CHAPTER 14

TRANSPORTABLE AND MOBILE INSTALLATIONS

14.1 GENERAL

This chapter discusses transportable and mobile communications-electronics configurations which are partial or complete electronics systems installed in shelters, vans, semitrailers, etc. This chapter deals with the more demanding materials and installation reliability requirements brought about by the restrictions, limitations, stresses, and strains of mobility and transportability. It discusses such areas as cable and wiring methods, cabinet positioning, ventilation and cooling, power and lighting, bonding and grounding, antennas and transmission lines, and painting and refinishing. When installation practices are identical to permanent installation practices, that information in the applicable chapter in the handbook is referred to. For purposes of clarity and understanding, transportable and mobile installations are defined as follows.

14.1.1 Transportable Installations

A transportable structure specifically designed to house electrical and/or electronic equipment so the equipment may be used without removal. It is designed to be transported from location to location on a low bed semitrailer over improved road surfaces at minimum speeds. These units are also designed to be sea and/or air transportable. Transportable installations usually are placed on concrete hardstands and take on a semi-permanent nature (see figure 14-1). Transportable installations are generally of a more complex nature providing facilities for large scale communications systems. They usually consist of several large size containers or shelters, about equal in size to a semitrailer, which are joined together on site to allow internal access from van to van and to permit operations similar in scope to a fixed shore station.

14.1.2 Mobile Installations

A mobile structure designed for tactical employment and equipped with special shock resistant mounts for the mounting of electronic equipment. The structure is designed to be carried on wheeled vehicles or has its own integral wheels capable of supporting all of its weight. These units are also air and/or sea transportable. Mobile installations are designed for transporting electronic equipment over rough terrain under combat conditions, with quick tear-down and set-up features where rapid deployment is of the essence (see figure 14-2).

14.1.3 Structure

Where feasible, both transportable and mobile installations utilize standard size containers modified as necessary which will provide the advantages of intermodal transport (sea, rail, road, and air) or are designed to standard (USASI/ISO) container dimensions and have standard fittings.

14.2 CABLE AND WIRE

Cable and wire selected for use on transportable and mobile installations differs from fixed installations in that stranded cable is predominately used. The use of stranded conductor for power wiring is mandatory. Use of solid conductors often results in wiring and lead breakage creating major operative problems. Thus, stranded wire, properly laced or wrapped, with adequately spaced clamps for cable and wire bundle support, and the incorporation of slack at terminal connections play an important part in minimizing operative problems. In all cases, installation must be in accordance with the National Electric Code (NEC). One factor of particular importance in transportable and mobile installations is that in those non-power instances where solid conductors must be used, it becomes doubly important that they be securely anchored along the entire run to prevent unnecessary flexing and sufficient slack must be incorporated at the termination points to compensate for in-transit motion.

14.3 CABLING AND WIRING METHODS

14.3.1 General

Basically, the NEC must be adhered to, but special practices must be used when the layout of cabling and wiring is considered in relationship to these types of installations. This portion of the handbook addresses those practices peculiar to transportable and mobile installation cabling and wiring methods. (Chapter 4 provides detailed information on general cabling and wiring.) The following factors should be considered when installing cabling and wiring:

a. Space limitations are constantly encountered in these installations. Therefore, maintainability and future expansion requirements must be considered whenever routing cable and wire.

b. Cabling and wiring must be installed in a manner that permits circuit checking or circuit renewal without removing major pieces of equipment. Planned wiring-preformed harnesses should be incorporated wherever possible to create a neat, orderly installation conducive to rapid checking and repair (see figure 14-3).

c. When assembling cabling and wiring on preformed harnesses: wires and cables must be situated to minimize inductive and capacitive effects; connector plugs and receptacles should be positioned at strategic locations to facilitate rapid connection and disconnection of major items; wire and cables should be long enough to allow otherwise unaccessible equipment to be removed for service without disconnection.

d. Cabling and wiring should have sufficient clearance from high-heat radiating components.

e. Minimum bending radius of wire and cable must be considered.

14.3.2 Metallic Ducts

Ducting must be in accordance with the NEC. A wide variety of metallic ducts is available for the various applications within an installation. Ducting is a preferred method of running cable due to its flexibility in meeting most installation requirements while still providing the required cable segregation and physical protection along with a relatively neat appearance. Underfloor areas can be used for cabling if the underfloor structure is designed for this purpose. A means of access by removable panels and lack of sharp edges and protruding fasteners should be considered.

a. Wireways. Wireways are a fabricated sheet metal trough, with either hinged or removable cover used to support large numbers of conductors without using cable clamps. The sides of the trough generally have closely spaced variable size knockouts where conduit may be attached. This type construction provides a flexible means of supplying branch circuits. A limitation of this type of system is that the voltage between conductors or conductor and ground should not exceed 600 volts, and the sum of the cable cross-sectional areas used must not exceed 20 percent of the interior area at any one cross section of the duct. Wireways intended for outdoor use should be of approved rain-tight construction. Wireways should not be installed where subject to severe damage or corrosion, nor in any hazardous location. Installation of a wireway system is accomplished by the use of special fittings and support attachments. Any electrical supply catalogue will provide a wide selection of manufacturers and specific parts information.

b. Metallic Surface Raceways. Sometimes called over-floor pancake raceway, these wireways are designed in such a manner that they will constitute a minimum hazard to foot traffic if properly installed. When used, they must conform to NEC requirements. The amount and sizes of conductors that may be run through these raceways are specified for each size by the manufacturer based on the NEC. Several manufacturers fabricate equivalent products; a complete line of one or more is "off-the-shelf" available from most electrical supply houses.

(1) Wiremold. Wiremold is another form of surface duct available in several styles and sizes designed specifically to prevent physical damage and provides shielding to cables and wiring. In transportable installations, the more commonly used types are the series 2000 and 3000. Wiremold series 3000 is unique in that it may be used for power, signal, or control distribution. The series 2000, also known as plugmold, can be ordered with 2 and 3 wire grounding receptacles, single receptacles, and single-pole switches. The series 2000 is rated for 15 or 20 ampere service and consists of a channel base with a snap fitting cover. It measures 1-9/32 inches from side to side and is 3/4 inch high with 1/2-inch entrance knockouts on 8-inch centers and is supplied in 5- or 10-foot lengths. The series 3000, also known as plugmold, can be used with any device designed for a standard single gang box. This series is rated for 50-ampere service and consists of a channel base with snap fitting cover. It measures 2-3/4 inches from side to side and is 1-7/16 inches high with 1/2- and 3/4-inch entrance knockouts on 9-1/4-inch centers and is supplied in 10-foot lengths.

(2) Dual Compartment Ducting. Dual Compartment Ducting consists of a metallic duct with two individual compartments sharing a common cover. It is ideally suited for separating power from communications circuits. A wide variety of fittings is available for use with this ducting. Wiremold series 4000 can be ordered with or without the divider strip. With the divider, the ducting will accept devices up to 20 amperes and without the divider it will accept devices up to 50 amperes. It measures 4-3/4 inches from side to side with each compartment measuring 2-3/8 inches when the divider strip is used and is 1-3/4 inches high and is supplied in 5- or 10-foot lengths.

c. Conduit. In transportable installations conduit is used in primary power distribution systems to couple power-input receptacles to power distribution panels and to interconnect sub-panels. Conduit is also required where penetration of walls, floors, or roofs is necessary for control-circuit. The most important factors to keep in mind are vibration and the transmission of vibration, since rigid conduit transmits vibrations from one unit to the next. It is, therefore, imperative to fasten the conduit securely and to insert a section of flexible conduit between the rigid conduit and a piece of equipment which causes vibrations or movement. Protective bushings must be used where rough edges might chafe the cable or wire.

