
# ORION

## SERVICE DIGEST

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# ORION

## CRIMPED CONTACT CONNECTORS




editor ROY BLAY

assistant editors DON WADSWORTH : WAYNE CRADDUCK

art VIRGINIA ROBINS : ROBERT BROOKS


**FRONT AND BACK COVERS** Patrol Squadron Forty-four (VP-44) was the second fleet squadron to transition to the P-3A Orion. The first of the new sub-hunters was delivered on the 29th of August 1962, and the ceremony on this gala occasion included the christening of the new aircraft as **Rigel**, a blue-white star of first magnitude in the constellation of Orion. As other P-3As arrived in the squadron they too were christened after stars in the Orion constellation.

VP-44 was commissioned in 1951 flying PBM Mariners, and has since operated P5M Marlins and P-2 Neptunes. Although a comparatively young squadron, it has quickly earned an enviable reputation for its proficiency in the art of ASW. In particular VP-44 prides itself on being in a state of operational readiness at all times, and was recently cited for this as well as for the excellent performance of its crews in qualification and competitive exercises. This proficiency proved invaluable with the advent of the Cuban crisis in October 1962. VP-44 undertook many ship-surveillance missions with the Orion during this period, even though the squadron was still deeply involved with indoctrination training and most of their new aircraft had yet to be delivered. It should perhaps be noted for the record that, before this, VP-44's commanding officer became the first designated P-3A Patrol Plane Commander.

Since the acceptance of their first Orion, VP-44 has, in emulation of the Pelican emblazoned on the tail of each of the squadron's aircraft, spread its wings over the Atlantic. From the squadron's home base at NAS Patuxent River in Maryland, the Pelican has been seen as far afield as Trinidad, Labrador, and Paris, France.

Of interest: the picture on page 14 shows one of VP-44's Orions, **Alnilam**, flying over the communist-hijacked Venezuelan freighter **Anzoategui**, which was tracked by Navy patrol aircraft until it put into a Brazilian port.


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**LOCKHEED SERVICE DIGEST**
**BURBANK, CALIFORNIA, U.S.A.**

# crimped contact connectors

## INTRODUCTION

DURING THE PAST decade, improvements in airborne Anti-Submarine Warfare technology have enabled the sub-hunters to seek their quarry more efficiently. One of the newcomers to the ASW field, the P-3A Orion, has been equipped with the best electronic devices that are available. However, the nature of the electronics industry is such that electronic equipments are continually being improved upon, necessitating modification of equipments already installed aboard aircraft. Often it is necessary to completely replace components that still function well within the scope of their intended use, but which have become obsolete. The rewiring involved during incorporation of such modifications on earlier types of ASW and AEW aircraft has, on occasion, been stupendous.

Recently the manufacturers of electrical connectors introduced the crimped contact type connector to alleviate these frustrating situations. Lockheed has incorporated relatively small sized crimped contact connectors wherever practical in the design of the P-3A electrical and electronic systems, thus facilitating the initial installation of electrical wiring and the subsequent maintenance of these systems.

At a casual glance the crimped contact connector appears physically similar to the older style soldered contact connector, but closer scrutiny reveals significant changes. The most apparent change is the contact itself. The contact does not have the conventional cut-away solder-pot, but instead has a wire well in one end of the contact. The bare wire is inserted into this well in the contact, and the contact is staked to the wire with a special crimping tool.

About four years ago, development of crimped contact connectors had reached the point where their reliability was at least equal to that of the soldered contact connectors. In conjunction with this was the development of a compounded rubber type insulation material that is used in many of the crimped contact connectors today. The properties of this insulating material enable the electrician to install or remove any or all of the connector contacts without having to completely disassemble the connector — if he has the proper tools. Insulation fabricated from this resilient material also affords an added benefit when used with environmental connectors. The connectors do not have to be potted.

The need for an environmental connector with contacts that may be easily replaced is painfully apparent when you consider the insulated jungle of wire that supports the electrical and electronic equipment on ASW aircraft such as the P-3A. Certainly the replacement of a few individual contacts in a crimped contact connector is a decided improvement over the replacement of soldered contacts in a potted connector. This latter operation generally entails the difficult task of removing the potting compound prior to gaining access to the soldered contacts, and this is followed by the involved task of re-potting the connector after the circuitry modifications have been made.

Another feature that the electrician might appreciate is the ease of working with a crimping tool in confined quarters, rather than the sometimes unwieldy operation of soldering a wire to a contact in a cramped area. An additional benefit is also realized, for the ratchet action of the crimping tool ensures that each contact will be crimped uniformly. A tool of this type will not release the contact until the proper crimping cycle has been completed.

Naturally there have been a few difficulties involved with the introduction of crimped contact connectors, but these problem areas usually involve operator technique and the selection of the proper tool for the job. Very little can be said about operator technique, since this goes hand in hand with training and experience. However, a brief discussion of the tooling required to support these connectors may prove to be enlightening.

There are actually three different types of tools required for the crimped contact connector — the crimping tools, the insertion tools, and the removal tools. Each of these categories must be further broken down, for each size of contact usually requires its own special tools. Finally, each connector manufacturer has his own particular connector designs, so each brand of crimped contact requires its own peculiar tooling, and few if any tools are interchangeable. Therein lie most of the problems. Perhaps in time there will be some form of standardization in the field of crimped contact connectors, but that has yet to occur.

As you can see, the tool situation could reach nightmarish proportions unless some prudence is exercised when the sources of these connectors are being selected. There is a pretty fair chance that at least some tools produced by a vendor to support one line of his connectors will be common to some other line of his products. It logically follows that to minimize the tooling inventory required to install or remove crimped contacts, the number of vendors should be reduced to an absolute minimum — with due consideration being given to spares availability and the military requirement for alternate manufacturing sources of hardware. Lockheed has used, is using, or will use the following series of connectors on the P-3A Orion: Airborn RK series relay sockets (Lockheed Standard LS 9104-8 and LS 9104-10); Amphenol 69 series; Bendix PT-CE series; Burndy ME series; Cannon RX and SRC series; and Viking relay sockets.

The P-3A also uses Cannon KE connectors as disconnects for the power plants. The contacts in these connectors are the crimp type, but complete disassembly of the connector is required for contact replacement. Naturally, most of the tools discussed in this article would not apply to KE connectors. For this reason these connectors are not covered in this article.

Lockheed has found it expedient to improve the tooling by combining the best features of the vendor's tools with Lockheed designs wherever deemed necessary. The tooling that has resulted from the incorporation of these improvements is offered by Lockheed in the form of a crimped contact connector tool kit. The individual tools of this kit may also be purchased from Lockheed.

Perhaps it may seem that the tooling facet of this topic has received more emphasis than it deserves, but it is important that the electrician be

aware of the special tools that are required to work with crimped contact connectors. It must also be stressed that Lockheed believes that those difficulties experienced with the introduction of these connectors will be more than compensated for by their reliability, ease of installation, and particularly their ease of maintenance.

The features of crimped contact connectors that make the use of these connectors desirable can not be fully exploited if the contacts are incorrectly crimped or if the wrong installation procedures are followed. Lockheed feels so strongly about this matter that a special training program has been set up to instruct and certify factory personnel who have been selected to work with crimped contact connectors. Much of the information contained in this article is essentially the same as is presented in classes to the Lockheed personnel who assemble and install these connectors.

The body of this article is separated into four categories. The first part deals with choosing the correct contacts to install into a connector. The second part of the article describes how to crimp a contact to a wire. Third is how to install the crimped contacts into a connector, and the fourth part is concerned with removing contacts from a connector.

