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GUIDE FOR THE DESIGN OF ELECTRICAL EQUIPMENT TERMINALS

PREPARED BY

Committee A-2, Aircraft Electrical Equipment

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GUIDE FOR THE DESIGN OF ELECTRICAL EQUIPMENT TERMINALS

INTRODUCTION

The design of electrical equipment terminals has frequently been left to draftsmen or technicians when many cases should have had the attention of an electrical engineer. Aircraft maintenance methods and safety requirements must be considered. This guide sets forth recommended practices for equipment terminals that will provide adequate connections for aircraft electrical equipment.

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1. SCOPE: The recommendations apply to all types and sizes of equipment. Some modifications or compromises may be necessary for very large or very small equipment but such deviations should be kept to a minimum.

1.1 Definitions: The terms "stud", "contact", "terminal" and "wire terminal" are graphically defined in Figure 1.

2. PHYSICAL DESIGN REQUIREMENTS:

2.1 Screw Threads: Screws or studs should have threads in accordance with MIL-S-7742. This is standard practice for Air Force and BuAer equipment. Commercial users will then have a standard by taking those items standard for the Services. The MIL standard should be constantly coordinated with the Federal Standards and the new Unified International Standard. Only the thread sizes listed in Table I should be used.

2.2 Contact Surfaces: Current carrying studs should be avoided where possible. Contact surfaces should be flat, clean, free of burrs and have an area which will permit a current density of no more than approximately 1,000 amps per square inch based on normal rating of the equipment or on single cable in free air rating for maximum cable to be accommodated. This area does not include the terminal stud or bolt. An alternate design criteria is that the area shall be equal to or greater than that of the terminal (per AN659) for the smallest conductor that is rated to carry the maximum design current of the device. Contact surfaces shall be raised above surrounding insulating materials.

2.2.1 Contact Supporting Materials: The pressure for electrical contact must not be transmitted through or be dependent upon materials which are known to shrink or relax with time or under heat. Phenolics and soft solder are examples of such materials. Thin dipped solder coatings (hot tin plate) on contact materials are of course acceptable.

2.3 Screw or Stud Length: The length of the screw or stud should be sufficient to accommodate at least two wire terminals, a flat washer, a lockwasher, and a nut. The two wire terminals will usually be positioned back to back. When determining the largest probable wire size to be used, assume one size larger (for reasons of voltage drop or circuit protection) than the bundled wire ratings listed in Table II.

Consideration should be given to aluminum as well as copper wire terminals. These requirements do not apply to terminal boards which are designed for connecting more than two wire terminals.

2.4 Materials and Finish: Current carrying members should be made of copper or high conductivity copper alloy. Iron and steel should be avoided except for low current applications. Copper or copper alloys should be silver-plated, tin-plated, or gold-plated. Steel, except stainless steel, should be cadmium-plated. Aluminum should be tin-plated.

Contact pressure exerting members should be made of high strength material. Thus, screws, studs, nuts and washers should be steel. If copper or relatively soft copper alloy (such as brass) studs are used, excessive wear of threads will result from repeated application of high temperature self-locking nuts. This may result in stud failure.

2.5 Strength:

2.5.1 Tension: Terminal or equipment should not be deformed or damaged when submitted to tension tests in any normally possible direction. Tensile values for such tests are listed in Table I. The method and means of mounting equipment should also consider these loads and be designed to accommodate them where they govern.

2.5.2 Torque: Studs and threaded terminals should be designed to take torques listed in Table I.

2.5.3 Vibration: If no strain relief is provided the terminals and mounting should be designed to withstand the vibration test of the equipment specification with the largest probable wire size (See 2.3) attached and secured as in an actual installation.

2.6 Covers: Covers to provide electrical protection are required for all terminals. They should accommodate at least two wire terminals at each point and should prevent shorts between adjacent terminals, unless this is accomplished by other means. When equipment may be located in otherwise protected locations such as junction boxes, the covers should be removable so as to eliminate weight in those applications. In general, covers should be made of insulating materials, flexible types preferred. Where a cover is also to serve as shielding for radio noise suppression, it may be made of metal but must be proof against causing short-circuits due to accidental crushing.

2.7 Barriers: Barriers should provide creepage paths at least equal to those recommended in the AIA Design Manual on Aircraft Electrical Installations. The temperature rise at the barriers must be compatible with the insulating material used, taking into account the maximum ambient temperature.

2.8 Terminal Spacing: Constantly increasing design flight altitude is creating a serious problem of insulation flashover. Therefore spacing shall provide clearance at least equal to that specified in MIL-C-5015. In addition to these electrical requirements, take advantage of size of equipment to provide as much space as possible to simplify wire terminal installation (use of tools) and minimize electrical hazards.

2.9 Preferred Terminal Stud and Screw Sizes: Table II lists the minimum recommended stud size for various load currents. In general, the preferred stud would be one size larger than this minimum. This will assure adequate terminations when voltage drop considerations dictate use of conductors larger than required on basis of current rating.

2.10 Preferred Hardware Arrangement: Preferred hardware arrangements for screws and studs and an acceptable arrangement for current-carrying studs are shown in Fig. I. Nuts may be any of the following: AN315, AN340, AN341, AN363 or AN365. The AN363 high temperature nut is preferred for all steel studs #10 and larger. AN935 lockwashers should be used with regular nuts and may be used even with self-locking nuts. AN936 tooth lockwashers shall not be used. Flat washers are used to distribute pressure to the wire terminals. Until agreement as to optimum washer diameters for use with aluminum wire terminals is reached, the washers shall be per AN960, regular weight or AN961. In order to maintain minimum electrical resistance, washers should not be placed in the current path. Thus no washers are used on current-carrying studs. All of the hardware furnished should have a finish compatible with the terminal pad or stud.

3. Special Requirements:

3.1 Special Tools: Refrain from incorporating anything in the design which might require special tools. Design to use only such tools as pliers, screw drivers and socket or spinner wrenches or the like.

TABLE I

TERMINAL SIZE	TENSION (lbs)	TORQUE (in.-lbs.)
6-32-NC2	30	10
8-32-NC2	35	20
10-32-NF3*	40	40
1/4-28-NF3*	50	80
5/16-24-NF3*	70	160
3/8-24-NF3*	100	240
1/2-20-NF3	150	400
5/8-18-NF3	200	500

*Class 2 fits also acceptable in these sizes.