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SUPERSEDING
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MILITARY SPECIFICATION

LOAD BANK, AC, 0-33 KW/0-44 KW, RESISTIVE

This specification is approved for use by the USA Belvoir Research and Development Center, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a load bank that is used to provide balanced three phase loads of 0-33 kW and 0-44 kW and single phase loads of 0-33 kW (see 3.1) when connected to ac power sources operating at specific terminal voltages in the frequency range of 45 to 440 Hz.

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

QQ-S-781	- Strapping, Steel and Seals.
ZZ-R-765	- Rubber, Silicone: Low and High Temperature and Tear Resistant.
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: USA Belvoir Research and Development Center, ATTN: STRBE-DS, Fort Belvoir, VA 22060 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 6115

MILITARY

MIL-M-14	- Molding Plastics and Molded Plastic Parts, Thermosetting.
MIL-V-173	- Varnish, Moisture-and-Fungus Resistant (for Treatment of Communications, Electronic and Associated Equipment).
MIL-C-5015	- Connectors, Electrical, Circular Threaded AN Type, General Specification for.
MIL-T-704	- Treatment and Painting of Materiel.
MIL-W-5086/2	- Wire, Electric, Polyvinyl Chloride Insulated, PVC-Glass-Nylon, Tin Coated Copper Conductor, 600 Volt, 105° C.
MIL-P-15024	- Plates, Tags and Bands for Identification of Equipment.
MIL-P-15037	- Plastic Sheet, Laminated, Thermosetting, Glass-Cloth, Melamine Resin.
MIL-P-53022	- Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free and Solvent Resistant.
MIL-R-47195	- Rivets Blind, Self Plugging, Preparation for and Installation of.
MIL-R-47196	- Rivets, Buck Type, Preparation for and Installation of.
MIL-S-81733	- Sealing and Coating Compound, Corrosion Inhibitive.

STANDARDS

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	- Marking for Shipment and Storage.
MIL-STD-130	- Identification Marking of US Military Requirements.
MIL-STD-461	- Electromagnetic Interference Characteristics Requirements for Equipment.
MIL-STD-810	- Environmental Tests Methods.
MIL-STD-889	- Dissimilar Metals.

DRAWINGS

DOD PM-MEP

69-657	- Paddle Lock.

(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(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B1.1 - Unified Screw Threads.

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

ANS/IEEE-315 - Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Class Designation Letters).

(Application for copies should be addressed to the American National Standards Institute Inc., 1430 Broadway, New York, NY 10018 or to the Institute of Electrical and Electronics Engineers Service Center, 445 Hoes Lane, Piscataway, NJ 08854.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D3951 - Standard Practices for Commerical Packaging.

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

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

Rule 442 - Usage of Solvents.

(Application for copies should be addressed to the South Coast Air Quality Management District, 9150 Flair Drive, El Monte, CA 91731.)

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

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 Description. The load bank shall be an electrical unit designed to be used as balanced three phase loads with provisions for converting to single phase loads. The loads shall consist of three separate and identical sets of resistance elements and each set shall be contained in a standard design forced air cooled resistance module. Each element shall be rated in units of kilowatts and represent a specific quantity of electrical power for a constant value of voltage applied across its terminals. Each set of resistance elements shall be

grouped and arranged to be systematically reconnectable into either parallel circuits or series circuits so that the load value of each element remains constant when the load bank is used at either the low voltage or high voltage connections for the normal power rating of 0 to 33 kW. For the low voltage-high power rating of 0 to 44 kW, the load value rating of each resistance element shall be increased by 33 percent. The sum of the kilowatt values for each parallel circuit or each series circuit of each resistance module shall constitute the basic load increments and the sum of three increments, one from each resistance module, shall be identified as the magnitude of the load available for individual switching. The switched loads shall consist of a continuously variable load and a set of fixed loads which will provide for selection of any load value within the specified range. The switching system shall permit the load value to be changed by independent operation of the selector switches and the variable load control while each phase bus is energized. The total selected load shall be the sum of the switched loads that have been turned on. The kW rating of the switched loads shall consist of the values listed in table I. The line currents for each parallel circuit and each series circuit (basic load increments) are listed in table II and represents the values at each line input terminal when the resistance elements are operating at their forced air cooled operating temperature.

TABLE I. Switched loads (kW).

Conn	Voltage	Incremental loads x three						Tot (kW)
		Low Voltage Connections						
3P-4W	120/208	0-3	3	3	6	6	6	6	33
3P-3W(1)	(139)/240	0-4	4	4	8	8	8	8	44
1P-2W(2)	120	0-3	3	3	6	6	6	6	33
		High Voltage Connections							
3P-4W	240/416	0-3	3	3	6	6	6	6	33
1P-2W(3)	240	0-3	3	3	6	6	6	6	33

TABLE II. Incremental currents (amps/input terminal).

(Does not include control circuit currents)

Conn	Voltage	Load Elements at operating temperature							Tot (Amps)
		Low Voltage Connections							
3P-4W	120/208	0-8.33	8.33	8.33	16.66	16.66	16.66	16.66	91.66
3P-3W(1)	(139/240)	0-9.62	9.62	9.62	19.24	19.24	19.24	19.24	105.82
1P-2W(2)	120	0-8.33	8.33	8.33	16.66	16.66	16.66	16.66	91.66
		High Voltage Connections							
3P-4W	240/416	0-4.17	4.17	4.17	8.33	8.33	8.33	8.33	45.83
1P-2W(3)	240	0-4.17	4.17	4.17	8.33	8.33	8.33	8.33	45.83

(1) High power. Use 120/208 connection without neutral.
(2) Use 120/208 connection. Install phase shorting link.
(3) Use 240/416 connection. Install phase shorting link.

Unless otherwise specified, all terminal markings and all function, instruction, operating and identification plates shall use three phase designations and terminology. The frequency range for operation shall be 45 thru 440 Hz. The total load shall not include the power required by the control circuits. Power for the control circuits shall not exceed 600 watts.

3.1.1 Primary features. The primary features of the load bank shall consist of the following: Enclosure - consisting of skid base assembly and housing; power input terminal board assembly; normally open electromagnetically operated switches of the power relay or contactor type [hereinafter referred to as the main line contactor(s)]; an array of switches located on an operator control panel and used to select and preselect circuits between the load side of the main line contactor(s) and the common return; three identical forced air cooled resistance modules that are thermally protected; switches and circuits that provide for operation, personnel safety and equipment protection.

3.2 First article. When specified, one or more preproduction model load bank units shall be subjected to first article inspection (see 4.3 and 6.2).

3.3 Materials and material treatments. Materials and material treatments shall be as specified herein and on the drawings. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this specification.

3.3.1 Material deterioration prevention and control. The load bank shall be fabricated from compatible materials. The materials shall be inherently corrosion resistant or treated to provide protection against the various forms of corrosion and deterioration that may be encountered in any of the storage and operating environments to which the load bank may be exposed.

3.3.2 Dissimilar metals. Dissimilar metals, as defined in MIL-STD-889, shall be electrically insulated from one another to prevent or minimize galvanic corrosion. When dissimilar metals are connected together an insulating barrier shall be provided by a coat of epoxy primer conforming to MIL-P-53022 or a corrosion inhibiting sealing and coating compound conforming to MIL-S-81733. These barriers shall be protected from the effects of final treatment before painting or they may be applied following surface preparation and treatment prior to painting.

3.3.3 Treatment and painting. The load bank shall be treated and painted in accordance with MIL-T-704, type A, color as specified for Army use.

3.3.4 Electrical insulation. Terminal boards, terminal strips and other supports for electrical terminations shall be made of molded or laminated plastic. Molded plastic shall be in accordance with MIL-M-14, alkyd, melamine or silicone resin. Laminated plastic shall be in accordance with MIL-P-15037.

Insulation used internally to the resistance load assemblies shall be determined by the contractor and shall meet all performance requirements specified herein.

3.3.5 Fungus and moisture treatment. The electrical circuitry, including all components and connections except as specified below, shall be protected against the effects of fungus growth and moisture by an overall treatment with varnish conforming to MIL-V-173, composition I or II as applicable (see 3.3.5.1). The varnish shall be applied by spray, brush or a combination of both, to give a dry film thickness of not less than 1 mil to component or element surfaces previously cleaned and prepared so that surfaces are free from all foreign matter that would interfere with the adherence or function of the varnish.

a. Components or circuit elements that are inherently fungus and moisture resistant or which are hermetically sealed need not be treated.
b. Components or circuit elements whose functions will be adversely affected by the varnish coating shall not be treated.

3.3.5.1 Composition. Composition II shall be used only in the case when local air pollution regulations, in the application of the varnish, precludes the use of composition I. When composition II is used, the contractor shall provide evidence to the Government that the use of composition II is required and shall certify that the composition II material complies with Rule 442, (Usage of Solvents).

3.3.6 Identification of materials and material treatments. The contractor shall provide a listing of all materials and material treatments where corrosion, fungus and moisture treatment has been applied. Electrical insulation used in components of the load bank shall be provided with certification that the materials are intrinsically fungus inert or have been processed or treated to be fungus inert.