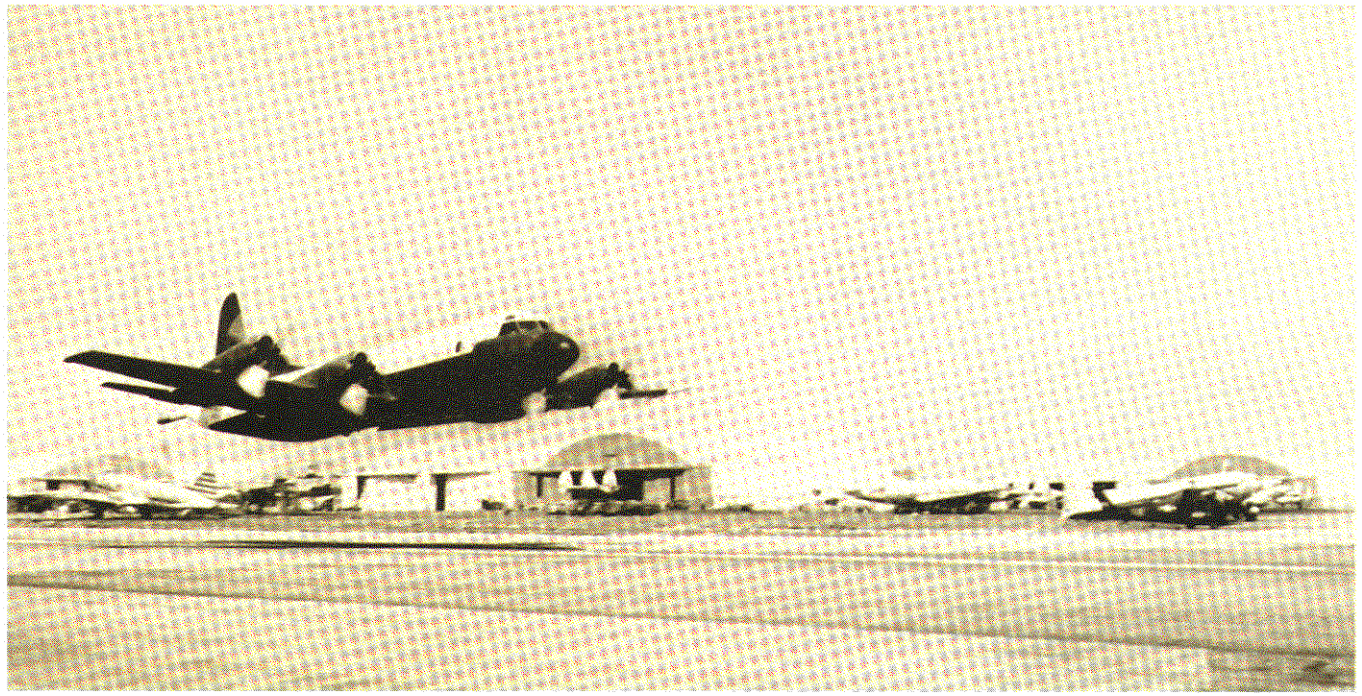
## SELECTING THE CONTACTS

Modification or installation of a connector must begin with an inspection of the connector. It must be in a serviceable condition, otherwise it must be replaced. If this is necessary, the replacement must match the old connector in all respects with regard to keying position, mating of the lock-ring threads or slots, strain relief clamp provisions, and mounting hole spacing.

When handling any electrical connector, it behooves a person to treat it as a delicate instrument. Electrical connectors are designed to withstand adverse conditions, but there are limitations. Please do not use a connector as a hammer, foot rest, or for some other unauthorized purpose.

If the connector's condition is satisfactory, the next step is to determine the manufacturer's name and the connector part number. The name and part number are found on the connector, but both may not necessarily be in the same place. With this information, the electrician may refer to the contact selection chart in the center of this magazine and choose the correct contacts.

If a contact in an existing connector is to be replaced, remove the old contact from the connec-



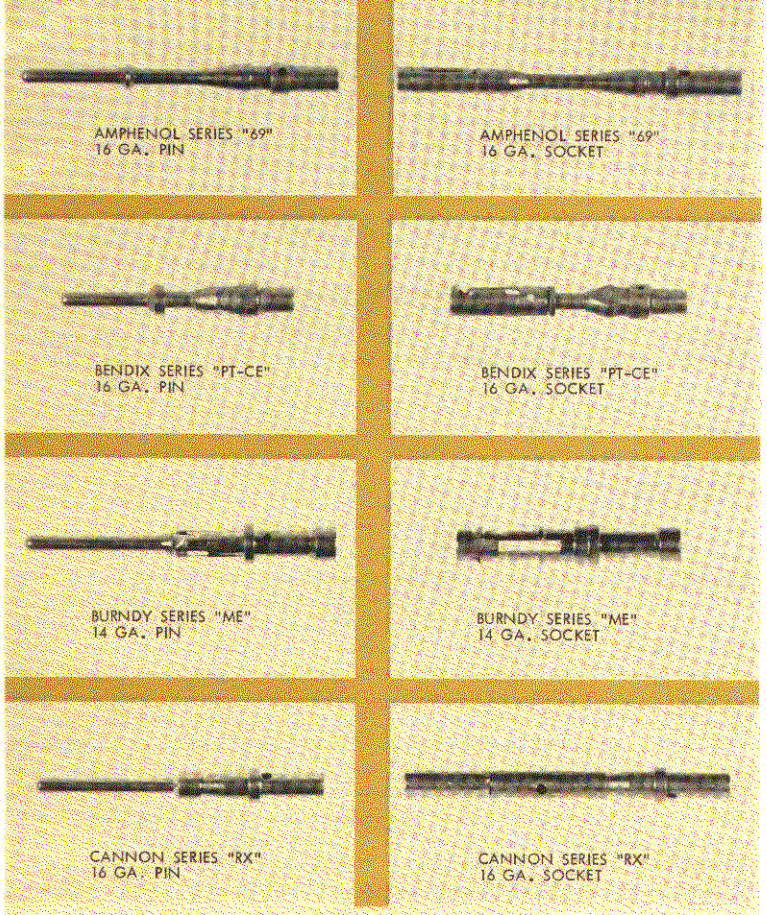



Figure 1 Typical Contacts Used on Amphenol "69", Bendix "PT-CE", Burndy "ME", and Cannon "RX" Crimped Contact Connectors.

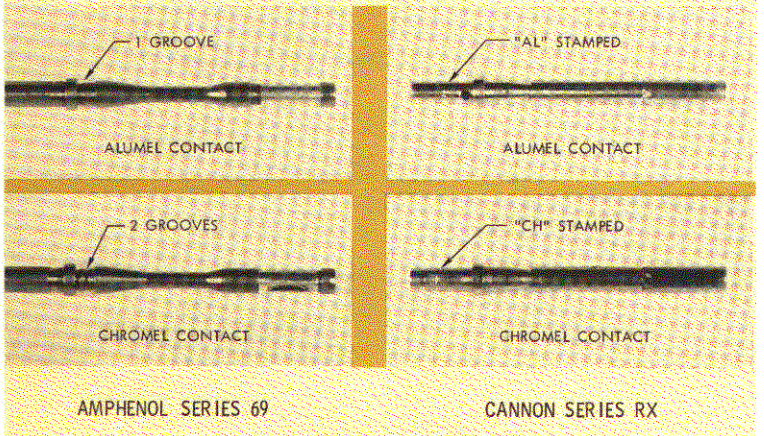



Figure 2 Typical Alumel and Chromel Contacts Used on Amphenol "69" and Cannon "RX" Connectors.

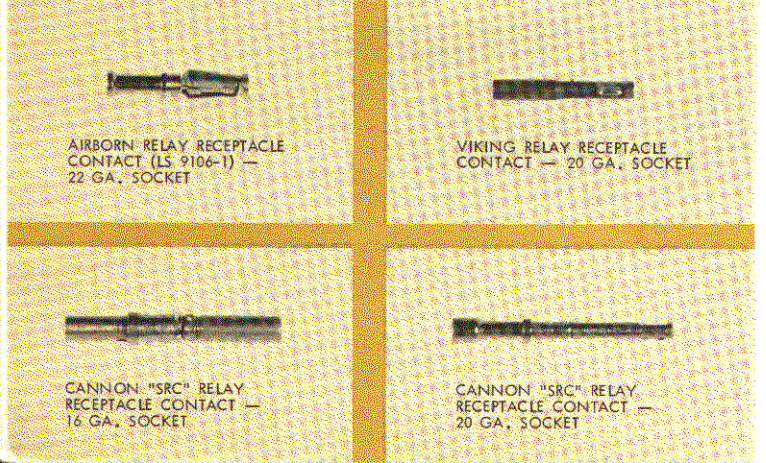



Figure 3 Contacts used on Airborn "RK" (LS 9104-8 and -10), Cannon "SRC", and Viking Relay Connectors.

tor *first*, and compare the new contact with it. If they are not the same, recheck the contact chart.* Removal of contacts from a connector is discussed in the appropriate section later in the article.

Always be certain that the correct contacts are used, otherwise the connector might be damaged when contact installation is attempted. Bent, cracked, or otherwise deformed contacts must never be installed, and *no attempt should be made to straighten a bent contact* except to facilitate its removal. A bent contact will probably become work hardened if it is straightened, which will most likely result in failure of the contact after it has been in use.

If a particular connector was designed to accommodate contacts with retaining rings or other such retaining members, the retainer must be present and intact on the contact; if not, discard the contact and get one that does have the retaining member. Female contacts (sockets) without spring clips on their mating ends are useless, so always be certain that the socket has a clip on it before using the contact.

There is always the possibility that contacts may have been placed in the wrong parts bin, so it is helpful to be able to identify contacts by their physical appearance. Presently it seems that each electrical manufacturer has his own design for retaining the removable crimped contacts in their connectors. For this reason, each manufacturer's contacts differ from those of other manufacturers, and some of these differences may be used as a guide to selecting the correct contact.

Naturally it is impossible to discuss all the contacts of every manufacturer, but it may be beneficial to point out characteristics of some types of contacts installed in those crimped contact connectors most commonly used on the P-3A. Some of the connectors mentioned have yet to be used on P-3A aircraft, and use of others will be discontinued in the future.