14.4 CABLE AND CONDUCTOR TERMINATING AND MARKING

Cable and conductor terminating and marking on transportable installations is accomplished in much the same way as is done in permanent installations. However, certain practices utilized on mobile and transportable installations are peculiar to this type of effort. Special emphasis is required in the following areas:

o Arrange wires and cables on terminal boards or connectors so that inductive and capacitive effects will be at a minimum. All design precautions to maintain low interference levels may be nullified if this is not done properly.

o Wherever possible, terminals that grip the wire insulation shall be used to provide additional support and strain relief.

o Do not depend solely on solder for mechanical support.

o Secure textile- and glass-insulated ends of wires against fraying by mechanical means or by applying varnish conforming to military specifications.

o Leave sufficient slack in wires and cables to make at least two additional terminations (service loops); this type of installation is subject to vibration and shock.

o A general Navy requirement is that 10-percent spares be available so that conductors may be replaced without having to run new cables. These spares should be long enough to reach the most remote terminal board within the cabinet or equipment; they must be folded back and laced until used.

o All cables, except antenna cables, carrying information to or from equipment, cabinets, or containers terminate on a distribution frame or junction box. When connecting to the distribution frame, keep audio and control circuits separate to minimize interference.

o In order to facilitate removal of equipment for servicing, a quick-disconnect cable termination is desirable.

o Strain relief must be provided so that when portable cables are plugged into container-mounted connectors, the weight of the cable does not hand on the connector. This may be accomplished in the design of the box; a rack may be placed in front of the panel or the cables may be tied to the frame of the mobile unit. (See figure 14-4 for a possible method.)

o Where control and signal cables leading to antennas penetrate the roof of a van, a suitable protective cover must be provided. (Figure 14-5 shows a preferred method.)

14.5 LAY-OUT OF EQUIPMENT CABINETS

14.5.1 Equipment Lay-Out

a. Container Modification. The maximum practicable size for an equipment container is 40 feet long, 10 feet wide, and 10 feet high (see figure 14-1). Modification of standard commercial containers or existing transportable enclosures generally involve entrance, egress, access and cable penetration openings; the installation of equipment, partitions, interior linings, lighting and environmental control ducting. The foremost consideration is to avoid degradation of primary structure and to reinforce same where necessary.

b. Weight Distribution. When planning the installation of equipment emphasis will be given to locating the heaviest units in the lowest positions and in a well divided manner laterally and longitudinally to improve the resulting center of gravity (c.g.). Supplementary framing and tapping plates should be added where floor construction is not adequate to hold the normal load plus additional factors dependent upon mode of transportation such as air transportability in accordance with MIL-A-8421. The c.g. for each of the three axis (vertical, lateral, and longitudinal) is determined by the sum of all the individual component weights times their c.g. distance from a convenient reference divided by the total weight which gives the final c.g. distance from the reference. The three calculations then locate the final c.g. in space which should be as low as possible vertically and as near centered as possible laterally and longitudinally. A c.g. mark ⊕ should be placed on the external surface of each side and end where a perpendicular to that plane would penetrate the c.g. for reference by loaders, handlers, riggers and drivers.

c. Service and Accessibility. Equipment service and accessibility factors must receive adequate consideration during the design and engineering phase of the configuration. Access into a cabinet or rack to service the equipment and to perform essential maintenance is a function of the physical configuration of the equipment package as well as the type, size, and locations of the access openings and cabinet slides and drawers. Poor design of accesses can cause difficulty in reaching recessed components and unnecessarily restricts the technician in the inspection, troubleshooting, and repair of defective items. The following questions should be answered in the affirmative, if the entire configuration is to be considered as properly installed:

- Are all primary controls within easy reach?

- Are all meters, dials, and control indicators visible without having to bend or strain?

- Are all secondary controls reasonably accessible for periodic adjustments?

- Can individual units be serviced while still attached to their cabinets?

- Is it possible to remove chassis without danger or strain?

d. Human Engineering. The discussion of human engineering factors is beyond the scope of this handbook; however, proper consideration of all elements which contribute to efficient operation of the equipment and permit ease of maintenance under satisfactory conditions must receive full analysis and evaluation and be satisfactorily resolved by the design engineers. Refer to MIL-STD-1472, "Human Engineering Design Criteria for Military Systems, Equipment, and Facilities."

14.5.2 Cabinet Mounting

The installation of cabinets in transportable configurations will vary depending on the weight and size of the equipment and the maintenance consideration involved. Receivers, teletypewriters, and similar-size items are usually installed in standard and commercial cabinets which can accommodate 19-inch panels. Because of space limitations within the container, the cabinets are installed against both walls with access to each equipment after installation only from the front. The equipment must be mounted on the cabinet rack or installed in drawers or slides which can be easily pulled out or removed for necessary maintenance. (See figure 14-6.)

Large radio transmitters and power amplifiers installed in many transportable configurations are of such a size and weight as to require installation only down the center of the container for proper balance and distribution of weight. The sets are placed on specially designed bases and bolted to the tapping plates in the reinforced floor. Maintenance operations and the necessity to remove and replace bulky items at intervals requires access to the equipment cabinets from both the front and at the rear. (See figure 14-7.)

14.5.3 Shock Mounts

Shock mounts are not used to a great extent in large transportable configurations as the equipment is not subjected to sustained vibration, acceleration, shock, or changes in load direction. During movement to operating site, care must be taken that the equipment racks are securely fastened and supported by bracing and tie-down cables, that all wire and cables are securely fastened in place, and cabinet drawers, slides, and doors are locked or otherwise secured to prevent damage during shipment. After the installation has been transported to its operating location, it will remain there for an indefinite period and be operated as a fixed, semi-permanent communication facility.

There may be instances when shock mounts are used to protect sensitive and delicate equipment from damage due to normal use and handling. In the event a defective mount has to be replaced, the installer should use the same type or an approved substitute.

14.5.4 Equipment Mounting

a. Slides. Equipment, where practicable, is slide mounted to permit individual units to be partially removed for servicing. Slides are available in many combinations of bearing and bracket configurations. One principal advantage of using slides is that it permits equipment of various depths to be rack mounted without modifying rear-mounting rails.

b. Mounting Hardware. To mount slides and accessories in the interior of cabinets, pan-head machine screws are used. The screws should be of the cadmium plated steel series AN (Aircraft) type. For exterior use, such as fastening the front panel to the front mounting rails, oval-head machine screws (AN type) in conjunction with cupwashers are preferred. Screw threads should project through the nut to a maximum of 1 to 1-1/2 threads. To guard against marring the front panels, nylon washers are recommended under the cup washers.

14.6 EQUIPMENT AND CABINET VENTILATION

14.6.1 General

Most equipments and cabinets are ventilated by natural convection or fan-forcing, depending on heat quantity and concentration. To preclude operation which would adversely affect reliability, refer to the manufacturers' installation data to determine:

- o Properties of air to be supplied such as temperature, moisture, contaminant, and pressure limits.

- o Need for, and quality of, external filtration.

- o Need for, and quantity of, external force ventilation.

Careful evaluation of the above with the requirements for operator comfort and the economics involved will determine whether the transportable or mobile enclosure as a whole should be ventilated, air conditioned or whether a combination system is the optimum solution. The ultimate solution for container ventilation systems is a NAVFAC responsibility.

14.6.2 Installation

It is preferable to locate air conditioning units on the inside of the transportable in lieu of outside wall mounting because they are less vulnerable to damage and do not require separate handling and shipping.

14.7 POWER AND LIGHTING

14.7.1 General

Transportable installations are designed to operate on either commercial power or generator power with the determining factor being the availability and reliability of the commercial power at the intended site. Mobile installations require portable generators for power. The following paragraphs will be restricted to the employment of generators in either the primary or standby mode since commercial power requires little, if any, further discussion.

14.7.2 Transportable-Installation Power Connections

The installation of power connections for transportable installations is a NAVFAC responsibility.