3.4 Weight and dimensions. The weight of the load bank shall not exceed 325 pounds. The dimensions shall not exceed the following: Vertical height equals 27 inches; transverse width equals 23 inches; longitudinal depth equals 36 inches.

3.5 Enclosure. The primary features of the enclosure shall be the skid base, the housing, the ventilation system and the maintenance access provisions.

3.5.1 Skid base. The skid base shall be an assembly of structural grade metals that are shaped, reinforced and assembled as required to form an integral unit. It shall consist of a reinforced frame with base supports to provide floor clearance, a sheet metal mounting surface for components, lifting bars, and tiedown/towing holes located in either the frame or base supports.

a. Base supports. The base supports shall be of the runner or pedestal types and used to elevate the frame a minimum of three inches above floor level. Runners, when used, shall extend the full width of the skid base. Pedestals, when used, shall be symmetrically located near each of the four corners. The supports, regardless of type, shall be

shaped to permit dragging and towing the complete load bank in the direction of either the longitudinal or transverse axis on wooden or dry dirt surfaces. They shall allow for the entrance of fork lift tines set for an exterior span of eighteen inches and have a total bearing surface area of not less than 64 square inches, equally proportioned among the supports.

b. Lifting bars. Two lifting bars of the casket style shall be provided for lifting the load bank. Each bar shall be one inch diameter round stock, mildly knurled, and length not less than 90 percent of the 36 inch reference dimension. The bars shall be symmetrically located, attached to each side of the skid frame and have an extend/retract feature for handling and stowage. The extend/retract feature may be a sliding arrangement with locking provisions or it may be an over center pivot-spring arrangement that permits the bars to be set and retained in either of the desired positions. In the extended position, the bars shall have adequate clearance so a firm grip may be obtained by personnel using arctic mittens. In the retracted position, the bars shall be flush within the side planes of the skid base. The bars shall be suitable for a six man lift and have a load capacity of two times the actual weight of the complete load bank.

c. Tiedown/towing holes. Holes having a measured diameter in the range of 1.375 to 1.500 inches and suitable for inserting a pipe or round bar of length that extends past each side surface of the load bank shall be provided. The holes may be located in either the frame or base supports.

3.5.2 Housing. The housing shall consist of a reinforced frame fabricated from structural grade and shaped metals to which is attached the top cover, side panels and access doors. The housing shall be assembled to the skid base by any method that will provide the required strength, durability and operation/maintenance access. All doors and panels shall have corners rounded to .125 inch minimum radius - sharp edges broken to .015 inch minimum.

a. Operational type doors. Doors shall be provided for access to the power input terminal board, the operator control panel, the reconnection circuits and any other functions required for routine operations. Any door may be used to provide access for more than one function. All doors shall be attached to the housing frame by means of piano type hinges that permit the doors to be folded back against adjacent surfaces. The hinges shall be secured with replaceable threaded or riveted type fasteners. Blind rivets shall not be used where high strength structural quality fastening is required. Open doors shall not impede the movement of personnel around the load bank, be a nuisance to operators or create an unsafe condition through unintentional closing.

(1) Power input terminals access door. The access door for the power input terminal board shall be designed so it can be latched after the cable connections are made and automatically locked after the terminals are energized. The locking device shall be an electri-

cally operated spring loaded solenoid or an equivalent mechanism that provides positive engagement when energized and positive disengagement when the terminals are not engergized. This device shall be part of the safety interlock and alerting system (see 3.13.1).

(2) Cable entrance opening. The opening for the power input cable shall be adequate for making connections of both of the following types: (a) five conductor cable of two inches diameter; (b) five single conductors of .75 inch diameter each. The opening shall be at the bottom of the power input terminal access door or within the surrounding framework.

b. Seals and gaskets. Seals and gaskets shall be used around the perimeter of doors and panels to exclude water, compression preload fasteners and latches, cushion mating surfaces and improve fit. Seals and gaskets shall be silicone rubber in accordance with ZZ-R-765, class 3b, grade as applicable.

c. Manual storage compartment. A storage compartment suitable for protecting and retaining the preserved technical publications shall be provided. It shall be located beneath the top cover or on an interior vertical surface that is sheltered from the weather during operation but is easily accessible to operator and maintenance personnel. The compartment shall exclude the entrance of water and contain openings for ventilation and cleanout.

3.5.3 Ventilation system. The ventilation system shall provide for the flow of coolant air to prevent overheating of the load bank components and to cool the resistance elements. The air flow shall be sufficient in quantity to permit full load operation of the load bank at the extreme high temperature and load conditions and in a direction to allow operation in the presence of wind driven rain.

3.5.3.1 Air intake system. Passages for the intake air shall be proportioned between any scheme or combination of louvers, vents, ducts and other openings that are systematically sized and located to form a complementary system and provide for a continuous flow of coolant air. The system shall prevent wind driven rain from entering into electrical components, onto moisture sensitive electrical circuits or into sensitive horizontally operated devices that could result in safety hazards caused by excessive leakage currents or performance failures. The essential features applicable to those methods selected in the design shall be as follows:

a. Louvers - regardless of type, shall naturally exclude wind driven rain from circuits that have high moisture sensitivity or they may be used with auxiliary diversion devices to perform this function. Louvered panels shall be recessed into a frame such that projecting slats or fins are interior to or flush with the plane of the exterior framework.

b. Vents - may be contained in the bottom. The velocity of air through the bottom vents shall not be sufficient to attract and introduce a regular drift of dirt particles into the airstream.

c. Ducts - should be of a geometric configuration to provide an updraft air flow and have their openings contained in the vicinity of the housing - skid base interface boundary.
d. Other openings - such as entrance of air through the exhaust surface, drainage holes or other methods determined by the manufacturer shall be utilized as required.

3.5.3.2 Air exhaust system. Air exhaust shall be through a set of air activated or manually operated jalousie type louvers with anti-rattle locking provisions or it may be through a door. When a door is used, it shall be capable of being set to a horizontal position for rainy conditions by means of adjustable struts and detachable from the struts so the door can be folded back against an adjacent surface. The struts shall be constrained to move in a guide or otherwise arranged to prevent accidental contact with internal electrical circuits.

3.5.4 Maintenance access. Access to all componets for diagnostic tests, electrical measurements and replacement of components shall be provided through door openings, removal of access panels or removal of the top cover. All components shall be clearly visible and accessible through a designated opening so diagnostic tests and electrical measurements are safely and easily performed. Fasteners used to retain components shall not be swaged or peened for vibration proofing and all components shall be replaceable by one man using common tools when the load bank is in its standard orientation. Replacement of all components, except the resistance load assemblies shall be easily performed without removal of the housing from the skid base. The resistance load assemblies shall be replaceable by a systematic method that does not exceed one man hour of maintenance time. Panels used for maintenance access shall be removable and replaceable using quick disconnect fasteners or they may be attached with hinges and secured closed with quick disconnect fasteners.

3.6 Standard hardware. Standard hardware shall be selected for its resistance to corrosion and its characteristics for inhibiting corrosion activity at the point of application.

3.6.1 Threaded fasteners and holes. Bolts, screws, nuts and threaded holes shall contain UNC, UNF or UNEF threads selected from the primary sizes recommended in ANSI B1.1. All threaded fasteners shall be selected from the military standard line and shall be identified by their MS number in the parts list of technical publications.

3.6.2 Washers. Washers shall be used to provide bearing surfaces and the locking feature for threaded fasteners. Washers shall be selected from the military standard line and identified by their MS number in the parts list of technical publications.

3.6.3 Rivets. Blind rivets used for construction and fastening shall be of the MS type and installed in accordance with MIL-R-47195. Jagged edges of the plugging mandrel shall be removed. Buck type rivets shall be installed in accordance with MIL-R-47196.

3.6.4 Quick disconnect fasteners. Quick disconnect fasteners shall be used to secure panels that are required to be removed for routine inpsection and maintenance. These fasteners shall be of the pushbutton on rotating type and shall be positive locking. Rotating fasteners shall be fully engaged or disengaged in less than one revolution. Regardless of type, quick disconnect fasteners shall be captive to the elements that are to be secured.

3.6.5 Latches. Latches shall be used to secure all panels and doors that are hinged. Latches shall be of the flush mounted paddle lock type in accordance with drawing 69-657.

3.6.6 Hinges. Hinges shall be of the continuous piano type that allows doors and panels to swing back against adjoining surfaces. Hinge pins shall be peened at each end to prevent axial shifting.

3.7 Operator control panel. The operator control panel shall contain an array of toggle switches for selecting fixed loads, the control knob for setting variable loads, a master control switch for initiating and terminating operation of the load bank and circuit breakers for overload protection of the control and protective circuits. When other switches and devices are used that require selection by the operator to initiate or terminate routine operations, they shall be located on the control panel. Switches and controls shall be arranged in a typical sequence of use according to functional grouping. Functions such as "CONNECT LOAD" shall be labeled rather than "S2". The variable load control shall increase in a clockwise direction and have an arrow which is labeled "INCREASE".