Figure 1 shows three examples of 16 gauge pins and one example of a 14 gauge pin. Regardless of the pin size, each type of pin has similarities common

**Although the possiblity is remote, the old contact may not have been the correct contact.*

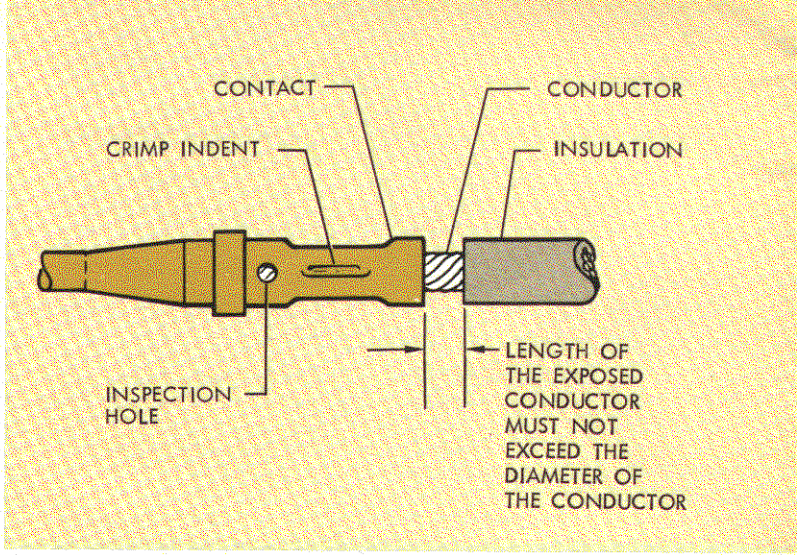



Figure 4
Wire Stripped of Insulation and Inserted into Wire Well.
(Contact does not have insulation support.)

only to other contacts of its particular series and make. The Amphenol Series 69 pin has a rather wide groove below the wire well — something that is not present on the Cannon RX pin. The Bendix PT-CE pin has flat surfaces milled into the pin, and the Burndy ME pin has a spring clip retaining member just below the wire well.

The four examples of sockets shown in Figure 1 also can be identified by their different characteristics. The Amphenol Series 69 sockets have the wide groove just below the wire well and are "necked down" in the middle. Bendix PT-CE sockets have the milled flat surfaces and their own peculiar style of spring clip on the mating end. The Burndy ME sockets are called "HYFEN" contacts because of the hyphen-like space in them. Comparison of the Cannon RX sockets to these other sockets shows that they are thicker than some, longer than others, and do *not* have the identifying characteristics of the other sockets.

Both Amphenol and Cannon make special alumel and chromel contacts used in the Series 69 and the RX connectors, samples of which are shown in Figure 2. These contacts are the same shape as the other contacts of their respective series, but are a different color — a shiny nickel rather than a golden color. The Amphenol Series 69 alumel contacts can be distinguished from the chromel contacts by the single groove cut within the larger groove that is just below the wire well. The Amphenol 69 chromel contacts have two small grooves cut within the larger groove.

The identifying marks on the Cannon alumel and chromel contacts are located on the exterior near the center of the wire well. Alumel contacts are stamped with the characters "AL", while chromel contacts have "CH" stamped on them.

Contacts used on three different types of relay connectors are shown in Figure 3. Both the Airborn Series RK contacts (LS 9106-1) and the Viking contacts are quite small compared to the Cannon SRC contacts. It is easy to tell the LS 9106-1 contacts from the Viking contacts because the former have a spring clip retainer while the latter have a split retaining ring.

## CRIMPING THE CONTACTS

After a serviceable contact has been selected, the wire to which the contact is to be affixed must be stripped of insulation. Lockheed's standard practice is to strip 9/32 inch of insulation from the end of the wire. If some wire strands spread when the wire is stripped, twist the stray strands gently in the same direction as the other strands are twisted.

Some small threads or other bits of insulation may remain after the wire has been stripped. These should be trimmed away before the contact is crimped to the wire. It also should be kept in mind that too much insulation should not be stripped from the end of the wire. The insulation serves as a support to the metal conductor, in addition to its primary function of preventing electrons from straying.

The next step is to make certain that the wire is stripped to the correct length. This is done by inserting the wire conductor into the wire well of the contact that is to be used. The wire conductor must be visible through the contact inspection hole, and should bottom out in the wire well. On contacts without an insulation support, the length of wire conductor exposed between the wire insulation and the contact must be not greater than the diameter of the conductor (see Figure 4). If the contact does have an insulation support, be certain that the wire insulation extends into the support portion of the wire well.

Assuming that the wire is properly stripped and that the correct contact has been selected, the tools for the crimping operation may now be obtained. Refer to the contact chart when choosing the crimping tool and the locator that correctly positions the contact.

At this point it must be stated that there are two vintages of crimping hand-tools in general use at Lockheed — the older and the newer. The main difference between the tooling is that the older tools *may* be used without locators, but the newer tool *must* be used with its locator set.

It is highly improbable that naval personnel will encounter any of these older tools; but, since the possibility exists, a brief mention of them seems appropriate. These tools, one of which is shown in Figure 5, are made by Buchanan and come in three sizes: one size color-coded yellow (Lockheed P/N L525C19-4) to accommodate size 12 contacts, one size color-coded blue (Lockheed P/N L525C19-3) for size 16 contacts, and one size color-coded red (Lockheed P/N L525C19-13) for size 20-22 contacts. Always select the crimping tool to suit the size of the contact, *not the gauge of the wire.* If locators are available, it is recommended that locators be used with these older type tools, because it is possible to position a contact incorrectly in a tool that does not have a locator. Under the same circumstances, it is just as easy to attempt to crimp a contact with the wrong size of tool. Use of locators prevents this awkward situation. Assuming that locators are not available, the prepared wire end must be inserted in the contact wire well, and the contact must be visually positioned in the correct crimping tool.

The newer tool, identified in this article by the Lockheed part number L525C19-300, is the MS3191 tool and is shown in Figure 6. This tool is used with contacts that are sizes 12, 16, or 20, and it must be used in conjunction with the locator that is specified to be used with each contact. The locators, as used with the -300 tool, not only correctly position the contact for the crimping operation, but control the depth of the crimp.

A third type of crimping hand-tool is made by Burndy, and is used on the contacts in the Burndy ME series connectors. Lockheed identifies this crimping tool, complete with the correct crimping dies, as part number L525C19-101. This tool does not use locators, so the wire conductor must be inserted into the contact and then the contact must be visually positioned in the crimping tool.

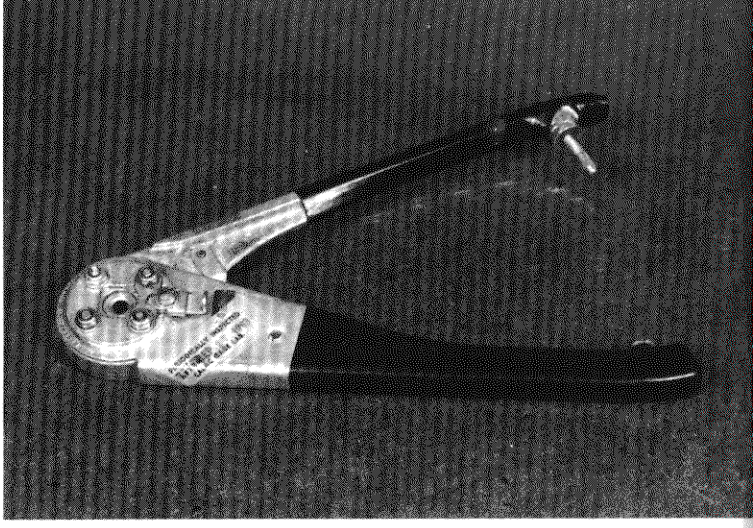


Figure 5 L525C19-3 Crimping Tool (Locator not shown)

