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TECHNOLOGY UTILIZATION

CABLES AND CONNECTORS

A COMPILATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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TECHNOLOGY UTILIZATION OFFICE 1971
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Foreword

The National Aeronautics and Space Administration and the Atomic Energy Commission have established a Technology Utilization Program for the dissemination of information on technological developments which have potential utility outside the aerospace and nuclear communities. By encouraging multiple application of the results of their research and development, NASA and AEC earn for the public an increased return on the investment in aerospace and nuclear research and development programs.

The technology presented represents new devices and modifications to existing devices that have been used in the implementation of a number of space programs. Industry should find these items economical in time and material savings, and, minor modifications to the basic items should permit their efficient application to a variety of requirements.

This compilation covers a selected group of devices that have been developed to fulfill those cable and connector requirements that could not be satisfied by use of existing hardware. Coverage includes quick couplers and disconnects, connector keying, alignment devices, attachment devices, wire and cable identification, coaxial cable problems, cable handling, assembly, and repair, and insulation. The devices have been found helpful in a variety of applications, and their simplicity makes them useful to personnel of intermediate skills.

Additional technical information on individual devices may be requested by circling the appropriate number on the Reader's Service Card included in this compilation.

Unless otherwise stated, NASA and AEC contemplate no patent action on the technology described.

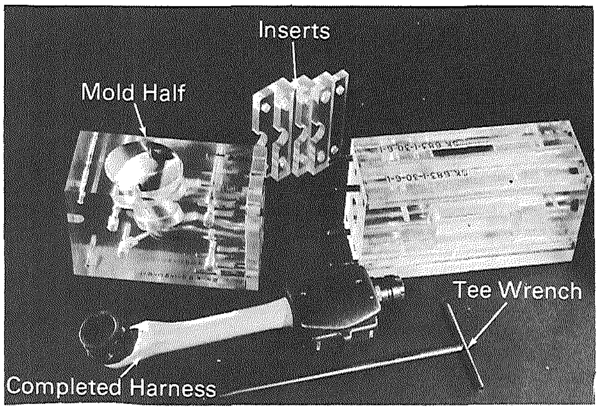
We appreciate comment by readers and welcome hearing about the relevance and utility of the information in this compilation.

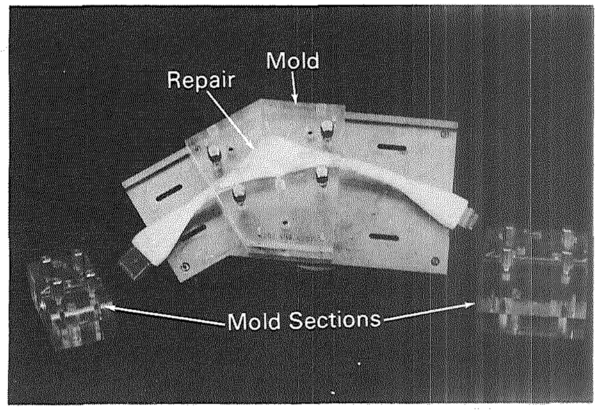
RONALD J. PHILIPS, *Director*
Technology Utilization Office
National Aeronautics and Space Administration

Contents

Section 1. Devices for Maintenance, Safety, and Repair

POTTING MOLDS FOR CABLE ASSEMBLY AND REPAIR





In the assembly of cable harnesses, where length tolerances are critical, precision molding has been expensive since molds must be manufactured for each different length. An answer to this problem is illustrated in the left figure. This shows a clear plastic potting mold featuring simple shim type inserts made to fit the central or mating section of each mold half. The bolted joint and special tee wrench for the socket head assembly bolts permit quick assembly of the mold sections to the desired length. The completed harness shown is covered by a soft silicone compound cured at 150°F. Use of clear plastic permits close inspection of the mold fill before cure.