3.8 Resistance load circuit. The resistance load circuit shall consist of the power input terminal board assembly, the contact section of the mainline contactor(s), load selection switches, ganged set of variable transformers, resistance elements of the resistance load modules and selected circuits in the reconnection system.

3.8.1 Power input connections. The power input connections shall consist of a terminal board assembly with studs marked L1, L2, L3 and L0 - to correspond with the standard markings of military generator sets, a shorting link suitable for shorting the studs L1, L2 and L3 together for single phase operation and a grounding stud for equipment ground.

3.8.1.1 Terminal board assembly. The studs shall be mounted in a board or slab of electrical insulation of the required thickness and toughness to retain a firm mechanical connection under conditions of repeated use and temperature changes. The stud size for L1, L2 and L3 shall be .375 inches in diameter minimum. The stud size for L0 shall be .500 inches minimum or a split neutral consisting of two .375 inch diameter studs bridged by a connecting link may be used. When the split neutral is used, it shall be marked that both are required for full load at the single phase connections. The stud material shall be copper or brass. Insulated knobs, having the same material insert as the studs and capable of being hand tightened, shall be furnished with each stud. The insulation color for the knobs of the L1, L2 and L3 studs shall be black and the insulation color for the L0 stud(s) shall be white or grey or have predominant white or grey characteristic markings.

3.8.1.2 Stud spacing and terminal board orientation. The center to center spacing of the studs shall provide for a minimum of one inch clearance between any pair of the insulated knobs. The location and orientation of the terminal board assembly shall provide for easy access, positive stud identification and sufficient space to make a secure connection.

3.8.1.3 Shorting link. The shorting link shall be made from copper or brass and stored in the vicinity of the power input terminal board assembly. Its function shall be identified.

3.8.1.4 Grounding stud. A grounding stud suitable for securing a wire of size AWG No. 6 shall be provided on the skid base. The stud shall be removable and shall be located within 12 inches from the power input terminals. It shall be fabricated from copper, brass or steel and when required, shall be treated to prevent long term corrosive activity with the material of the skid base. It shall be identified by a green plate.

3.8.2 Resistance load modules. Each resistance load modules shall consist of the resistance elements, fan motor and fan, air operated switch and thermal switch(es). Each module shall be self contained and enclosed in a housing designed for easy replacement as a complete assembly.

3.8.2.1 Resistance elements. The resistance elements shall be of a material and form that will provide for adequate heat dissipation, have a maximum resistance change not exceeding 10 percent between the local ambient and the forced air cooled operating temperature of the element and be at its steady state operating resistance within 15 seconds from the initial application of voltage to the resistance element.

3.8.2.2 Fan assembly. The fan assembly shall consist of the fan, fan motor and mounting bracket. The fan motor shall operate around the nominal range of 24 VDC that will include voltage variations resulting from single phase and three phase connections. The fan assembly may be installed at any position of the resistance load module that will provide for an adequate flow of coolant air and proper operation of the protective switches.

3.9 Reconnection system. The reconnection system shall provide for the reconnection of all circuits that are required to be changed to maintain the correct voltage to load relationship of the resistance elements, to establish the correct voltage levels for the control circuits and to provide for the interconnection of protective circuits that prevent the load from being energized when the voltage to load relationship is incorrect. Reconnection may be through one multiple contact electrical connector, two multiple contact electrical connectors or it may be through a connector and a switch. The number of operations required for reconnection shall not exceed two. When required, selected wiring for the protective circuit shall be transposed within the reconnection system so the protective circuit can sense and respond to the existing state of all circuit connections and initiate the operation or termination functions required. Electrical connectors shall be of the military standard class and meet the requirements of MIL-C-5015.

3.10 Control and protective circuits. The control and protective circuits shall provide all the functions required to initiate and sustain operation when the reconnection system is in the correct state, open the main line contactor(s) under conditions of overtemperature limits or reduced air flow or fan motor failure and maintain a non-operable condition when the reconnection system is not in the correct state. The circuits shall consist of circuit breakers, master control switch, transformers, rectifiers, air switches, thermal switches, coil(s) of the main line contactor(s), voltage sensing assemblies, protective relays and fan motors.

3.10.1 Electrical operating characteristics. Power for the control and protective circuits shall be obtained directly from the power input terminals. The total power required for these circuits shall not exceed 600 watts. The input voltage shall be transformed and rectified to provide a voltage of 24 volts dc plus or minus 20 percent from any of the specified input voltage connections. All components in the circuits shall be rated for continuous operation from the highest and lowest voltages that result from any of the three phase or single phase inputs.

3.11 Main line contactor(s), control relays, switches and circuit interrupters. These components shall be intrinsically sealed or otherwise enclosed to prevent the entry of dirt, dust, sand, water and water condensates into the operating mechanisms or into the areas containing the operating electrical contacts. Ratings and characteristics that are not specified but are essential to meet other requirements of this specification shall be determined by the contractor.

3.11.1 Main line contactor(s). Normally open, electromagnetically operated switch(es) of the power relay or contactor type shall be used to open and close the circuits between the input terminals and the load selector switches. The main line contactor(s) shall be of any of the types specified and be suitable for closing and interrupting a three phase circuit with a current/voltage rating of 105 amps/pole at 139/240 volts and 50 amps/pole at 240/416 volts. When multiple contactors are used, they shall be arranged to operate from the same input signal.

Type A. Quantity one. Single unit, three pole, single throw, normally open. Full current rating in amps per pole at each of the specified voltages.

Type B. Quantity two. Each, single unit, three pole, single throw, normally open. Both units shall be identical and each unit shall equal or exceed 50 percent of the current rating in amps per pole at each of the specified voltages.

Type C. Quantity three. Three separate one pole, single throw, normally open. All three units shall be identical and each unit shall be rated for full current in amps per pole at each of the specified voltages.

The main line contactor(s) shall meet the following requirements:

a. Interrupting frequencies: 45 through 440 Hz.

b. Circuit overload. Interrupt 500 amps/pole for the type A and C contactor(s) and 250 amps/pole for the type B contactors a minimum of five times at 50 Hz without contact weld, phase to phase or phase to ground arcing.
c. Operating coil rating. The operating coils shall be suitable for continuous operation at 24 volts dc plus or minus 20 percent.
d. Electrical operations. The contactor(s) shall perform a minimum of 2500 make-break cycles for the rated current at 139/240 volts at 60 Hz.
e. Mechanical operations. The contactor(s) shall perform a minimum of 10,000 closures with no current through the contacts.

3.11.2 Control relays. Relays used in the control and protective circuit may be either ac or dc.

3.11.3 Switches. All switches used in the load bank shall be properly rated for the voltages and currents at steady state conditions and also the inductive voltages and surge currents that will occur in the circuits where they are used. All switches except air operated switches shall operate as intended when the load bank is in any position.

3.11.3.1 Toggle switches. Toggle switches shall be used to switch the identical incremental resistance loads of each resistance module, to initiate and terminate operation of the load bank and to operate the bypass curcuit of the interlock system (see 3.13.3). Toggle switch(es) for the resistance loads may be a single unit, three pole, single throw assembly or they may be separate assemblies mechanically ganged together so they operate simultaneously. Toggle switches used for the master ON-OFF control and the interlock bypass shall be of a type that locks in the "OFF" position and requires a push or pull action before the switch can be operated or it may be of a type in which the toggle lever is protected from inadvertent operation by a salient type guard.

3.11.3.2 Air operated switches. Switches that are operated by air flow may respond through a sensitive snap action mechanism or they may respond by magnetic influence. Air operated switches shall perform their intended function for any position of the load bank in which the base makes an angle of up to 10 degrees from the horizontal.

3.11.3.3 Thermostatic switches. Thermally operated switches shall be of a type that senses and responds to temperatures that exceed the maximum temperature allowable for exhaust air and the maximum operating temperature for elements and components in the resistive load modules.

3.11.3.4 Rotary switches. Rotary switches, when used, shall be of closed construction and positive indexing.

3.11.4 Circuit interrupters. Circuit interrupters shall be of the trip free circuit breaker type and mounted on the control panel. Fuses shall not be used for circuit protection.

3.12 Electrical wire and wiring.

3.12.1 Electrical wire. Electrical wire shall be in accordance with MIL-W-5086/2 except for wires interior to the resistance load assemblies. Wires used interior to the resistance load assemblies shall be solid uninsulated wire or they shall be insulated with materials that will retain their shape and insulating properties in the presence of the operating temperature of the resistance elements. Regardless of the type used, the wires shall be adequately supported to retain their original routing under all conditions of required performance.

3.12.2 Electrical wire marking. Each wire shall be marked with character groups having the following content.

x	xxx	xx	xx	x
(a)	(b)	(c)	(d)	(e)

(a) Circuit function. Alpha character. X for ac and P for dc.
(b) Wire number. Numeral characters. Consecutive numbers for each circuit between functional components.
(c) Wire segment letter. Alpha characters. Used where circuits continue through connectors, terminal strips or splices. "I" and "O" are not used. Double letter sequence "AA" used when single letters are exhausted.
(d) Wire size number. Numeral characters.
(e) Phase designator. A for L1, B for L2, C for L3, N for LO, G for ground straps or wires.

