SECTION 2
CHAPTER 16

THERMOCOUPLE WIRE SOLDERING AND INSTALLATION

INTRODUCTION

1. Thermocouples are used in aircraft to detect and measure temperature changes. They consist of a pair of dissimilar metallic conductors that detect changes in temperature and are used to measure that change. Thermocouples are supplied with short leads that end in terminals such as AN5548 or AN5539. At installation, the technician fabricates extension leads to carry the voltages generated by the thermocouple to the indicating instruments. The components of a thermocouple system are designed to have a high degree of accuracy; correct installation is required to maintain this accuracy.

2. This chapter describes and illustrates recommended procedures for fabrication and installation of thermocouple extension leads.

3. The importance of good workmanship in the fabrication and installation of thermocouple wires cannot be over-emphasised.

REFERENCE SPECIFICATIONS

4. The following specifications are applicable to thermocouple wire soldering and installation:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-A-54192</td>
<td>Rosins: Gum, Wood, and Tall Oil</td>
</tr>
<tr>
<td>AN5537</td>
<td>Connector Assembly – Thermocouple Lead</td>
</tr>
<tr>
<td>AN5538</td>
<td>Terminal – Thermocouple Lead Soldering</td>
</tr>
<tr>
<td>AN5539</td>
<td>Terminal – Thermocouple, Brass</td>
</tr>
<tr>
<td>AN5548</td>
<td>Terminal – Lug, Thermocouple, Chromel and Alumel</td>
</tr>
<tr>
<td>MIL-PRF-680</td>
<td>Degreasing Solvent (Stoddard’s Solvent)</td>
</tr>
<tr>
<td>MS25036</td>
<td>Terminal, Lug, Crimp Style, Copper, Insulated, Ring-Tongue, Bell-Mouthed, Type II, Class 1</td>
</tr>
<tr>
<td>O-F-499</td>
<td>Flux, Brazing, Silver Alloy, Low Melting Point</td>
</tr>
<tr>
<td>QQ-B-654</td>
<td>Brazing Alloy, Silver</td>
</tr>
<tr>
<td>SAE AS 7928</td>
<td>Terminal, Lug and Splice, Crimp Style, Copper</td>
</tr>
<tr>
<td>TT-I-735</td>
<td>Isopropyl Alcohol</td>
</tr>
</tbody>
</table>

DESCRIPTION

Thermocouple Wire Leads

5. Thermocouple extension wires (see Figure 16–1) are paired in a braided jacket and colour-coded as detailed in Table 16–1. The material for extension leads is the same as the thermocouple material. Iron-constantan extensions are used for iron-constantan thermocouples, chromel-alumel extensions for chromel-alumel thermocouples, and copper-constantan extensions for copper-constantan thermocouples.

Thermocouple Terminals and Connectors

6. Selection of terminals for thermocouple wiring is based on location within the airframe, and on temperature conditions. Hot areas are those subject to high temperature, such as engine compartment, exhaust areas, etc. Cool areas are those on the side of the firewall away from the engine or other heat sources. Where the temperature does not exceed 120°C, use terminals listed in Table 16–2. Dash letters after basic numbers indicate whether terminal is plain or lock type, except for AN5538, where dash number indicates change in size only.

NOTE

Solderless terminals and splices may be used on thermocouple wires in cool areas.

7. Thermocouple connector AN5537 (shown in Figure 16–3) is used to carry thermocouple connections through firewalls. This is a plug and jack connection, supplied with an insulating plate for attachment to the firewall. Plugs and jacks are supplied in chromel-alumel or iron-constantan combinations. The jack part of the connector is installed on the cool side of the firewall. The pin plug part of the connector is installed on the hot side of the firewall.
Table 16–1 Thermocouple System

