

# AIRCRAFT ELECTRICAL INSTALLATION TIPS

BY BILL BLAKE

1103 Madison  
St. Charles, Missouri  
Layout Engineer, Electrical Installation  
McDonnell-Douglas Aircraft



**I** NSTALLING AN electrical system in your homebuilt is not merely sticking light bulbs in any handy spot on the wing tip and rudder, then taping the wires to any available piece of structure. The job may look good, and the lights may come on when the switch is thrown, but are those wires going to stay put? A loose wire or wires rubbing or chafing on a piece of sharp metal will soon rub through to the bare wire, short out, and set up the sequence for a fire in the air. This we do not need!

Routing those wires will entail thought, planning, forming single wires into wire bundles and fastening the bundles properly to the aircraft structure. The friendly inspector will be much happier at seeing a professional installation rather than a mess of loose wires fastened to the structure by friction tape or string bummed from the neighborhood grocer. The large aircraft manufacturers have entire departments of people who do nothing but design and improve wire installations in their aircraft. If the big manufacturer considers the electrical installation that important, then we in the homebuilding field should treat it with the same high degree of respect. Therefore, the following paragraphs are basics gleaned from thousands of pages of wiring procedures of the "big boys," but can be applied to the safe electrical installation in small planes.

## The Wire Bundle

A wire bundle in the aircraft industry is one or more single wires bound together by string ties or, in some cases, encased in a waterproof sheathing. A large heavy wire bundle may be given many coats of braided covering, while a smaller bundle is tied together with a flat tough Dacron string. Most of the small homebuilts will fall under the latter category. As to the type and gauge of wire to be used, the wiring schematic will normally specify this.

In some instances, the wire bundles must be free to move directionally with doors, landing gear, or movable control surfaces. This type of installation calls for protecting the wire bundle against the elements as well as rubbing and chafing. This is accomplished by wrapping or otherwise enclosing the bundle in the danger area with a tough, waterproof vinyl plastic. This can be either tape or an easily flexed tube.

A wire bundle must never be routed in close proximity with control cables or tubes, and must also be protected wherever it passes over sharp edges or through holes. This is done by covering the edge of the hole with a piece of alligator grommet as used in the industry or by splitting a piece of heavy plastic tubing and bonding to the sharp edge. A potential disaster area is where a loose bundle is free to rub on a sharp, uncovered edge. Sooner or later the covering will wear through, and—!

When routing the bundle in the airplane, care must be taken not to bend the bundle too sharply. If the bundle is

not broken upon installation, vibrations working on the bundle will tend to break wires by increasing and decreasing the bundle's bend radius. The action would be much like metal fatigue. A good rule of thumb to follow when bending the bundle around curves is: The curve radius is ten times the bundle diameter (10 x dia.). If the bundle is one-half inch in diameter, the bend radius is five inches minimum. If the bundle is one inch in diameter, the minimum radius would be ten inches.

## Bundle Clamps

The most commonly used types of clamps are the "loop" and the "square." Both types have either a single or double "tailpiece" for fastening to the structure. Both are formed from thin metal strap with a rubber cushion cover to protect the wires. The mounting holes in the tailpiece are normally No. 10, although larger holes can be obtained in the larger-size clamps. Clamps must be of a size that will grip the bundle firmly without crushing the wires, and yet tight enough to prevent movement within the clamp itself. All clamps must be mounted to the structure with aircraft-quality bolts, washers, and locknuts.

The clamp can be mounted to the primary aircraft structure in a variety of ways to obtain the proper bundle direction. The clamp may be mounted to a small right-angle bracket or straight tab, which is in turn riveted, welded, or bolted to the structure. When bolted, remember—aircraft-quality hardware! Care must also be taken not to weaken primary structure by the indiscriminate drilling of holes. When in doubt, reinforce the area with gussets, straps, doublers or, if in wood, blocks and plywood plates.

