Conductors play a vital role in reliable electronics equipment. With the advances over the past few years in equipment design, conductor variations have become as complex as the electronics components they serve, and requirements have become correspondingly exacting. Conductors are selected for their current-carrying capacity, mechanical strength, and the properties of their insulation. However, unique situations may require the use of wire with special characteristics, and several types of special wires may be needed in a single chassis. The electrical problems may include current-carrying capacity, impedance, voltage, RFI, operator protection, and special placement of components. These problems are best approached by both the electronics engineer and the mechanical engineer working as a team.

Mechanical design problems include resistance to shock and vibration, placement of the wires, types of connections, servicing, marking, replacement of components and parts, environmental protection, separation, and insulation. The environmental conditions to be considered include temperature, humidity, abrasion, fungus, shock, and vibration.

**TYPES AND USES**

Electrical conductors are available as solid or stranded, bare or insulated, individual or cabled wire. Soft, annealed copper is most commonly used in making wire because of its high conductivity and ductility, resistance to corrosion and mechanical fatigue, and ease of soldering. Aluminum is sometimes used where weight is a primary concern, and various other types of materials are used for specific applications.

Stranded wire is preferable to solid wire due to its greater flexibility. It can be easily bent and formed into wire assemblies. Also, stranded wire is less apt to
break when unsoldered and unwrapped during servicing. The most frequently used wire consists of seven strands twisted together.

The advantages of solid wire include rigidity and efficiency at higher frequencies. Solid wire may be used for jumpers up to 3 in. long, and for longer lengths where leads are securely mounted and not subject to vibration. When used, the bare wire can be insulated by using external sleeving. Untinned solid copper wire is the most efficient for high frequencies, since tinned or stranded wires exhibit greater losses. A major disadvantage of solid wire is its susceptibility to stress concentrations. A very slight nick in the conductor, which may occur as the insulation is stripped, will become a breaking point when the wire is subjected to flexing.

Multiconductor cables are selected according to the same factors governing the selection of individual wires, with special consideration given to the interwire insulation. Special wire and insulation are formed into cables used in specific application such as low-, medium-, or high-frequency applications. A variation of the multiconductor is coaxial cable, which is used where the distributed capacity must be constant over the entire length of the line. In the coaxial cable, one conductor follows a precise concentric path through another, and the space between is filled with an insulating material. It is important that the concentricity be maintained; if the space relationship is permitted to vary, circuit efficiency will be affected. When coaxial cable is bent, the minimum radius should be no less than 10 times the outside diameter of the cable; otherwise, cold flow can cause creeping of the inner cable at the bend.

The typical cable consists of a solid or stranded inner conductor, a dielectric other than air, outer conductor of braided shielding, and a protective, insulating material covering the braid.

**SIZE**

Wire size is most commonly designated by American Wire Gauge (AWG), by circular mils, or by the diameter of the wire in mils. The size to be selected depends on the current-carrying capacity (Table 13-1), permissible temperature rise, and the mechanical requirements, such as limited space and strength.

**AWG**

Wire sizes 22 through 24 are suitable for general chassis wiring. Filament wiring, particularly when heaters are wired in parallel, should use AWG 20 or larger, depending on the current requirements. Conductors intended to carry only audio-frequency or direct currents are chosen primarily on current and voltage requirements. In choosing conductors for radio frequency (RF), size must be correlated with the cable impedance.