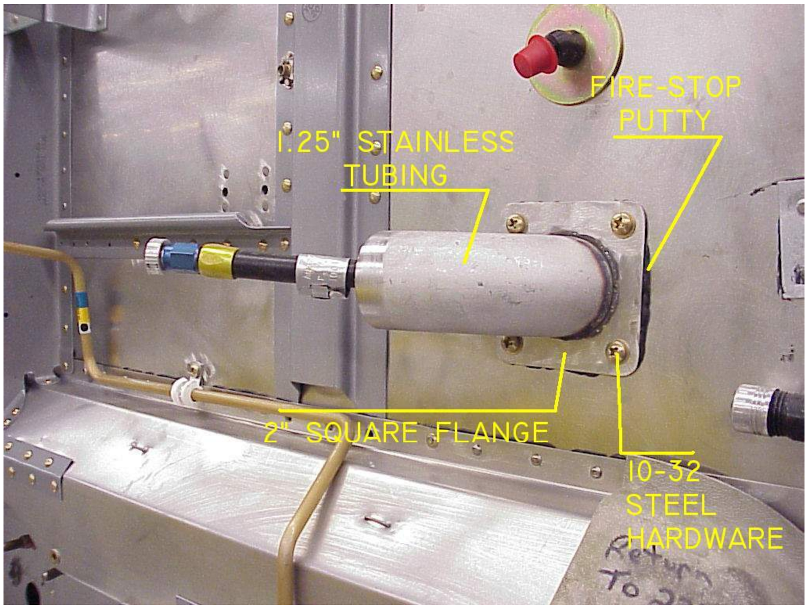
Bob's Shop Notes:
Getting the wires in while keeping the flames out . . .

The "firewall" on an airplane wasn't named with any sense of whimsy . . . 99.99% of the time, all it does is keep a blast of cold air out of the cockpit. But on rare occasions, it is expected to stand between a fuel fed fire and folks in the cockpit who are doing their best to survive the experience.

Hundreds of thousands of single engine aircraft have been built in the past 100 years. Most were fabricated with some attention paid to the physics of fire protection. Every firewall-sheet of stainless steel (or composite material selected for it's fire resistance) is perfectly capable of doing its job . . . as long as you don't cut holes in it. Unfortunately, it's necessary for things forward of the firewall to be in communication with things aft of the firewall. There are controls, fuel plumbing, instrumentation and power generation wiring that must run between engine compartment and cockpit thus requiring a certain number of HOLES in the firewall.

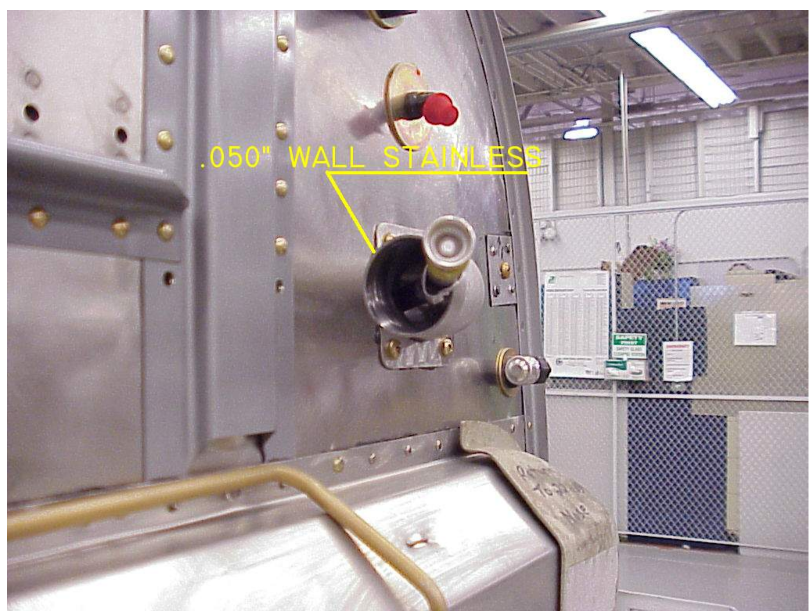
Penetrations of fuel and other fluid plumbing running through all metal bulkhead fittings require little further consideration. For certified airplanes, the FARs tell us that bulkhead feed through fittings of steel or copper-alloy may be used with no concerns for compromising firewall integrity. There are a variety of metal "eyeball" fittings available for easing the transition of throttle, prop, mixture and cowl flap controls at odd angles. This leaves us with the "soft" lines such as wires and perhaps small fluid lines for pressure instrumentation.



