SECTION 14. TERMINAL REPAIRS

11-174. GENERAL. Terminals are attached to the ends of electrical wires to facilitate connection of the wires to terminal strips or items of equipment. The tensile strength of the wire-to-terminal joint should be at least equivalent to the tensile strength of the wire itself, and its resistance negligible relative to the normal resistance of the wire.

a. Selection of Wire Terminals. The following should be considered in the selection of wire terminals.

(1) Current rating.

(2) Wire size (gauge) and insulation diameter.

(3) Conductor material compatibility.

(4) Stud size.

(5) Insulation material compatibility.

(6) Application environment.

(7) Solder/solderless.

Pre-insulated crimp-type ring-tongue terminals are preferred. The strength, size, and supporting means of studs and binding posts, as well as the wire size, should be considered when determining the number of terminals to be attached to any one post. In high-temperature applications, the terminal temperature rating must be greater than the ambient temperature plus current related temperature rise. Use of nickel-plated terminals and of uninsulated terminals with high-temperature insulating sleeves should be considered. Terminal blocks should be provided with adequate electrical clearance or insulation strips between mounting hardware and conductive parts.

b. Terminal Strips. Wires are usually joined at terminal strips. A terminal strip fitted with barriers should be used to prevent the terminals on adjacent studs from contacting each other. Studs should be anchored against rotation. When more than four terminals are to be connected together, a small metal bus should be mounted across two or more adjacent studs. In all cases, the current should be carried by the terminal contact surfaces and not by the stud itself. Defective studs should be replaced with studs of the same size and material since terminal strip studs of the smaller sizes may shear due to overtightening the nut. The replacement stud should be securely mounted in the terminal strip and the terminal securing nut should be tight. Terminal strips should be mounted in such a manner that loose metallic objects cannot fall across the terminals or studs. It is good practice to provide at least one spare stud for future circuit expansion or in case a stud is broken. Terminal strips that provide connection of radio and electronic systems to the aircraft electrical system should be inspected for loose connections, metallic objects that may have fallen across the terminal strip, dirt and grease accumulation, etc. These type conditions can cause arcing which may result in a fire, or system failures.

c. Terminal Lugs. Wire terminal lugs should be used to connect wiring to terminal block studs or equipment terminal studs. No more than four terminal lugs or three terminal lugs and a bus bar should be connected to any one stud. Total number of terminal lugs per stud includes a common bus bar joining adjacent studs. Four terminal lugs plus a common bus bar thus are not permitted on one stud. Terminal lugs should be selected with a stud hole diameter that matches the diameter of the stud. However, when the terminal lugs attached to a stud vary in diameter, the greatest

diameter should be placed on the bottom and the smallest diameter on top. Tightening terminal connections should not deform the terminal lugs or the studs. Terminal lugs should be so positioned that bending of the terminal lug is not required to remove the fastening screw or nut, and movement of the terminal lugs will tend to tighten the connection.

d. Copper Terminal Lugs. Solderless crimp style, copper wire, terminal lugs should be used and conform to MIL-T-7928. Spacers or washers should not be used between the tongues of terminal lugs.

e. Aluminum Terminal Lugs. The aluminum terminal lugs conforming to MIL-T-7099 (MS-25435, MS-25436, MS-25437, and MS-25438) should be crimped to aluminum wire only. The tongue of the aluminum terminal lugs or the total number of tongues of aluminum terminal lugs when stacked, should be sandwiched between two MS-25440 flat washers when terminated on terminal studs. Spacers or washers should not be used between the tongues of terminal lugs. Special attention should be given to aluminum wire and cable installations to guard against conditions that would result in excessive voltage drop and high resistance at junctions that may ultimately lead to failure of the junction. Examples of such conditions are improper installation of terminals and washers, improper torsion ("torquing" of nuts), and inadequate terminal contact areas.

f. Class 2 Terminal Lugs. The Class 2 terminal lugs conforming to MIL-T-7928 may be used for installation, provided that in such installations, Class 1 terminal lugs are adequate for replacement without rework of installation or terminal lugs. Class 2 terminal lugs should be the insulated type, unless the conductor temperature exceeds 105 °C. In that case uninsulated terminal lugs should be used. Parts' lists should indicate the appropriate Class 1 terminal lugs to be used for service replacement of any Class 2 terminal lugs installed.

g. Termination of Shielded Wire. For termination of shielded wire refer to MIL-DTL-27500.

