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January 20, 1987
SUPERSEDING
J-L-231B
March 30, 1977

FEDERAL SPECIFICATION

LEADS, STORAGE-BATTERY

This specification was approved by the Commissioner,
Federal Supply and Services, General Services Administration,
for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers low tension cables used for connections between storage batteries and other electrical equipment. The insulated leads are used for connections between the battery and equipment where heavy amperage 6, 12, and 24 volt (V) ungrounded circuits interconnect. The uninsulated leads and straps are used for bonding and grounding connections.

1.1.1 Federal specification coverage. Federal specifications do not include all varieties of the commodity as indicated by the title of this specification or which are commercially available, but are intended to cover those generally used by the Federal Government.

1.2 Classification.

1.2.1 Type, classes, and styles. Leads shall be one of the following types, classes, and styles, as specified (see 6.2).

Type I - Ground lead, uninsulating strap, flat woven or braided.

Style 1 - Battery to ground

Style 2 - Ground to ground (bonding strap)

Type II - Battery lead, insulated (rope strand, concentric lay or bunched)

Class A - Extra-flexible rope strand

Class B - Stranded concentric lay or bunched

AMSC N/A

FSC 6140

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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- Style 1 - Rope lay, concentric lay or bunched with generator lead
- Style 2 - Rope lay, concentric lay or bunched with lugs
- Style 3 - Rope lay, concentric lay or bunched with straight
universal post terminals
- Style 4 - Rope lay, concentric lay or bunched with angle universal
post terminals
- Style 5 - Rope lay, concentric lay or bunched with side terminal
and lug
- Style 6 - Rope lay, concentric lay or bunched with side terminals

1.2.2 Lead length. The length of the storage battery lead shall be measured in inches from hole center to hole center between lugs or battery terminal adapters, whichever is appropriate. Tolerance shall be + 1/2 inch - 0 inch for all battery leads. Thus a 24 in the length designation would mean a lead 24 inches long.

1.2.3 Lead size. The leads shall be furnished in sizes as specified. Thus a four in the lead size designation would mean a lead with an SAE wire size of four gage.

1.2.4 Designation. Storage battery leads covered by this specification shall be identified by a lead designation, formed as indicated in the following (see 6.2).

Spec. No.	Type No.	Class No.	Style No.	Length Inches	Lead size SAE #
J-L-231	II	A	1	24	4

(NOTE: Classes A and B are applicable to type II leads only.)

2. APPLICABLE DOCUMENTS

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

Federal Specifications:

- QQ-S-781 - Strapping, Steel, and Seals
- PPP-B-566 - Boxes, Folding, Paperboard
- PPP-B-636 - Boxes, Shipping, Fiberboard
- PPP-B-676 - Boxes, Setup

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions as outlined under General Information in the Index of Federal Specifications, Standards, and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

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(Single copies of this specification and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.

(Federal Government activities may obtain copies of Federal Specification documents, and the Index of Federal Specifications, Standards, and Commercial Item Descriptions from established distribution points in their agencies.)

Federal Standard:

FED-STD-123 - Marking for Shipment (Civil Agencies)

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-129 - Marking for Shipment and Storage

MIL-STD-147 - Palletized Unit Loads

MIL-STD-2073 - DOD Materiel Procedures for Development and Application of Packaging Requirements

(Copies of military specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of the documents not listed in the DODISS shall be the issue of the non-Government documents which is current on the date of the solicitation.

American Society for Testing and Materials (ASTM):

ASTM D 3951 - Packaging, Commercial

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

Society of Automotive Engineers, Inc. (SAE):

SAE Handbook

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specifications sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Description. The storage battery lead shall basically consist of a length of low tension cable which is terminated at each end with a post terminal or terminal lug as required.

3.2 First article. When specified (see 6.2), the contractor shall furnish one complete lead of each type, style, and class specified for first article inspection and approval (see 4.2.1 and 6.3).

3.3 Standard commercial product. The storage battery lead shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial product. Additional or better features which are not specifically prohibited by this specification but which are a part of the manufacturer's standard commercial product, shall be included in the storage battery lead being furnished. A standard commercial product is a product which has been sold or is being currently offered for sale on the commercial market through advertisements or manufacturer's catalogs, or brochures, and represents the latest production model.

3.4 Materials. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible 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 are allowed under this specification unless otherwise specified.

3.5 Design and construction.

3.5.1 Type I. Uninsulated flat straps made up of braided copper conductors shall be tin, zinc, or cadmium plated to resist corrosion and shall be of the braided gage size indicated in table I.