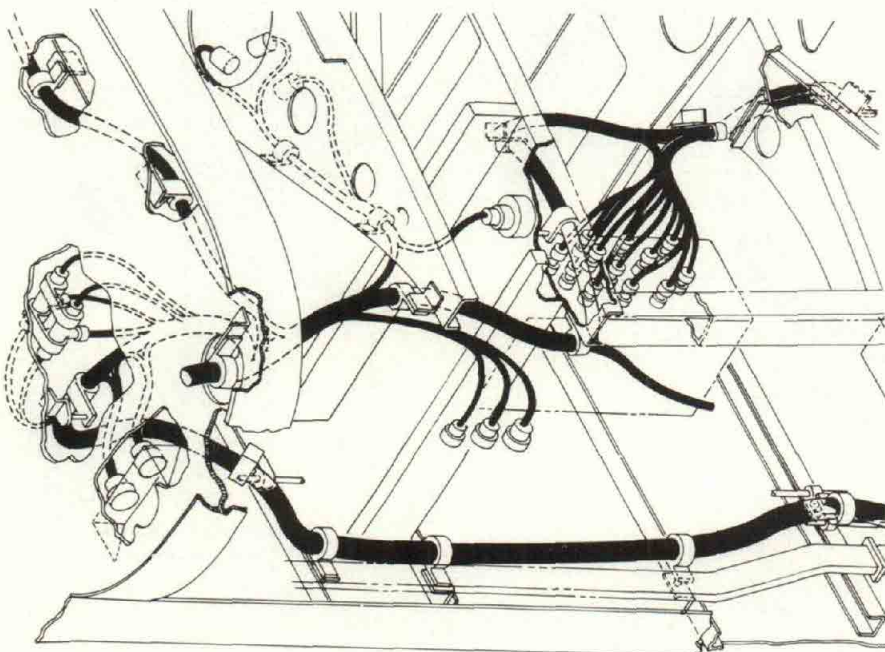
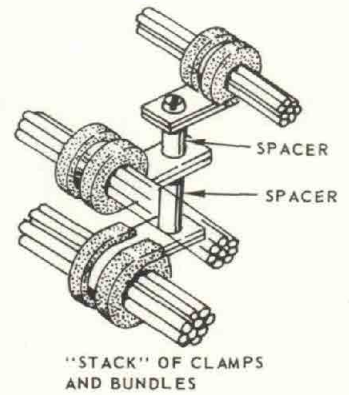
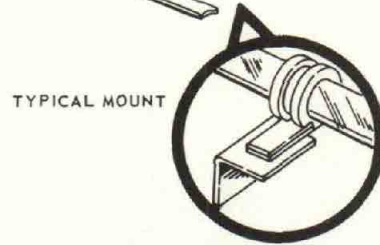
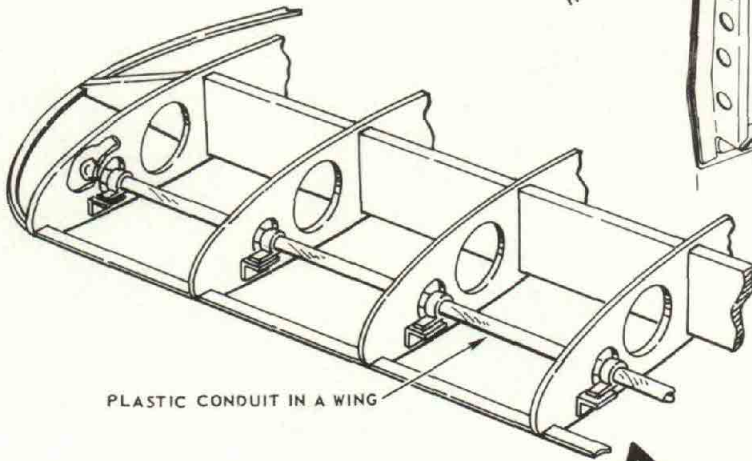
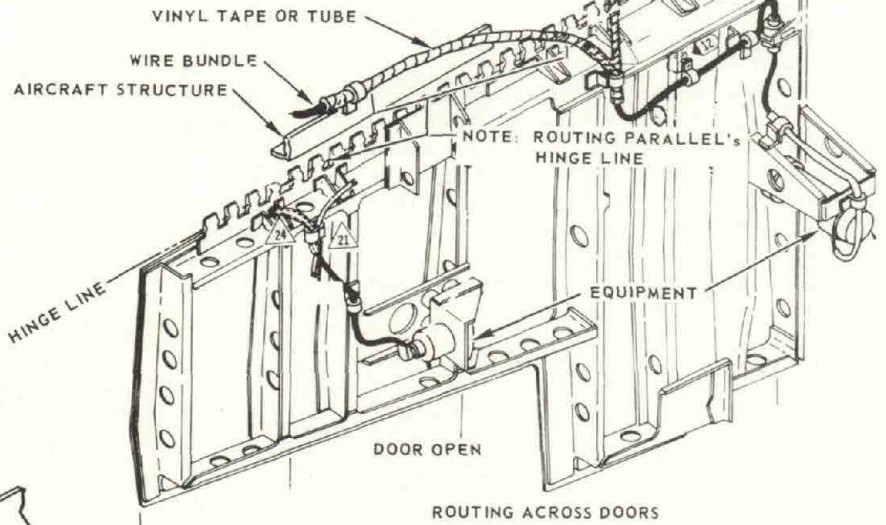
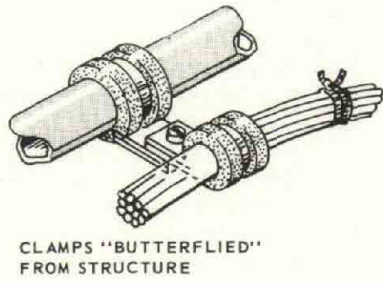
Clamps may also be "butterflied" from one clamp to another. Example: one clamp is fastened to the structure and its tailpiece is bolted to the tailpiece of a clamp carrying the wire bundle.