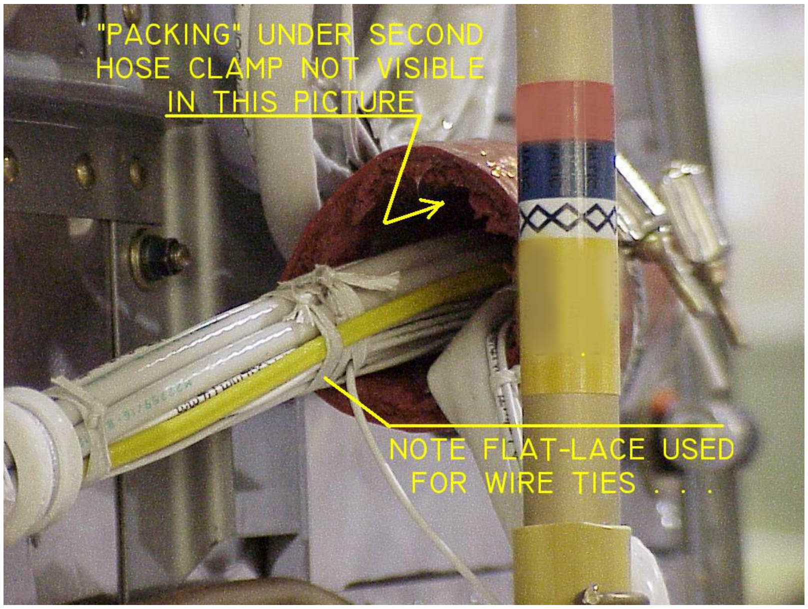
Click here for larger image A visit with camera in hand to a production line for certified piston aircraft allowed me to record and share a fabrication technique for soft penetration. This technique has a long history of laboratory testing for effectiveness, production line convenience, and field maintainability. In this case, all of the wiring comes through a single, fairly large penetration fitting . . . but there's no reason why multiple, smaller fittings wouldn't work too . . .

Here we see how a stainless weldment bolted to the firewall with steel hardware provides the structural component of a transition for wires and other relatively "soft" materials running between cockpit and engine compartment. Note generous flange area outside the tube to flange interface that is sealed with fire-stop when the flange is bolted into place.

Click here for larger image The fittings for this airplane are made from 0.050" stainless. Thickness and attaching geometry are a function of how much support the fitting needs to provide for the bundle of transitioning wires and tubes. The material shown here is pretty hefty stuff and may have been selected as handier to weld than thinner material. Drawings for other firewall fittings used in this same factory show materials as thin as 0.020" thick.