14.7.3 Lighting

Installations generally have two lighting systems: a normal (primary power) system and an emergency (battery operated) system to provide illumination for egress in the event of a power failure. Design and installation considerations must be in accordance with the criteria set forth in NAVELEX Handbook 0101,102.

14.8 BONDING AND GROUNDING

14.8.1 General

The proper bonding and grounding of electronic equipment is of paramount importance in all types of installations. It directly affects the operational efficiency of the equipment, contributes to the reduction of noise, and is a major safety factor in preventing serious injury. (See Chapter 10 for a general discussion of grounding and bonding.)

Transportable communication facilities are designed to provide operations at remote or selected locations throughout the world. The bonding and grounding techniques used can be of the more permanent type as the facility once installed will operate there for an indefinite period. In the event it is eventually moved, the grounding system will, to all intents, be abandoned in place. Mobile installations must carry their ground rods and interconnecting cables and its electronic equipment. Being shock-mounted requires extensive use of bonding straps to establish low impedance paths.

The grounding facilities at installations where the transportable configurations are used will be designed by NAVFAC and installed by public works or contractor personnel responsible for constructing the entire facility. The electronic-equipment installer will only have to tie into the ground stub with a short connection from the container.

14.8.2 Bonding

Bonding is the process of physically connecting two metallic surfaces to provide a low impedance path for electromagnetic interference and stray currents. A direct bond is a permanent or semi-permanent metal-to-metal contact joint between the mating parts. Soldering and welding are the preferred methods; however, are often impractical in mobile installations. Preparatory to bonding, mating surfaces must be cleansed of paint and oxidation. Caution is required when bonding anodized aluminum surfaces; this type of finish, although clean, can cause high resistance joints. Lock washers of the internal-external type are preferred for bonding as they bite into both surfaces and thus ensure contact. (See figures 14-8 and 14-9.)

In the event equipments are shock-mounted, low inductance bonding straps are required. High powered transmitters and power amplifiers generally use separate external ground connections bonded to the individual equipment.

The straps should be slightly curved and long enough to allow movement of the shock mounts when equipment moves. Strap ends should be brazed or silver-soldered to the ground bus or terminal. The connections to equipment or cabinets should be bolted and have a measured resistance of 0.01 ohm or less.

Bond and ground connections should be periodically inspected for corrosion. The two most common causes of corrosion are moisture and the electrolysis (electrolytic action) that takes place when two dissimilar metals are placed in contact with each other while immersed in an electrolyte (conductive fluid or paste). Evidence of electrolysis is exhibited by one of two metal surfaces being eaten away (corroded) while the other surface becomes plated.

14.8.3 Grounding

Proper grounding of transportable containers serves the following important purposes:

a. Personnel and Equipment Safety. Ground in accordance with NEC is necessary in case the equipment is struck by lightning or in case internal power wiring shorts occur. Lightning and static charges frequently follow the transmission line to the container and then to ground. A ground with excessive resistance or inductance could place the container at a very high potential with respect to the earth's surface.

b. Radio Frequency Return. Transmitting antenna radiation efficiency is directly proportional to grounding efficiency at both the antenna and the transmitter equipment. Excessive inductance in the ground lead could place the van above ground at radio frequencies, creating personnel and fueling hazards.

c. Interference Reduction. When the van is ineffectively grounded, the possibility of interference pick-up is greatly increased. Resistance or inductance in the grounding system makes the van electrically more susceptible to interference from external sources.

The equipment cabinets in the van are bonded to a common bus or strap which in turn is bonded to the van at an external ground plate. Ground plates should be constructed with sufficient surface area to carry the required current and to retain a low resistance connection for long periods of time (see figure 14-10). Bonding to the van at both ends of the common ground strap can create undesirable ground loops. All grounding circuits, therefore, generally terminate at one ground plate. Power circuits require a separate ground. Common ground busses should have a large surface area to reduce losses at radio frequencies.

The conductor between the van and the ground rod should be as short as possible. When excessive lengths of ground lead are used and are accidentally coiled, the resulting inductances could spoil an otherwise well-engineered grounding system. The conductor should be capable of carrying at least 100 amperes.

Standard steel or copper-clad steel ground rods approximately 8 feet in length and 3/4 to 1 inch in diameter are most commonly used. Multiple ground rods, connected parallel, are sometimes required to obtain good, low resistance ground.

14.8.4 Grounding Methods

The grounding methods required by the NEC and those described in NAVFAC and NAVELEX documents are applicable to both transportable and mobile installations as well as fixed facilities. The specific method used will be the result of an engineering evaluation of all factors including the operational characteristics of the system, power requirements, local environmental conditions and other applicable considerations. The driven type of ground electrode offers the most convenient means of providing electrical ground connections and will satisfy the grounding requirements of most transportable and mobile installations. It has the advantages of economy of installation and satisfactory ground terminations.

14.9 ANTENNAS AND TRANSMISSION LINES

The antennas and transmission lines used with transportable installations are identical in most respects to those installed for permanent fixed communication stations. Mobile vans require lighter and smaller antennas and transmission lines which can be easily erected and installed and can be dismantled in a short time using a minimum of personnel.

14.9.1 Antennas

Antennas for transportable configurations will normally be erected in an open area at some distance from the equipment vans and will be placed on steel towers or wooden poles. The type of antenna support selected will be based on the required elevation necessary for proper transmission and reception and the guying arrangements to maintain the necessary rigidity. The erection of the larger antennas will be done by specialists in antenna rigging supported by personnel and equipment from the base construction activity. The electronics equipment installer will be responsible only for the proper termination of the transmission lines to the antenna entrance panels on the equipment vans.

Mobile antenna installations are very susceptible to vibrations. Antenna bases and mountings have a tendency to loosen when subjected to the shifting action due to winds or motions of the vehicle. Mounting hardware should be carefully installed according to manufacturer's instructions. Locking nuts will be used wherever possible. Whenever non-standard type installations are made, the structural strength of the mounting surface must be taken into consideration. The average van wall or top must be reinforced with stiffening plates. Antennas with large surface areas, such as telemetry or radar reflectors, exert large amounts of torque on the mounting surface both in normal operation and in non-operating conditions, especially when high winds are encountered. Structural damage to the van may result if installation or operation of such antennas is attempted before the van is leveled and legs or braces are positioned.

14.9.2 Transmission Lines

Transmission lines used in transportable and mobile configurations are the same as those used in fixed station applications. Flexible coaxial lines of 50 ohms impedance are used almost exclusively. Since the lines in mobile installations are subject to considerable handling and abuse, the lines must be handled carefully and installed and terminated in the proper manner.

The termination of RF transmission lines can be a source of trouble if common-sense precautions are not observed. Strain relief should be provided at both ends to support cable weight. The clamping nut on most coaxial connectors is designed to provide a good electrical connection but not to support the cable. Clamps or supports should be selected which firmly grip the cable body without distorting the dielectric. Slack should be provided between the strain relief and the connector for ease in connecting and disconnecting. Exposed connections should be wrapped with vinyl tape (Military Specifications MIL-T-15126, type VF) if the installation is to remain assembled for extended periods of time.

External transmission lines must be protected from damage. For short runs, direct burial in the ground may be used. The trench should be about two feet deep. Soft dirt or sand should be placed in the bottom of the ditch and the first foot of fill dirt should be free from rocks (see chapter 5).

14.10 FINISHING

14.10.1 General

All materials not inherently corrosion resistant should be painted, plated, or otherwise protected as appropriate for the intended purpose and life of the product. Small parts subjected to constant wear of abrasion should be plated. There are many finishing systems which would be acceptable for transportable and mobile use and it is beyond the scope of this document to consider all systems. In general, however, use of Federal or Military Specification materials and procedures will insure a quality product. External parts should preferably be protected with enamel type paints of full gloss type, except for the tactical applications requiring a non-reflective surface, due to their superior weather resistance. Internal parts can be semi-gloss or lusterless, as appropriate, and can be either enamel or lacquer type finishes. Wearing and friction surfaces which must be lubricated and which are protected by lubricant need notbe painted or plated, but should have provision for relubrication.