**IRON CONSTANTAN SYSTEMS**

<table>
<thead>
<tr>
<th>Conductor</th>
<th>Insulation Colour</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>Black</td>
<td>Positive (+)</td>
</tr>
<tr>
<td>Constantan</td>
<td>Yellow</td>
<td>Negative (–)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type II – 8 ohms per 30.5 m.</th>
<th>Type III – 8 ohms per 61.0m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Jacket Base Colour</td>
<td>Class A</td>
</tr>
<tr>
<td>Tracer Colour</td>
<td>Light Blue</td>
</tr>
<tr>
<td>Temperature Limit of Insulation</td>
<td>120°C</td>
</tr>
</tbody>
</table>

**CHROMEL-ALUMEL SYSTEM**

<table>
<thead>
<tr>
<th>Conductor</th>
<th>Insulation Colour</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromel</td>
<td>White</td>
<td>Positive (+)</td>
</tr>
<tr>
<td>Alumel</td>
<td>Green</td>
<td>Negative (–)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type II – 7 ohms per 7.6m.</th>
<th>Type III – 7 ohms per 15.2m</th>
<th>Type IV – 7 ohms per 30.5m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Jacket Base Colour</td>
<td>Class A</td>
<td>Class A</td>
</tr>
<tr>
<td>Tracer Colour</td>
<td>White</td>
<td>White</td>
</tr>
<tr>
<td>Temperature Limit of Insulation</td>
<td>315°C</td>
<td>315°C</td>
</tr>
</tbody>
</table>

**COPPER-CONSTANTAN SYSTEM**

<table>
<thead>
<tr>
<th>Conductor</th>
<th>Insulation Colour</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>Red</td>
<td>Positive (+)</td>
</tr>
<tr>
<td>Constantan</td>
<td>Yellow</td>
<td>Negative (–)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type II – 7 ohms per 61.0m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Jacket Base Colour</td>
</tr>
<tr>
<td>Tracer Colour</td>
</tr>
<tr>
<td>Temperature Limit of Insulation</td>
</tr>
</tbody>
</table>

Table 16–2 Thermocouple Terminals

<table>
<thead>
<tr>
<th></th>
<th>Hot Areas (Silver Soldered)</th>
<th>Cool Areas (Tin-Lead Soldered)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron-Constantan</td>
<td>AN5539</td>
<td>AN5538</td>
</tr>
<tr>
<td>Chromel-Alumel</td>
<td>AN5548</td>
<td>AN5538</td>
</tr>
</tbody>
</table>

Figure 16–1 Thermocouple Wire
**AC 21-99 Aircraft Wiring and Bonding**  
*Sect 2 Chap 16*

8. MS type connectors may be supplied with iron-constantan or chromel-alumel contacts in sizes 12, 16, or 20 in insert arrangements for thermocouple connections. These contacts are coded to identify the material. (See Table 16–3.)

**DEFINITIONS**

9. Definitions are as follows:

a. **Soft Solder.** A mixture of 60% tin and 40% lead, as specified in J-STD-006. It may be in bar form to be melted for tinning, or in the form of rosin core solder wire for use with soldering iron.

b. **Hard Solder.** Silver alloy with flow point at approximately 635°C, as specified in QQ-B-654.

c. **Soft Solder Flux.** Fluxes shall conform to the requirements of J-STD-004.

d. **Hard Solder Flux.** For hard solder, use flux qualified to Federal Specification O-F-499, mixed to a paste-like consistency with water.

e. **Soldering and Brazing.** For purposes of this chapter, the term "soldering" includes soft soldering, silver (hard) soldering, and brazing.

**THERMOCOUPLE WIRE PREPARATION**

**Cutting and Identifying Thermocouple Wire**

10. Cut thermocouple wire with diagonal pliers to length specified in drawing. Cut so that end is clean and square. Identify wire with sleeves as described in Section 2, Chapter 2. If outer covering is removed more than 76mm from termination, install sleeve just back of serving at branching point (refer to Paragraph 21).

