Standard No. S24.802
March 1, 1974
(Revised 6/15/1999)

GENERAL REQUIREMENTS FOR GROUND ELECTRONIC EQUIPMENT

1.0 SCOPE

1.1 Scope. This document establishes standard electrical, electronic, and mechanical requirements for ground electronic equipment.

1.2 Application. The requirements of this standard shall apply to equipment developed or fabricated to Government specifications, including commercial production (original equipment manufacture (OEM)) items. When applied to OEM items, the requirement of this document shall serve as a basis of selection among comparably performing equipment.

1.3 Contracting Officer's Technical Representative (COTR). The COTR shall provide the final interpretation of any conflict between this standard and specific contract requirements.

1.4 Waivers. Any request for waiver of specific requirements of this standard shall be submitted in writing to the COTR and to the Contracting Officer. A request for waiver must include: a) identification of the paragraphs for which the waiver is requested; b) identification of the systems, equipment, or components for which the waiver is requested; and c) a discussion of rationale for granting the waiver, including impact on reliability, maintainability, schedule, and cost if the waiver is not granted.

2.0 APPLICABLE DOCUMENTS

2.1 Government documents. The following documents, of the issue in effect on the date of invitation for bid or request for proposal, form a part of this standard to the extent specified herein:

Federal

Federal Standard No. 595a "Colors"
Federal Specifications and Standards are available from:

The Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

Military

MIL-STD-454 "Standard General Requirements for Electronic Equipment"

MIL-STD-461 "Electromagnetic Interference Requirements for Equipment"

MIL-F-14072 "Finishes for Ground Signal Equipment"

Military specifications and standards are available from Commanding Officer, U.S. Naval Supply Center, 580l Tabor Avenue, Philadelphia, Pennsylvania 19120.

NOAA/NEDSIS
Standard No. S24.801 "Preparation of Operation and Maintenance Manuals"
Standard No. S24.803 "Cable and Wire Identification"
Standard No. S24.805 "Spare Parts"
Standard No. S24.806 "Software Development, and Maintenance and User Documentation"
Drawing No. S200.002 "Standard Name Plate " (A copy is included as an attachment to this Standard).

NOAA standards are available from: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, OSD3, Washington, D.C. 20233.

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bid or request for proposal shall apply. Copies may be obtained from the address listed for each publication.

"National Electrical Code"
National Fire Protection Association
Batterymarch Park, Quincy, Massachusetts 02269

ANSI-Y32.16 "Electrical and Electronic Reference Designations"
American National Standards Institute, Inc.
1430 Broadway, New York City, New York 10018

3.0 REQUIREMENTS

3.1 General. All equipment whose procurement specifications reference this standard shall comply with its applicable requirements to the extent specified therein.

3.2 Materials and workmanship. The materials used shall be new and of the highest quality to ensure minimum of maintenance. Unless otherwise specified, all materials shall be of the best commercial grade. Materials, parts, components, or equipment designated by its manufacturer as "obsolete" or "discontinued," or anticipated by the manufacturer to be "discontinued" prior to final delivery of the equipment being developed or fabricated, shall not be used. Equipment models which have been in production or use for over twelve (12) years shall not be used.

Workmanship standards shall be in accordance with MIL-STD-454.

3.2.1 Metals. Metals shall be of a corrosive-resistant type or suitably treated or protected to resist corrosive action likely to be met in shipment or service.

3.2.1.1 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in Specification MIL-F-14072.

3.2.1.2 Thermal coefficient of expansion. Metals having different thermal coefficients of expansion shall not be used in interrelated assemblies where dimensional changes through the environmental temperature range may have a degrading effect on operation or maintainability.

3.2.2 Fungus-resistant materials. Materials that are nutrients for fungi shall not be used where it is practicable to avoid them. When a fungus-nutrient material is required, it shall be treated with a non-toxic fungicidal agent.

3.2.3 Flammable materials. Flammable materials shall not be used in the equipment.

3.2.4 Toxic materials. Toxic materials, or those giving off toxic fumes when overheated, to the extent of being a hazard to the health and safety of operating and maintenance personnel, shall not be incorporated into the equipment.

3.2.5 Components. Standard and readily available electrical and electronic components, expected to remain available during the useful life of the equipment, shall be used to the maximum extent practicable. Components manufactured in conformance with military standards shall be used where possible. If such components are not available, the best commercial grade shall be used. Values of capacitors and resistors shall be selected from Electronic Industries Association preferred values with a $\pm$10 percent tolerance for capacitors and a $\pm$5 percent tolerance for resistors, except where closer tolerances are necessary. Preference shall be given to solid-state components wherever their use is practicable. Nothing above the component level shall be encapsulated or sealed in such a way it cannot be field serviced.

3.2.5.1 Component selection. Special selection (sorting) of transistors, semiconductors, integrated circuits, resistors, capacitors, and other similar components within the same type designation will not be permitted. Circuit design shall be such that the performance objectives of this specification are met by using any replacement component of the same type and model considered by its manufacturer to be normal, within allowable tolerance, and representative of the statistically variable parameters under which they are manufactured.

3.2.5.2 Active Electronic Devices - transistors, integrated circuits, and semiconductors. Transistors, integrated circuits, and semiconductors employed shall be chosen from the respective manufacturers' current preferred-type lists. A minimum number of types of transistors, integrated circuits, and semiconductors shall be employed, consistent with achieving the design objectives. All devices shall be sufficiently derated to assure meeting the reliability requirements of this specification for all probable environmental conditions.

3.2.5.3 Component derating. Unless otherwise specified all components shall be derated according to the following

schedule:

(a) Inductors:	0.5 rated current
(b) Diodes:	0.5 rated forward current 0.7 rated peak inverse voltage
(c) Relays:	1.0 rated coil voltage 0.5 rated contact current
(d) Capacitors:	0.4 to 0.8 rated voltage
(e) Connectors:	0.5 rated current
(f) Transistors:	
High and Medium power	0.3 rated power
General purpose	0.4 rated power
High speed switching	0.4 rated power
(g) Resistors:	0.8 rated voltage 0.6 rated current
(h) Integrated circuit outputs	0.7 rated load

3.2.5.4 Resistors. Fixed composition resistors shall be equivalent to military standard types. Variable resistors shall be one of three types depending on the application.

(a) Variable composition type, military or best commercial grade.

(b) Variable wire-wound type, best commercial grade.

(c) Attenuator type (rotary switch selected fixed resistors), best commercial grade.

Limited life (miniature and trimmer types) units shall not be used for controls.