Character groups shall be located not closer than one half inch nor more than three inches from the insulation edge of the wire ends. Characters for each group shall be consecutively locked together or they may be broken into two sections of consecutively locked characters with each section located on the same line and spaced not more than one fourth inch apart. For wires less than four inches long, the wires shall be marked on opposite sides of the diameter and the character groups offset toward the terminals they are intended to identify.

3.12.3 Wire terminations. Wires that are connected to switches, terminal strips and other components where screw type electrical connections are made shall be terminated with ring tongue style electical terminals having crimp type barrels. Electrical terminals shall be correctly sized for the mating studs and wire size. The crimping operation shall result in a connection where the stripped section of the wire extends the full length of the barrel but does not extend more than 1/16th inch past either end.

3.12.4 Wires, wire groups and harnesses - forming, routing and securing. Wires that originate or terminate at a common connector, terminal strip, bus bar, multi-terminal switch, switch array, etc. shall be formed into groups. Wire groups shall be routed so they may be combined into harnesses with the entrance and exit points of each group clearly defined by means of wire ties and lacing. All wires and harnesses shall be temperature derated by consideration

of wire size and harness size. Wires, wire groups and harnesses that are routed through or around metal plates or panels shall be protected by grommets or insulation barriers. Wires and wire groups shall be supported by means of plastic straps or cushion type clamps. Wire harnesses shall be supported by cushion type clamps. Electrical hardware used for wire ties, clamping and providing insulation barriers shall be selected from the military standard line and identified by their MS number in the parts list of technical publications.

3.13 Safety. The load bank shall be designed to reduce the potential for accidental injury resulting from hookup, operation, handling and maintenance of the load bank. Positive measures shall be taken to identify and correct areas where safety is compromised.

3.13.1 Electrical safety. There shall be no exposed terminals or conductors on the face of the control panel and exterior surfaces of the load bank that is above the voltage of the enclosure. Areas that become exposed during operation shall be shielded or guarded to prevent unrestricted access to interior components. All shielding shall have sufficient clearance from exposed conductors to prevent shorting or arcing between the conductor and the shielding. The input terminal board assembly shall be enclosed and provided with a bypassable interlock. The interlock will be composed of an automatic switch to deny access to the terminals when they are hot and a manually operated electrical bypass device to allow equipment test when desired. This pypass device shall be of such design that closing the associated cover will automatically open the bypass device and leave the interlock in position to function normally. All elements of the enclosure and all electrical components that are not isolated by design shall be at the same voltage as the grounding stud. Hinges or slides are not considered adequate grounding paths, therefore doors and panels with hinges or slides shall be grounded by use of a flexible ground strap.

3.13.2 Thermal safety. The exterior temperature of all surfaces of the load bank - except the items exposed to the air exhaust of the resistance modules - shall not exceed 150° F when the load bank is operated at 44 kW in an ambient temperature environment of 125° F. The temperature of the exhaust air shall not exceed 265° F at these same conditions. Air from the resistance modules shall not be exhausted from the same surface that contains the operator control panel. Direct access to all areas that operate at temperatures above 150° F shall be prevented by the use of rigid grid style barriers. The grid size shall not exceed .500 inches. The barriers shall be removable for maintenance access.

3.13.3 Mechanical safety. The ON-OFF master control switch and the electrical bypass switch shall be located on the operator control panel and be of such design that accidental contact by personnel will not place equipment into operation. A green indicator light will be readily visible to the operator to indicate the master control switch is ON. A red indicator light will be readily visible to the operator to indicate when the interlock is bypassed. Grid type barriers shall be used to prevent direct access to the fan areas of the resistance load assemblies. Materials shall have burrs and sharp edges removed.

3.13.4 Signs. Guards, barriers, and access doors, covers or plates shall be marked to indicate the hazard which may be reached upon removal of such devices. When possible, marking shall be located such that it is not removed or hidden when the barrier or access door is removed or opened. For potentials between 70 and 500 volts, warning signs or shield labels shall read, as a minimum, "Caution - (Insert maximum voltage applicable) Volts." The letters shall be yellow gothic capitals on a black background. The voltage shall be black on a yellow background.

3.14 Lifting bars overload effects. There shall be no permanent deformation, degradation or failure of any materials that results or could result in an unsafe condition when handling the load bank or impair operation of the lifting bars between the extended and retracted position when the lifting bars are loaded with the weight of the load bank plus an additional weight equal to that of the load bank. These effects shall be determined as specified.

3.15 Insulation resistance. The insulation resistance between the power input terminals and the grounding stud shall be not less than one megohm for all materials and components that are used in circuits where the voltage at the power input terminals is applied either directly or through contactors, switches and relays. This resistance shall be determined as specified.

3.16 Dielectric withstanding voltage. All circuits of the load bank where the voltage at the power input terminals is applied either directly or through contactors, switches and relays to the materials and components in these circuits, shall withstand a voltage of 1250 volts rms or 1250 volts dc for one minute between the power input terminals and the grounding stud.

3.17 Control circuit characteristics. The total power required to operate the control circuits shall not exceed 600 watts and the output voltage shall remain within the limits of 20 to 29 volts dc for any of the required input connections at the specified voltages. There shall be no failures of any material or component in the control circuit when a short circuit is applied across the dc output terminals. These characteristics shall be determined as specified.

3.18 Functional performance. The load bank shall function as follows for each of the conditions specified.

a. Normal operation. Applied voltage - any of the voltages specifed. Reconnection system - set for the correct value of applied voltage. Switched loads - any combination of switches turned on. Voltage selector switch (when used) - set to the proper voltage. Master switch - turned on. Fan motors operate and close wind switches. Main line contactors close and selected load is applied. Load bank operates continuously. Switched loads are added or subtracted in any combination without affecting operation.
b. Overvoltage connection. Applied voltage - 240/416 or 240 volts. Reconnection system - set for 120/208 or 139/240 or 120. Switched loads - any combination of switches turned on. Voltage selector

switch (when used) - set to the high voltage range. Master switch - turned on. Load bank will not operate or performs a systematic shutdown without damage to the load bank. The voltage selector switch is changed to the low voltage range and load bank does not operate or performs a systematic shutdown without damage to the load bank.

c. Undervoltage connection. Applied voltage - 120/208 or 139/240 or 120 volts. Reconnection system - set for 240/416 or 240 volts. Switched loads - any combination of switches turned on. Voltage selector switch (when used) - set to the low voltage range. Master switch - turned on. Load bank will not operate or performs a systematic shutdown without damage to the load bank. The voltage selector switch is changed to the high voltage range and load bank does not operate or performs a systematic shutdown without damage to the load bank.

d. Fan failure shutdown. With the load bank connected for normal operation and operating, the main line contactor(s) shall disconnect the circuits of the resistance load modules from the power input terminals when the fan motor of any of the resistance modules cease to operate or operates below design speed.

e. Overheat shutdown. With the load bank connected for normal operation and operating, the main line contactor(s) shall disconnect the circuits of the resistance load modules from the power input terminals when the resistance elements operate at a temperature above their rated value or when the temperature of the exhaust air exceeds 265° F. Fans shall continue to operate and the circuits shall automatically reset when the temperature is reduced to its operating range.

The functional performance shall be determined as specified.

3.19 Warmup transient. The change in the value of each line current for each switched load not exceed ten percent of the values specified in 3.1, table II when the temperature of the resistance elements change from their non-energized forced air cooled temperature in a local ambient temperature range of 60° to 90° F to their steady state forced air cooled operating temperature when the resistance elements are energized by a 3P-4W, 120/208, 60 Hz voltage. The line currents shall reach their steady state values within 15 seconds after the switched loads are energized. These values shall be determined as specified.

3.20 Representative resistance values. The incremental line currents shall be used as representative values of the resistance load increments when the resistance elements are at their energized forced air cooled operating temperature and the local ambient air is in the temperature range of 60° to 90° F. The currents shall not exceed plus or minus three percent of the values specified in 3.1, table II. These currents shall be determined as specified.

3.21 Resistance to vibration damage. There shall be no breakage, loosening, change of fit or deformation of any part of the load bank that results in any of the following conditions when the load bank is subjected to the vibration test specified: (a) Operational failure; (b) loss of mechanical integrity of materials, fasteners and welds; (c) reduction of clearance between ungrounded

circuit elements and grounded supports that could compromise safety; (d) cracking, splitting and fatigue failure of insulating materials; (e) significant changes in the insulation resistance. This test shall be performed as specified.

3.22 Resistance to drop damage. There shall be no breakage, loosening, change of fit or deformation of any part of the load bank that results in any of the following conditions when the load bank is subjected to the half sine wave impact pulses in the directions and magnitudes specified: (a) Operational failure; (b) loss of mechanical integrity of materials, fasteners and welds; (c) reduction of clearance between ungrounded circuit elements and grounded supports that could compromise safety; (d) cracking, splitting or stress failure of insulating materials; (e) other factors that affect safety, structural soundness or operation. This test shall be performed as specified.