**Stripping Thermocouple Wire**

11. Remove outer covering, of thermocouple wire with a knife by slitting between parallel conductors and trimming the fabric braid with scissors or diagonal pliers. The stripping dimensions for each use are shown in Figure 16–4, Figure 16–5 and Figure 16–6. Note that longer stripped lengths are required if the wires are to be resistance tinned. Use a hand stripper, as illustrated in Section 2, Figure 3–3, for removing the primary insulation from each conductor.

**Cleaning Wire Prior To Soldering**

12. If necessary, clean stripped conductor as follows:

<table>
<thead>
<tr>
<th><strong>WARNING</strong></th>
<th>Appropriate personal protective equipment should be worn when handling and using cleaning solutions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Remove grease and dirt by brushing or wiping with MIL-PRF-680 (Stoddard’s Solvent).</td>
<td></td>
</tr>
<tr>
<td>b. Dry with clean lint free cloth.</td>
<td></td>
</tr>
</tbody>
</table>

| **CAUTION** | Do not use extra heat and special fluxes as a substitute for clean soldering surfaces. |
Table 16–3  Coding for Thermocouple Contacts in MS Connectors

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Method of Coding</th>
<th>Code</th>
<th>Constantan</th>
<th>Chromel</th>
<th>Alumel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphenol</td>
<td>Colour</td>
<td>White</td>
<td>Red</td>
<td>Green</td>
<td>Orange</td>
</tr>
<tr>
<td>Bendix</td>
<td>Letters</td>
<td>Ir.</td>
<td>Con.</td>
<td>Ch.</td>
<td>Al.</td>
</tr>
<tr>
<td>Cannon</td>
<td>Letters</td>
<td>IR</td>
<td>CO</td>
<td>CH</td>
<td>AL</td>
</tr>
</tbody>
</table>

Figure 16–3  Thermocouple Connector Assembly (AN5537)

Figure 16–4  Stripping Thermocouple Wire for Terminal and for AN5537 Connector Installation

Figure 16–5  Stripping Thermocouple Wire for Splice Installation
HARD SOLDERING THERMOCOUPLE WIRE

Torch Tinning with Silver Solder

13. Before wires are soldered to terminals or other connections, they are tinned. The inability to obtain a good tinned surface indicates that the wire was not clean. The procedure for torch tinning is as follows (see Figure 16–7):

**WARNING**
Open flames shall not be used on or near fuelled aircraft or in other hazardous locations.

- a. Dip half of exposed, clean conductor into hard solder flux.
- b. Protect wire insulation with notched copper sheet shield, to prevent scorching.
- c. Apply flame to wire until flux bubbles. Then feed a small amount of silver solder, in wire form, to fluxed area while flame is kept there. After the silver solder has flowed, remove the flame and allow the wire to cool in the air.

**CAUTION**
Silver solder will flow and adhere to conductor at approximately 635°C. Avoid greater heat than necessary. Excess heat will decompose flux and prevent alloying of silver solder to the wire.

Dip Tinning Wire with Silver Solder

14. Thermocouple wires can be dip-tinned in molten silver solder if a solder pot capable of maintaining the required 635°C heat is available. The process is similar to that used in a dip tinning copper wire in soft solder as described in Section 2, Chapter 7. The procedure for dip tinning with silver solder is as follows (see Figure 16–8):

- a. Dip half of exposed, clean conductor into hard solder flux.
- b. Dip fluxed conductor into solder pot. Do not dip conductor deeper than one-half of exposed area.

**NOTE**
Powdered borax sprinkled over top of molten solder will retard oxidation of solder and aid alloying of silver solder to the wire.