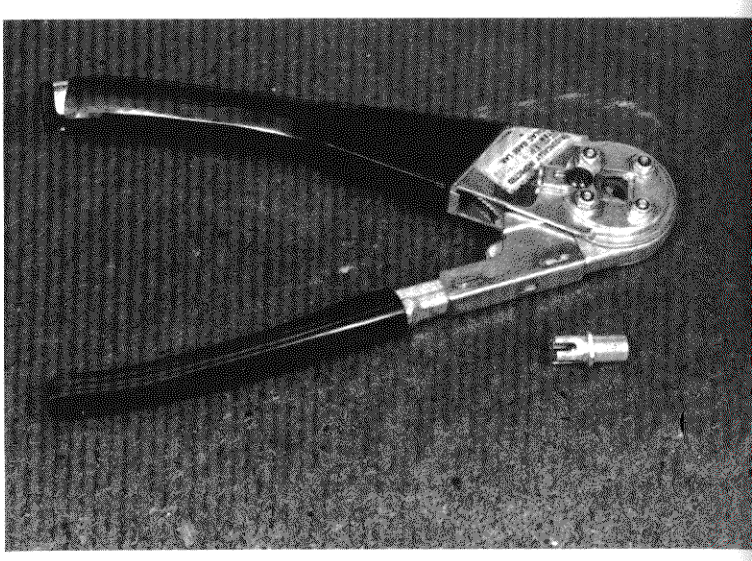


Figure 6 L525C19-300 Crimping Tool with -306 Locator

Figure 7 Crimping a Contact to a Wire

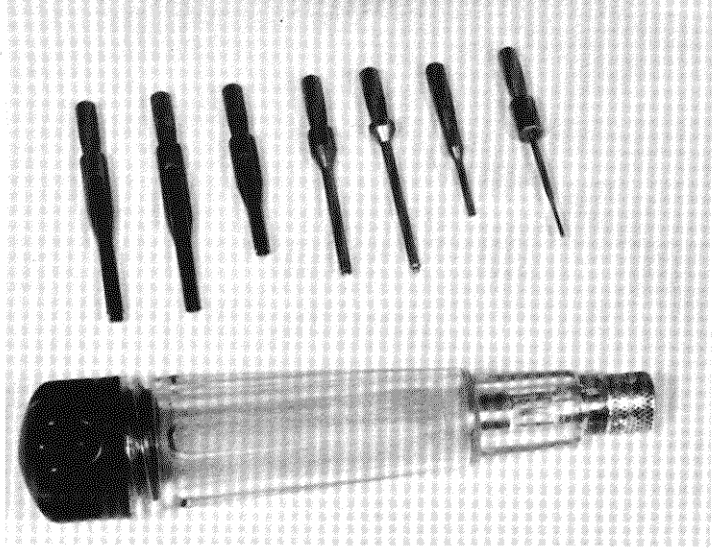


Figure 8 Combination Insertion-Removal Tool

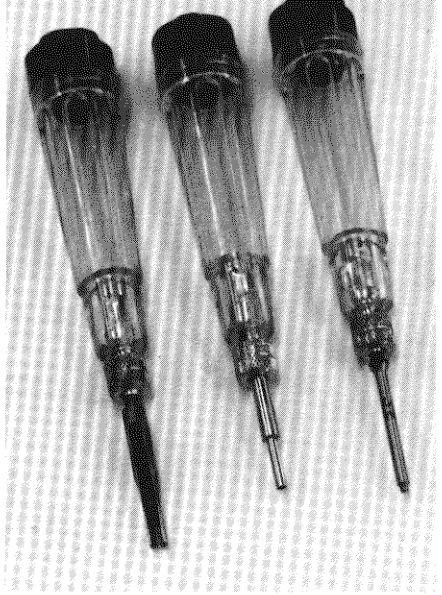


Figure 9 Insertion (l.) and Removal (c. and r.) Tools for Size 12 Contacts

The crimping operation itself is simple. With the correct locator inserted into the tool, the tool is held by the handle grips in one hand with the locator pointed away from the operator. The contact is then placed into the hole in the face of the tool with the wire well in the contact pointed toward the operator. The stripped end of the wire is then inserted into the contact wire well until the conductor portion of the wire is bottomed. Be certain that all the strands of wire are in the contact well. Application of excessive force should be unnecessary when inserting the wire conductor into the contact well. Holding the wire in the position shown in Figure 7, squeeze the handles of the crimping tool together, exerting pressure on the tool handles until the crimping cycle is completed.

After the crimping cycle is completed, withdraw the crimped contact from the tool and examine the contact to ensure that it is properly crimped to the wire. The crimp indent on the contact must not break over on the wire entry end of the contact well or on the insulation support shoulder of the contact. In addition, the crimp indent on the contact must not distort or close the wire well inspection hole to the extent that visual inspection of the conductor depth would be prevented. If the same type of damage to the contact occurs continually, the fault may be with the crimping tool. Faulty tools should be returned to supply or tool inspection for repair.

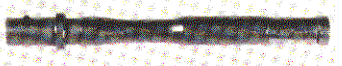
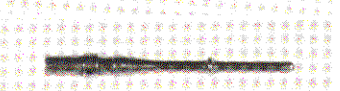
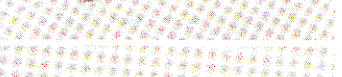
If none of the above damage has occurred, if the wire conductor can be viewed through the inspection hole, and if the contact has not been bent or otherwise damaged, the crimped contact is acceptable and is ready for insertion into the connector. The crimping operation may now be repeated for joining the next contact and wire.

## INSERTING THE CONTACTS

Insertion of contacts into a connector usually requires the use of a special insertion tool. Most of the tools required for inserting or removing size 16 and size 20 contacts from most types of crimped contact connectors used on the P-3A are contained in the handle of Lockheed's combination insertion-removal tool shown in Figure 8. A separate set of 3 tools shown in Figure 9 is used with size 12 Amphenol "69" and Cannon "RX" contacts. However, there are some crimped contact connectors that do not require any special tooling for insertion of the contacts. The relay sockets made by Airborn and Viking require only the deft fingers of the electrician to install the contacts.

Most of the environmental connectors have a removable back shell. When this shell is tightened it exerts pressure on the resilient seal on the back of the connector, thereby securing the environmental integrity of the connector. Prior to inserting or removing any contacts from these connectors, the pressure on this back seal must be relieved. This is done by loosening or removing the back shell of the connector. If the electrician has a Cannon SRC relay socket in his hand and is wondering how to relieve the pressure on the back seal — forget it. These Cannon relay sockets do not have provisions to relieve the pressure on the back seal.

The preferred procedure of relieving the pressure on the resilient seal is to remove the back shell of the connector rather than merely loosening it, but if the back shell is removed care must be taken to ensure that all the wires that are to be installed in the connector are first threaded through this shell. If a wire is not threaded through the back shell prior

| CONNECTOR MANUFACTURER & SERIES | CONTACT SIZE & TYPE | CONTACT SHOWN ACTUAL SIZE | CONTACT PART NUMBER (VENDOR'S PART NUMBER) | WIRE SIZE | CRIMP TOOL PART NUMBER | CRIMP TOOL LOCATOR PART NUMBER | INSERT TOOL PART NUMBER | REMOVAL TOOL PART NUMBER |
|---|---|---|---|---|---|---|---|---|
| **AIRBORN SERIES "RK" RELAY RECEPTACLE**<br>COMPLIES TO LOCKHEED STANDARD LS 9104-8 or LS 9104-10 | 22S |  | LS 9106-1 (LS P/N) | 20-22 | -300 | -106 | NONE REQ. | -105 |
| **AMPHENOL SERIES "69"**<br>SAMPLE P/N<br>69-0R24-20P (100)<br>(100) - BASIC CONNECTOR WITH CONTACTS<br>(101) - BASIC CONNECTOR WITHOUT CONTACTS<br>DENOTES ALTERNATE INSERT POSITION, IF PRESENT (W, X, Y, or Z)<br>CONTACT TYPE (P - PIN, S - SOCKET)<br>INSERT ARRANGEMENT (SHELL SIZE - PATTERN)<br>CONNECTOR TYPE ( R - ENVIRONMENTAL)<br>SHELL STYLE (0 - WALL MOUNTED RECEPTACLE, 1 - CABLE RECEPTACLE, 6 - STRAIGHT PLUG)<br>CONNECTOR SERIES | 12S |  | 69-1100-03 | 12-20 | -300<br>-4 | -307<br>-22 | -86 | -32 |
| | 12P |  | 69-1115-03 | 12-20 | -300<br>-4 | -307<br>-22 | -86 | -28 |
| | 16S |  | 69-1105-03 | 16-22 | -300<br>-3 | -306<br>-21 | -24 | -59 |
| | 16P |  | 69-1120-03 | 16-22 | -300<br>-3 | -306<br>-21 | -24 | -69 |
| | 16SS |  | 69-1110-03 | 16-22 | -300<br>-3 | -306<br>-21 | -24 | -59 |
| | 16SP |  | 69-1125-03 | 16-22 | -300<br>-3 | -306<br>-21 | -24 | -69 |
| | 16SS |  | 69-1173 | 16-20 | -300<br>-3 | -306<br>-30 | -24 | -59 |
| | 16SP |  | 69-1143 | 16-20 | -300<br>-3 | -306<br>-30 | -24 | -69 |
| | 16SS |  | 69-1176 | 16-20 | -300<br>-3 | -306<br>-30 | -24 | -59 |
| | 16SP |  | 69-1146 | 16-20 | -300<br>-3 | -306<br>-30 | -24 | -69 |
| **BENDIX SERIES "PT-CE"**<br>SAMPLE P/N<br>PT06CE-14-12P (SR)<br>(SR) - DENOTES STRAIN RELIEF CLAMP, IF PRESENT<br>DENOTES ALTERNATE INSERT POSITION, IF PRESENT (W, X, Y, or Z)<br>CONTACT TYPE (P - PIN, S - SOCKET)<br>INSERT ARRANGEMENT (SHELL SIZE - PATTERN)<br>SHELL STYLE (00 - WALL MOUNTED RECEPTACLE, 01 - CABLE CONNECTING PLUG, 02 - BOX MOUNTED RECEPTACLE, 06 - STRAIGHT PLUG, 07 - JAM NUT RECEPTACLE, 08 - 90° PLUG)<br>CONNECTOR SERIES | 16S |  | 10-189006-162 | 16-22 | -300<br>-3 | -302<br>-30 | -42 | -59 |
| | 16P |  | 10-189004-162 | 16-22 | -300<br>-3 | -302<br>-30 | -42 | -69 |
| | 20S |  | 10-189002-202 | 20-22 | -300<br>-13 | -301<br>-29 | -40 | -58 |
| | 20P |  | 10-189000-202 | 20-22 | -300<br>-13 | -301<br>-29 | -40 | -68 |

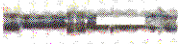
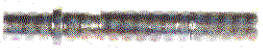
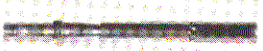
**NOTE**

1. BASIC LOCKHEED PART NUMBER FOR HAND-OPERATED TOOLS FOR CONTACT CRIMPING, INSERTION, AND REMOVAL IS L525C19-( ). ADD DASH NUMBER IN THE ABOVE COLUMNS FOR COMPLETE LOCKHEED TOOL PART NUMBER. EXAMPLE: L525C19-300.
2. PART NUMBERS SHOWN IN RED ARE PART NUMBERS OF OLDER TOOLING. AFTER AN OLDER TOOL HAS WORN OUT, REPLACE IT WITH THE APPROPRIATE NEWER TOOL.
3. P - PIN
   S - SOCKET
   SP - SHORT PIN
   SS - SHORT SOCKET