3.2.5.5 Capacitors. Capacitors shall employ mica, glass, ceramic, plastic, or oil-filled paper dielectric material. Electrolytic capacitors shall be used only upon prior approval of the COTR and then only in power supply filter applications. Capacitors containing PCB's shall not be used.

3.2.5.6 Rectifiers. Preference shall be given to silicon solid- state rectifiers wherever their use is practicable. Protection against internally generated transients shall be included in the design. Adequate cooling shall be provided to permit continuous operation under the required environmental conditions.

3.2.5.7 Time/Cycle limited items. Components, parts, or equipment (e.g., relays, switches, keyboards, incandescent lights, etc.) which have limited life, expressed either in hours of operation or number of operations, and have been used by the contractor in the development of the system in excess of 30 percent of their rated life shall be replaced by the contractor with new, unused items at the time of delivery of the equipment to the Government.

3.3 Design. Within the limitations of the applicable specifications, the Contractor shall make his own designs and circuit arrangements. The Contractor shall submit copies of his designs for review and approval, prior to fabrication. Approval of the design by the COTR will not in any way relieve or decrease Contractor responsibility for satisfactory compliance with all requirements including installation of the equipment on-site and ready for use.

3.3.1 Reliability. The equipment shall be designed to exhibit a high degree of reliability to assure continuous 24-hour per day operation capability. Maximum use shall be made of established- reliability solid-state devices.

Electron tubes are permitted should that have a guaranteed mean time before failure of not less than 5,000 hours and the application cannot be satisfied by off-the-shelf solid state components. The Contractor shall submit with his proposal a design analysis projecting expected downtime rates.

3.3.2 Maintainability. Design of the equipment shall be such as to ensure ease of maintenance. Proposals shall reflect the desire for continuous operation and the maintenance problems associated with housing the equipment, or portions thereof, including on antenna structures and at remote field locations.

3.3.2.1 Accessibility. Access to all components and assemblies (electrical, electronic, or mechanical) requiring repair or adjustment during routine maintenance shall not be obstructed. All items shall be accessible for removal independently of other assemblies. All covers requiring removal for adjustments shall have quick release fasteners. Access to sides of rack cabinets shall not be required for maintenance purposes.

3.3.2.2 Interchangeability. The design shall be such that all corresponding components and parts shall be interchangeable as to value, physical size and shape, geometrical location of pins, mounting holes, etc., among subassemblies. All corresponding subassemblies shall be interchangeable throughout the system. Circuit components, parts, and subassemblies shall not be modified, altered, or changed so as to render them unique unless detailed drawings and instructions are provided to enable the Government to duplicate the changes.

3.3.2.3 Redundancy. Where redundant components, assemblies, or subsystems are supplied for critical areas it shall be possible to resume operation within 30 minutes (mean time) of a failure detection.

3.3.2.4 Availability. By using established reliability components, redundancy, and designing for ease of maintenance, each equipment described herein shall be available for operation at least 99 percent of the time based on continuous operation, 24 hours per day. This requirement shall not apply to equipment used for off-line, non-operational, test or diagnostic functions.

3.3.2.5 Component identification. Electronic components shall be marked with the corresponding identification number (e.g., R201, C302, T106, etc.) as shown on the schematic or wiring diagram for that particular unit, in accordance with ANSI-Y32.16 ("Electrical and Electronic Reference designations") wherever possible. Sockets for all unpluggable components shall be properly identified. In all cases, complete component location diagrams shall be provided.

3.3.2.6 Subassembly identification. All subassemblies shall be labelled with the corresponding identification number as shown on the schematic or wiring diagram for that particular unit. Sockets for all unplug gable subassemblies, including circuit cards, shall be properly identified. In all cases, complete subassembly location diagrams shall be provided.

3.3.2.7 Wire identification. All wires and cables shall be identified to enable positive identification of wire ends in accordance with NOAA/NESDIS Standard No. S24.803.

3.3.2.8 Connector and terminal identification. All connectors (plugs and receptacles), jacks, binding posts, screw terminals and test points shall be identified by name and/or number. The identification shall correspond with labeling applied to the item on the schematic and wiring diagrams.

3.3.2.9 Assembly techniques. Small components (composition resistors, mica capacitors, diodes, etc.) shall be mounted on circuit cards or terminal boards unless circuit requirements dictate otherwise. All parts which may require replacement, including electron tube and semiconductor sockets, shall be fastened with machine screws. No rivets, sheet metal screws, or self-tapping screws shall be used for assembly.

3.4 Hardware. Hardware (screws, nuts, washers, spacers, etc.) used shall be of a quality to withstand the specified environmental conditions. Stainless steel is preferred, but other suitably protected materials may be used upon approval of the COTR. (Cadmium plating is not acceptable.) All bolts shall be provided with elastic stop nuts, lock washers, or other means of preventing parts from loosening under prolonged use. All hardware shall be manufactured to domestic standards.

3.5 Rack-mounted equipment. The equipment rack shall nominally measure 87 inches in height excluding a 3 inch pontoon base, by 30 inches deep by 24 inches in width. Equipment designed for installation in racks shall conform to the following requirements:

(a) All panels shall conform to Electronic Industries Association standard dimensions for rack mounting. Heights shall be in multiples of 1 3/4 inches.

(b) Panel width shall be 19 inches unless otherwise specified.

(c) Chassis shall not exceed 17 1/2 inches in width if mounted behind a 19-inch panel.

(d) Overall chassis depth (front-to-rear), including connectors and cable bends, shall not exceed 28 inches unless otherwise specified.

(e) Unless otherwise specified all chassis shall be provided with slides to permit complete withdrawal to the front for servicing and trouble-shooting during normal operation. If access to chassis underside is required, tilt-type slides shall be used. Chassis installed four feet, or more, above the floor shall also be capable of tilting forward (panel down) to give access to the topside. Slides shall be chosen in accordance with chassis weight, shall be of good quality using nylon rollers or ball bearings, and shall be subject to approval by the COTR.

(f) Cable control shall be used on all chassis to prevent cable damage when chassis are completely withdrawn. Cable carriers shall be Jonathan Manufacturing Co. Type CRS-25, or approved equal.

(g) All cable and wiring connections shall be made at the rear of the chassis. Test points shall be on the front panel and provided with captive dust covers. Rack-mounted commercial equipment incorporated as part of a system shall be modified, if necessary, to conform with this requirement.

(h) All cable connections shall be made at a common panel at the inside, bottom rear of the rack. Racks to be installed over raised floor areas shall penetrate the raised floors through 4½ inch diameter circular holes with cable protective abrasion boots. Power and signal cables shall be routed through separate penetrations.