- c. After solder has flowed between strands, remove the wire and allow it to cool in air.
Resistance Tinning Wire with Silver Solder

15. Electrical resistance heat is a good method for silver soldering thermocouple wires. Use a unit that has a capacity of 1000 watts (Figure 16–9). Wire that is to be tinned by means of electrical resistance should be stripped 12.7mm longer than wire which is to be dip-tinned or torch-tinned. The extra 12.7mm provides a holding area which is removed after tinning is complete. See Figure 16–4, Figure 16–5 and Figure 16–6 for stripping dimensions. The procedure for resistance tinning is as follows:

- Apply hard solder flux to area to be tinned. This is an area about 3mm long, as shown in Figure 16–9.
- Grasp end of wire in resistance heating pliers. Grasp wire only as shown.
- Apply current for approximately five seconds and then touch silver solder wire to area previously fluxed.
- After solder has flowed between strands, shut off the current and allow the wire to cool in air.

**CAUTION**

Do not overheat the wire by allowing the current to remain on longer than necessary to flow the silver solder.

- Trim off the holding area of the exposed conductor. The conductor should be trimmed with diagonal pliers to the point of tinning.

**WARNING**

Resistance soldering shall not be used on or near fuelled aircraft or in other hazardous locations.
Figure 16–10 Resistance Tinning of Terminal

**WARNING**
Soldering may result in the emission of hazardous metallic fumes and vapours from fluxes used. Workers should position themselves so as not to directly inhale the fumes/vapours.

**Tinning Terminals with Silver Solder**

16. Tin only section of thermocouple terminals inside wire grip as shown in Figure 16–10. Terminals for silver soldering should not be plated.

**CAUTION**
Do not allow any flux or solder to get on the insulation grip or on the ring tongue.

- a. With a brush, apply a small amount of hard solder flux to the area to be tinned.
- b. Using a torch or the resistance heating pliers, melt a thin coat of silver solder onto inside of wire grip. See Figure 16–10 for use of resistance heating pliers in this operation.
- c. Allow terminal to cool in air.

**Procedure for Attaching Terminals to Thermocouple Wire**

17. Secure terminal to thermocouple wire as follows:

- a. Flux previously tinned areas of terminal and wire.
- b. Install terminal on wire so that insulation is flush with or protrudes slightly beyond insulation grip.

The tinned portion of the conductor should then be inside the wire grip. (See Figure 16–11.)

**CAUTION**
Do not crimp insulation grip until after soldering operation. The heat of soldering may damage insulation if insulation grip is tight during soldering.

c. Crimp wire grip over conductor using modified crimping tool illustrated in Figure 16–12.
Torch Soldering Terminals to Thermocouple Wire

18. Secure terminal to thermocouple wire as follows: (See Figure 16–11.)
   a. Use copper shield to protect insulation.
   b. Heat joint until flux bubbles and then apply silver solder wire to joint as shown. Keep flame in motion to assure uniform heating.
   c. When solder has flowed down into wire grip, remove flame and allow joint to cool without disturbing it.

   **NOTE**
   AN 5539 terminals require reinforcement with silver solder at indicated areas. (See Figure 16–13).

   **CAUTION**
   Do not allow solder to flow onto ring tongue as this will prevent proper assembly into system.

Resistance Soldering Terminals to Thermocouple Wire

19. Secure terminal to thermocouple wire as follows:
   a. Grasp terminal and wire assembly, prepared in accordance with Paragraph 17, at wire grip area. The resistance heating pliers are to be in the position shown in Figure 16–10.
   b. Apply current until flux bubbles; then apply silver solder wire to connection from conductor end of assembly.
   c. Continue to apply heat and watch for flow of solder inside wire grip. When solder is visible at opposite end of wire grip from where it was applied, turn off current.
   d. Allow assembly to solidify before removing from pliers.

Cleaning and Completing Silver Soldered Terminal Connections

20. After the silver solder has solidified and cooled, the junction must be completed as follows:
   a. Remove flux residues with warm water and a bristle brush, then dry thoroughly.
   b. Secure insulation grip on insulation using modified crimping tool shown in Figure 16–12. The final result is shown in Figure 16–11.

   **NOTE**
   Insulation grip tabs may be trimmed so they butt.
c. Examine junction to be sure that silver solder has alloyed to wire and terminal. Examine also to be sure that insulation has not been scorched. Rework any connection that is defective.