**CODE**

ALUMEL CONTACT

CHROMEL CONTACT

| CONNECTOR MANUFACTURER & SERIES | CONTACT SIZE & STYLE | CONTACT SHOWN ACTUAL SIZE | CONTACT PART NUMBER (VENDOR'S PART NUMBER) | WIRE SIZE | CRIMP TOOL PART NUMBER | CRIMP TOOL LOCATOR PART NUMBER | INSERT TOOL PART NUMBER | REMOVAL TOOL PART NUMBER |
|---|---|---|---|---|---|---|---|---|
| **BURNDY SERIES "ME"**<br>SAMPLE P/N<br>ME26R - 1<br>1 - INSERT POSITION (1 - NORMAL, 2 - ALTERNATE)<br>R - SHELL STYLE (P - PLUG, R - RECEPTACLE)<br>26 - NUMBER OF CONTACTS CONNECTOR CAN ACCOMODATE<br>ME - CONNECTOR SERIES<br>CAUTION: THESE BURNDY CONTACTS ARE OUTWARDLY IDENTICAL (AS SHOWN BY THE PHOTOS), AND DIFFER ONLY IN THE DIAMETER OF THE WIRE WELL. | 14S |  | RC14M-1F31 | 14-18 | -101 | NONE REQ. | NONE REQ. | -126 |
| | 14P |  | RM14M-1F30 | 14-18 | -101 | NONE REQ. | NONE REQ. | -127 |
| | 20S |  | RC20M-1F31 | 20-22 | -101 | NONE REQ. | NONE REQ. | -126 |
| | 20P |  | RM20M-1F30 | 20-22 | -101 | NONE REQ. | NONE REQ. | -127 |
| **CANNON SERIES "RX"**<br>SAMPLE P/N<br>RX0R24-20P<br>0 - DENOTES ALTERNATE INSERT POSITION, IF PRESENT (W, X, Y, or Z)<br>P - CONTACT TYPE (P - PIN, S - SOCKET)<br>24 - INSERT ARRANGEMENT (SHELL SIZE - PATTERN)<br>R - CONNECTOR TYPE (R - ENVIRONMENTAL)<br>0 - SHELL STYLE (0 - WALL MOUNTED RECEPTACLE, 6 - STRAIGHT PLUG)<br>RX - CONNECTOR SERIES | 12S |  | B1212SC-B01 | 12-20 | -300<br>-4 | -307<br>-22 | -86 | -32 |
| | 12P |  | B1212PC-A01 | 12-20 | -300<br>-4 | -307<br>-22 | -86 | -28 |
| | 16S |  | B1616SC-G01 | 16-22 | -300<br>-3 | -306<br>-21 | -24 | -59 |
| | 16P |  | B1616PC-A01 | 16-22 | -300<br>-3 | -306<br>-21 | -24 | -69 |
| | 16S |  | B1616SC-G90 | 16-20 | -300<br>-3 | -306<br>-21 | -24 | -59 |
| | 16P |  | B1616PC-A90 | 16-20 | -300<br>-3 | -306<br>-21 | -24 | -69 |
| | 16S |  | B1616SC-G91 | 16-20 | -300<br>-3 | -306<br>-21 | -24 | -59 |
| | 16P |  | B1616PC-A91 | 16-20 | -300<br>-3 | -306<br>-21 | -24 | -69 |
| **CANNON SERIES "SRC" RELAY RECEPTACLE**<br>SAMPLE P/N<br>SRC - A8<br>A - CONTACT ARRANGEMENT<br>SRC - CONNECTOR SERIES | 16S |  | 031-0945-001 | 16-20 | -300<br>-3 | -306<br>-21 | -42 | -59 |
| | 20S |  | 031-0900-000 | 20-22 | -300<br>-13 | -304<br>-50 | -40 | -58 |
| **VIKING RELAY RECEPTACLE**<br>PART NUMBER 000300-0274 (8 CONTACTS), OR PART NUMBER 000300-0280 (10 CONTACTS) | 20S |  | 019-0104-000 | 20-22 | -300<br>-13 | -303<br>-61 | NONE REQ. | -62 & -63 ASSY. |

**NOTE**

1. BASIC LOCKHEED PART NUMBER FOR HAND-OPERATED TOOLS FOR CONTACT CRIMPING, INSERTION, AND REMOVAL IS L525C19-( ). ADD DASH NUMBER IN THE ABOVE COLUMNS FOR COMPLETE LOCKHEED TOOL PART NUMBER. EXAMPLE: L525C19-300.
2. PART NUMBERS SHOWN IN RED ARE PART NUMBERS OF OLDER TOOLING. AFTER AN OLDER TOOL HAS WORN OUT, REPLACE IT WITH THE APPROPRIATE NEWER TOOL.
3. P - PIN
   S - SOCKET
   SP - SHORT PIN
   SS - SHORT SOCKET

**CODE**

ALUMEL CONTACT

CHROMEL CONTACT


to insertion of the contact, the connector cannot be reassembled. Should an electrician discover that he has installed a contact without threading the wire through the back shell, such a blunder should not assume the magnitude of a tragedy, for the contact can be easily removed from the connector and correctly threaded through the back shell. When all the wires are threaded through the back shell, the electrician may insert the contacts.

Start the first contact by hand into the appropriate hole in the rear resilient seal of the connector. Be certain to leave the crimped portion of the contact protruding from the rear seal. Refer to the contact chart and select the proper insertion tool. Place the wire in the groove of the tool and slide the tool down the wire until it fits over the end of the contact. Position the tool as shown in Figure 10 so that it is perpendicular to the back of the seal*, hold the face of the connector against a convenient flat surface, and push the contact into the connector with a steady even force. When the electrician feels the contact enter the locking detent or feels the contact bottom, he may assume that the contact is seated. Naturally, this "feel" comes with experience. It is suggested, when there is any choice available, that the contacts first be installed in those spaces in the center of the connector and that installation progress outward until all the contacts have been inserted.

In repair operations that necessitate contact replacement, it will usually be advantageous to remove one contact at a time from the connector. Presuming that the circuitry has not been subject to too many modifications, adequate wire length should be available to permit the insulation at the wire end to be stripped the customary 9/32 inch after the old contact has been removed. The new contact may then be crimped to the freshly prepared wire end and inserted into the connector. Be certain that the contact is installed in the appropriate hole position.

**Failure to hold the tool straight as described above may permit the tool to slip off the contact and damage the connector, contact or tool. It can also lead to a painful injury to the hand.*

It does not make much difference which direction the open side of the tool is facing during installation of contacts near the center of the connector, but the open side of the tool should face outward when contacts are installed near the edge of the connector. The reason for this is to prevent or at least minimize distortion of the back seal.

During installation of the crimped contacts there are some things that just are not done. Once the insertion tool has been withdrawn from the back seal of the connector, NEVER attempt to push a contact farther into the connector by re-inserting the tool through the back seal. If such action is attempted it will probably result in damage to the wire, contact, or seal. The only approved procedure is to push the contact back through the resilient seal with the appropriate removal tool, then re-install the contact with the insertion tool.

The design of some connectors makes it necessary to exercise additional care when installing the contacts. The "Poke Home" contacts used on the Amphenol Series 69 connectors can be poked all the way through the connector if too much force is used during insertion of the contacts. Since there is a possibility of inserting these contacts too far in the connector, extra care should be taken when installing these contacts. If a contact *is* pushed too far into the connector, it should be pushed back out with the removal tool as soon as possible and re-installed with the proper insertion tool. The retaining member of the connector will be stretched out of shape and lose its retention ability if a contact has been pushed too far into the connector and left in that position for an extended period of time.

The female Amphenol "Poke Home" contact seems to be somewhat more difficult to insert than her male counterpart. To ease the installation of this particular type of female contact, a device called a "bullet" (see Figure 11) may be used under certain conditions. The bullet is inserted into the socket's mating end and acts as a guide when the contact is inserted, preventing the contact from cutting into the rubber insert of the connector. Part of the advantage of using a bullet is offset by a necessary limitation to its use. At Lockheed it is *forbidden* to use one of these devices *in an airplane* because it is so easy to lose. This small piece of metal rattling around an area infested with electrical or electronic equipment could be a menace in its own right, and if lost in an area where there are cables and pulleys it could jam an otherwise perfectly functioning system.