11-175. ATTACHMENT OF TERMINALS TO STUDS. Connectors and terminals in aircraft require special attention to ensure a safe and satisfactory installation. Every possibility of short circuits, due to misinstallation, poor maintenance, and service life, should be addressed in the design. Electrical equipment malfunction has frequently been traced to poor terminal connections at terminal boards. Loose, dirty, or corroded contact surfaces can produce localized heating that may ignite nearby combustible materials or overheat adjacent wire insulation. (See paragraph 11-178)

11-176. STUDS AND INSULATORS. The following recommendations concerning studs also apply to other feed-through conductors.

a. Current Carrying Stud Resistance. Due to heat loss arising from wire-to-lug and lug-to-stud voltage drop, the resistance per unit length of a current carrying stud should not be greater than that of the wire.

b. Size of Studs. In designing the stud for a feed-through connection, attention should be given to the higher resistance of brass, as compared to copper. A suggested method of determining the size is to use a current density in the stud equivalent to that of the wire, compensating for the difference of resistance of the metals. Consideration should also be given to mechanical strength.

c. Support for Studs. The main stud support in the feed-through insulation should be independent of the attachment of the lugs to the stud. Therefore, loosening of the insulation support of the stud will not affect the

electric contact efficiency. In other words, the contact pressure on the wire lugs should not in any way be affected by the loosening of the stud in the insulator.

d. Support of Wire at Studs. Unless some other positive locking action is provided, the lug or wire should be supported next to the stud to prevent loosening the connection with a side pull on the wire. Torque recommendations for attaching electrical wiring devices to terminal boards or blocks, studs, posts, etc., are normally found in the manufacturer's maintenance instruction manual.

e. Feed-Through Insulator and Stud Design. Feed-through insulator design should be such as to prevent a loose insulator from failing to provide circuit isolation. It should not be able to move from between the stud and the structure, thus allowing the two to come into contact. The assembly should be so designed that it is impossible to inadvertently misassemble the parts so that faults will result. Also, it is desirable to provide means to prevent the feed-through stud from turning while tightening the connection.

11-177. WIRE TERMINALS AND BINDING POSTS. All wire terminals in or on electrical equipment, except case ground, must be firmly held together with two nuts or suitable locking provisions, or should be secured in a positive manner to equipment in such a way that no insulation material is involved in maintaining physical pressure between the various current carrying members of an electrical connection. Terminal studs or binding posts should be of a size that is entirely adequate for the current requirements of the equipment and have sufficient mechanical strength to withstand the torque required to attach the cable to the equipment. All terminals on equipment should have barriers and covers provided by equipment manufacturers.

11-178. CRIMP ON TERMINAL LUGS AND SPLICES (pre-insulated crimp type). The crimp on terminal lugs and splices must be installed using a high quality ratchet-type, crimping tool. We recommend the use of the proper calibrated tool. Aircraft quality crimp tools are manufactured to standards. Such tools are provided with positioners for the wire size and are adjusted for each wire size. It is essential that the crimp depth be appropriate for each wire size. If the crimp is too deep or not deep enough, it may break or cut individual strands, or it may not be tight enough to retain the wire in the terminal or connector. Crimps that are not tight enough are also susceptible to high resistance due to corrosion build-up between the crimped terminal and the wire. MIL-C22520/2 or MIL-T-DTl2250G specification covers in detail the general requirement for crimp tools, inspection gages and tool kits.

a. Hand, portable, and stationary power tools are available for crimping terminal lugs. These tools crimp the barrel to the conductor, and simultaneously from the insulation support to the wire insulation.

b. Crimp tools must be carefully inspected:

(1) Insure that the full cycle ratchet mechanism is tamper-proof so that it cannot be disengaged prior to or during the crimp cycle.

(2) If the tool does not function or faults are found, reject the tool and send the tool to be repaired.

(3) The tool calibration and adjustments are make only by the manufacturer or an approved calibration laboratory.

(4) Suitable gages of the Go/No Go type are available and shall be used prior to

any crimping operation and whenever possible during operation to ensure crimp dimensions.

11-179. LOCK WASHERS FOR TERMINALS ON EQUIPMENT. Where locknuts are used to ensure binding and locking of electrical terminals, they should be of the all metal type. In addition, a spring lock washer of suitable thickness may be installed under the nut to ensure good contact pressure. A plain washer should be used between the spring washer and the terminal to prevent galling. A plain nut with a spring lock washer and a plain washer may be used to provide binding and contact pressure.

11-180.—11-184. [RESERVED.]