(i) All drawer type chassis shall be provided with a top cover to keep out dirt and falling objects.

(j) Every equipment rack shall contain a copper rack ground bus (minimum ¼-inch thick x 1-inch wide, and length determined by the height of the rack), structure and frame ground. Every equipment chassis within the rack shall be connected to the copper bus by means of an AWG #8 tinned copper braid. The braid shall be of sufficient length to accommodate the requirements of chassis slides and cable carriers.

(k) Every equipment rack installed over raised flooring shall sit flush on the floor and draw its cooling air from the under-floor plenum. Cooling air shall be drawn through one or more 4½ inch diameter circular holes cut in the raised floor. Unless specified otherwise every rack shall be a permanent, fixed-location, non-portable installation (e.g. no casters).

3.5.1 Rack Space Utilization. Each rack shall be accompanied by a rack layout drawing (in addition to those provided in the documentation set) of the form shown in Attachment 1. The top- most panel shall be designated "A1" successive panels, including blanks, being "A2," "A3," ... .

3.5.2 Rack numbering/designations. Rack numbers (e.g. for equipment installed at Command and Data Aquisition (CDA) stations) or alpha designators (e.g. for equipment installed at the Satellite Operations Control Center (SOCC)) will be assigned by the government.

The numbering convention to be used is: NN(N)x(x)n:

where NN(N)= A two digit number (CDA), or two or three letter character (SOCC), identifying the system or subsystem.

x(x) = A one or two letter character identifying either the number systems or subsystem or a functional element. Letters typically assigned in a two satellite operation are: A - the operational `A' system/subsystem; B - the operational `B' system/subsystem; C-S-R - spare or redundant systems/subsystems; AB, AC, AD, ect. - Common operational equipment shared by two or more subsystems; AZ - systems/subsystems shared by all facilities; T - maintenance, test, or developmental systems/subsystems.

n = The rack number within the system/subsystem set.

Labels prominently displaying the rack number/designator shall be attached to the upper center front and upper center rear of each rack, but not on a removable panel or movable door.

3.6 Cables. All cables shall be supported in racks to prevent strain on connectors. Where several cables run parallel they shall be neatly bundled together. Individual harness break-outs shall have a sufficient service loop to permit at least two repairs. Slack shall be provided to allow chassis to be fully withdrawn from the rack on slides.

3.6.1 Control cables. Control cables between various units of a system shall, in general, be multiconductor types. Shielding shall be used as required for proper operation. The external jacket shall be suitable for the environment, i.e., building interior, direct burial, exposure to sun-light, abrasion hazard, etc.

3.6.2 Power cables. Materials and workmanship for all primary power wiring (120 volts ac, 208 volts ac, etc.) shall be in accordance with the National Electrical Code. Low power drain, single-phase, interior installed items may utilize standard 3- wire power cords with grounding plugs, unless otherwise specified. High power drain, three-phase supplied items, particularly those mounted at remote locations, shall be supplied through grounded metallic conduit for shielding, protection, and safety.

3.6.3 Signal cables. Signal cables shall be of a type suitable to the signal characteristics.

(a) Audio or other low frequency, low impedance level, signals balanced to ground shall use twisted pair, shielded as required.

(b) Video or other baseband signals, unbalanced to ground, shall use small coaxial cable, type RG-223/U, or approved equal.

(c) Low level RF (radio frequency) signals shall use nominal half-inch coaxial cable, type RG-214/U, or approved equal.

(d) High level RF signals shall use large coaxial cable, rigid coaxial line, or waveguide. Choice of cable

or waveguide type shall be consistent with power level, frequency, and permissible loss.

(e) Digital signals shall use cables suitable to the signal amplitude, impedance level, and length of run.

Departures from these requirements shall be submitted to the COTR for review and approval.

3.6.4 Spare conductors. All multi-conductor control cables shall include spare conductors to provide for expansion or back- up. A minimum of twenty percent spares of each type shall be provided.

3.6.5 Cable identification. All cables shall be permanently marked in accordance with Standard S24.803, "Cable and Wire Identification."

3.6.6 Transient protection and EMI/RFI filtering. Control, signal, and power lines installed on or connected to antenna structures or other points remote to the main system shall be protected and filtered in accordance with 3.10.6 and 3.10.7, consistent with the operational frequency and level of each line.

3.7 Connectors. All cables, with exception of power cables, shall be terminated in appropriate connectors to facilitate disconnection for maintenance or relocation. Mating connectors shall be provided on all chassis or cabinets comprising the equipment. All connectors shall have mechanical restraints to prevent accidental un-mating. Heavy wire leads, AWG No. 12 or larger, may be terminated in lugs and terminal strips. Connectors shall be appropriate to the environment they must withstand. Departure from these requirements shall be submitted to the COTR for review and approval.

3.7.1 Control connectors. Control cables shall use MS type, or equivalent, connectors. To preclude improper connection, each pair of mating connectors shall be unique in size, pin arrangement or key-way position. All control cable chassis connectors shall be mounted on the rear surfaces of chassis or enclosures.

3.7.2 Power connectors. Low power drain, single-phase items shall use standard twist-lock or MS type connectors. High power drain items shall be provided with a terminal block or junction box appropriate to the size and number of conductors required.

3.7.3 Signal connectors. Signal connectors shall be standard coaxial, twinax, or audio types as listed below:

(a) Audio signals: Audio type connectors consistent with cable used

(b) Video, baseband signals: Type TNC coaxial (unbalanced)

(c) Low level r-f signals: Type N coaxial

(d) High level r-f signals: Coaxial or waveguide as appropriate

(e) Digital signals: Multi-pin type consistent with cable used

(f) Test points: Type BNC coaxial

3.7.4 Connector materials. RF signal connectors shall be fabricated of brass and copper alloys and silver or gold plated. No ferromagnetic materials shall be used. Specifically prohibited are stainless steel and nickel plate. Hermetically sealed connectors with "Kovar" center pins shall not be used. All of the prohibited materials cause intermodulation effects in the presence of radio frequency fields.

3.8 Circuit cards. If circuit cards are used in the equipment, they shall conform to the requirements for subassemblies in addition to the following:

3.8.1 Mounting. Unplug gable circuit cards are preferred and shall be utilized unless specific exemptions are granted by the COTR. Cards shall be a secure fit or locked into place.

3.8.2 Extenders. If cards are not accessible for maintenance in their normal position, card extenders shall be provided for both commercial/OEM and custom equipment. At least one extender shall be included for each physically unique card.