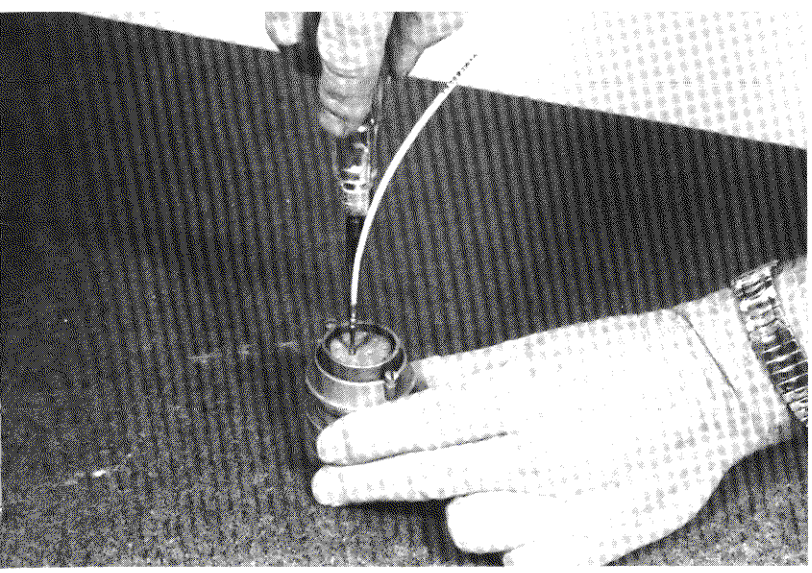


Figure 10 Inserting a Contact (Back shell shown loosened)

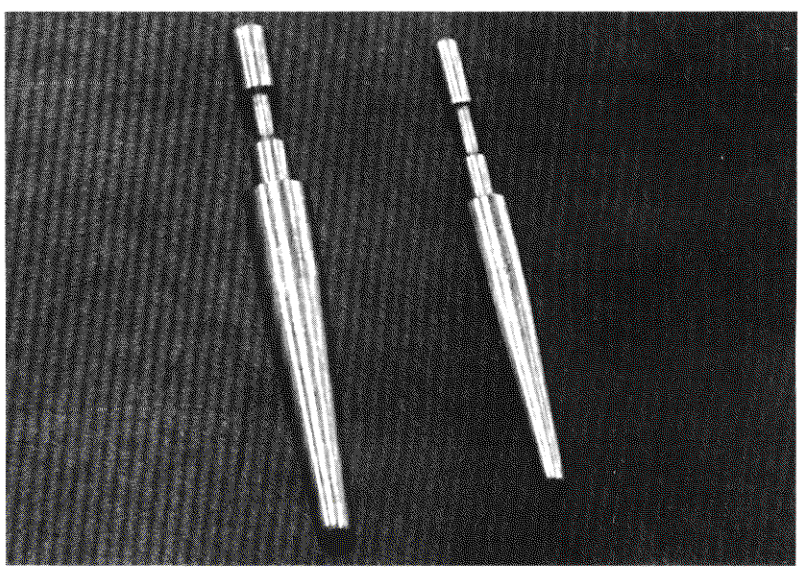
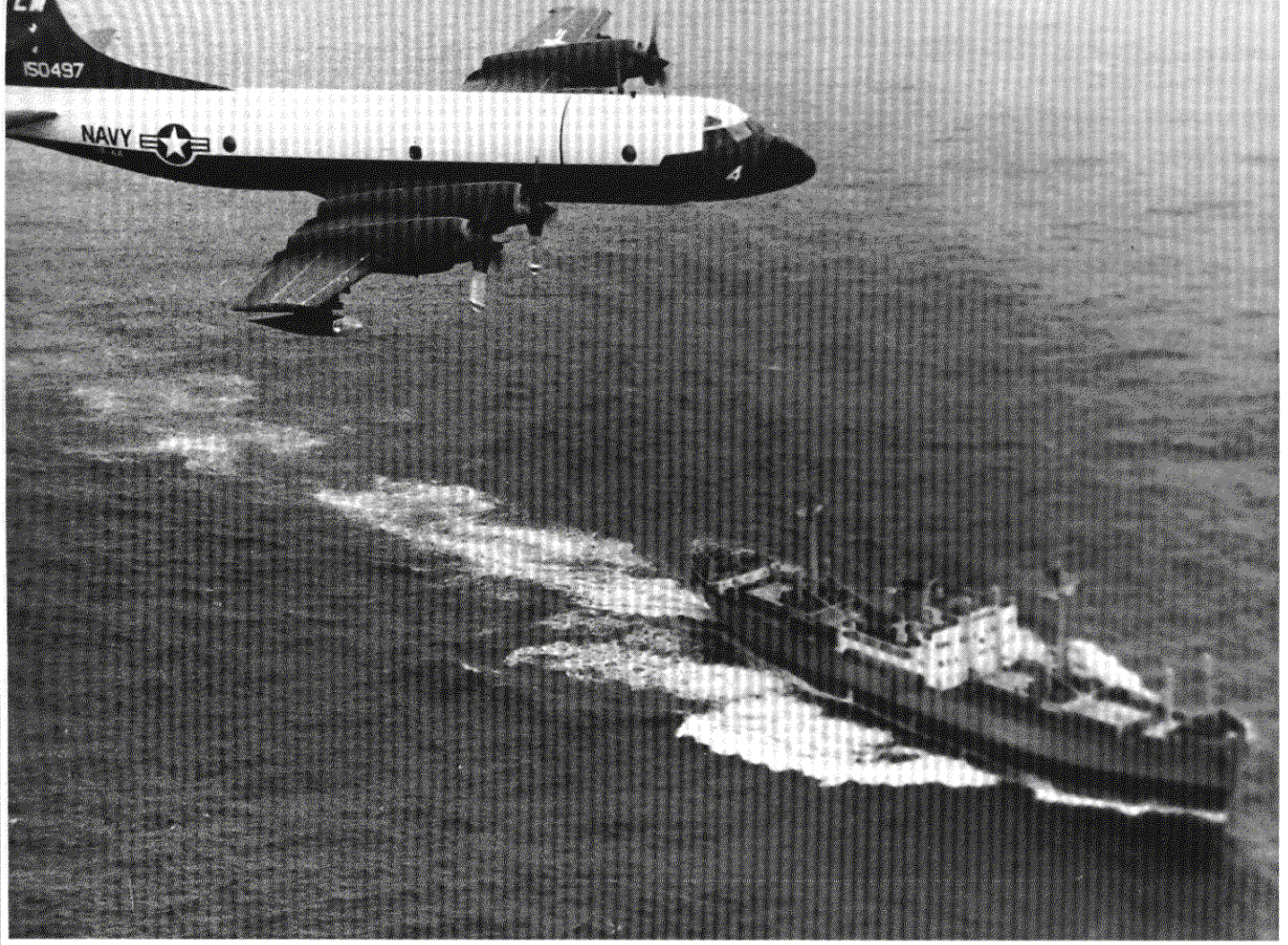


Figure 11 Bullets — 12 Gauge (l.) and 16 Gauge (r.)




It is unnecessary to be quite so finicky about exerting so much pressure when inserting the contacts in the other types of crimped contact connectors used on the P-3A. These connectors provide a more positive stop for the contact. Nonetheless, all operations with crimped contact connectors — or any other connector for that matter — should be done as gently as possible. One school of thought enshrines connectors in the category of "delicate instruments" rather than just plain old "plugs". People of this school, particularly maintenance supervisors, have been known to get violent when they observe connectors being abused.

After all the contacts that are crimped to wires have been installed, there may be some holes left over. An unused contact of the appropriate gauge and design must be inserted into each of these open holes. (There may be a few exceptions with non-environmental connectors.) This helps to prevent contaminants from entering the connector.

When all the contacts, both crimped and unused, have been installed it is wise to check the face of the connector to see that all the contacts are seated correctly. All the sockets *of the same gauge* should be at a uniform depth from the face of the connector, although the socket depth for different gauges of contacts on the same connector may vary. This same principle applies to the pins. All the pins of the same gauge must protrude the same distance from the face of the connector, but the larger gauge pins may protrude farther from the face of the connector than smaller gauge pins. It will be noted that Figure 12 gives dimensions for the socket depth from the face of Amphenol "69" connectors. This information is presented only as a matter of general interest, since most electricians probably would have neither the appropriate measuring devices nor the inclination to make such a measurement on each contact they encounter.

This brings us to the subject of dumbbells. On the environmental connector, stuffing the unused holes with contacts does not guarantee that the connector is protected from the elements. These unused holes must be closed on the rear resilient seal with