Square clamps are used to flatten a bundle where it passes through a greatly restricted area such as between structural members or between two pieces of electrical equipment. However, restricted areas such as this are not likely to be found on the smaller homebuilts. We mention it only to aid someone who some day may get into a bind due to poor planning of his routing.

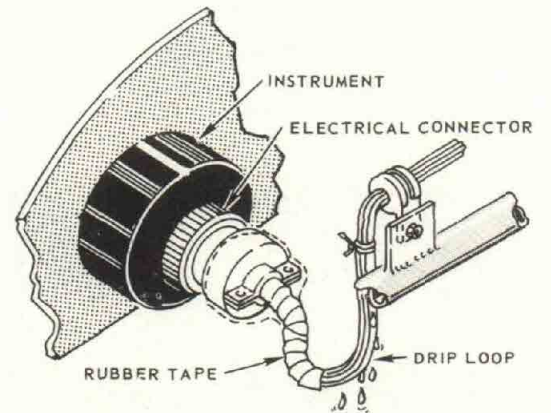
One way to plan the actual routing is with string. Here it is forgivable to scrounge from the grocer. String the wire from its point of origin to its point of termination. By using string, actual wire lengths can also be determined. If you have the slightest intention of ever installing an electrical system on the plane at a later date, plan ahead! One thing to do during construction is to install plastic conduits in areas you know will later be inaccessible. Later it will be a simple matter to fish the wires through the conduit.

## Drip Loops

Bundles coming from above an electrical connector or termination point should have a drip loop formed in the



WIRE BUNDLE INSTALLATION DRAWING (PRODUCTION AIRCRAFT)