3.8.3 Card puller. If a card puller is required to remove cards from their sockets, one (each, pair, or set) shall be provided of each physically unique type, as a special tool, for each card file (bucket).

3.9 Equipment protection. Adequate protective circuitry shall be incorporated to prevent damage to the equipment due to improper sequencing, internal faults, excessive heating, surges, transients, improper adjustment, or human error. In particular, protection against any of the following conditions applicable to the equipment shall be provided:

(a) Loss of cooling air flow through cabinet or any critical portion of the equipment.

(b) Failure of cooling system.

(c) Open cabinet door, panel, or other cover.

(d) Excessive temperature of any critical component, assembly, or other item.

(e) Primary power or other critical overcurrent condition.

(f) Any critical undercurrent condition.

(g) Excessive over-voltage condition.

(h) Any critical under-voltage condition.

(i) Arc in high voltage power supplies.

(j) Excessive reflected output power (transmitters).

Equipment using readily unpluggable power cords shall include fuses or circuit breakers for primary overload protection. Equipment permanently wired to its power source shall include circuit breakers for primary overload protection and power disconnect.

Visual and audible warnings of the existence of any of these conditions shall be available to equipment operators.

3.10 Power. Requirements for primary power and power supplies shall be as follows:

3.10.1 Power source. The Government will make available, unless otherwise specified, power to operate the equipment at or adjacent to the installation site. Power requirements shall be supplied to the COTR within thirty days, or other negotiated time, after award of contract.

3.10.2 Single-phase power. All single-phase power equipment, unless otherwise specified, shall be designed to operate from a primary source of 120 volts $\pm$10 percent, over a range from 58 to 62 Hz. Each system shall be designed so the primary source voltage will work into an ungrounded transformer primary. The AC (alternating current) system neutral shall not be chassis or rack grounded under any circumstances. The use of by-pass capacitors between any power input lead and chassis ground is prohibited.

3.10.3 Three-phase power. All three-phase power equipment, unless otherwise specified, shall be designed to operate from a primary 4-wire source of 208/120 volts $\pm$10 percent, over a range from 58 to 62 Hz with a power factor of 0.8 or greater. If the power input transformer is three-phase "delta" connected, the neutral wire of the 4-wire system is not connected. If the input transformer is three-phase "wye" connected, the fourth or neutral wire shall be connected but not grounded to the system. **The AC system neutral shall not be chassis or rack grounded under any circumstances**. The three-phase loads shall be balanced so when fully operational, the currents in each line (phase) do not differ by more than 10 percent. If equipment contains any components, such as motors, requiring a specific phase sequence to assure proper operations, the Contractor shall be responsible for determination of proper phasing, connection, and operation. The use of by-pass capacitors between any power lead and chassis ground is prohibited.

3.10.4 Control and protection. All single racks comprising an integrated system and all multi-rack integrated systems shall have a single point for control and protection of power inputs. Where three-phase power is used, circuit breaker protection shall be provided in each line. Systems containing test or diagnostic equipment in the same rack as operational equipment, provision must be made to control and protect the test or diagnostic equipment power independently of the operational equipment power.

A single rack equipment utilizing AC outlet strip power interface need not comply with this requirement.

3.10.5 Sags/surges. Power system sags or surges of as much as 15 percent change from the nominal voltage for a period of up to five cycles of the line frequency shall not deteriorate performance of the equipment. The equipment shall be designed to withstand erratic variations of +30 percent in voltage and +15 percent in frequency for periods of up to 10 seconds once every 5 minutes.

3.10.6 Transients. Power system transients (spikes and impulses) of as much as 2.5K volts peak, both positive and negative, of an "8u-second x 20u-second" waveform, randomly distributed on the line frequency wave shape once every 2 seconds and with a peak power of 2,500-watts, shall not deteriorate performance of the equipment. Protection in the form of a combination of metal-oxide varistors, silicone avalanche (zener) diodes, gas discharge devices, or other transient suppression devices shall be provided on each AC power line at the point the lines enter each cabinet, rack, or enclosure.

3.10.7 EMI/RFI filtering. Filters shall be installed on power lines to prevent conducted interference from entering or leaving the equipment cabinet, rack, or enclosure via the power connection.

3.10.8 Power supply monitor. Meters shall be provided to monitor all power supply output voltages. Individual meters are not required. A single meter may be switched to monitor several voltages.

3.11 Grounding. Equipment installation shall not compromise the integrity of the station grounding system. The CDA station grounding system is divided into two separate systems designated as the Utility (Safety) Ground and the Technical (Signal) Ground.

3.11.1 Technical (Signal) Ground. The technical ground provides an insulated low noise common-bus network for the grounding of electronic equpment signals. This ground is insulated from earth at all points except at the one point where the equipment is connected to the technical systems ground point. Noise due to the flow of currents caused by a potential difference between two separate points of earth contact is minimized by insulating the system from ground at all points except one (see Attachment 2). Receptacles connected to Technical Ground shall be ivory in color with **ivory** coverplates.

3.11.2 Utility (Safety) Ground. The utility (safety) ground provides an uninsulated common-bus network for the grounding of electrical equipment (e.g. power panels, equipment racks, fan motors, etc.), buildings, and antenna structures. This ground shall combine the ground points at various station structures into a common-bus ground network to insure a definite common ground is continuously maintained to reduce the hazard of shock to personnel (see Attachment 3). Receptacles connected to Utility Ground shall be **brown** in color with brown coverplates.

3.12 Personnel protection. Equipment shall be designed and constructed to provide maximum protection for operating and maintenance personnel. Particular attention shall be given to the following points:

(a) Protection shall be provided against accidental contact by personnel with voltages in excess of 50 volts.

(b) Wherever voltages in excess of 50 volts are present warning labels so stating shall be provided on the cover.

(c) All terminal strips and areas containing hazardous voltages shall be covered. Design of covers and high-voltage barriers shall provide sufficient mechanical rigidity and clearance to prevent short circuits or other failures.

(d) The outside of all cabinets, racks, chassis, and component enclosures as well as external metal parts, meter cases, control shafts, and adjustment knobs shall be grounded.

(e) Connectors containing energized conductors shall have such conductors appearing on female pins.

(f) Provision shall be employed to automatically discharge high-voltage capacitors within 5 seconds after power is removed.

(g) Grounding rods shall be provided in all areas of the equipment where voltages in excess of 300 volts exist. The rods shall be permanently connected to the rack or cabinet ground. Storage clips shall be provided.