14.10.2 Surface Preparation

Parts to be painted should be mechanically cleaned of all welding slag, scale, and rust or other corrosion. Other contaminants, especially petroleum residues, should be removed with a cleaning solvent.

14.10.3 Chemical Pretreatments

After cleaning and prior to priming, various chemical surface-treatments can be applied to provide additional protection in the event of damage to the paint and/or to provide a better bite with subsequent better adhesion of the paint system. Examples of these are:

- Pre-treatment coating for steel in accordance with MIL SPEC Mil-P-15328.
- Phosphate coating for steel in accordance with FED SPEC TT-C-490 Type I.
- Anodize for aluminum per MIL-A-8625.
- Chemical treatment for aluminum per MIL-C-5541.

14.10.4 Primers

Primers can be either enamel or lacquer types, but only enamel paint can be used over an enamel primer. Primers should be selected which have ingredients suitable for protection of the surface material such as FED SPEC TT-P-664 for steel and MIL-P-8585 for aluminum alloys.

Where a better appearance is desired over rough or scratch surfaces, a primer/ surfacer such as FED SPEC TT-P-662 can be used.

14.10.5 Finish Coat

The finish coat must be compatible with the previous coatings or blistering and lifting may occur. Enamels require fewer coats, one as a minimum, and lacquers require several coats with compound rubbing between coats for adequate protection without frequent additional care such as waxing. A lacquered surface weathers more rapidly than enamel but has a smoother surface. Typical quality materials are enamel per FED SPEC TT-E-489 or MIL-E-15090 and lacquer per FED SPEC TT-L-32 or MIL-L-19537. Colors for final finishes should always be selected from, and specified as a color number in accordance with, FED-STD-595. Colors most generally used are:

a. Color #17875 (gloss white). For external surfaces where a minimum solar heat gain is desired.

b. Color #16187 (gloss grey). For external surfaces where traditional Navy color is desired.

c. Color #13538 (gloss yellow). For equipment which must be conspicuous as an obstruction.

d. Color #17038 (gloss black). For external marking.

e. Color #26187 (semi-gloss grey). For equipment and internal surfaces such as cabinets, wireways, framing, etc.

f. Color #27875 (semi-gloss white). For interior ceilings.

g. Color #24466 (semi-gloss green). For interior walls, not otherwise covered such as simulated wood grain vinyl.

14.10.6 Refinishing and Maintenance

Unless necessary for extra protection or uniform appearance on visible surfaces, commercial finishes normally supplied on procured equipment need not be refinished. Where surfaces have deteriorated or have been damaged, it will be necessary to clean, prime, surface if necessary, and refinish. Care should be used in identifying the original surface so that compatible refinishing materials are used. When covering existing finish coats, the outer gloss should be removed by light sanding to provide bite for the new surface and to aid in observing coverage. When it is desired to use finishing materials which are not compatible with existing materials on the surface, surfacer/sealer materials are available for use as an in-between isolator. Such materials must be selected and used with care.

14.11 CONTAINER CONSTRUCTION

14.11.1 General

Most enclosures whether they be standard or non-standard utilize the longeron/stressed skin (semi-monocogue) riveted design concept. This permits maximum cube with respect to outside dimensions but places limitations on size and location of openings and requires careful design of framing around openings. Frame sections and location/spacing is a function of skin type and thickness, both inner and outer. It is beyond the scope of this document to treat this matter further due to the many varieties of constructions which are available and most of which would be acceptable for some application. Also it is not in the best interest of the Navy to specify one particular type of construction to the exclusion of others and competition.

14.11.2 Framing

Framing can be formed, rolled, or extruded sections of standard or non-standard sizes fabricated from steel or aluminum. Load capability of the completed structure should be assured through known performance or through acceptable calculations.

14.11.3 Skins

On industry products for mobile applications, skins are often aluminum to take advantage of its lightweight and corrosion-resistant properties. On electronic housing applications, this material is used for its light weight but primarily to gain long life. Either aluminum or steel can be used provided adequate finishes are applied.

14.11.4 Floor

Industry flooring is almost universally a tongue and groove hardwood deck. These floors, however, do not meet electronic equipment mounting requirements and fire criteria and so are usually replaced by a solid aluminum plate floor or plywood-metal lamination so that only a metal surface is exposed on both the bottom and top sides. A vinyl tile surface is subsequently added to the top surface.

14.11.5 Walls

For the simplicity of adding insulation and an interior skin an enclosure with internal framing (smooth or ribbed external skins) is generally selected. A thermal barrier such as wood or plastic laminate, in accordance with MIL-P-15047, is used to break the through-structure heat-path from outer to inner skins. Where the inner skin is plymetal laminate, this isolation is improved. The remaining space within the wall is usually filled with 1.5 lbs/ft^2 fiberglass blanket or 2.5 lbs/ft^2 frothed-in-position/ foamed-in-place polyurethane insulation. The interior wall surface, where the equipment is not predominantly mounted along the walls, is usually covered with a simulated wood finish material of phenolic or vinyl laminated to the surface.

14.11.6 Roof

Roof construction is sometimes similar to wall construction but usually departs as follows:

a. Where units are designed for predominantly over-the-road service and the shock, vibration, and twisting which results therefrom, a one-piece roof sheet is used which is attached only at the edges. This design lets the anti-rack stresses be reacted by the heavy floor structure in lieu of the lightweight roof sheet which would loosen around crossbow rivets and leak.

b. To preclude work hardening and cracking from wind ripple, oil canning, and to resist the stresses resulting from the possibility of personnel walking on the roof, a hardboard backing sheet is interposed between the roof sheet and the crossbow framing with an adhesive between the roof sheet and hardboard. A competent structural or mechanical engineer should be consulted when choosing the type of construction to be used. Insulation, thermal barrier, and inner skin is similar to the wall construction. The air ducting is generally located below the roof and above a false ceiling.

14.11.7 Other Features

a. Generally standard construction methods preclude the need for special bonding or grounding of individual parts. However, if construction methods or shock mounting electrically isolate a component or part, that item should be bonded or grounded as appropriate.

b. Coupling provisions to connect one container to another at the site should include the following features:

(1) A means to provide essentially a wide open continuity of space from one container to the next or passageway through a normal entrance egress door.

(2) A weather seal between the containers which will allow individual anchoring (tie-down) of each container which will accommodate at least a plus or minus two-inch departure from a nominal 8-inch spacing and misalignment up to one inch.

(3) An inter-container ramp which will also accommodate the above variations, while providing a smooth transition from one container to the other.

14.12 TRANSPORTABLE CONTAINER HANDLING

14.12.1 Standard Containers

When standard USASI/ISO containers are utilized no additional handling equipment, such as slings, is necessary. When containers depart from these standards, stacking, connecting, and handling by standard intermodal means is forfeited and other means of handling the units must be provided. When a departure is made, the only advantage in providing standard corner castings on the container would be to utilize them for a site adaptation convenience. NAVFACELECSUPPDIV Sketch 66 shows a typical standard container.

14.12.2 Non-Standard Containers

In considering the location for hoist fittings or rings on these units the following should be noted:

a. Placement of hoist points along the roof rail requires handling personnel to climb to the roof, or at least above ground level, to make connections. This should be avoided.

b. Placement of hoist points along the rub rail, at or near the ends, results in excessive sling height or angles which necessitate special and expensive spreader bars.

c. Placement of the hoist points at the quarter points along the lower rub rail will still provide adequate spacing for stability, will simplify sling requirements, will reduce stresses within the container, and is a location where heavy duty "D" rings or other fittings can be attached to heavy floor framing, thereby reducing the need for supplementary hoist framing to spread the loads into the container. This location for the hoist fittings, plus the use of cable retainers along the roof rail which are in line with the sling cable and heavy roof bows between the retainers, will preclude the need for external spreaders and special slings. This is the recommended arrangement. NAVFACELEXSUPPDIV Sketch 67 shows a typical non-standard container.