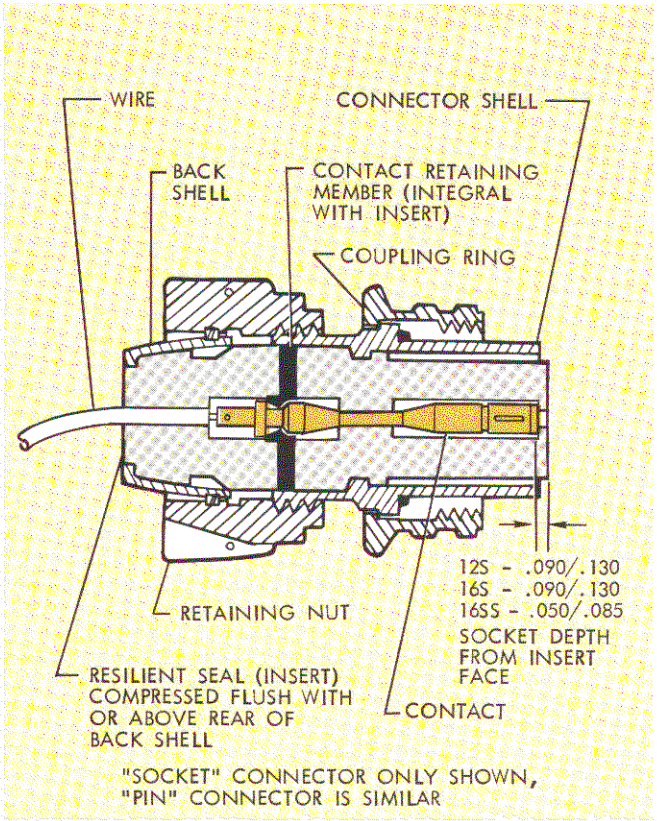



Figure 12 Cutaway Drawing of Typical Amphenol "69" Connector

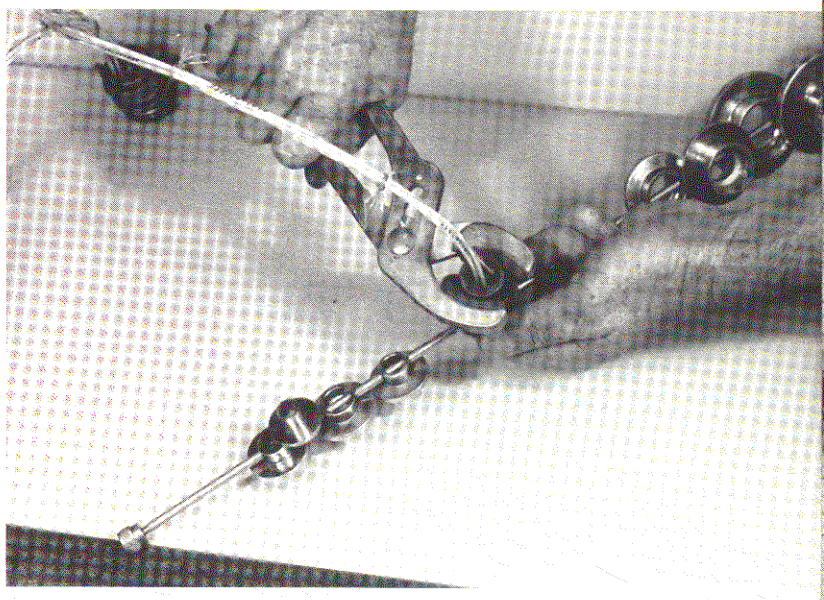


Figure 13 Tightening Back Shell of Bendix "PT-CE" Connector, Using Holding Fixture and L206C26-1 Pliers

nylon plugs. Due to the unique shape of these plugs, they are affectionately known as "dumbbells." There are sizes of dumbbells tailored to plug 8, 12, 16, and 20-gauge holes, and they are color coded as shown below:

| DUMBBELL SIZE | DUMBBELL COLOR |
|---|---|
| 8 | WHITE |
| 12 | YELLOW |
| 16 | BLUE |
| 20 (large) | RED |
| 20 (small) | BROWN |

It will be noted that there are two colors of size 20 plugs. It is recommended that the larger size be used whenever possible, for when the back shell of the connector is tightened the resilient seal must be squeezed at least flush with the rear of the back shell — and it is strongly recommended that the seal be squeezed enough so that it protrudes a little bit above the back shell of the connector. After the connector has been checked to ensure that all the contacts are undamaged and correctly installed, that all the open holes are filled with unused contacts and dumbbells of the proper size, and that the body of the connector itself is in serviceable condition, the back shell shall be tightened with pliers (P/N L206C26-1) that have a broad curved plastic insert facing on the jaws. If the back seal is not compressed enough after the back shell has been tightened, loosen the back shell and replace some of the smaller dumbbells with the next larger size (e.g. substitute a size 12 for a size 16 dumbbell), and retighten the back shell. On Bendix PT-CE connectors, this tightening operation can be facilitated by use of a holding fixture which mates with the face of the connector (see Figure 13). Two types of these fixtures (one for plugs and one for receptacles) are furnished in Lockheed's crimped contact connector tool kit, or they can be ordered separately from Lockheed.

## REMOVING THE CONTACTS

Inevitably, circuitry on aircraft such as the P-3A will be modified when some new black box arrives on the scene. When this occurs, the electrician will appreciate the ease of removal of these crimped contacts from a connector. Complete disassembly of the connector is unnecessary for contact removal, and replacing contacts is a simple and quick operation.

As trite as it may seem, the first step in contact removal is to disconnect the connector and look at it. A contact removal tool must be selected, and the only way to do this is to examine the connector in order to determine the name of the manufacturer and the part number. With this information the electrician may refer to the contact chart, find the series of the connector under the manufacturer's name, check the sizes of contacts used in that particular series of connector, and select the proper contact removal tool.

It is just as essential to be certain that the connector is the crimped contact type. Attention should be directed particularly toward the Bendix miniature connectors. Bendix makes miniature connectors that have crimped contacts, and others that have soldered contacts. The physical appearance of these two types of connectors is so similar that attempts have been made to remove soldered contacts from their connectors with crimped contact tools. This usually results in damage to the connector or tool, and sometimes the person.

Examination of the connector will also tell the electrician if the connector is an environmental connector. This is important because several types of crimped contact environmental connectors have a rear resilient seal that is compressed by a removable back shell. If such is the case, the back shell must be loosened until no pressure is exerted upon the resilient seal, and it is recommended that the back shell be completely removed.

Many of these environmental connectors will have unused holes plugged with "dumbbells," the weird-shaped little nylon plugs. Before attempting to remove a contact, all of the dumbbells must be removed from the rear resilient seal. (Long-nosed pliers are a convenient removal tool.) This is necessary, since a function of these dumbbells is to exert pressure on the rear seal as well as to plug the unused holes. The resilient seal of the connector could be damaged if a contact were removed while the seal had pressure applied to it.

When the correct tool has been selected, and (if applicable) the pressure on the resilient seal of the connector has been relieved, the electrician can settle down to the business of actually removing the contact.

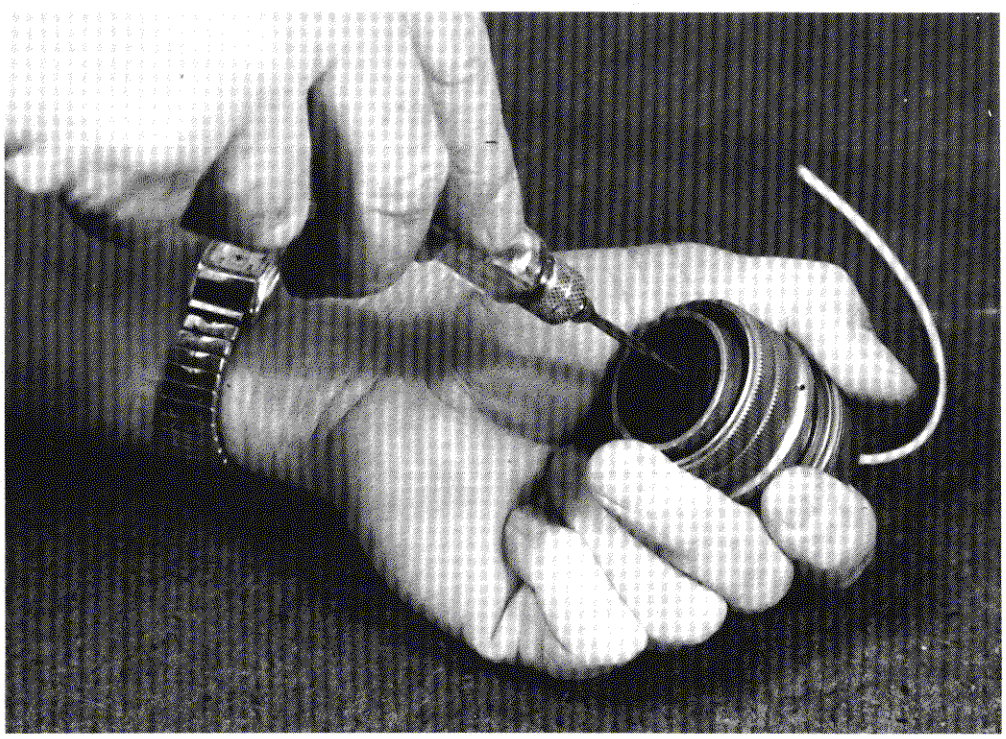


Figure 14
Removing a Contact

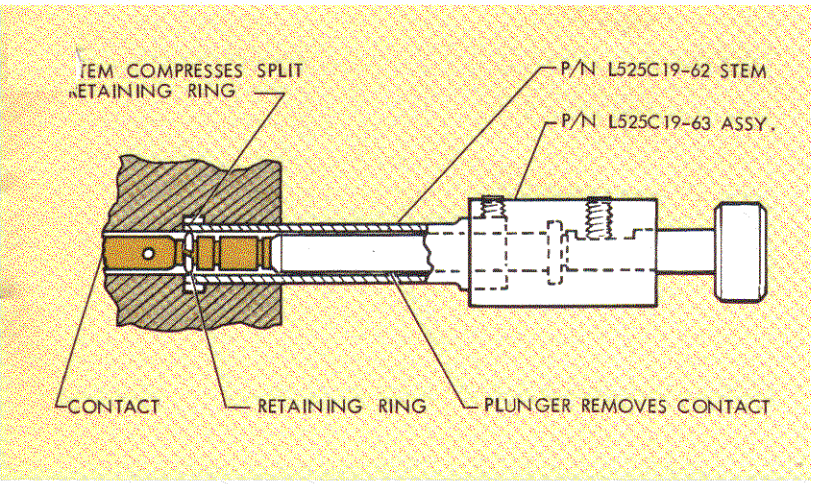



Figure 15 Operation of the L525C19-62 and -63 Viking Contact Removal Tool Assembly

Contact removal is approached from the mating face of all crimped contact connectors presently in use on the P-3A. Mate the end of the removal tool with the contact as shown on Figure 14, and push firmly against the contact. On those contacts retained by a spring clip or ring attached to the contact, this push by the removal tool will de-activate the retaining mechanism. For other contacts which are held in place by a retainer built into the connector, the push on the tool will force the contact out of the retaining member. After the contact is released, it may be pushed with the tool far enough back through the connector so that the crimped end of the contact can be grasped by the fingers, and then completely withdrawn from the connector. *Never attempt to remove a contact from a connector by pulling on the wire.*

Gentleness must be exercised when removing the contacts from a Viking relay socket. These contacts are retained in the connector by a split ring which must be compressed in order to accomplish contact removal. The view in Figure 15 shows how the removal tool works. The hollow stem fits over the contact and must be pushed and rotated until a solid stop is felt. This indicates that the retaining ring has been compressed. The plunger on the tool may now be pushed. The contact will be forced back through the connector far enough so that it may be removed. Never use excessive force when trying to remove this type of contact. If difficulty is encountered, withdraw the tool and repeat the removal procedure. Any force applied to the plunger before the stem is properly seated will make removal of the contact difficult, and sometimes impossible.