(h) Interlocks shall be provided on all doors or covers giving access to voltages in excess of 50 volts. Interlocks shall be of a type to allow "cheating" for maintenance purposes. They shall reset when door is closed or covers replaced. Connections shall be provided to permit insertion of an external interlock into the chain. Opening of an interlock shall turn on the interlock indicator.

(i) To prevent accumulation of an electrostatic charge, all cable conductors and shields shall have a DC (direct current) path to ground.

3.13 Surface protection. All equipment surfaces shall be suitably protected to prevent corrosion and withstand the specified environmental conditions.

3.13.1 Cleaning. Prior to application of any finish process all surfaces shall be cleaned free of dirt, grease, oil, flux, scale, oxides and all the debris that might interfere with adherence of the finish.

3.13.2 Painting. All external surfaces shall be primed with a suitable primer and finished with enamel. Chassis and internal metal parts shall be plated, iridited, or otherwise protected if painting is not practicable.

3.13.3 Colors. The equipment shall be finished in colors corresponding to the color chips of Federal Standard No. 595a or other referenced document. Unless otherwise indicated in the detailed equipment specification, the following colors shall be used:

(a)	Racks and cabinets	#24172 (green)
(b)	Panels	#26555 (cream)
(c)	Legends	#27038 (black)

(d) Antenna Mounted Items #17875 (white)

3.14 Environmental conditions. Equipment to be installed in the operations building will, unless otherwise specified, be rack- mounted and supplied with cooling air from a below-the-floor plenum. This cooling air will be at a temperature of approximately 58 degrees Fahrenheit (dry bulb), a pressure of about 0.25 inches of water, and a relative humidity of 50 percent.

Equipment to be installed on antenna structures or other remote points must withstand and operate normally under any realizable combination of the environmental conditions described in 3.14.1 through 3.14.7.

3.14.1 Ambient temperature.

(a) Operating -20<F to +120<F

(b) Non-Operating -30<F to +130<F

(c) Transport -60<F to +135<F

3.14.2 Humidity. Any relative humidity up to 100 percent including condensation caused by temperature changes.

3.14.3 Dust. Dust storm conditions as encountered in desert regions within a shelter.

3.14.4 Salt atmosphere. Salt atmosphere as encountered within one mile of salt water.

3.14.5 Altitude. Sea level to 10,000 feet.

3.14.6 Orientation. Any orientation to which the antenna may be positioned.

3.14.7 Shock and vibration. Any shock and vibration generated by movable portions of the antenna.

3.15 Electromagnetic interference. All equipment shall be designed to comply with MIL-STD-461B, Emission and Suseptibility Requirements and Limits set forth in 461B - Part 3. Electromagnetic Interference measurements, radiated emissions and power line conducted suseptibility, shall be performed in accordance with MIL-STD-462. Definitions relative to Electromagnetic Interference, test and measurement, terms, etc. are set forth in MIL-463.

3.15.1 Rack shielding. Racks, cabinets, and enclosures shall be EMI/RFI gasketed to reduce radiated emissions.

3.15.2 Radiated emission. Radiated emission measurements shall be performed to document equipment compliance/non-compliance with the levels of MIL-STD-462.

3.16 Operation and maintenance manuals. Six (6) copies of an operation and maintenance manual, in accordance with Standard No. S24.801, "Preparation of Operation and Maintenance Manuals," shall be supplied with each system or subsystem.

Six (6) copies of operation and maintenance manuals, as supplied by the OEM vendor, shall be supplied for all OEM equipment. All but two (2) copies of OEM manuals may be delivered in microfiche format (24x or 48x reduction).

3.17 Operating spares. Included and shipped with the equipment shall be a set of operating spares to cover one year (24-hour/day) of operation. Spares shall consist of the following:

(a) One (1) set consisting of one (1) each spare for every type of board, subassembly, module, or where applicable integrated circuit, semiconductor device, circuit breaker or relay installed in the equipment, with at least 10 percent of any particular item. Where circuit cards are used, one card of each type used shall be supplied in lieu of those spare integrated circuits, semiconductor devices, and relays used exclusively on the circuit cards.

(b) One (1) set of fuses consisting of ten (10) of each type used in the equipment.

(c) One (1) set of pilot lamps consisting of five (5) of each type used in the equipment.

(d) One (1) unit of each electronic or electrical component or subassembly which is modified, built to specfication, or not commercially available. This refers specifically to items peculiar to the contractor's own design, and especially fabricated by or for the contractor or commercially available items modified or altered in such a manner that an identical replacement item cannot be procured on the open market as a "shelf" item. (A "shelf" item shall be considered as one appearing in the Federal Supply Catalog or is available from multiple domestic sources.)

3.18 Special tools. The need for special tools for adjustment and maintenance of the equipment shall be minimized. If special tools are required, one set shall be provided. Special tools are defined as those items not listed in the Federal Supply Catalog or available from multiple domestic sources.

3.19 Recommended test equipment. A recommended list of test equipment required for maintenance shall be provided for each system. The list shall include a description of the application and uses of each piece of recommended equipment. This list shall be furnished to the COTR in advance of equipment delivery. It shall also be included in the operation and maintenance manual.

3.20 Nameplates. Nameplates, as shown in drawing S200.002, shall be permanently affixed to each major unit of the equipment. Serial numbering to be employed will be determined at time of the first design review.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General. Unless otherwise specified, the Contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the Contractor may utilize his own facilities or any commercial laboratory acceptable to the COTR. The Government reserves the right to perform any or all of the inspections set forth in the specifications where such inspections are deemed necessary to assure the supplies and/or services do conform to prescribed requirements.

4.2 Design reviews. The Contractor shall conduct two design reviews, preliminary and final. The design reviews and the design plan shall specifically address the requirements outlined in Section 3.0 of this Standard, as well as the unique performance requirements of the contract. Both design reviews shall be held at the Contractor's plant. After the preliminary review the Contractor shall prepare, and submit to the COTR for approval, a design plan.

4.2.1 Preliminary design review. The preliminary design review shall be held within 60 days after award of contract. At this time the Contractor shall describe his design philosophy and present preliminary copies of electrical schematics, drawings, or other means of describing the equipment design and construction. The software portion of the review shall concentrate on major modules, routines, and their respective execution. Expected performance parameters shall also be stated. The Contractor shall obtain approval of the preliminary design concept before start of detailed design.

4.2.2 Design plan. The Contractor shall submit to the COTR final schematics layout and principal shop drawings, final expected performance specifications, and a detailed description of the proposed equipment at least two weeks prior to the final design review.

