N385)

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE. This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. 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.

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