3.23 High power performance (60 Hz). There shall be no apparent changes in operational performance, no visible damage to material and components or failure of the load bank to operate for 72 hours at 44 kW in an environment where the ambient temperature is maintained between 120° and 130° F. This test shall be performed as specified.

3.24 Operational endurance (60 Hz). There shall be no apparent changes in operational performance, no visible damage to material and components or failure of the load bank to operate for 312 hours at 33 kW in an environment where the ambient temperature is maintained between 120° and 130° F. The operating time for each connection shall be as stated in the test procedure. All testing shall be performed as specified.

3.25 High frequency operation (400 Hz). There shall be no apparent changes in operational performance, no visible damage to material and components or failure of the load bank to operate for 72 hours at 15 kW or higher in a local ambient temperature environment. The 15 kW shall include the total load value of the variable load circuits. This test shall be performed as specified.

3.26 Rain exposure, storage condition. The load bank, with all panels and doors secured, shall exclude the entrance of rain into electrical components, onto moisture sensitive electrical circuits and moisture vulnerable mechanical devices. The rain shall have an intensity of greater than two inches per hour but less than four inches per hour and be wind driven to form an angle of not less than 15 degrees from the vertical. The load bank shall be repositioned so that each side surface is exposed for a minimum average rainfall accumulation of one inch. This feature shall be determined as specified.

3.27 Rain exposure, operating condition. The load bank, with all doors and panels secured except the air exhaust door, shall shield all interior electrical components, connections and material from the direct or indirect entrance of rain that could cause unsafe operating conditions or failure of the load bank. The intensity of the rain shall exceed two inches per hour but be less than four inches per hour and be wind driven to form an angle not less than 15 degrees from the vertical. Each surface of the load bank, except the air exhaust surface, shall be exposed for an average accumulation of one inch total rainfall. This feature shall be determined as specified.

3.28 Low temperature storage. There shall be no evidence of breakage, deformation, permanent change of fit and deterioration of parts, components, assemblies, insulation or framing resulting from storage of the load bank in a temperature environment of minus 65° F for 24 hours. The effects of low temperature storage shall be determined as specified.

3.29 Low temperature operation. The load bank shall start and operate without malfunction or failure after it has been temperature stabilized in a minus 25° F environment. This test shall be performed as specified.

3.30 Humidity - high temperature exposure. There shall be no significant deteriorating influences on materials, material finishes, safety and operational performance that results in the following conditions when the load bank is subjected to method 507.2 of MIL-STD-810, procedure I, cycle 4, for twelve repetitions of the exposure cycle: (a) insulation resistance below one hundred kilohms at the completion of every third exposure cycle; (b) destructive moisture penetration of plated, treated and painted surfaces; (c) split, cracked and peeled electrical insulation; (d) insulation resistance below one megohm and failure to sustain the dielectric withstanding voltage following an eight hour conditioning period at local ambient conditions; (e) failure to start and operate. Resistance to humidity damage shall be determined as specified.

3.31 Electromagnetic interference. The electromagnetic interference characteristics of the load bank shall not exceed the requirements specified in MIL-STD-461 for equipment class C2 (engine generator sets). Electrolytic capacitors shall not be used for interference reduction. This test shall be performed as specified.

3.32 Identification marking. The load bank shall be identified in accordance with MIL-STD-130. The marking shall be applied to the load bank on plates conforming to MIL-P-15024, type C, material optional.

3.33 Information and instruction plates. Information and instruction plates shall be in accordance with MIL-P-15024, type A or type H, style II or style III except for the grounding stud plate (see 3.33.6).

3.33.1 Schematic and wiring diagram. The schematic diagram shall be contained on a different plate than the wiring diagram. Electrical symbols shall be in accordance with ANS/IEEE 315. Component designations shall be the same for both diagrams. The plates shall be mounted on the interior surface of an access panel or door.

3.33.1.1 Schematic diagram. The schematic diagram shall show all electrical circuit elements in their functional sequence. All wires shall be marked with an abbreviated reference to the markings contained on the wiring diagram and the characters shall be not less than .09 inch high. Characters for components, terminal boards and assemblies shall be not less than .18 inch high.

3.33.1.2 Wiring diagram. The wiring diagram shall show the interconnection of all components in approximate correlation to their physical location. Terminal boards and connectors shall be identified. All wires and wire segments

shall be marked as specified. Characters for wire marking shall be not less than .09 inch high. Characters for components, terminal boards and assemblies shall be not less than .18 inch high.

3.33.1.3 Wire running list. A wire running list shall be tabulated for each wire and wire segment of the wiring diagram. The wire running list shall be a sequential list of the wire markings required by 3.12.2. Wire segments shall be numerically sequenced and associated with their primary wire number. The origin of each wire and wire segment in the direction from the input terminals to the destination shall be tabulated with "FROM" - TO" designations. The plate containing the wire running list shall be mounted adjacent to the wiring diagram.

3.33.2 Operating instructions. The instruction plate shall be mounted on the inside of the door to the control panel. The introduction shall highlight cautions and warnings for procedures that could result in unsafe conditions. The instructions shall describe the correct grounding, hookup and reconnection procedures and checks for the various voltage-load relationships and the sequence of functions required to initiate operation.

3.33.3 Voltage-load relationships. Plate(s) shall be used to identify the voltage connection and kW rating of each load selection switch and the variable load control. Information on plates shall be .38 inch high gothic characters.

3.33.4 Reconnection plates. Components that require reconnection to establish the voltage-load relationships shall be identified by plates that specify function, range and position in a clear and nonambiguous manner. Information on plates shall be in .38 inch high gothic characters.

3.33.5 Operational information. Switches, controls and signal type lamps for which a plate has not been previously specified shall have their functions, range and position identified. Information on plates shall be in .38 inch high Gothic characters.

3.33.6 Grounding stud plate. A plate having a green background shall be mounted at the ground terminal stud and marked "GROUND". It shall conform to MIL-P-15024, type A or type H.

3.34 Other information. Other information shall be marked as specified.

3.34.1 Terminal strips and boards. All terminal strips shall be labeled TB and each terminal strip lug shall be numbered.

3.34.2 Handling information. The following information shall be stenciled on the top surface of the load bank in a rectangular blocked arrangement and characters .50 inch high. The color of characters shall be white or yellow. The actual weight of the load bank shall be used. CAUTION - XXX POUNDS-MALE 4 - FEMALE 8.

3.35 Workmanship. The load bank shall be examined for improperly crimped terminals, frayed electrical wire strands, incomplete or defective welds, cross

threaded fasteners, improperly set rivets, legibility of instruction plates, sprung or improper fitting doors, breakdown of corrosion treatments or other defects that would affect operation, service or storage life. Standards for workmanship should be established for the first article model and used as the comparison for all production models.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsiblity for inspections. Unless otherwise specifed in the contract, the contractor is responsible for the performance of all inspection requirements as specifed herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for 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 Material, components and processes. The contractor is responsible for assuring that the specified materials, components and processes are examined and tested in accordance with referenced specifications and standards.

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

a. First article inspection (see 4.3).
b. Quality conformance inspection (see 4.4).
c. Comparison inspection (see 4.6).
d. Packaging inspection (see 4.7).

4.3 First article inspection.

4.3.1 Examination. The first article load bank shall be examined as specified in 4.5.1. The presence of one or more defects shall be cause for rejection.

4.3.2 Tests. When specifed (see 6.2), two load banks shall be furnished for first article testing. One load bank shall be subjected to the tests marked "X" in column 1 of table IV and the other to the tests marked "X" in column 2 of table IV. Testing of both units shall be performed concurrently. If failure of either load bank occurs, all testing shall be discontinued until the cause of failure has been determined. Corrective action taken by the contractor shall be approved by the Government. If only one first article model is required it shall be subjected to each test of the test schedule. Failure of any test shall be cause for rejection.

4.4 Quality conformance inspection.

4.4.1 Examination. Each load bank shall be examined for the defects specified in 4.5.1. The presence of one or more defects shall be cause for rejection.

4.4.2 Tests.

4.4.2.1 Individual. Each load bank shall be subject to the tests marked "X" in column 3 of table IV. Failure of any test shall be cause for rejection.

4.4.2.2 Samples. Sampling for tests shall be in accordance with MIL-STD-105, inspection level II and AQL of 6.5 percent defective. Samples shall be selected from lots that have passed individual tests and be subjected to the tests marked "X" in column 4 of table IV. Failure of any test shall be cause for rejection.

4.5 Inspection procedure.

4.5.1 Examination. Each load bank shall be examined for the defects listed in table III. The examination shall include all requirements listed under the main paragraph.

TABLE III. Examination.