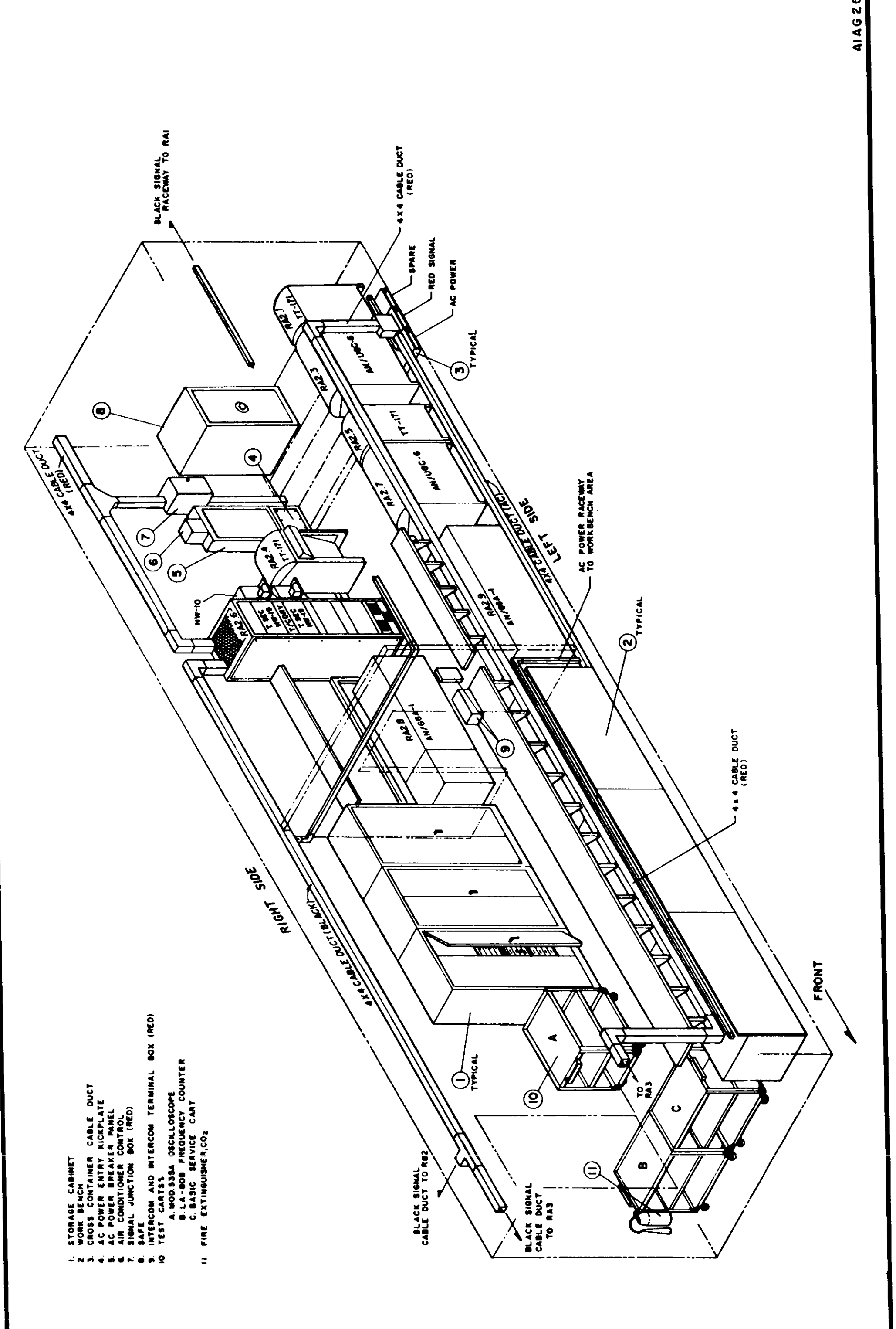

Figure 14-1. Typical Transportable Installation

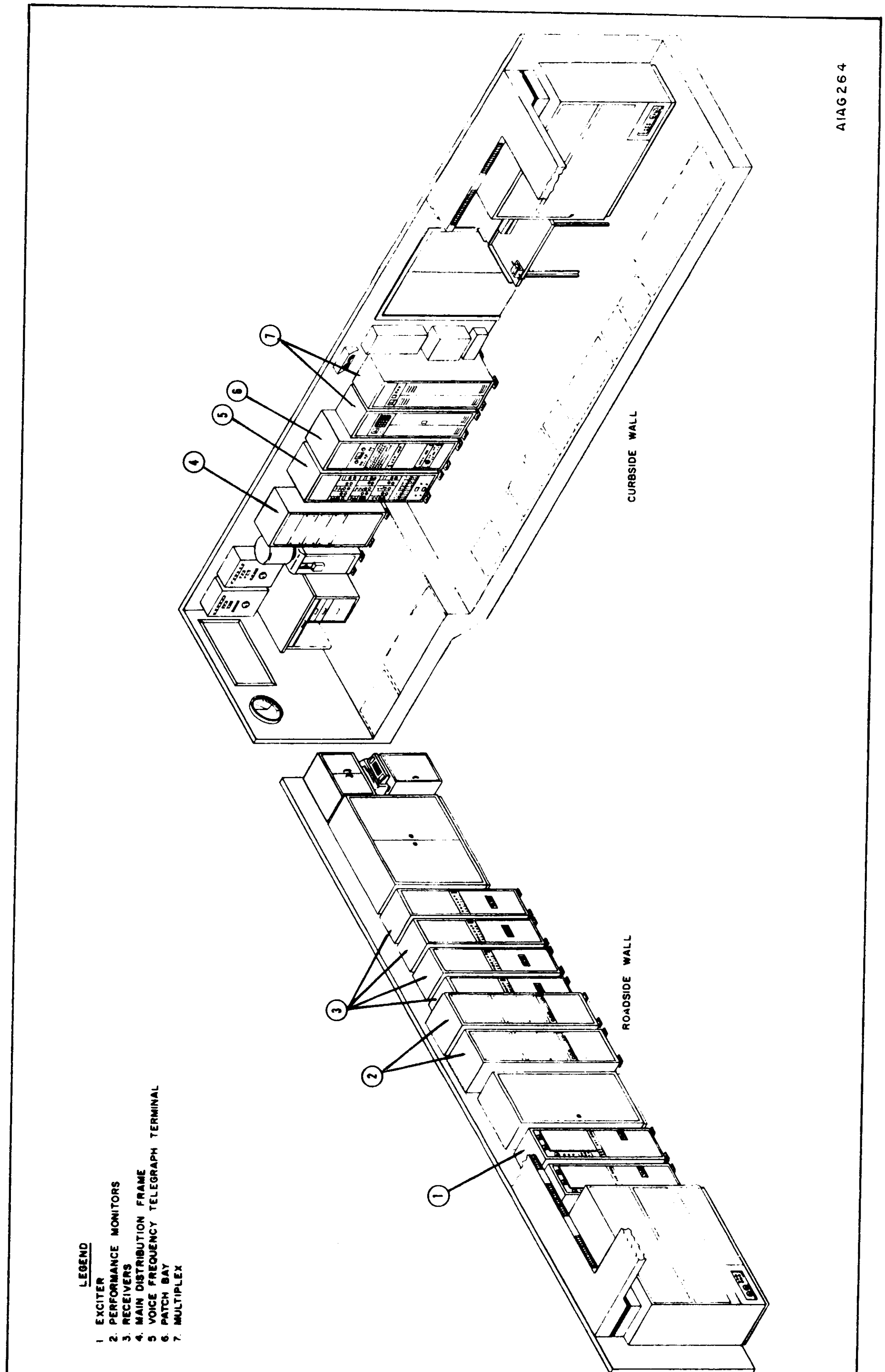

Figure 14-2. Typical Mobile Installation

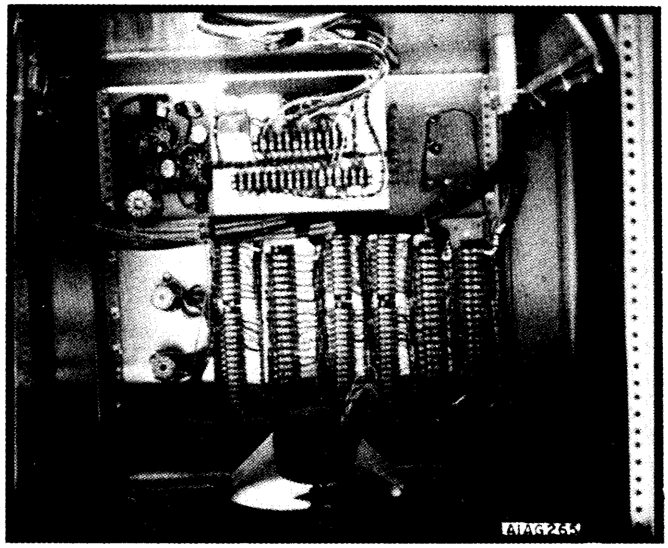