Serving Thermocouple Wire

21. After soldering operation has been completed, and solder has cooled, serve thermocouples at the branching point as shown in Figure 16–14. Use nylon or waxed cotton cord in cool areas, and fibreglass cord in hot areas. Coat the serving with clear lacquer. The serving will prevent unravelling of the outer jacket.

SOFT SOLDERING THERMOCOUPLE WIRE

Soft Soldering Thermocouple Wire

22. Tin thermocouple wire for soft soldering in the same manner as copper wire as described in Section 2, Chapter 7. Either dip tinning or soldering iron tinning is satisfactory. Occasionally, if wires are oxidised, rosin-alcohol flux may not do a satisfactory job of tinning. If this happens, use flux A-A-59142 or equivalent. After tinning, remove flux and flux residue on the tinned surface by using a cleaning solution of 50 percent water and 50 percent isopropyl alcohol, grade A, technical (TT-I-735). Dry thoroughly.

Tinning Terminals for Soft Soldering

23. Tin terminal section inside wire grip, using a 200 to 250 watt soldering iron and rosin core solder. Do not allow flux or solder to get on the insulation grip or on the ring part of the tongue.

Soft-Soldering Wire to Terminals

24. The procedure for soft-soldering thermocouple wires to terminals is as follows:
   a. Install terminals on thermocouple wires as described in Para 17, and illustrated in Figure 16–11.
   b. Soft solder, using 200 to 250 watt iron and rosin core solder. Make sure that solder flows inside wire grip and forms a smooth fillet.
   d. Bend insulation grip ears around insulation using modified crimping tool shown in Figure 16–12. Trim ears so they butt flush around small wires. (See Figure 16–11.)

CAUTION
For soft-soldering, do not use any flux other than rosin-alcohol, regardless of flux used for tinning.
Soldering Wire to MS Connectors

25. Thermocouple contacts in MS series connectors are not tinned by the manufacturer. Therefore, it is necessary to properly tin these contacts with soft solder before thermocouple wire is soft soldered into place. MS connector contacts must be removed from inserts for soldering because of the extra heat required to raise thermocouple wire to solder temperature. Best results are obtained when electrical resistance heating pliers are used to tin the contact and also for soldering wire into contact. The procedure for tinning and soldering is as follows:

a. Tin contact by use of resistance heating pliers or torch. Use rosin-alcohol flux and 60/40 tin-lead solder or, if necessary, use flux described in paragraph 22 with the same 60/40 tin-lead solder.

**WARNING**

Appropriate personal protective equipment should be worn when handling and using cleaning solutions.

b. Remove flux residues by brushing vigorously with Stoddard’s solvent (MIL-PRF-680) or with denatured alcohol (A-A-51693). Lactic acid flux is removed by brushing in warm water. Dry each tinned contact thoroughly before proceeding with next step.

c. Check contact coding and wire coding carefully to avoid mismatch of materials. (See Table 16–1 and Table 16–3.)

**CAUTION**

It is important that thermocouple materials match. Ensure that the thermocouple wire is soldered to a contact of the same material.

d. Insert properly pre-tinned wire into contact and solder using resistance pliers or torch. Use only rosin core solder for this operation. (See Figure 16–15.)

e. After solder has flowed and alloyed, allow connection to cool without motion. Then remove flux residues with Stoddard’s solvent (MIL-PRF-680) or with denatured alcohol (A-A-51693).

f. Examine joint to be sure solder has flowed to form a smooth fillet, and that no solder is left on outside of solder cup.

g. Reassemble contacts into MS connector as described in Section 2, Chapter 10. Be careful to reassemble each contact into the hole from which it was removed.

---

**NOTE**

For chromel and alunel contacts, material verification can be made with the aid of a magnet, since a magnet will attract the alunel contact but not the chromel contact.