Defect	Type	Paragraph
101.	Materials and material treatments not as specified.	3.3
102.	Weight and dimensions not as specified.	3.4
103.	Enclosure not as specified.	3.5
104.	Standard hardware not as specified.	3.6
105.	Operator control panel not as specified.	3.7
106.	Resistance load circuit not as specified.	3.8
107.	Reconnection system not as specified.	3.9
108.	Control and protective circuits not as specified.	3.10
109.	Main line contactor(s), control relays, switches and interrupters not as specified.	3.11
110.	Electrical wire and wiring not as specified.	3.12
111.	Safety not as specified.	3.13
112.	Identification marking not as specified.	3.32
113.	Information and instruction plates not as specified.	3.33
114.	Other information not as specified.	3.34
115.	Workmanship not as specified.	3.35

4.5.2 Tests. Tests shall be performed as specified and in the sequence listed in table IV.

TABLE IV. Test schedule.

First Article		Quality Conformance			Test	References	
#1	#2	Ind	Sample	Compar Insp		Reg	Test
1	2	3	4	5	6	7	8
X			X	X	Lifting bars overload effects.	3.14	4.5.3.1
X	X		X	X	Insulation resistance.	3.15	4.5.3.2
X	X	X		X	Dielectric withstanding voltage.	3.16	4.5.3.3
X				X	Control circuit characteristics.	3.17	4.5.3.4
X	X		X	X	Functional performance.	3.18	4.5.3.5
X	X			X	Warmup transient	3.19	4.5.3.6
X	X	X		X	Representative resistance values.	3.20	4.5.3.7
X				X	Resistance to vibration damage.	3.21	4.5.3.8
X				X	Resistance to drop damage.	3.22	4.5.3.9
X	X		X[1/]	X	High power performance.	3.23	4.5.3.10
	X			X	Operational endurance.	3.24	4.5.3.11
	X			X	High frequency operation.	3.25	4.5.3.12
	X			X	Rain test, storage condition.	3.26	4.5.3.13
	X			X	Rain test, operating condition.	3.27	4.5.3.14
X				X	Low temperature storage.	3.28	4.5.3.15
X				X	Low temperature operation.	3.29	4.5.3.16
X				X	Humidity - high temperature exposure.	3.30	4.5.3.17
X				X	Electromagnetic interference	3.31	4.5.3.18

1/ Sample test. Operate for 24 hours.

4.5.3 Test procedures. Pretest preparations shall include installation of the circuits required for performance of the insulation resistance test (see 4.5.3.2) with provisions for isolating these circuits to obtain normal operations. Tests shall be conducted as specified herein. Instruments used for tests shall be suitable for the quantity and units measured and the accuracy of the measurements shall not exceed one percent. Instruments shall be calibrated at intervals recommended by the instrument manufacturer or at six month intervals, whichever is less. Reference standards shall have an accuracy at least four times better than the instruments to be calibrated.

4.5.3.1 Lifting bars overload effects. Set the lifting bars to the carrying position. Stack spacers (wooden or other material) at four positions under the lifting bars and of sufficient height to provide a minimum of one inch floor clearance of the runners or pedestals. The contact line between each spacer stack and the lifting bar shall not exceed four inches and the stack locations shall be approximately one fourth of the distance from the ends of each lifting bar. Uniformly distribute weight equal to that of the load bank on top and retain the loaded condition for a minimum of one hour. Inspect the bars for excessive deflection. Inspect the supporting framework for cracked material,

welds and distortion. Remove the test load and supporting blocks. Inspect for free movement, permanent deformation and other factors that affect operation and safety of the lifting bars and the structural attachments. Failure to meet the specified requirements shall be cause for rejection.

4.5.3.2 Insulation resistance. Connect the single phase shorting link to power input terminals L1, L2 and L3. Close the main line contactor(s) by operating the coil(s) from an external electrical input. Close all load selection switches and set the variable load to full on. For each transformer that normally operates from line input voltage, connect one side of the secondary to the enclosure ground. Close all circuits to the transformer primaries. Measure the insulation resistance between the power input terminals and the ground stud at a minimum voltage of 500 volts rms ac or 500 volts dc. Record the insulation resistance measured. Measured values below those specified for initial performance or functional checkout shall constitute failure of this test.

4.5.3.3 Dielectric withstanding voltage. Maintain the load bank in the same circuit connection as used for insulation resistance. Apply a voltage of 1250 volts rms at 60 Hz or 1250 volts dc between the power input terminals and the ground stud for one minute. Any evidence of insulation breakdown occurring during the initial performance or functional checkout shall constitute failure of this test.

4.5.3.4 Control circuit characteristics. Open all selector switches. Connect wattmeter(s) to the power input terminals and a dc voltmeter across the rectifier output terminals. Measure the power required by the control circuit and the dc voltage for the following connections: 3P-4W at 120/208 volts; 3P-3W at 139/240 volts; 1P-2W at 120 volts. For each connection, the control circuit shall operate all fans and close the main line contactor(s). Following the determination at each connection, place a short circuit across the rectifier output terminals. The protective circuit or circuit breakers shall prevent any damage to the control circuits. Failure to meet the specified requirements shall be cause for rejection.

4.5.3.5 Functional performance.

a. Normal operation. For each of the specified connections and voltage ranges, verify that the load bank operates when the reconnection system is in the required state and the proper switches are set to initiate operation.
b. Overvoltage connection. With the reconnection system set for 3P-4W and 120/208 volts, apply 240/416 volts to the power input terminals and verify that the load bank does not operate or performs a systematic shutdown. When more than one operation is required to reconnect the system each operation must be performed independently until all combinations have been checked. For example, if two connectors are used, each must be repositioned independently from 120/208 volts to 240/416 volts and the startup switches operated for each connector position. The load bank shall not sustain operation

under any condition in which all reconnection circuits and switches are not in the proper position. Verify that the load bank will not sustain operation when 240 volts single phase is applied to the load bank when it is connected for 120 volt single phase operation. Failure of the load bank to respond correctly and any damage resulting from performance of this test shall be cause for rejection.

c. Undervoltage connection. With the reconnection system set for 3P-4W and 240/416 volts, apply 120/208 volts to the power input terminals and verify that the load bank does not operate or performs a systematic shutdown. Reposition all connectors and switches for the reconnection circuits in independent combinations until all combinations have been checked. The load bank shall not sustain operation under any conditions in which all reconnection circuits and switches are not in the proper position. Failure of the load bank to respond correctly and any damage resulting from performance of this test shall be cause for rejection.

d. Fan failure shutdown. Insert a set of switches in series with the input of each line that provides power for the fan motors. Apply any convenient voltage to the power input terminals and switch on a minimum of 3 kW load. Open one fan motor switch and observe that the wind switch operates unaided to open the main line contactor(s). Repeat for the other two fan motors. Rotate the load bank about an axis parallel to the axis on which the wind switch swings and at an angle of not less than 10 degrees between the load bank base and the horizontal. Repeat the test for both clockwise and counterclockwise rotations. Failure of the wind switches to open the main line contactors shall be cause for rejection.

e. Overheat shutdown. Insert a set of switches in series with the input of each line that provides power for the fan motors. Operate the load bank at 44 kW in a temperature environment of 120 to 130° F. Open one fan motor switch and allow the temperature of the resistance elements to rise until the thermal switch(es) open the main line contactor. Close the switch and allow the resistance elements and thermal switch(es) to cool until they automatically reset and normal operation is resumed. Repeat for the other two fan motors. At the completion of testing, inspect the resistance modules for sagging and burnt resistance elements, burnt insulation and other defects. Failure of the thermal switches to open the main line contactors before damage occurs or failure to obtain automatic reset of the thermal switches shall be cause for rejection.

4.5.3.6 Warmup transient. Instrument the power input terminals to measure the line to neutral voltages for each terminal, the line currents in two lines and to prepare an oscillograph or strip chart recorder record of the line current in the remaining line. If an oscillograph is used, it shall have a flat response from constant dc to 60 Hz ac minimum. If a strip chart recorder is used, it shall respond from zero to full value in less than 100 milliseconds. Set the variable load control to its full value. Connect a 3P-4W, 120/208 volt, 60 Hz power source to the instrumented power input terminals and maintain a voltage of 120 volts plus or minus one volt. Record the line to neutral

voltages. Turn on the main power switch and record the currents required by the control circuits. If an oscillograph is used, set the chart speed to a minimum of 20 Hz per inch at 60 Hz. If a strip chart recorder is used, set the chart speed to a minimum of two inches per second. Turn on the selector switch for the variable load. Mark the chart for the beginning and end of the time interval and the point at which steady state values are reached. Record the ammeter readings. Turn off the selector switch for the variable load and repeat the measurements for one 3 kW fixed load and one 6 kW fixed load. Any results where the transient condition exceeds the required value and the steady state condition is not achieved in less than 15 seconds, shall constitute failure of this test.

4.5.3.7 Representative resistance values. Instrument the power input terminals to measure the line to neutral voltages and the line currents in each line. Set the main power switch and all load selector switches to off. Set the variable load to its minimum value. Connect a 3P-4W, 120/208 volt power source of the required frequency to the power input terminals. Maintain a voltage of 120 volts plus or minus one volt for each line to neutral voltage and record these voltages. Determine the representative values in accordance with the following schedule:

Part (a) - 60 Hz. Applicable to first article models, all quality conformance models, comparison inspection models and functional checks incorporated into designated test procedures of the test schedule. Turn on the main power switch and record the current required by the control circuits. Turn on the load selector switch for the variable load and operate the variable load control from its minimum to its maximum value. Observe that the line currents increase smoothly with the positioning of the control knob. Record the composite line currents for the control circuits and the load increments of the variable load. Operate the variable load control and its selector switch to off. Turn on the selector switch for a fixed 3 kW load and record the composite line currents. Measure and record the composite line currents for each switched load at 60 Hz.

Part (b) - 400 Hz. Applicable to first article models and comparison inspection models. Not applicable to functional checks in the test procedures. Repeat part (a) except at 400 Hz.

Part (c) - Evaluation of results. Applicable to the first article models (including measurement made during functional checks), samples of quality conformance inspection and comparison inspection models. Subtract the currents required by the control circuits from the measured composite line currents and record the difference of each reading obtained in part (a) and part (b). These values shall be within plus or minus three percent of the values specified in 3.1, table II.

Any results that exceed the tolerances specified shall constitute failure of this test.

4.5.3.8 Resistance to vibration damage. The load bank shall be secured directly to a vibration table and subjected to seven sweeps (5.5-200-5.5 Hz) of

sinusoidal vibration in each of three mutually perpendicular axes. Each sweep shall be traversed at a logarithmic rate in 12 minutes for a total time of 84 minutes per axis. The amplitude of vibration shall be varied to maintain a 1.5g input over the complete frequency range. At the completion of vibration along each axis, make a damage assessment. The damage assessment shall consist of inspecting for mechanical damage and performing the insulation resistance and representative resistance value test. Any defects that affect safety, mechanical soundness or electrical performance shall constitute failure of this test.

4.5.3.9 Resistance to drop damage. The load bank shall be subjected to a series of half sine wave shock impulses along the specified axes. The half sine wave impulse shall be of 30g amplitude, 11 milliseconds duration and be in conformance with the requirements of figure 1. The specified axes for this test are as follows:

a. STEP 1. The first set shall consist of three impulses directed along the vertical axis with the base supports of the load bank in contact with the test table. Following this set, make an assessment of mechanical damage. Perform the insulation resistance test and the representative resistance values test.
b. STEP 2. The second set shall consist of one impulse each in each direction of the transverse axis, one impulse each in each direction of the longitudinal axis and one impulse in the direction of the vertical axis toward the top for a total of five additional impulses. Following each impulse, make an assessment of mechanical damages, perform the insulation resistance test and the representative resistance values test.
c. STEP 3. If there are no defects, operate the load bank at full load at any convenient voltage and frequency.

Any defects that affect mechanical soundness, safety or operational performance shall constitute failure of this test.

4.5.3.10 High power performance (60 Hz). Operate the load bank for 72 hours on the 3P-3W, 139/240 V, 44 kW configuration with full load switched on, in an area where the ambient temperature is maintained between 120° and 130° F. During the first hour of each 24 hour period, operate each load selector switch and the main power switch a total of 20 times. The off period between operations of the main power switch shall last until all fans stop spinning. Failure to meet the specified requirments shall be cause for rejection.

4.5.3.11 Operational endurance (60 Hz). Operate the load bank in an area where the ambient temperature is maintained between 120° and 130° F during each of the following tests. During the first hour of each 24 hour period operate each load selector switch and the main power switch a total of 20 times. The shutdown period between operation of the main power switch shall last until all fans stop spinning.

a. Three phase-four wire (60 Hz). Operate for 240 hours from a 120/208V or a 240/416V power source with full load switched on.
b. Three phase-four wire (50 Hz). Operate for 24 hours from a 240/416V, 50 Hz power source with full load switched on.
c. Singlephase-two wire (60 Hz). Operate for 48 hours at either 120V or 240V with full load switched on.

Failure to meet the specified requirements shall be cause for rejection.

4.5.3.12 High frequency operation (400 Hz). Operate the load bank at any frequency in the range of 388 to 412 Hz and at any convenient voltage in a local ambient environment for 72 hours. The applied load shall be not less than 15 kW but shall include the full range of the variable load. Failure to meet the specified requirements shall be cause for rejection.

4.5.3.13 Rain exposure, storage conditions. Expose the top and each vertical surface of the load bank, when configured in its normal storage condition, to a simulated wind-driven rain that has an average rate of two inches per hour but less than four inches per hour. The top shall be exposed with each vertical surface and each vertical surface shall be exposed until the average rainfall accumulation measures one inch minimum. Set up a test facility with a sprinkler or spray arrangement suitable for varying the size and rate of water drops and a fan or propeller arrangement for producing the wind-driven conditions. Select a location within the test site and set up the initial conditions relative to the longitudinal dimensions of the load bank. Establish a theoretical vertical plane, where the load bank impact surface will be positioned, and that extends from ground level to a minimum of three feet beyond the top and side framing edges of the load bank perimeter. Generate a horizontal windstream transverse to the vertical plane and having a minimum velocity of 25 miles per hour at any location within the plane. Locate the spray/sprinkler system so the simulated rain is in the air stream. Adjust the size of the water drops so the accumulation is reasonably consistent with the rate and the drops are blown through the vertical plane at an angle of not less than 15 degrees from the vertical, and impact the surface where the load bank will be positioned. Place the load bank in the rain impact area so its longitudinal axis is transverse to the direction of the approaching rain. Position a set of six rain gauges to measure the rainfall as follows: two on the top surface of the load bank (one at each corner on the side opposite to the approaching rain); two on the test area surface adjacent to the vertical surface of the load bank that is exposed to the windstream (one each located at the one third and two third points of the distance between the vertical edges); one at each side (located in a bisecting vertical plane and six inches distant from the sides). Operate the system so the approaching rain uniformly impacts the exposed vertical surface and the top. Maintain these conditions until the average value measured by the six rain gauges is one inch and the minimum value of any gauge is one half inch. After the requirements have been met for the first surface, examine the interior for the presence of water on electrical circuits, areas of inadequate drainage and the condition of technical publications. Record the results. Reposition the load bank so each vertical surface is exposed in turn, set the rain gauges at locations that retain the same general relationship to those established for the

first exposure and repeat the initial procedures. Expose each vertical surface until the rain gauge conditions are satisfied at each surface and perform an examination at the completion of each exposure. At the completion of the last exposure, make a routine examination and perform the insulation resistance test. If the insulation resistance is not below one megohm, energize the load bank at any convenient voltage and frequency and systematically check the performance of all switches and controls. The accumulation of water where damage could result from freezing temperatures, damage to technical publications, insulation resistance below one megohm or any deficiency revealed that affects safety shall constitute failure of this test.

4.5.3.14 Rain test, operating condition. Operate the load bank at 15 kW under the same simulated rainfall conditions specified in 4.5.3.13. Test each vertical surface except the air exhaust surface for a minimum of fifteen minutes. Any failures occurring during test, the formation of excessive steam or water vapor, conditions that result in unsafe operation or damage to technical publications shall be cause for rejection.

4.5.3.15 Low temperature storage (minus 65° F). Move the load bank from the local ambient environment into a temperature controlled environment where the temperature can be reduced to minus 65° F in a period not exceeding 8 hours. Expose the load bank to minus 65° F for a minimum time of 24 hours. After completion of the exposure period, perform a visual inspection to determine that no mechanical defects resulting from temperature induced stresses are apparent. Failure to meet the specified requirements shall be cause for rejection.

4.5.3.16 Low temperature operation (minus 25° F). If no defects are apparent at the completion of the low temperature storage test, raise the temperature of the environment to minus 25° F and retain the load bank in this temperature environment for a minimum of 8 hours. Place all load selector switches and the master control switch to the off positions and connect a 120/208V power source to the power input terminals. Position the master control switch to the on position and verify that fan motors start and run at approximately normal speed. Position the master control switch to off. After fans have stopped spinning, repeat the fan motor start and stop procedure an additional 4 times and then position the master control switch to on. Operate each load selector switch between the on and off positions and the variable load knob over its total range a minimum of 5 times. At the completion of test, place the load bank in a local ambient temperature environment. After a minimum of two hours, examine for evidence of damage. Failure of the load bank to respond normally to the test conditions or visual evidence of material damage shall be cause for rejection.

4.5.3.17 Humidity - high temperature exposure. Subject the load bank to twelve repetitions of procedure II, cycle 4, method 507.2 of MIL-STD-810. The load bank shall be exposed to the humidity-high temperature environment while in its storage configuration. At the completion of every third repetition of the test cycle (including the last cycle) perform the insulation resistance test. At the completion of the last cycle, remove the load bank from the humidity chamber, open the access doors and panels, and allow the load bank to dry at

local ambient conditions for a period of eight hours plus or minus one. Examine for significant damage to electrical insulation, corrosion of electrical connections and corrosion of surface finishes. Perform the insulation resistance test and the dielectric withstanding voltage test. If there are no defects or if any defects disclosed as a result of test have been determined by the Government not to be significant, energize the load bank at any convenient voltage and frequency and systematically check the performance of all switches and controls. Operate the load bank for 30 minutes. Damage that would affect safety, excessive corrosion, damage to technical publications or unsatisfactory performance shall consititue failure of this test.

4.5.3.18 Electromagnetic interference. The load bank shall be tested for electromagnetic interference as required by MIL-STD-461. A complete report shall be furnished as required by the reference documents and be included in the first article test report. Following successful completion of testing and approval by the procuring activity, the tested and approved load bank shall be used as the configuration model for all production units. Failure to meet the specified requirements shall be cause for rejection.

4.6 Comparison inspection. The government may select load banks at any time during the contract period and subject the load banks to the examination specified in 4.5.1, and to the tests specified in column 5 of table IV to determine conformance to the requirments of this specification. The inspection will be performed by the Government, at a site selected by the Government, on units selected at random from those which have been accepted by the Government, and will not include previously inspected first article load banks. In addition to any test specified as part of the comparison inspection, the Government reserves the right to conduct any and all other tests contained in this specification as part of the comparison inspection and failure of such additional tests shall have the same effect as failure of those tests specified as comparison inspection.

4.6.1 Inspection failure. Failure of an inspection comparison load bank to meet any requirement specified herein during and as a result of the examination and tests specified in 4.5.1 and 4.5.2 shall be cause for rejection of the inspection comparision load bank(s) and shall be cause for refusal by the Government to continue acceptance of production load banks until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies. Correction of such deficiencies shall be accomplished by the contractor at no cost to the Government on load banks previously accepted and produced under the contract. Any deficiencies found as a result of the inspection comparison will be considered prima facie evidence that all load banks accepted prior to the completion of the inspection comparison are similarly deficient unless evidence to the contrary is furnished by the contractor and such evidence is acceptable to the contracting officer.

4.7 Packaging inspection.

4.7.1 Quality conformance inspection of pack.

4.7.1.1 Unit of product. For the purpose of inspection, a complete pack prepared for shipment shall be considered a unit of product.

4.7.1.2 Sampling. Sampling for examination shall be in accordance with MIL-STD-105.

4.7.1.3 Examination. Samples selected in accordance with 4.7.1.2 shall be examined for the following defects. The AQL shall be 2.5 percent defective.

115.	Materials, methods or containers not as specified.	Each incorrect material, method or container shall be considered one defect.
116.	Load bank not securely blocked, braced or anchored within the box.	
117.	Strapping not as specified.	
118.	Marking not legible, incorrect, incomplete or missing.	

5. PACKAGING

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

5.1.1 Level A. Preservation of the load bank is not required. Technical publications shall be placed in a sealed waterproof envelope and placed in the manual storage compartment.

5.1.2 Commercial. Preservation of each load bank shall be in accordance with ASTM D3951.

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

5.2.1 Level A. Each load bank shall be packed in a close fitting box conforming to PPP-B-601, overseas type, style optional; and secured within the box to prevent movement or damage. Blocking or bracing as required to provide securement shall be applied to the skid base and not to the housing. Box closure shall be in accordance with the appendix to the box specification. Strapping shall conform to QQ-S-781, class 1, type I or IV, size as applicable. Unless otherwise specified (see 6.2), strapping shall be finish B. When specified (see 6.2) strapping shall be finish A.

5.2.2 Commercial. Each load bank shall be packed in accordance with ASTM D3951.

5.3 Marking.

5.3.1 Military. Marking for level A shall be in accordance with MIL-STD-129.

5.3.2 Commercial. Marking for commercial shall be in accordance with ASTM D3951 with the additional requirement that the weight and cube data shall be marked on the container.

6. NOTES

6.1 Intended use. The load bank is an item of support equipment primarily used with TMDE during development, production and maintenance evaluation of engine driven generator sets. A required feature is the 23 x 36 plan view dimensions for locating this item within an assigned mounting frame on the M447 semitrailer mobile electrical repair shop. Occasional applications include use as a parasitic load for lightly loaded diesel engine driven generator sets.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition requirements should specify the following:

a. Title, number and date of this specification.
b. When first article models are specified, the number required and the date on which they are required for first article inspection should be specified. Two items are recommended, one for the tests in column 1 of table IV and the other for the tests in column 2 of table IV (see 3.2, 4.3.2 and 6.3).
c. Date for submission of DI-M-6153 (Technical Manuals/Commercial Literature) (see 6.2.2). Recommend that draft TM be required with submission of first article models.
d. Disposition of first article models. Recommend one unit be retained at contractor facility for comparison of quality conformance models.
e. Date for submission of DI-T-1906 (Test and Demonstration Report) (see 6.2.2).
f. Date for submission of DI-R-7062 (Electromagnetic Interference Test Report) (see 6.2.2). Recommended this be included as an annex to DI-T-1906.
g. Degree of preservation (see 5.1) and degree of packing (see 5.2) required.
h. Type of strapping required for level A packing. Specify finish A (organic coating) for sheltered storage and temporary weather exposure during shipment. Specify finish B (zinc plated) for weather exposure during shipment and storage (see 5.2.1).

6.2.2 Data requirements. When this specification is used in an acquisition which incorporates 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 (DID) (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9 (n) (2) are invoked and 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 list.

DID No.	Description	Notes
DI-V-7000	Supplementary Provisioning Technical Documentation (SPTD)	W/Add
DI-V-7002	Provisioning Parts List (PPL)	
DI-V-7009	Design Change Notices (DCN)	
DI-V-7016B	Provisioning and Other Procurement Screening Data	
DI-E-7031	Drawings, Engineering and Associated Lists	
DI-M-6155	Technical Manual Status and Schedule	
DI-M-6153	Technical Manuals/Commercial Literature	W/Add
DI-M-6159	Validation Record (TMs).	W/Add
DI-R-7062	Electromagnetic Interference Test Report	
DI-T-1906	Test and Demonstration Report	

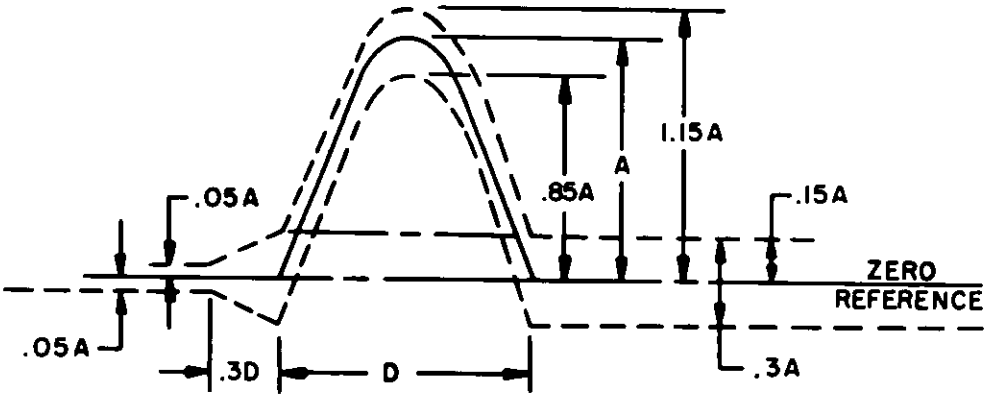
6.3 First article. When a first article inspection is required, the load banks will be examined and tested in accordance with this specification. The first article should consist of either one or two units (see 4.3.2). The contracting officer should include specific instructions in acquisition documents regarding inspection and approval of the first article models and the test and demonstration report.

6.4 Changes from previous issue. There has been numerous changes in the content and structure of this revision and no attempt has been made to identify these changes with respect to the previous issue.

Custodian:
Army - ME

Preparing Activity:
Army - ME

Project 6115-A486



PEAK AMPLITUDE = "A" = 30 g

PULSE DURATION = "D" = 11 milliseconds

THE OSCILLOSCOPE TRACE SHALL INCLUDE A TIME ABOUT 3D LONG WITH A PULSE LOCATED APPROXIMATELY IN THE CENTER. A PHOTOGRAPH OF EACH TRACE SHALL BE PREPARED. THE ACCELERATION AMPLITUDE OF THE IDEAL HALF SINE PULSE IS "A" AND ITS DURATION IS "D". THE MEASURED ACCELERATION PULSE SHALL BE CONTAINED BETWEEN THE BROKEN LINE BOUNDARIES AND THE MEASURED VELOCITY CHANGE (WHICH MAY BE OBTAINED BY INTEGRATION OF THE ACCELERATION PULSE) SHALL BE WITHIN THE LIMITS $V_i \pm 0.1\ V_i$ WHERE V_i IS THE VELOCITY-CHANGE ASSOCIATED WITH THE IDEAL PULSE WHICH EQUALS 2 AD ~~/T~~. THE INTEGRATION TO DETERMINE VELOCITY CHANGE SHALL EXTEND FROM 0.4D BEFORE THE PULSE TO 0.1D AFTER THE PULSE.

FIGURE 1. Half sine shock pulse configuration.

X-4262

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-L-52366C(ME)	Load Bank, AC, 0-33 KW/0-44 KW, Resistive

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.