Figure 14-3. Example of Planned Wiring

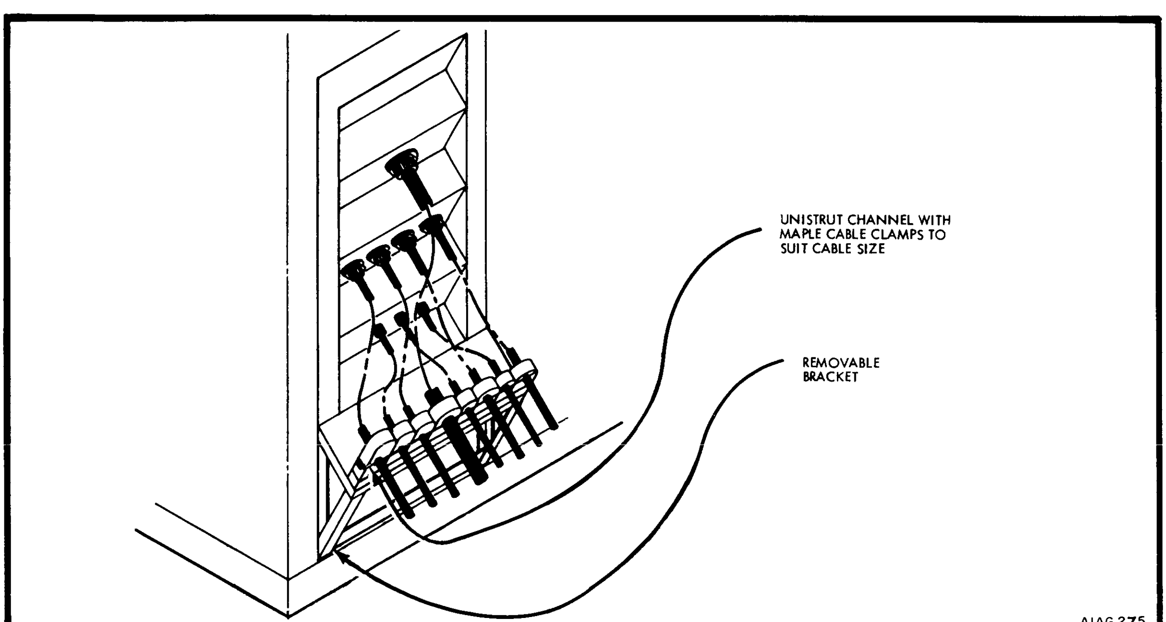

Figure 14-4. Method of Strain Relief for Cables

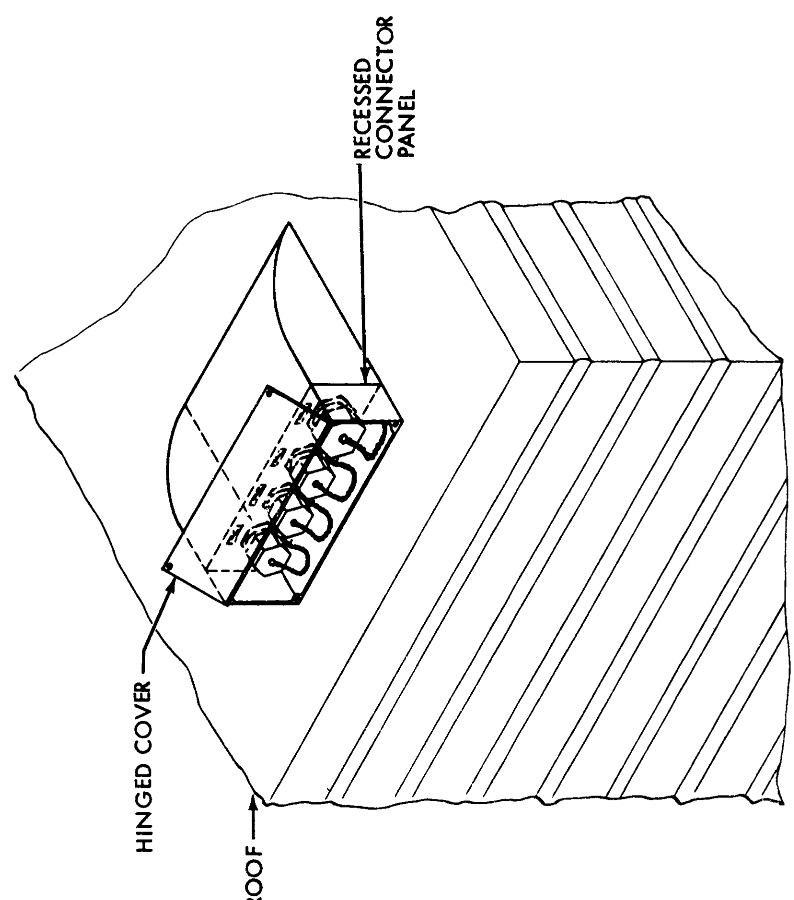

Figure 14-5. Entrance Panel for Control and Signal Cables