Soft Soldering With Silver Solder Bonding Paste

26. In areas where temperatures do not exceed 120°C and a high tensile strength or high electrical conductivity is required, silver solder bonding paste may be used as an alternative to the procedures described in paragraphs 22 to 25, as follows:

a. For attaching terminals, clean terminals and wire with isopropyl alcohol. Next, install terminal, apply bonding paste to wire, and heat with a 140 watt soldering iron. Wipe clean with isopropyl alcohol.

b. For soldering MS and AN connectors, clean wire and socket contacts of connector with isopropyl alcohol. Apply bonding paste to wire and insert into socket. Heat with a 140 watt soldering iron, then clean with isopropyl alcohol. Inspect joint to ensure smooth fillet and that no excess solder is outside of solder cup or socket. Assemble the connector.

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Figure 16–15  Torch Soldering Thermocouple Wire to MS Connector Contact
Soldering Wire to AN5537 Firewall Connector

27. Thermocouple wires are brought through firewalls by means of AN5537 firewall connectors. To preserve the integrity of the system, it is necessary to hard solder wires to the connector on the hot side of the firewall. The cool side of the firewall may be either hard or soft soldered. The procedure for attaching wires is as follows (refer to Figure 16–3):

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure wire leads are connected to mating materials of connector. Connector plugs and sockets are coded with letters to indicate materials. Sizes are also different to aid in quick identification. (SEE Table 16–4 for code.)</td>
</tr>
</tbody>
</table>

a. Disassemble connector as shown. Slide nuts over the pre-tinned leads that will be installed on the hot side of the firewall.

b. Tin the wire grips of the socket assemblies using hard solder as described in Paragraph 16.

c. Assemble and hard-solder wires to socket assemblies as described in Paragraphs 17 through 19.

d. Complete assembly of hot side wires by cleaning and crimping insulation grips.

e. Attach plugs to wires on cold side of firewall by using hard or soft solder, as required on applicable drawing for the specific installation. The method of attachment, soldering, cleaning, etc, is the same as that previously described.

<table>
<thead>
<tr>
<th>Table 16–4 Code for Markings on AN5537</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Iron</td>
</tr>
<tr>
<td>Constantan</td>
</tr>
<tr>
<td>Chromel</td>
</tr>
<tr>
<td>Alumel</td>
</tr>
</tbody>
</table>

THERMOCOUPLE WIRE SPLICING

Installing Thermocouple Wire Splices on MIL-W-5846, Type I, Stranded Conductor, AWG 20 Alumel-Chromel Thermocouple Cable

28. Similar metal terminations are required to make connections from the thermocouple probe to the circuitry cable at any point where temperature changes may be expected. Termination of thermocouple cables in areas where all components would be at the same temperature normally would not require similar metal terminations. Splicing and connections of Alumel-Chromel thermocouple cables in engine nacelles, individual cable runs and wire bundles will be made using Alumel-Chromel Butt Splice with Insulation Support. These splices are uninsulated and separate insulation must be installed over the splice at the time of installation. An additional outer jacket must also be installed for cable protection and mechanical support.

29. Install thermocouple splices as detailed in Figure 16–16.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use only hot air gun M83521/5-01 or equivalent on fuelled aircraft.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of nitrogen with hot air gun M83521/5-01 in an enclosed area can be hazardous. Ensure area is well ventilated.</td>
</tr>
</tbody>
</table>

30. Tools and Equipment:

a. Heat Gun: Raychem Part Nos. AA-400, CV5700 or M83521/5-01 Heat Gun Kit.

b. Crimp Tool: Amp Part No. 46673.

31. Materials:


b. MIL-W-5846 (M5846/1E2/20-(AC)) Alumel Chromel Thermocouple Cable (as required).

c. 12.7mm wide fibreglass tape with thermosetting adhesive (optional).
NOTE
The following materials are contained in the Raychem Part No. D-436-0133 Materials Installation Kit:

- Qty 1 D-436-133-01 Chromel Splice, Colour Coded Gray.
- Qty 1 D-436-133-02 Alumel Splice, Colour Coded Green.
- Qty 2 D-436-133-03 Splice Sealing Sleeves.
- Qty 1 D-436-133-04 Overall Insulation Sleeve.