TABLE I. Construction details of type I braided straps.

Braided gage size identification	Minimum conductor area ¹		Approximate width (inch)
	Cir mil	mm ²	
9	12,060	6.0	7/16
6	26,532	13.0	5/8
4	38,592	19.0	7/8
3	48,240	24.0	7/8
2	65,124	32.0	15/16
1	82,008	40.0	15/16
0	106,128	50.0	15/16
2/0	130,248	62.0	15/16

¹Metric wire size is the approximate nominal area of the stranded conductor.

²Metric dimensions are not direct conversions from circular mils.

3.5.1.1 Type I, style 1. Type I, style 1 ground lead shall be tin, zinc, or cadmium plated to resist corrosion and shall have a post terminal (see 3.5.6.1) on one end and a terminal lug (see 3.5.6.3) on the other end. The style 1 lead is used for connection from the battery to ground.

3.5.1.2 Type I, style 2. Type I, style 2 ground lead shall be uncoated and have a terminal lug (see 3.5.6.3) on each end for use from engine to ground.

3.5.2 Type II, insulated. The type II insulated lead shall be general purpose, insulated, braidless and classified as extra flexible rope strand construction (class A) bunched or stranded concentric lay (class B), and shall be of the SAE wire size indicated in table II. Insulation properties for all type II leads shall meet the requirements of SAE J1127 or J1128, as appropriate (see 4.5).

TABLE II. Construction details of type II cables.

SAE wire size	Metric wire size, mm ²	Minimum conductor area for finished cable	
		Cir mil	mm ²
12	3.0	5,833	2.91
10	5.0	9,343	4.65
8	8.0	14,810	7.23
6	13.0	25,910	12.1
4	19.0	37,360	18.3
2	32.0	62,450	31.1
1	40.0	77,790	38.1
0	50.0	98,980	48.3
2/0	62.0	125,100	59.8
3/0	81.0	158,600	77.6
4/0	103.0	205,500	98.5

3.5.2.1 Type II, class A. The type II, class A insulated extra flexible rope strand lead shall be cabled in accordance with table II. This lead is used for connection between the battery and the starter, the battery and the solenoid, the starter and the solenoid, or between the battery and ground.

3.5.2.2 Type II, class B. The type II, class B insulated stranded concentric lay or bunched lead shall be cabled in accordance with table II. This lead is normally used for connection between the battery and the starter, the battery and the solenoid, the starter and the solenoid, or between the battery and ground.

3.5.3 Cable style. Type II, class A or B cable design shall be designated by the cable styles.

3.5.3.1 Type II, class A or B, style 1. The type II, style 1 lead shall be a 12-gage insulated generator lead attached to a universal post terminal (see 3.5.6.1). The other end of lead shall be fitted with a terminal lug (see 3.5.6.3).

3.5.3.2 Type II, class A or B, style 2. The type II, style 2 lead shall have a terminal lug (see 3.5.6.3) on each end. This lead is used for connection between the solenoid and starter and similar application.

3.5.3.3 Type II, class A or B, style 3. The type II, style 3 lead shall have straight-neck post terminals (see 3.5.6.1) on each end. The post terminals used on these leads are the universal type fitting either a negative or positive battery post. This style lead is used as a connector when arranging batteries in series or parallel combinations.

3.5.3.4 Type II, class A or B, style 4. The type II, style 4 lead shall have angle type post terminals (see 3.5.6.1). The post terminals used on these leads are the universal type arranged 180 degrees with respect to each other. This style lead is used as a connector when arranging batteries in series or parallel combinations.

3.5.3.5 Type II, class A or B, style 5. The type II, style 5 lead shall have a side terminal with integral bolt (see 3.5.6.2) on one end and a lug (see 3.5.6.3) on the other end. This style lead is used for connection between a side terminal battery and the starter or between the battery and ground.

3.5.3.6 Type II, class A or B, style 6. The type II, style 6 lead shall have a side terminal with integral bolt on each end (see 3.5.6.2). This style lead is used as a connector when arranging side terminal batteries in series or parallel combinations.

3.5.4 Construction. Construction shall conform to SAE J1127 or J1128 and the requirements specified herein. The post terminals and lugs required for the leads shall be furnished in accordance with SAE J537, J561, and as specified herein. If there is a conflict between SAE J537, J1127, J1128, and J561 and this specification, this specification shall govern.