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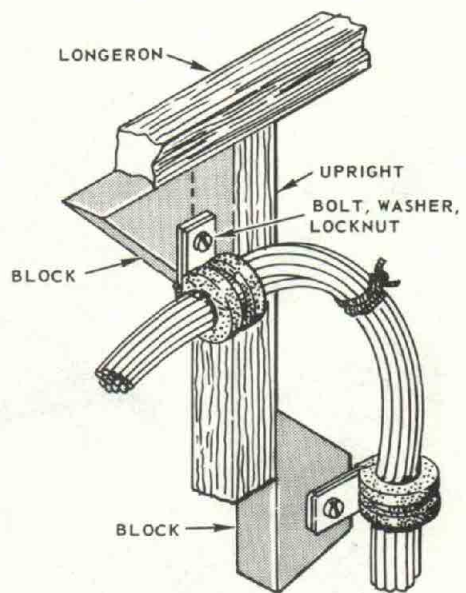
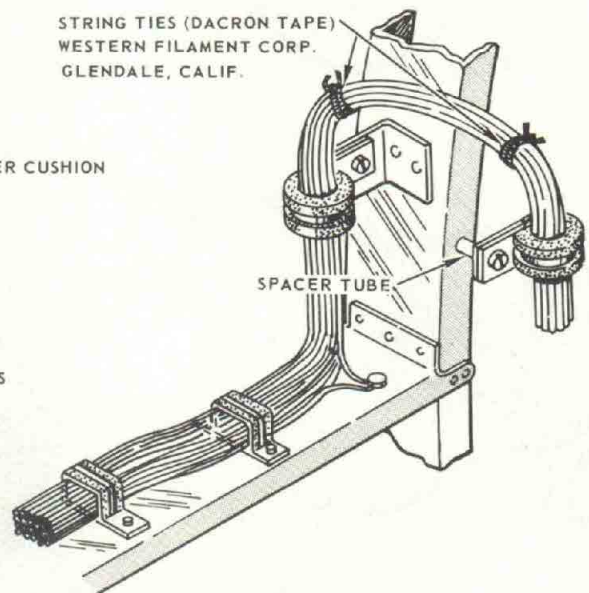
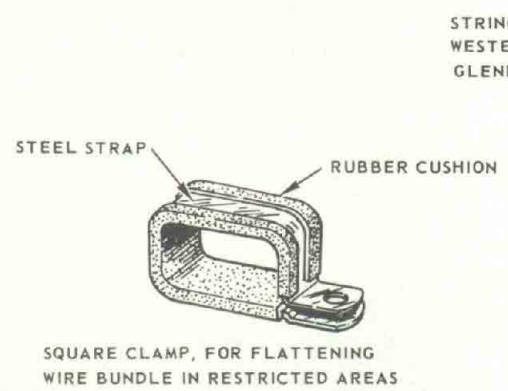
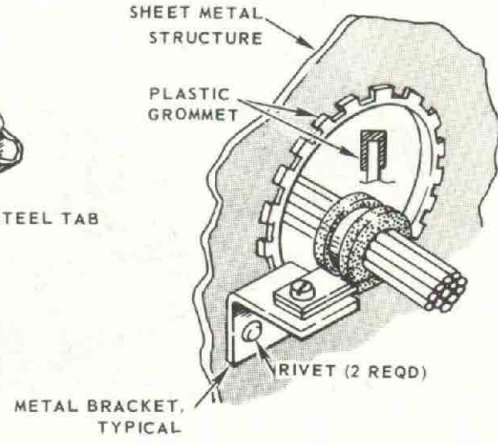
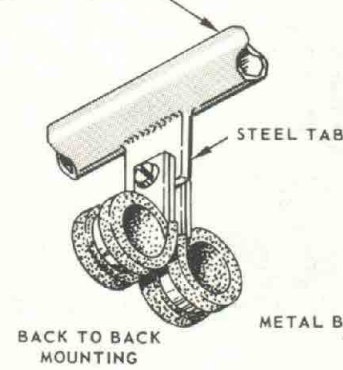
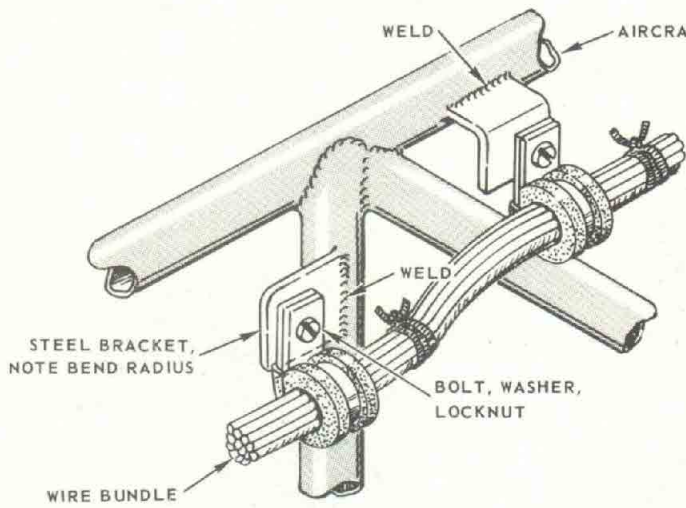
bundle. This is accomplished by having just enough slack in the routing to allow the bundle to go down below the connector a few inches and back up, forming a 180-degree bend. The connector should further be protected by wrapping from the connector (dotted lines on illustrations) to the bottom of the drip loop. This will allow moisture to drip off the bottom of the loop rather than to seep into the connector proper.

### Spacers

Spacers are merely short lengths of steel tubing used to set the clamp away from any surface on which the bundle may tend to rub. It is also used where more than one bundle may take the same routing path. As the illustration shows, the bundles are stacked rather than put under one large unwieldy clamp. In order to restrict the length of spacers, keep them under one inch in length and make sure they fit without play or wobble over the bolt being used.

### Routing Over Doors

Here again, most of the small airplanes will not be concerned with moving bundles over a landing-gear door, etc. However, for a builder who may be faced with such an installation, here is a point to remember. Always route the bundle over the door hinge as parallel to the hinge line as possible. This will allow the bundle to roll with the door movement rather than to flex back and forth at right angles. Clamps should be planned and installed with the door in an open position to allow for just enough slack in the bundle so it may roll with the door action. When in doubt here, build a small mock-up to check the bundle action as the door is cycled. In all cases, the bundle must be protected in the area of movement by wrapping in plastic tape (industrial SPIRAP). Clamp securely on each side of the area where the bundle rolls over the hinge.



VENDOR FOR CLAMPS:  
TA MANUFACTURING CO.  
407 ALGER ST.  
LOS ANGELES, CALIF.  
90039

