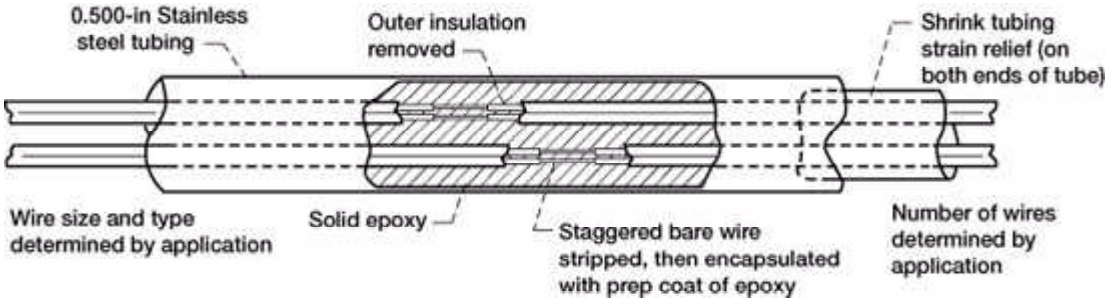
Customized Hermetic Feedthrough Developed to Isolate Fluids

A common problem occurs when refrigerant fluids wick inside the insulation of thermocouple wires through a compressor's casing feedthrough and then leak into the adjacent disconnect box outside the casing. Leaking fluids create an unfavorable situation inside the disconnect box and may contaminate the fluids. To address this problem, NASA Lewis Research Center's Manufacturing Engineering Division developed a customized hermetic feedthrough for a bank of Worthington compressors.



Cutaway diagram of a customized hermetic feedthrough.

In these compressors, bearing temperatures are measured by internal thermocouples embedded in bearings located inside the compressor casings. The thermocouple wires need to be routed outside the casing and read at another location. These wires are short and are terminated to a disconnect strip inside the casing. The bearings operate at about 170 °F, but because the casing is filled with R12 refrigerant oil, the casing has a maximum temperature of about 100 °F.

The operating conditions of these compressors permit the use of an epoxy that is compatible with the R12 fluid. The desired finished product is a stainless steel tube that has been filled solid with epoxy after thermocouple wires bonded and sealed by epoxy have been inserted through its length. Shrink tubing extends from both ends of the tube. The process that was developed to isolate the thermocouple wires from the R12 fluid follows.

For this application, use an 8-in.-long piece of 0.500-in. 304 stainless steel tube with six pairs of 24-gauge stranded, PTFE-insulated (polytetrafluoroethylene) type "T" thermocouple wires for each feedthrough. Use shrink tubing to strain relief the insulated wires at their exit from the stainless steel tube.

Cut the wire to length and identify the location of the stainless steel tube sleeve with masking tape. Then, remove the outer insulation from a 2-in. section of wire that will be inside the tube, and carefully strip to bare wire a 1-in. section in the middle of the section with the outer insulation removed. For an effective seal, the epoxy must penetrate between the strands when stranded conductors are used. Make the seal with epoxy bond on the

bare wire. The bare wire must be encapsulated with a thin layer of the epoxy that leaves only a very low profile. These encapsulated wires must cure before the assembly can be continued. Then, inspect the cured wires for complete encapsulation before going to the next step.

Insert the wires in the stainless steel tube and orient them so that the epoxied stripped sections are staggered within the tube (see the illustration); then, apply shrink tubing to one end of the cleaned wires, positioning it inside the edge of the tube. The small gaps between the wires on the other end will be used to inject the epoxy into the tube. Let the epoxy cure inside the tube, free of any voids. Then, continue to fill the tube until the entire 8-in. length is nearly filled, allowing room for the other strain-relieving shrink tubing.

Since this first design, the process has been adjusted to fit many needs and situations. Customized feedthroughs have been assembled from various wire types, wire gauges, and/or stainless steel tube passages. The fittings selected to mount these feedthroughs allow their use in other areas, such as pressure or vacuum systems.

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