32. Butt Splicing Procedure. Procedures for butt splicing are shown in Figure 16–16.

33. Quality Assurance Summary:
   a. Ensure butt splices have been properly selected to match colour code of conductors:
      (1) ALUMEL (AL) Green
      (2) CHROMEL (CH) Gray
   b. Ensure butt splices are completely insulated by D436-133-03 sealing sleeves.
   c. Ensure splices have been staggered. See Figure 16–16, step 6.

Stub Splicing in Stub Splice Areas

34. In stub splice areas, all components can be expected to be at the same temperature. Similar metal connections and terminations are not required.

WARNING
Use only hot air gun M83521/5-01 or equivalent on fuelled aircraft.

WARNING
Use of nitrogen with hot air gun M83521/5-01 in an enclosed area can be hazardous. Ensure area is well ventilated.

35. Tools and Equipment:
   b. Crimp Tool: Amp Part No. 49935 or Raychem Part No. AD1377.

36. Materials:
   a. Parallel Connector, 34130 or D-609-04.
   b. Raychem D-300-08 End Cap, Shrinkable, Self sealing.
   c. 12.7mm Fibreglass Tape, with thermo-setting adhesive.

37. Stub Splicing Procedure. Procedures for stub splicing are shown in Figure 16–17.

38. Quality Assurance Summary:
   a. Ensure like colour-coded wires have been spliced together.
   b. Ensure individual stub splices have been completely insulated.
STEP #1 - REMOVE 53.3±2.5mm OF JACKET FROM CABLES TO BE SPLICED

ALUMEL (GREEN) CHROMEL (GREY)

STEP #2 - CUT THE CHROMEL LEAD OF ONE CABLE AND THE ALUMEL LEAD OF THE OTHER CABLE TO 23.0±1.3mm

CHROMEL ALUMEL

STEP #3 - STRIP 10.0±1.3mm FROM END OF EACH WIRED

CHROMEL ALUMEL

STEP #4 - a. PLACE A D-436-0133-04 (LARGE SLEEVE) ONTO ONE OF THE CABLES.
  b. PLACE A D-436-0133-03 ON THE LONGER LEAD OF EACH CABLE.

STEP #5 - a. CRIMP CHROMEL LEADS (GREY INSULATION) INTO OPPOSITE ENDS OF THE D-436-0133-01 (GREY) CRIMP BARREL.
  b. CRIMP ALUMEL LEADS (GREEN INSULATION) INTO OPPOSITE ENDS OF THE D-436-0133-02 (GREEN) CRIMP BARREL.

NOTE: MAKE CRIMP USING AMP TOOL #46673.

STEP #6 - CENTER THE D-436-0133-03 SEALING SLEEVES OVER THE SPLICES, AND HEAT TO SHRINK, USING A HOT-AIR HEATER, UNTIL THE SLEEVE RECOVERS AND THE SEALING INSERTS MELT AND FLOW ALONG WIRE. HEAT MUST BE APPLIED TO INDIVIDUAL SEALING RINGS UNTIL THEY MELT AND FLOW.

STEP #7 - CENTER D-436-0133-04 OUTER COVER OVER THE COMPLETED SPlice ASSEMBLY AND HEAT UNTIL IT RECOVERS TIGHTLY ONTO THE ASSEMBLY. SLEEVE SHOULD OVERLAP CABLE JACKETS APPROXIMATELY 0.5 INCH.

STEP #8 - WRAP SPlice AREA WITH FIBREGLASS TAPE IF ADDITIONAL PROTECTION OR SUPPORT IS NEEDED.