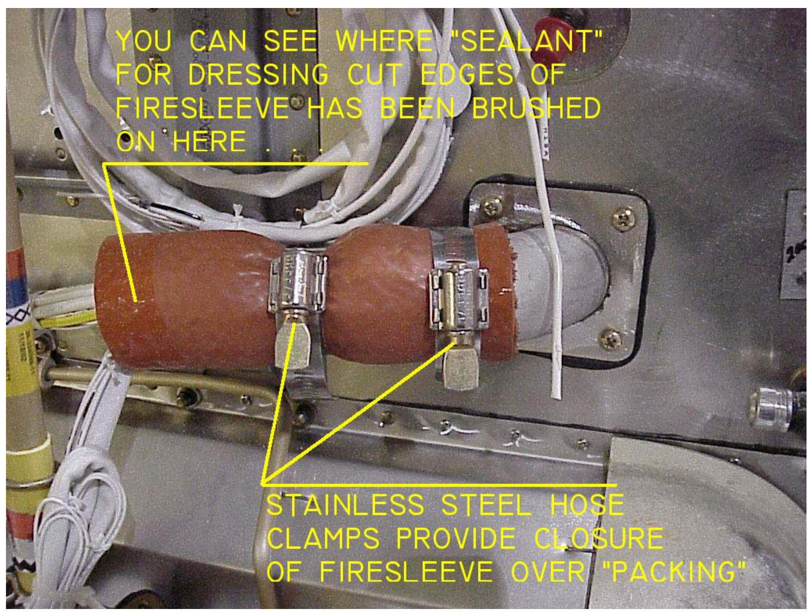


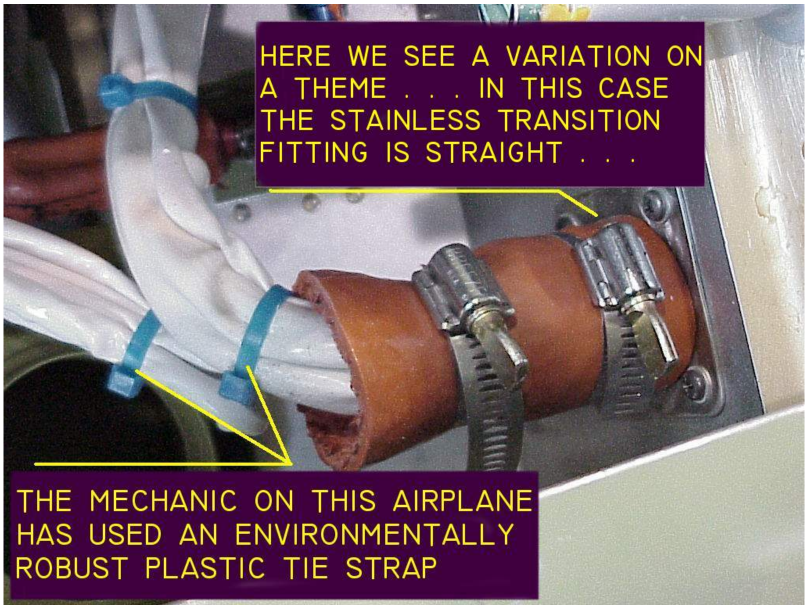
Builders can certainly experiment with thinner material and alternative joining techniques. Periodic inspections will show whether or not there are issues of mechanical robustness . . . not strong enough, they'll simply come apart. Given that fires are VERY rare, the failure of an experimental fitting doesn't represent a great threat as long as you do reasonably complete inspections during normal P/M activities . . . like every oil change. The worst thing that happens is that you have to build a more robust transition fitting and replace the broken one.



Click here for larger image Looking up the business end of the finished transition. What's not visible in this view is the packing placed around wires so that the second hose clamp doesn't have to put a super-crush on the fire sleeve . . . . more on this later.

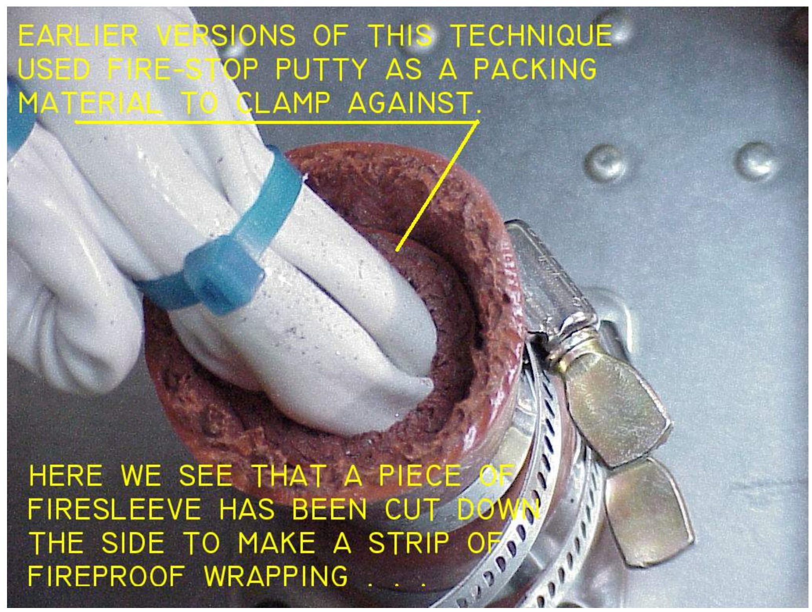
Click here for larger image The flight-ready firewall penetration. A second hose clamp brings the fire sleeve down for a snug fit on the wire bundle. A filler wrap around a wire bundle much smaller than the i.d. of the fire sleeve makes for a better seal with less crush under the second hose clamp . . .





Click here for larger image On another airplane, we find a similar technique except that the stainless steel firewall fitting is straight, no 90-degree bend. Otherwise, installation and functionality is same as shown above.

Click here for larger image This view illustrates an interesting packing material used to build up the wire bundle size. A piece of fire sleeve was cut down the side and made into a strip of wrapping filler. Note that all exposed edges of the fire sleeve are "doped" with the recommended sealer to preclude entry of moisture and to keep the edges from fraying . . .



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