3.5.5 Insulation protective covering. When additional protective covering, such as a waterproof loom, is required for type II lead, the length of the loom and its location on the lead shall be as specified (see 6.2).

3.5.6 Termination. The termination for the leads shall conform to the requirements of 3.5.6.1 through 3.5.6.3, as applicable.

3.5.6.1 Lead terminals (battery post). The lead terminals for battery posts shall be the straight-neck type cast or molded from a corrosion-resisting metal. The corrosion-resisting metal shall be brass alloy, tin, or zinc plated, or an alloy of lead and antimony containing from 3 percent to 7-1/2 percent of antimony. On the type II battery lead, the terminal shall have an overlap to cover the insulation of the lead by at least 1/4 inch. The bore of the terminal shall allow at least 1/2 inch of length of bare copper of the lead for contact. On the type I flat-strap ground cable, the terminal shall contact not less than 5/8 inch of the length and the full width of the copper conductor. The terminal shall be of such design as to permit complete tightening with full contact on the battery post and shall be in accordance with SAE J537. A bolt and nut having a corrosion-resisting finish shall be provided with each terminal. The clamping bolt shall be at least 5/16 inch in diameter and the bolting arrangement shall permit tightening to the degree necessary to provide a full power connection. The bolthead shall bear against a portion of the terminal so that the bolt shall not turn when setting up the nut. The terminal shall be capable of providing a full power connection to either a positive or negative post.

3.5.6.2 Lead terminals (side). Leads having side terminals shall be of correct design to connect to the electrical connection of a side terminal type battery as listed in SAE J537, and shall have a corrosion-resistant finish. Each lead terminal must include a bolt having a 3/8-16 thread that has a maximum exposed length of 0.30 inch. The bolt shall have a maximum size of 5/16 inch across the flats. The lead terminal shall provide at least 1/2 inch of bare copper at the connection between the terminal and the cable, and an insulation overlap of at least 1/4 inch. The terminal shall be capable of providing a full power connection to either a positive or negative contact of a side terminal type battery.

3.5.6.3 Terminal lugs. Type II terminal lugs shall be formed from copper or brass alloy. The lug shall be plated or coated with lead-antimony alloy specified in 3.5.6.1. Type I leads terminal lugs shall be compressed to fit closely around the flat ground strap so that the thickness at this point is held to a minimum. The connector shall be cadmium plated or coated with lead-antimony alloy specified in 3.5.6.1. A hole $0.395 + 0.015$ inch in diameter shall be provided through the lug.

3.5.7 Mechanical strength. All completed cable leads shall be capable of withstanding a pull of 75 pounds for 1 minute when tested as specified in 4.5.1.

3.6 Identification data. The lead assembly shall show inscribed on, or attached thereto, the manufacturer's name or trademark and part number. When specified (see 6.2), the lead assembly will also identify the manufacturer's production lot number.

3.7 Workmanship. The lead shall be uniform in quality and shape, and shall be free from kinks, nonuniform braiding and stranding, excessive solder scale, solder pits, defects in insulation, and other defects.

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.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with

all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Component and material inspection. Components and materials shall be inspected in accordance with all the requirements specified herein and in applicable referenced documents.

4.2.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2.1).
- b. Quality conformance inspection (see 4.2.2).

4.2.1 First article inspection. The first article inspection shall be performed on one complete storage battery lead of each type, style, and class included under a specific contract when a first article is required (see 3.2 and 6.2). This inspection shall include the examination of 4.4, the tests of 4.5. The first article may be either a first production item or a standard production item from the supplier's current inventory provided the item meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining items to be furnished under the contract.

4.2.2 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.4, the tests of 4.5, and the packaging inspection of 4.6. This inspection shall be performed on the samples selected in accordance with 4.3.

4.3 Sampling. Sampling and inspection procedures shall be in accordance with MIL-STD-105. The unit of product shall be storage battery lead. All storage battery cables offered for delivery at one time shall be considered a lot for the purpose of inspection. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for a complete reinspection. Resubmitted lots shall be reinspected using tightened inspection. If the rejected lot was screened, reinspection shall be limited to the defect causing rejection. If the lot was reprocessed, reinspection shall be performed for all defects. Rejected lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.3.1 Sampling for examination. Examination shall be based on inspection level S-4 and an Acceptable Quality Level (AQL) of 4.0 percent defective.

4.3.2 Sampling for tests. Tests shall be based on inspection level S-2 and an AQL of 1.5 percent defective.

4.4 Examination. Each sample selected in accordance with 4.3.1 shall be examined for compliance with the requirements specified in section 3 of this specification. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection. This examination shall be conducted as specified in table III and as otherwise specified in this document.