Figure 16–16 Butt Splicing Procedure
**Figure 16–17 Stub Splicing Procedure**

**STEP#1** - END STRIP OUTER JACKET OFF ALUMEL_CHROMEL THERMOCOUPLE WIRE 53.3±2.5mm.

**STEP#2** - END STRIP BOTH CONDUCTORS 19±1.3mm.

**STEP#3** - KEEPING THE ENDS OF INSULATION FLUSH, TWIST STRIPPED WIRE ENDS AS NECESSARY TO PERMIT THEIR INSERTION INTO CONNECTOR.

**NOTE**

TWIST ENDS OF SAME COLOUR CODED WIRES TOGETHER

ALUMEL-GREEN  
CHROMEL-GRAY

**STEP#4** - POSITION WIRES IN PARALLEL CONNECTORS SO THAT AFTER CRIMPING WITH CRIMP TOOL 49935 AND CONNECTOR 34130 OR CRIMP TOOL AD1377 AND D-609-04 CONNECTOR THERE WILL BE A MAXIMUM OF 0.8 TO 2.3 mm BETWEEN CONNECTION AND WIRE INSULATION.

**NOTE**

USE CRIMP TOOL AD1377 WITH D-609-04 CONNECTOR, USE CRIMP TOOL 49935 WITH 34130 CONNECTOR.

IF CONNECTOR HAS A WELDED SEAM, THE SEAM MUST BE IN THE NEXT SECTION OF CRIMPING TOOL.

**STEP#5** - CRIMP CONNECTOR

**STEP#6** - CUT PROTRUDING WIRE FLUSH WITH END OF CONNECTOR.

**STEP#7** - POSITION D-300-08 SELF-SEALING, SHRINKABLE END CAP OVER CONNECTOR SUCH THAT CONNECTOR IS BOTTOMED OUT IN CAP.

**STEP#8** - SHRINK END CAP USING HEAT GUN.

**STEP#9** - WRAP 2 ½ TURNS OF 0.5 INCH FIBREGLASS TAPE AROUND BOTH CABLE JACkETS FOR MECHANICAL SUPPORT.
MOUNTING AN5537 CONNECTOR ASSEMBLY

39. AN5537 firewall connector assemblies are mounted as follows (refer to Figure 16–3):
   a. Attach insulating block to firewall on hot side. Bosses on block should fit into holes in firewall so that block face is flush against wall.
   b. Push socket assemblies through holes and lock into place with coupling nuts.
   c. Push plugs into socket assemblies from cold side of firewall.

ROUTING THERMOCOUPLE WIRING

40. Route thermocouple wiring as described in Section 2, Chapter 4. In addition, observe the following special precautions:
   a. Support thermocouple wiring so it will not come into contact with heat producing surfaces, such as exhaust pipe or combustion chamber, at any point.
   b. Do not bend thermocouple leads sharply.
   c. Do not splice thermocouple leads except where specifically indicated, and then only with approved splices such as shown in Figure 16–16.
   d. Protect adjacent wiring against abrasion from thermocouple splices as described in Paragraph 41.
   e. Route thermocouple wiring away from hot spots.

Protection

41. Insulate thermocouple spliced terminal connections with sleeves to protect the insulation of adjacent wires from abrasion. Use plastic sleeving in cool areas and silicon impregnated rubber or glass sleeving in hot areas. Tie sleeving securely at both ends.

Slack in Thermocouple Wiring

42. Thermocouple wire installations require the use of fixed wire lengths to maintain a specified resistance (See Figure 16–18). The slack that results should be distributed by one of the following methods:
   a. Distribute excess slack evenly between wire supports, as shown in Figure 16–18.
   b. If sufficient slack is available, take it up at a support, in the form of a loop of which the diameter is at least 20 times the thickness of the thermocouple wire, as shown in Figure 16–18.

CAUTION

Do not use sleeving as a substitute for safe routing.

Figure 16–18 Distributing Slack in Thermocouple Wire

A. DISTRIBUTED SLACK
B. COILED SLACK