If a male contact is bent to the extent that removal would be difficult, the end may be carefully straightened enough so that when the removal tool is mated with the contact it will be perpendicular to the face of the connector. Keep in mind that straightening a contact is only a means to facilitate contact removal and to prevent damage to the connector insulating material during contact removal. After straightening a contact, always remove it from the connector *immediately*. This is the only way to be certain that the contact has been removed from service.

The Bendix PT-CE miniature connectors have been susceptible to bent contacts because the pins are so small and delicate. Damage of this nature generally occurs when the connectors are mated in areas where the access and visibility are limited. Sometimes the electrician's only recourse is to try to mate the connectors by the "feel" method. If the bayonet coupling is not mated properly, the plug can be cocked askew in such a manner that the pins do not mate with the sockets. Instead, the pins may be pushed *into* the insulating member and bent, especially when the connector coupling is tightened. When an electrician is faced with mating this type of connector under such adverse conditions, extreme care must be exercised during the operation.

## CONCLUSION

Many reasons could be offered to substantiate the use of 'crimped contact connectors — greater reliability, cost savings, and weight savings are some of the more popular factors. All of these statements are valid, but sometimes it is necessary to follow a devious path of logic to understand why.

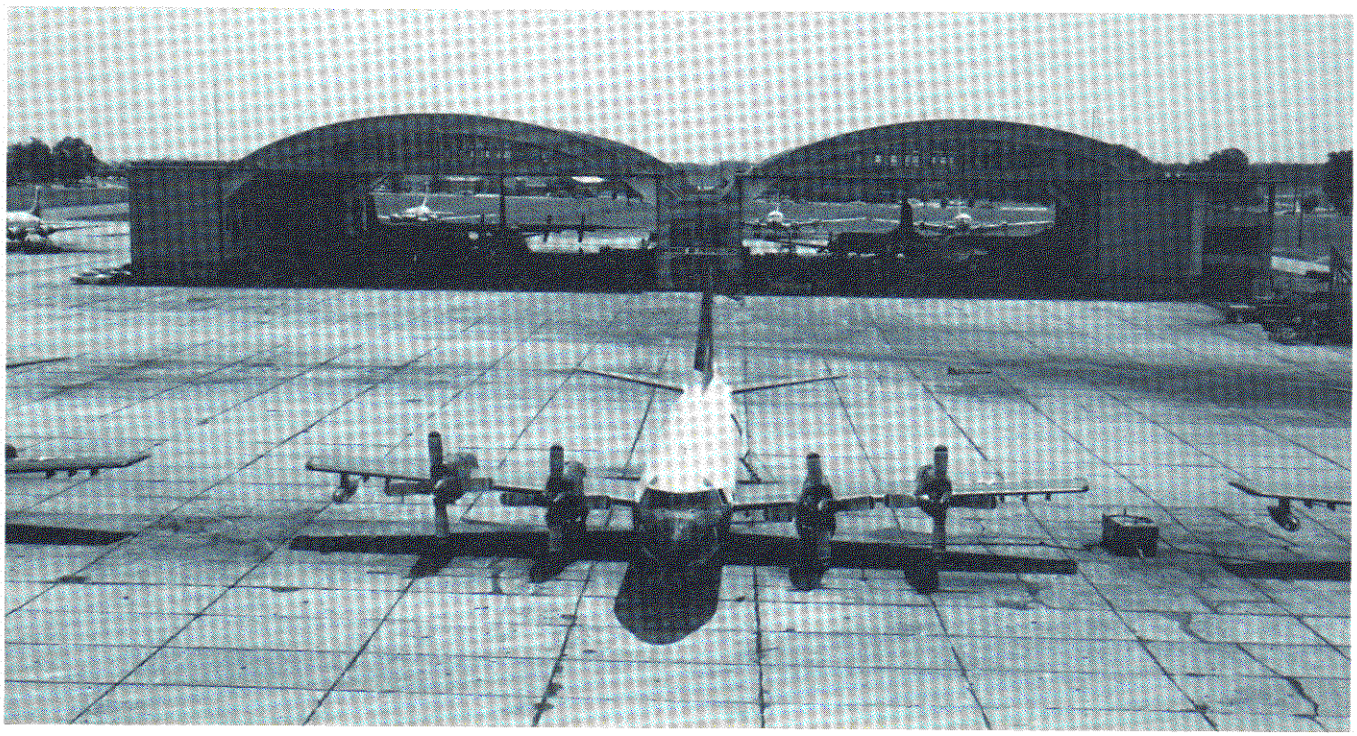
Most apparent is the reliability factor. The act of mechanically fastening a contact to a wire is rather difficult to botch. On the other hand, the quality of a soldered joint is at the mercy of the technician's technique. Sloppy soldering or cold solder joints are two of the problems that do not plague the crimped contact connector, simply because there is no solder present.

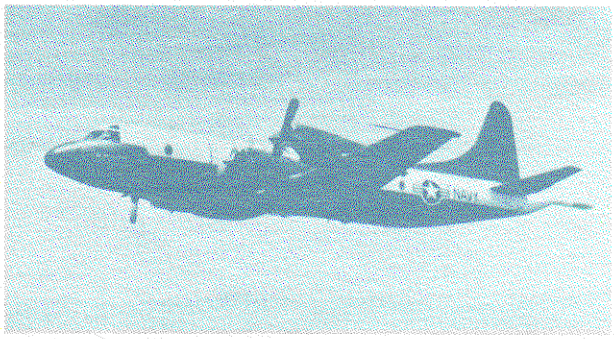
Cost savings are not quite so obvious. Per unit, a crimped contact connector generally costs more than its soldered counterpart. However, there is usually less time consumed during assembly and installation of a crimped contact connector, and wiring changes can be made quickly on existing installations. This saving in man-hours can well be applied against the cost of the product.

Usually a weight saving can be realized with the use of crimped contact connectors, but it generally falls short of the designer's fondest expectations. One reliable source suggests that the total weight saved by using crimped contact connectors wherever possible on the P-3A Orion amounts to only a few pounds — the weight of the solder and potting compound not used with these connectors. This weight saving is important, but can be overemphasized.

Presently, the most irksome thing about crimped contact connectors is that each brand of connector usually requires its own bits and pieces of tooling. But even now progress is being made along this line. The Cannon Electric Company has recently introduced crimped contact connectors with their "Little Caeser" retaining system. The only tool required to insert or remove contacts is a plastic tool that is so inexpensive that one is furnished with each new connector. DPXAMA rack and panel connectors with this type of retaining mechanism will soon appear on Orion aircraft.

Some day in the not too distant future it is envisioned that use of the crimped contact connector will be as commonplace as that of the soldered contact connector. Maybe the wildest dreams of the proponents of crimped contact connectors will be realized, and the only place historians will find soldered contact connectors will be in museums.





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| LOCATION | NAME | MAILING ADDRESS | TELEPHONE |
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| Patuxent River NATC, Maryland | D. H. Horadam, Regional Rep. | P.O. Box 218, NATC<br>Patuxent River, Maryland | Volunteer 3-3111<br>Ext. 645 or 251 |
| Patuxent River NATC, Maryland | F. Hampton, Resident Rep. | P.O. Box 218, NATC<br>Patuxent River, Maryland | Volunteer 3-3111<br>Ext. 645 or 251 |
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| Patuxent River NATC, Maryland | T. Snelling, Resident Rep. | P.O. Box 218, NATC<br>Patuxent River, Maryland | Volunteer 3-3111<br>Ext. 645 or 251 |
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| Key West NAS, Florida | S. Brown, Resident Rep. | P.O. Box 1087, Key West, Florida | 294-4417,<br>Key West |
| Moffett Field NAS, Calif. | F. Hays, Resident Rep. | Lockheed P-3A Office<br>Unit One, General Delivery<br>Moffett Field, Calif. | 961-1717<br>Mountain View,<br>California |
| North Island NAS, San Diego | R. B. Hedin, Resident Rep. | P.O. Box 525<br>Coronado, California | 435-6169<br>San Diego |
| Burbank, California | R. E. Kananen, Supervisor<br>P-3 Project, Customer Service | Lockheed-California Company<br>P.O. Box 551, Burbank, California | Thornwall 2-9151<br>or Triangle 7-2711<br>Ext. 4628 or 4307 |


PATROL SQUADRON FORTY-FOUR

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