TABLE III. Classification of defects.

Categories	Defects	Reference paragraph
Major:		
101	Type and class not as specified.	3.5.1, 3.5.2, 3.5.3
102	Dimensions not as specified or within tolerance;	
	Lead length	3.5.6.3
	Terminal lug hole size	3.5.1, 3.5.2
	Clamping bolt size and thread.	3.5.6.1, 3.5.6.2
103	Protective covering not as specified.	3.5.5, 6.2
104	Insulation overlap not as specified.	3.5.6.1, 3.5.6.2
105	Identification data not as specified.	3.6, 6.2
Minor:		
111	Nonuniform shape, braiding, stranding, and quality.	3.7
112	Excessive solder scale and solder pits.	3.7

4.5 Tests. Each sample selected in accordance with 4.3.2 shall be tested for conformance to the applicable requirements of SAE J1127 or J1128. All samples selected in accordance with 4.3.2 shall be tested for compliance with 4.5.1.

4.5.1 Mechanical strength test. In addition to the test specified in SAE J1127 or J1128, all samples selected in accordance with 4.3.2 shall be subjected to the mechanical strength test. The mechanical strength of the completed leads and the security of the terminal attachments to the leads shall be determined by means of freely hanging weights or by means of a suitable testing machine. The completely assembled lead shall withstand the pull specified in 3.5.7 without failure.

4.6 Preparation for delivery inspection. The preservation, packaging, packing, and marking of the item shall be inspected to verify conformance to the requirements of section 5.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Preservation and packaging shall be level A or commercial as specified (see 6.2).

5.1.1 Level A. Each battery lead shall be packaged in a close-fitting box conforming to PPP-B-636, class weather-resistant, PPP-B-566, or PPP-B-676, variety 2.

5.1.1.1 Intermediate packaging. When specified (see 6.2), leads of like description shall be intermediate packaged in fiberboard boxes conforming to PPP-B-636, class weather-resistant. The container shall not exceed 40 pounds and shall be closed in accordance with method V in the appendix of the box specification.

5.1.2 Commercial. Material shall be packaged in accordance with ASTM D3951.

5.2 Packing. Packing shall be level A, B, or commercial as specified (see 6.2).

5.2.1 Level A and B. Packing shall be accordance with MIL-STD-2073. Containers shall be selected from table VII, appendix C, for the appropriate level.

5.2.2 Commercial. Material shall be packed in accordance with ASTM D3951.

5.2.3 Palletized and containerization unit loads. When specified (see 6.2), the packaged or packed lead shall be palletized in accordance with MIL-STD-147, load type I or Ia, as applicable. The load shall be bonded to the pallet with strapping conforming to QQ-S-781, class 1, type I, finish A, or shrink film.

5.3 Marking.

5.3.1 Military agencies. Shipments to military agencies shall be marked in accordance with MIL-STD-129.

5.3.2 Civil agencies. Shipments to civil agencies shall be marked in accordance with FED-STD-123.

6. NOTES

6.1 Intended use. The battery cables covered by this specification are used to electrically interconnect low voltage (6, 12, and 24V), high amperage circuits associated with automotive storage batteries. Insulated leads are used to interconnect ungrounded circuits between the battery and related electrical equipments as well as to connect two or more pieces of high amperage electrical equipment. The insulated lead may also be used between the battery and ground. Uninsulated leads are used for bonding and ground connections.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in acquisition documents:

- a. Title, number, and date of this specification.
- b. Type, class, style, length and lead size required (see 1.2.1 and 1.2.4).
- c. When first article is required for inspection and approval (see 3.2, 4.2.1, and 6.3).
- d. When additional insulation protective cover shall be furnished, indicate the length and location on the lead (see 3.5.5).
- e. When identification of the manufacturer's production lot number is required (see 3.6).
- f. Level of preservation and packaging and level of packing required (see 5.1 and 5.2).
- g. When intermediate packaging is required (see 5.1.1.1).
- h. When palletized unit loads are required (see 5.2.3).

6.3 First article. When a first article inspection is required, the item will be tested and should be a first production item or it may be a standard production item from the contractor's current inventory as specified in 4.2.1. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examination, test, and approval of the first article.

MILITARY INTERESTS:

Custodians

Army - ER

Navy - YD

Air Force - 99

PREPARING ACTIVITY:

Navy - YD

(Project 6140-0619)

Review Activity

Air Force - 80

Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein.