

PORTABLE SWITCHBOARD

1. **SCOPE.** This specification covers the requirements for a portable switchboard with Square D I-Line interior(s), Square D I-Line circuit breakers and integral bus bars for use with lugged 800 kcmil cables. Switchboard is for use in the industrial and maritime environment of a Naval shipyard. Unit shall be rated 480 volt, 3 phase, 3 wire, 2000 amps and be listed and labeled by an Accredited Electrical Testing Laboratory. Unit must be constructed to withstand 65,000 amps short circuit current.

2. **APPLICABLE REFERENCES.** The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids shall apply.

ASTM B 187-B 187M-03 - Standard Specification for Copper Bar, Bus Bar, Rod and Shapes

UL 50 - Enclosures for Electrical Equipment

UL 746B - Polymeric Materials - Long Term Property Evaluations

UL 746C - Polymeric Materials - Use in Electrical Equipment Evaluations

UL 891 - Dead Front Switchboards

MIL-C-5541 - Chemical Conversion Coatings on Aluminum and Aluminum Alloys

MIL-A-8625 - Anodic Coatings for Aluminum and Aluminum Alloys

MIL-STD-129 - Marking for Shipment and Storage

3. **REQUIREMENTS.** Requirements in this specification are designed to assure procurement of equipment that (1) provides a means to provide adequate temporary power distribution; (2) has bus, bus supports, and bus bracing of specified ampacity and short circuit current rating; (3) is portable and ruggedly built and weatherproof; and (4) has dimensions not exceeding space available at user's site.

3.1 **DESCRIPTION.** See Figures 1, 2 & 3 for views showing enclosure dimensions, circuit breaker layout and bus drilling. The switchboard shall be rated 480 volt, 3 phase, 3 wire, 2000 amps and be listed and labeled by an accredited electrical testing laboratory of Paragraph 4.2 (a) below. Unit must be constructed to withstand 65,000 amps short circuit current. Unit shall have full height front and rear door for access of circuit breakers and input bussing. Unit bussing shall be designed to connect three (3) each 900 kcmil (Thomas & Betts p/n 54226) two-hole lugged single-conductor 800 kcmil portable power cables per phase. Unit shall be freestanding and shall have a rugged base and shall be designed to allow handling by forklift and crane. Design and construction shall provide the strength and rigidity needed for the unit to keep its shape and for hinged covers to close tightly.

Unit is intended for use outdoors in a salt-laden marine atmosphere and under conditions of varying temperature and heavy vibration during movement. Operating temperature of the

bussing shall not exceed 90 deg C in a 40 deg C ambient. Space availability at the shipyard is limited and overall dimensions must therefore be minimized.

3.2 MATERIALS

3.2.1 FERROUS PARTS. All exposed ferrous parts such as screws, bolts, nuts, washers, etc., shall be chrome plated, galvanized or otherwise surface protected by an electrical/chemical process or of stainless steel to resist corrosion in a salt-laden moist, variable temperature environment.

3.2.2 ALUMINUM PARTS. All aluminum parts for use outdoors shall be anodized in accordance with MIL-I-8625 or chemically treated in accordance with MIL-C-5541, followed by two coats of weather-resistant exterior paint.

3.2.3 DISSIMILAR METALS. Intimate contact between dissimilar metals which can be expected to cause galvanic corrosion shall be avoided as much as practicable. When such contact cannot be avoided, an interposing insulating material shall be provided to minimize the corrosion effect.

3.2.4 USE OF MERCURY. The equipment shall neither contain mercury or mercury compounds nor be exposed to free mercury during manufacture.

3.2.5 USE OF ASBESTOS. The use of asbestos and materials containing asbestos on or in the furnished equipment is prohibited.

3.2.6 CLEANING, TREATMENT AND PAINTING. Surfaces to be painted shall be cleaned and dried to insure that they are free from scale, water, dirt, corrosion product, or any other contaminating substances. As soon as practicable after cleaning, and before any corrosion product or other contamination can result, the surfaces shall be prepared or treated to insure the adhesion of the coating system. The painting shall consist of at least one coat of primer and one finish coat. The primer shall be applied to a clean, dry surface as soon as practicable after cleaning and treating. Painting shall be with manufacturer's current materials according to manufacturer's current processes and the total dry film thickness shall be not less than 2.5 mils over the entire surface. The paint shall be free from runs, sags, orange peel, or other defects. Only lead-free and chromate-free materials shall be used.

3.3 WORKMANSHIP

3.3.1 STEEL FABRICATION. The steel used in fabrication shall be free from kinks, sharp bends, and other conditions that would be deleterious to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. All bends shall be made by controlled means to ensure uniformity of size and shape.

3.3.2 BOLTED CONNECTIONS. Boltholes shall be accurately punched or drilled and shall have the burrs removed. Washers or lock washers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.3.3 RIVETED CONNECTIONS. Rivets may be used for minor attachments (e.g., label plates). Rivets shall not be used for main structural support. Rivet holes shall be accurately punched or drilled and shall have the burrs removed. Rivets shall be driven with pressure tools and shall completely fill the holes. Rivet heads, when not countersunk or flattened, shall be of

an approved shape and of uniform size for the same diameter of rivet. Rivet heads shall be full, neatly made, concentric with the rivet holes, and in full contact with the surface of the member.

3.3.4 WELDING. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.4 ELECTRICAL DESIGN

3.4.1 GENERAL. Construction shall be per Table 24.1 and Supplement "B" to UL 891 except as otherwise shown for the configuration in Figure 1 and except as otherwise specified herein. Bus supports may be suitable non-conductive structural sections instead of the standoff type. Supports must meet the performance tests of section SB4 of UL 891. Bus bars and supports shall be designed and supported to withstand a short circuit current of 65,000 amperes RMS symmetrical. Bus and bus supports must also withstand the loads that would be produced by the weight of the installed cable and force of pulling on the cables at installation. Supports shall be designed to minimize dirt collection and to facilitate cleaning. Bus bars, bus supports and associated supporting structural members shall be designed by a registered professional engineer.

3.4.2 INSULATION. Insulation material shall provide the level of performance specified for direct and indirect support of live parts in UL 746C. Relative thermal index of insulation per UL 746B shall be at least 130 deg C electrical and 130 deg C mechanical. A front safety barrier of insulating material shall be provided over ends of busing otherwise exposed when the front doors are open.

3.4.3 BUS BARS. Bus bars shall be copper per ASTM B 187-B 187M-03. One bus shall be provided for each phase of the 480-volt, 3 phase, 3-wire system. Bus bars shall be suitable for continuous operation at 2000 amps. Operating temperature of the busing shall not exceed 90 deg C in a 40 deg C ambient. Three (3) single-conductor 800 kcmil cables per phase will be connected at input end for 2000 amps. Adequate spacing must be utilized to meet 480 VAC clearance requirements between all three phases. See Figure 3 for bus bar hole size/configuration requirements.

The bending of bars shall not result in visible cracks, but roughening or slight surface crazing is acceptable. Bus shall be drilled to permit connection of three (3) 900 kcmil, (Thomas & Betts p/n 54226) 2-hole lugs along the bottom edge of each bar.

3.4.4 GROUNDING. All exposed, non-current-carrying metal parts on the equipment shall be maintained at common, zero ground potential. Enclosure shall be provided with a steel grounding pad welded on or near the base of the enclosure interior. Pad shall be sized and installed for connection of a lugged 500 kcmil grounding cable. Pad shall be drilled for two 1/2-inch diameter bolts on 1-3/4 inch centers. All main doors shall have grounding straps across the hinged components such that the hinge is not relied upon for the grounding path.

3.4.5 BUS BAR SUPPORTS. Bus bar supports system, including any I-beams, shall be expected to withstand operating temperatures of 90 deg C in a 40 deg C ambient environment.

3.5 ENCLOSURE DESIGN.

3.5.1 ENCLOSURE. The enclosure will be designed for outdoor use. No water shall enter the enclosure above live parts when subjected to the rain test of UL 50. The enclosure shall be designed so that any water that enters will drain from the enclosure. Drain holes shall be present at each of the four corners in the base. The enclosure shall meet the requirements of UL 50 for protection against corrosion.

Enclosure shall be constructed of heavy gauge steel and shall be sufficiently rugged to allow movement by crane and by forklift traveling over uneven pavement and train tracks. Enclosure, including bus bars, shall be constructed to withstand the loads that would be produced by the weight of the installed cable and force of pulling on the cables at installation as well as forces developed by 65,000 amps short circuit current. Enclosure shall meet the minimum thickness requirement of UL 50.

Enclosure shall be sized to fully enclose all bus bars and circuit breakers; and shall be sized and arranged to facilitate access for installation, and bolting-up, of the input and output power cables. A 400 ampere (minimum) bus gutter shall be mounted to the enclosure for the installation of circuit breaker output cabling. Enclosure front and rear doors and bus gutter door shall have weatherproof-hinged covers; covers shall be of positive rain-excluding design and construction and shall open the full height of the enclosure and bus gutter (less any necessary framing). Covers shall be hinged on the side and shall have keyed or padlocking capability.

Four (4) each, four (4) inch stuffing tubes for cable access from the 400 amp bus gutter to the installed circuit breakers shall be provided to enable installation of three (3) each 500 kcmil type W cables per circuit breaker. Also, an additional one (1) each four (4) inch stuffing tube shall be installed in the lower section of the enclosure for ground cabling installation from the input bussing section to the circuit breaker section of the enclosure.

Enclosure shall have two (2) each 6" holes (approximate) and two (2) each 6" square louvered covers mounted on the circuit breaker section sides. One mounted at the upper level on one side and the other mounted at the lower level on the other side for heat dissipation.

All parts, components, mechanisms, and assemblies furnished on the unit shall comply with all specific requirements of "OSHA Safety and Health Standard (29 CFR 1910), General Industry" that are applicable to the equipment itself.

3.5.2 SQUARE D I-LINE INTERIORS AND CIRCUIT BREAKERS

3.5.2.1 Square D I-Line interior part numbers 8023561170 and 8023553303 shall be installed in enclosure and mounted to input bus bars. Square D I-Line interiors must be mounted appropriately to accept installation of four (4) each Square D I-Line circuit breakers. One (1) each 600 ampere, 600 volt, 3 phase, Square D type MH I-Line circuit breaker and three (3) each 400 ampere, 600 volt, 3 phase Square D type LA I-Line circuit breakers shall be installed on Square D I-Line interiors.

3.5.3 LIFTING PROVISIONS.

3.5.3.1 Enclosure base shall include forklift tine guides with inside dimensions of approximately four inches high by eight inches wide. The guides shall be placed approximately 36 inches apart, center-to-center on the front/rear (48-inch side) and approximately 20 inches apart, center-to-center on the sides (32-inch side). Base shall be designed so that there is forklift access from all four sides. All sides of base shall protrude beyond the enclosure by approximately 3 inches to aid in protecting the enclosure during transit by forklift.

3.5.3.2 Enclosure shall have certified crane lifting padeyes at/near the top corners. Lifting padeyes need to be certified to 150% (minimum) of full enclosure weight. A label shall be installed on the outside of the enclosure specifying the lifting padeye weight capacity.

3.5.3.3 Enclosure shall be marked with total lifting weight.

3.5.4 LABELING. Labels shall be of a type and installed in a manner so as to be permanent under ordinary usage including exposure to weather and handling. Except as otherwise specified, labels may be inside or outside the enclosure. Labels shall be permanent, corrosion-resistant material.

3.5.4.1 IDENTIFICATION PLATE. A nameplate of corrosion-resistant metal shall be installed on the front of the unit with nonferrous metal screws, rivets, or bolts of not less than 1/8-inch diameter. The nameplate shall be permanently and legibly marked by inscribing or stamping manufacturer's name, model and serial number, ampacity, voltage, phases, short circuit withstand rating in RMS symmetrical amperes, weight, date of manufacture, and contract number.

4. QUALITY ASSURANCE PROVISIONS.

4.1 DRAWINGS AND CALCULATIONS FOR DESIGN REVIEW. Upon award of contract and prior to start of construction, contractor shall submit certified drawing(s) and calculations. Drawings must show bus cross-section, and bus supports and attachment; along with Square D I-Line interior(s) and Square D I-Line circuit breakers. Calculations must verify bus ampacity and short circuit withstand rating are as specified. Drawings should also show structural details including sheet steel gages, structural members, welding and fasteners, forklift tine guides, lifting padeyes, access openings for cables, space available for bolting lugs to buses, and enclosure drainage.

4.2 REQUIREMENTS REGARDING OSHA APPROVAL. The equipment specified herein shall be in compliance with the applicable OSHA regulations and approved in accordance with CFR Title 29, Chapter XVII, Subpart "S", Part 1910.399 (i) [paragraph (a) below].

a. Approval as specified under Part 1910.399 (i) requires the equipment to be accepted, certified, listed, labeled, or otherwise determined to be safe by a nationally recognized testing laboratory. Accredited Electrical Testing Laboratories approved by OSHA are as follows:

American Gas Association Laboratories (AGA)
(216) 524-4990 Cleveland, Ohio

Canadian Standards Association (CSA)
(416) 747-4000 Ontario, Canada

Communication Certification Laboratory (CCL)
(801) 972-6146 Salt Lake City, Utah

Dash, Straus, and Goodhue, Inc. (DSG)
(508) 263-2662 Foxborough, Massachusetts

ETL Testing Laboratories, Inc. (ETL)
(800) 345-3851 Cortland, New York

Factory Mutual Research Corporation (FMRC)
(617) 762 -4300 Norwood, Massachusetts

MET Laboratories, Inc. (MET)
(800) 638-6057 Baltimore, Maryland

Southwest Research Institute (SWRI)
(512) 684-5111 San Antonio, Texas

Underwriters Laboratories, Inc. (UL)
(708) 272-8800 Northbrook, Illinois

United States Testing Company, Inc. (UST-CA)
(213) 723-7181 Los Angeles, California

4.3 CERTIFICATION OF COMPLIANCE.

Prior to, or at the time of equipment delivery, the contractor shall provide signed, written certification of compliance to above requirements to:

Puget Sound Naval Shipyard & Intermediate Maintenance Facility
Code 270.12 (Bldg. 850)
1400 Farragut Avenue
Bremerton, WA 98314-5001

Failure to provide this certification will delay acceptance of the equipment, and could result in rejection for failure with the terms of the contract.

4.4 EXAMINATION FOR DAMAGE IN SHIPMENT. Examination at destination shall consist of inspection for damage in shipment within (7) calendar days after receipt.

4.5 FINAL INSPECTION ACCEPTANCE AT DESTINATION AND AUTHORIZATION OF PAYMENT. Inspection and acceptance of the equipment to be furnished shall be made at destination by Engineering and Planning Department, Code 270.12, within 60 days after receipt. Components and materials of the portable switchboard shall be inspected as deemed necessary by the receiving activity to verify conformance with the requirements specified herein and in applicable referenced documents. This element of inspection shall encompass a visual examination and dimensional measurements and may include an operational check to prove all components function properly and in a manner that fully conforms to the requirements of this specification. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection. Puget

Sound Naval Shipyard & Intermediate Maintenance Facility, Code 270.12 will authorize payment for the equipment subsequent to satisfactory inspection and proof of conformance.

5. **PREPARATION FOR DELIVERY.**

(MILITARY SPECIFICATION)

5.1 **PRESERVATION-PACKAGING AND PACKING.**

5.1.1 **PACKING (DOMESTIC).** Material shall be packed for shipment in such a manner that will ensure acceptance by common carrier and safe delivery at destination. Containers and enclosures shall comply with the Interstate Commerce Commission regulations, Uniform Freight Classification Rules or regulations of other carriers as applicable to the mode of transportation.

5.2 **PACKING MATERIAL.** The use of shredded paper, whether newspaper, office scrap, computer sheets, or waxed paper, in packing materials for shipment to Navy activities is prohibited.

5.3 **MARKING OF SHIPMENT.** Shipments shall be marked in accordance with MIL-STD-129.

6. **DATA REQUIREMENTS.** The following minimum information shall be provided with the connection box:

a. Two copies of the Assembly and Detail drawings showing dimensions and tolerances and torque values. Also see 4.1 above.

b. Two copies of the complete parts list showing the manufacturer, model, and/or part number, and material specification of each part.

c. One disk with all information associated with a & b above in PDF format.