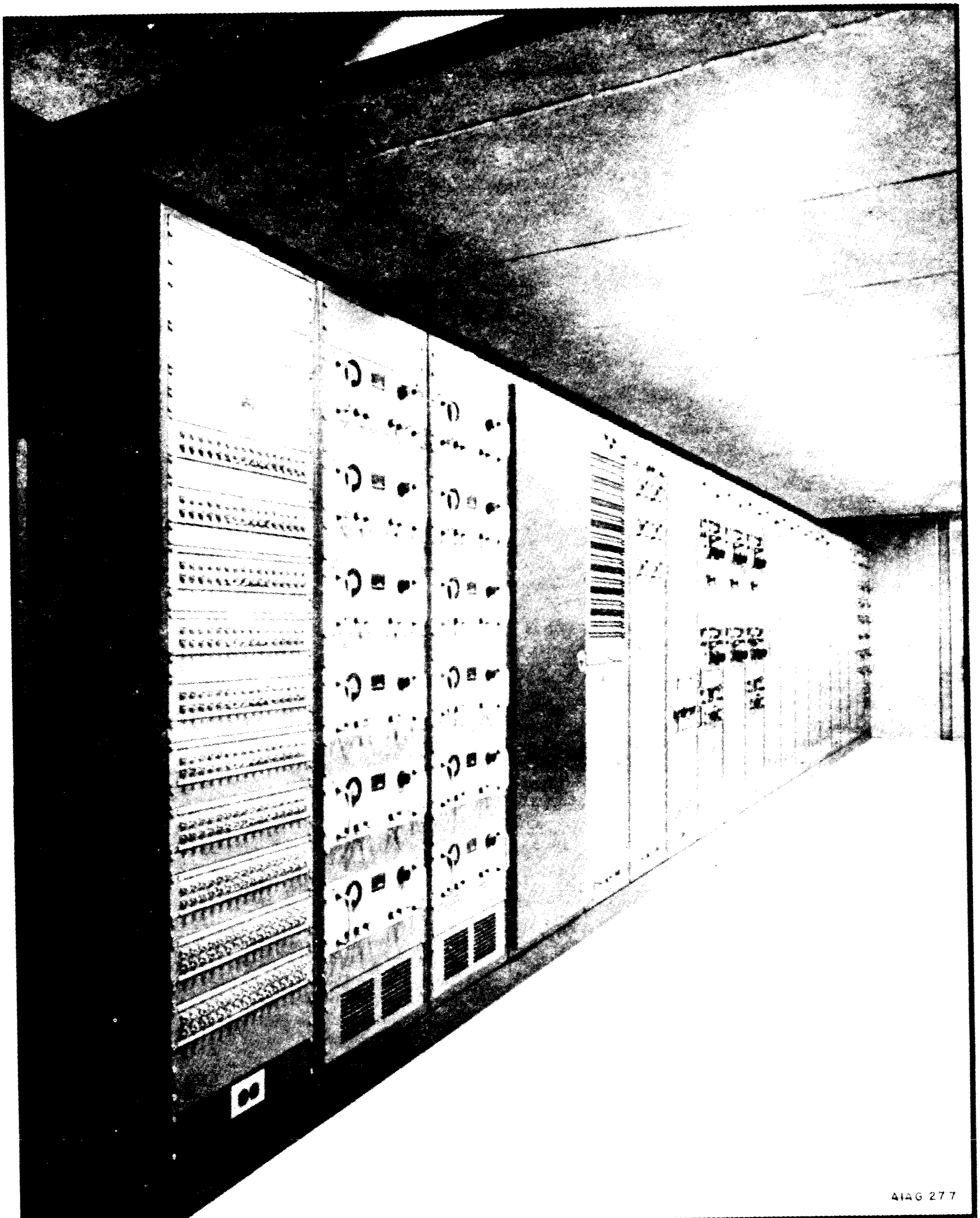

Figure 14-6. Typical Flush - Well Installation

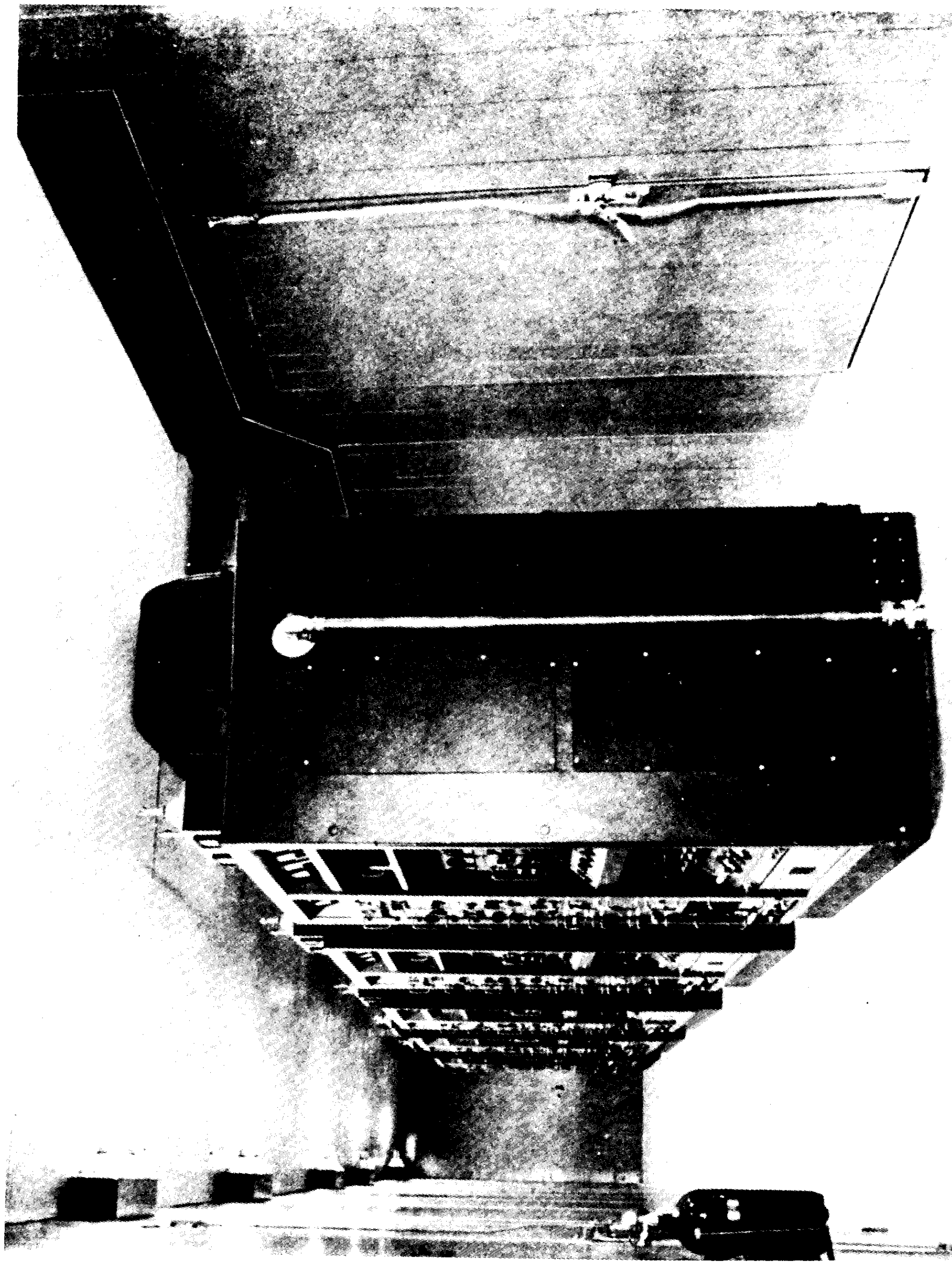

Figure 14-7. Typical Center - Mount Configuration

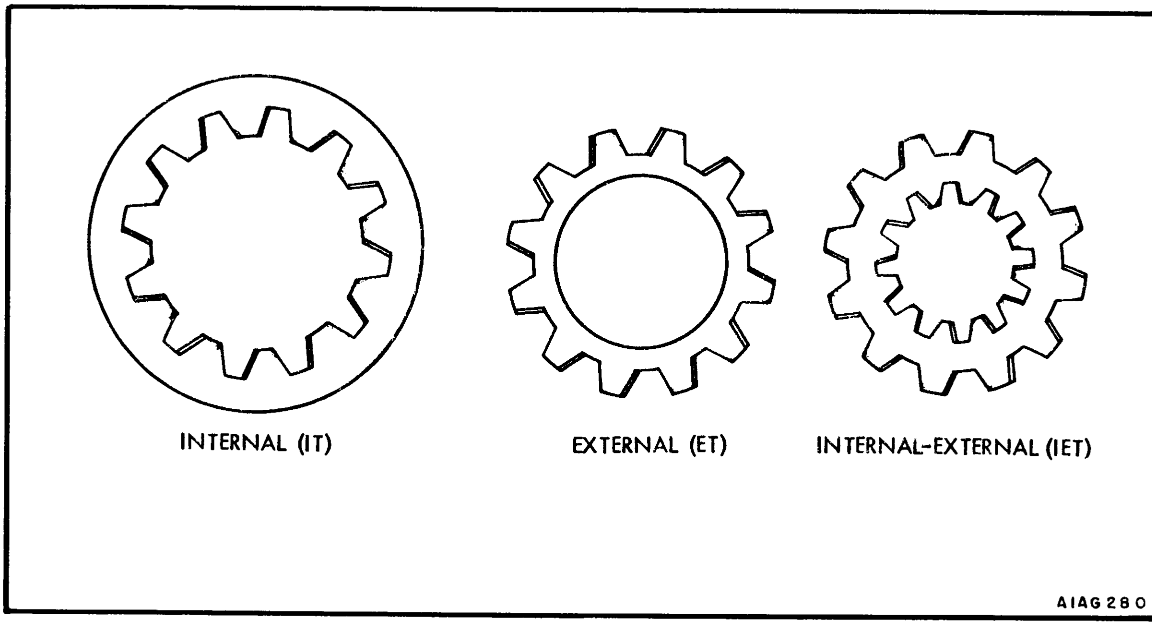

Figure 14-8. Tooth - Type Lock Washers

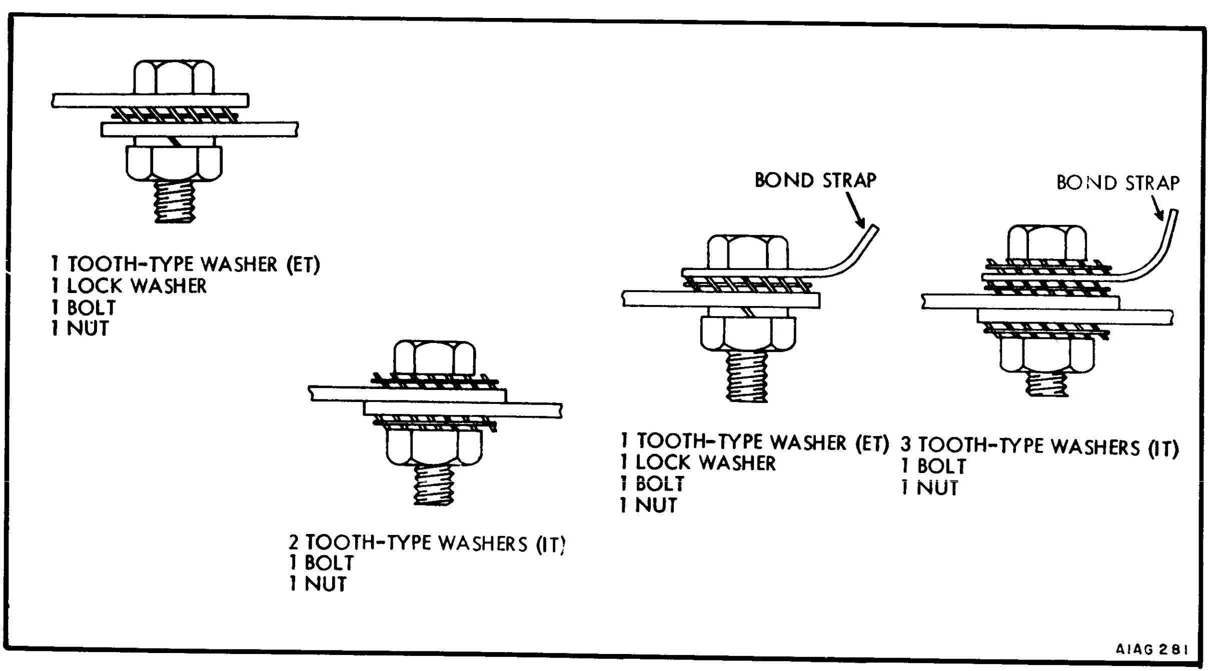

Figure 14-9. Typical Grounding and Bonding Applications of Washers, Bolts, and Nuts

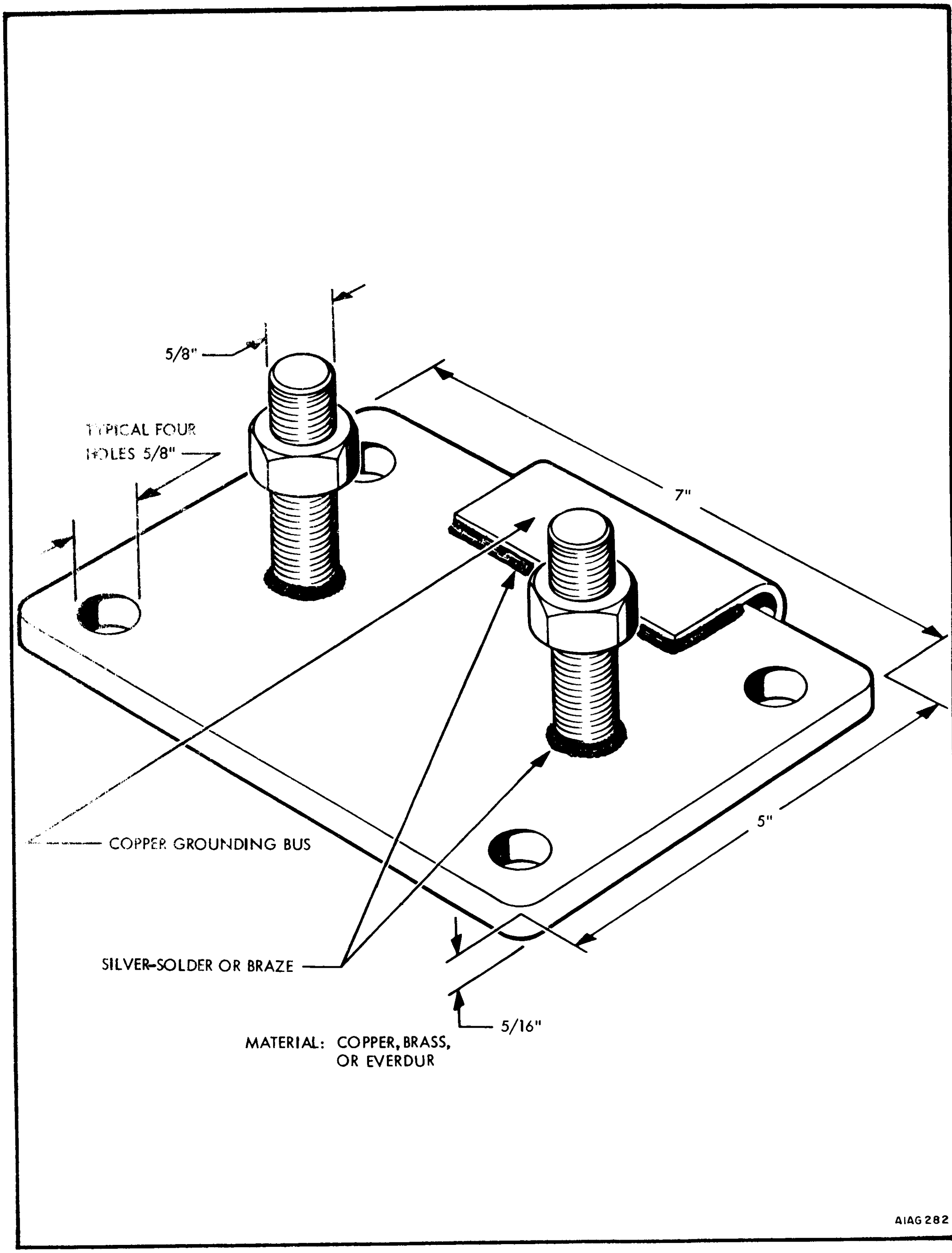

Figure 14-10. Ground Plate Construction