4.2.3 Final design review. The Contractor shall hold a formal final design review and obtain approval of the COTR prior to releasing shop drawings or purchase requisitions. At this time, all drawings, schematics and performance will be reviewed in detail for conformance to the specifications. The contractor shall prepare visual aids to support this presentation and provide copies to each attendee.

4.2.4 Final design plan. A final review of design changes incorporated as a result of the design reviews will be held at the contractor's facility within 30 days of the Final Design Review. The contractor shall provide the COTR a copy of the final design plan at this meeting. The final design plan shall provide a detailed description of the final design and every other element in the contract.

4.3 Test and acceptance. The Contractor shall prepare, and submit to the COTR for review and approval, a test plan designed to demonstrate conformance with the specifications. This test plan, to be executed by the contractor, shall include the following in-plant and on-site tests:

a) Unit Level tests of hardware (including back-up and spare units) and software -- These tests shall be conducted in-plant and shall demonstrate the required functionality and performance of individual

system components and processes within each subsystem. The hardware tests shall include running diagnostic(s) for each component.

b) Subsystem/System Level tests of hardware and software -- These tests shall be conducted in-plant and shall demonstrate required functionality and performance of the entire system utilizing simulated external devices. The contractor shall provide an effective method of debugging and testing developed software in an environment which simulates all configurations and operating conditions.

c) Pre-shipment, in-plant, form, fit, and functions tests demonstrating resolution of all discrepancies, errors, and omissions identified during unit and subsystem/system level tests.

d) Post-shipment, on-site, hardware and software tests demonstrating proper system function following installation.

e) System Integration tests, on-site, demonstrating proper interfacing, functionality, and performance with all actual external systems and equipment.

f) Final Acceptance Tests of hardware and software -- These tests shall be conducted on-site, after satisfactory installation, completion of other in-plant and on-site tests in accordance with the approved plan, and correction of all difficiencies identified during the tests or other Government inspections. The Final acceptance tests shall demonstrate total system interfacing, functionality, and performance of both hardware and software, and shall include demonstration of equipment/system availability for seven consecutive days.

4.4 Test reports. Upon completion of both the in-plant and on- site tests the Contractor shall submit to the COTR two copies of the test results. These reports shall clearly identify any deviation from the specification requirements and reasons for them.

4.5 Warranty. The system, including all parts and spare parts shall be guaranteed against faulty design, materials, and workmanship for a period of at least one (1) year after installation and activation. Should any defect in the design, workmanship or material develop, the defective part(s) shall be replaced with satisfactory part(s) by the Contractor at the point of installation without further expense to the Government.

Determination of the cause of failure and the subsequent redesign of components relating to warranty requirements shall be the sole responsiblity of the Contractor. Failure due to poor workmanship, while not necessarily indicating poor design, will be considered in the same category as failure due to poor design. Redesigned replacements, including installation instructions and manual revisions resulting therefrom, which will ensure proper operation of the equipment, shall be supplied promptly, transportation prepaid, to the point of installation upon receipt of proper notice and without cost to the Government. If the Contractor elects to have the defective or replaced part(s) return to his plant, it will be returned upon receipt by the Government of proper notification and at the Contractor's expense.

In addition, the Contractor shall state the number of years, after the warranty period, during which special or non-standard parts will be available for procurement by the Government.

5.0 PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Preservation and packaging shall be sufficient to afford protection against corrosion and deterioration during shipment from the Contractor's plant to the destination and until installation. This degree of protection may conform to the manufacturer's commercial practice when such practice meets or exceeds these requirements.

5.2 Packing. Each unit of the equipment shall be substantially packed, including necessary bracing, to assure delivery in undamaged condition. Large parts, electrical and electronic assemblies, and other delicate mechanisms shall be packed in sturdy wooden crates or heavy boxes. Large structural items need not be completely packaged so long as they are adequately protected.

5.3 Marking. Each crate, box, or unit or equipment shipped as less than a truckload shall be legibly marked with consignee's name and address, Contractor's identification, contract number, and any additional required labelling. If shipment is by Contractor's vehicle these marking requirements are waived.

6.0 NOTES

6.1 Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

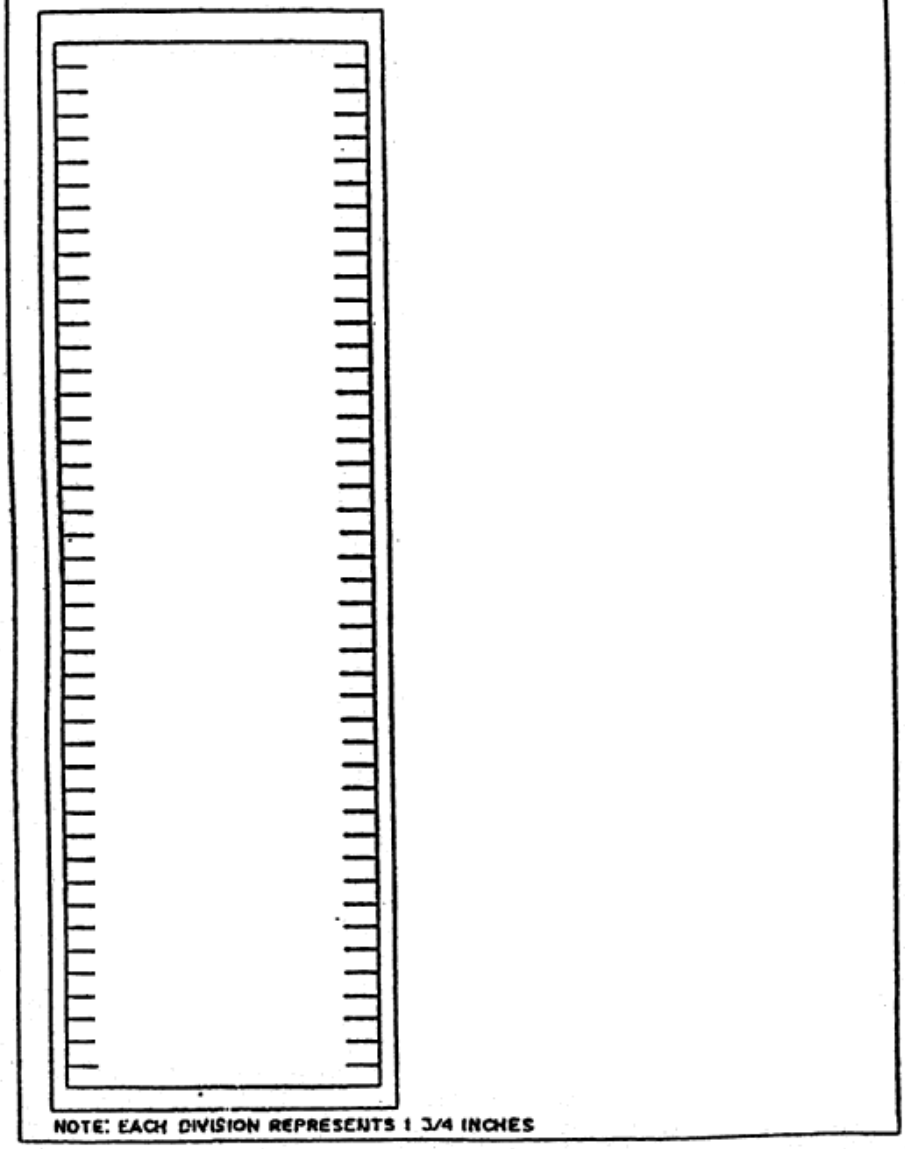
ATTACHMENT #1

RACK LAYOUT

EC No:
EC Title:

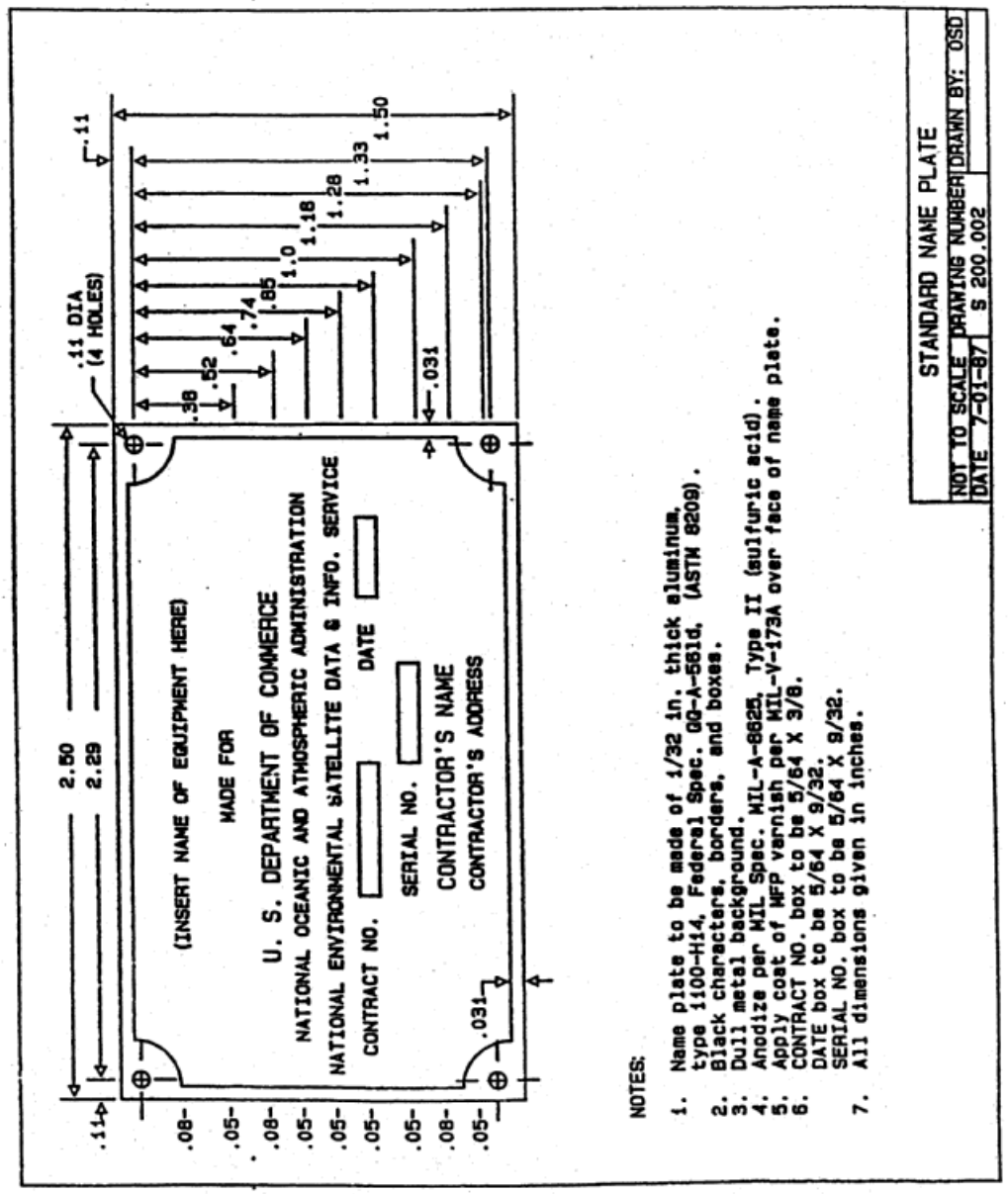
RACK LAYOUT

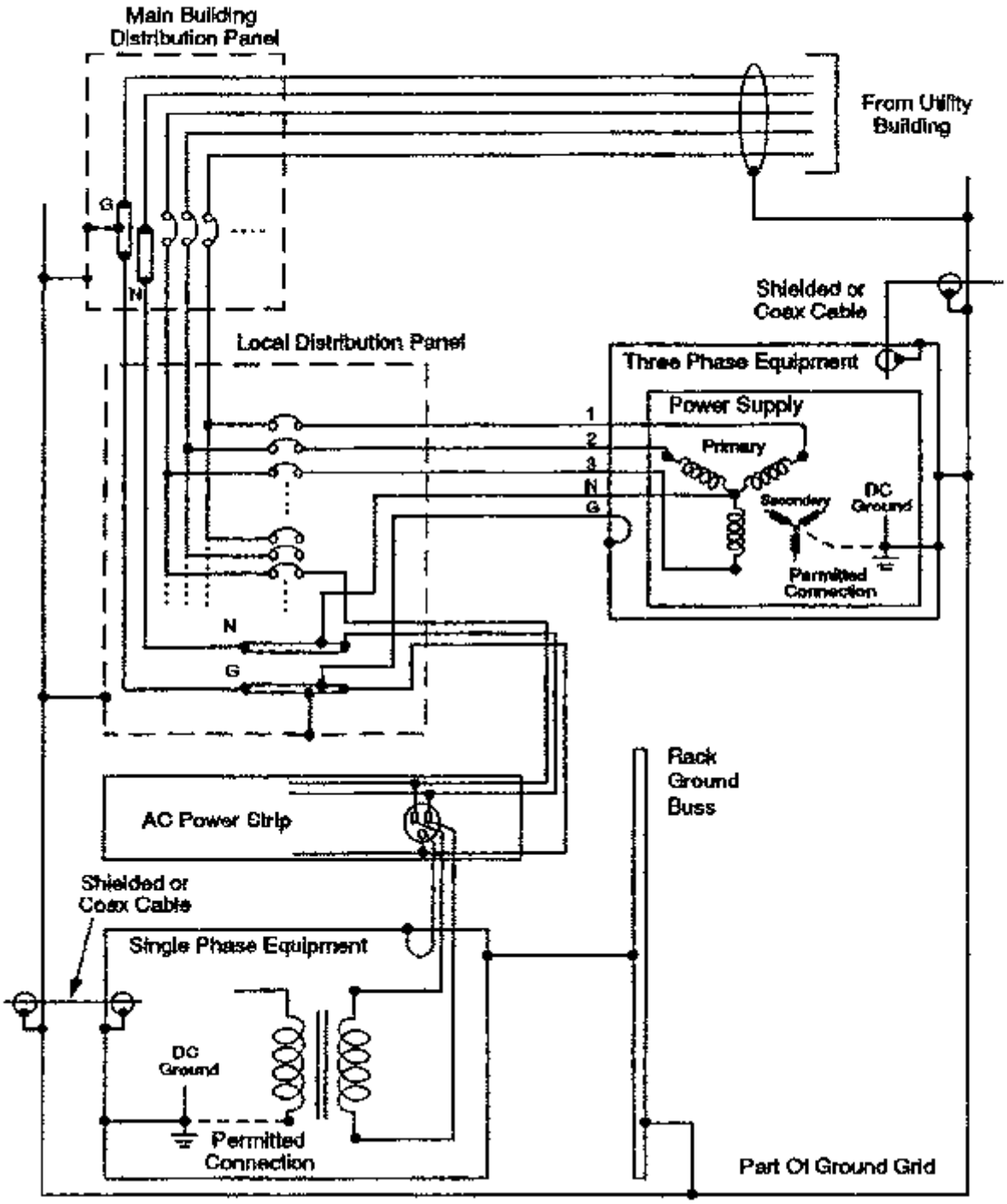
Figure ____
Page ____ of ____



Drawing No. S200.002 "Standard Name Plate "

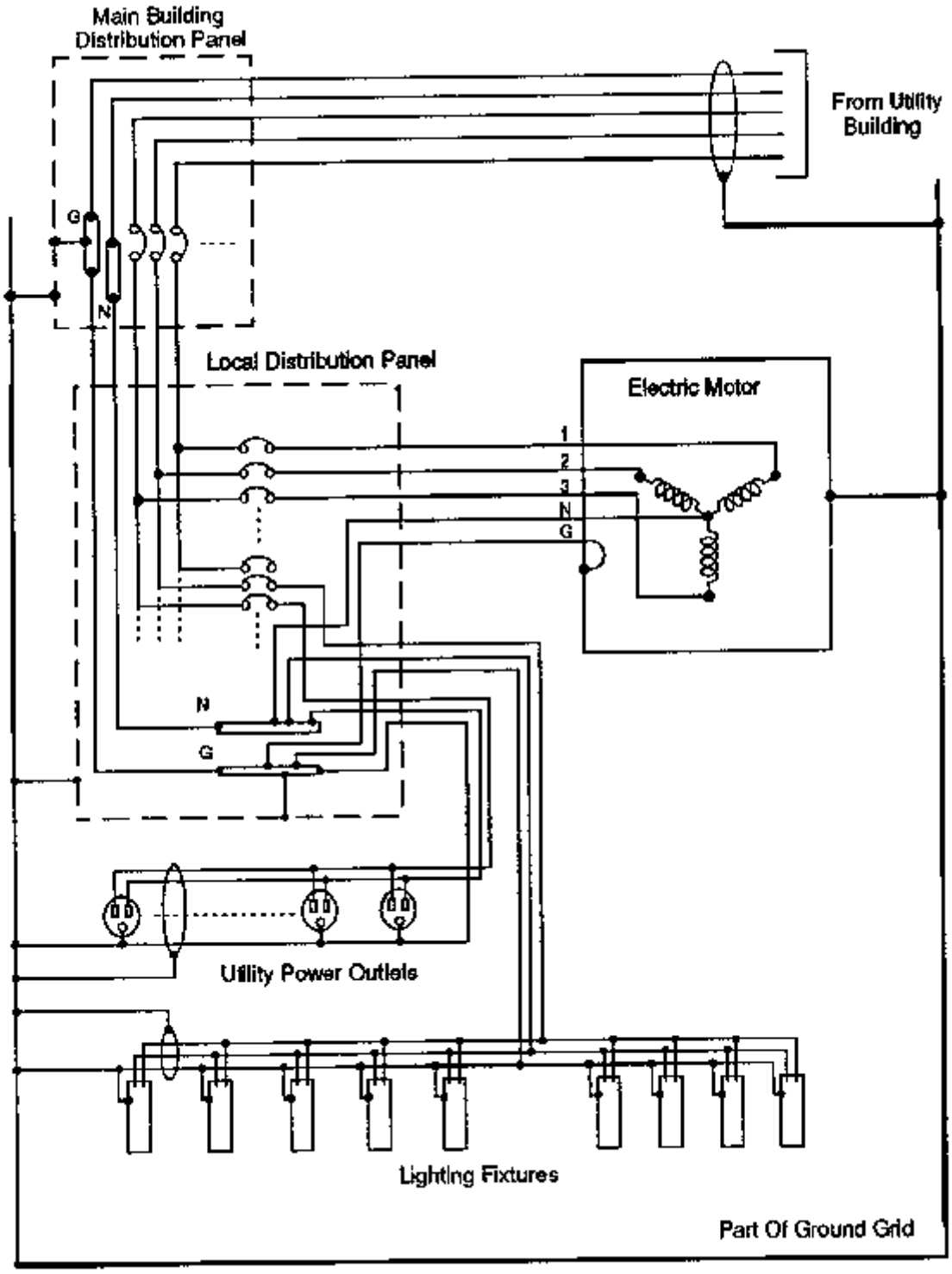
S24.802





Attachment #2 - Technical Power Distribution and Grounding for CDA Equipment Rooms

Requirements for Compliance with National Electrical Code and S24.809



Attachment #3 - Utility Power Distribution and Grounding for CDA Equipment Rooms
Requirements for Compliance with National Electrical Code and S24.809