The illustration at the right shows another mold that is used to repair a communication cable encapsulation having a localized defect. After the defect is repaired, the mold sections are placed around the repair and encapsulating compound is forced into the void area by pressure gun injection. Back pressure relief vents assure complete filling of the void area. Repairing such defects in place reduces costs that would be associated with complete rework.

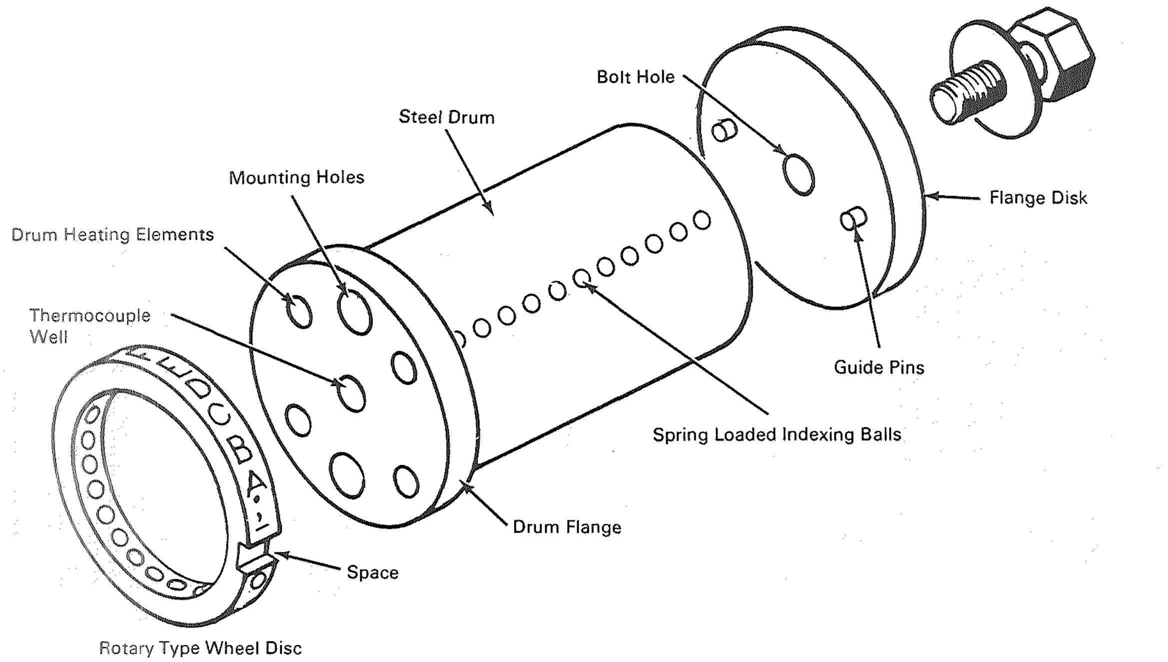
Source: Austreberto A. Campoy of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15687 &15691)

Circle 1 on Reader's Service Card.

WHEEL DISKS FOR WIRE MARKING

In coding individual wires in cable assemblies, commercially available "hot type" wire marking machines use individual type segments to set the code to be printed. This individual type setting process, while suitable for high production runs where coding need not be changed often, is very time consuming where coding is constantly being changed.

A steel drum with rotary type wheel disks has been proposed that should make code changing between marking cycles very simple. The disks, with type faces cast on the outside and round depressions machined on the inside, fit over a steel drum that is mounted in place of the existing type holder mounting block of the commercially available wire marking



machine. The drum is equipped with electric heating elements and a thermocouple used to monitor temperature. In operation, the type disks are fitted over the drum so the inner depressions index with spring loaded indexing balls retained in the drum outer surface. Each disk is faced with the required alpha and numeric characters required for all possible coding jobs. For a given coding, the required number of disks are rotated to present the desired characters to the surface to be coded. Each disk is faced with one open space so that any combination of characters and spaces is possible.

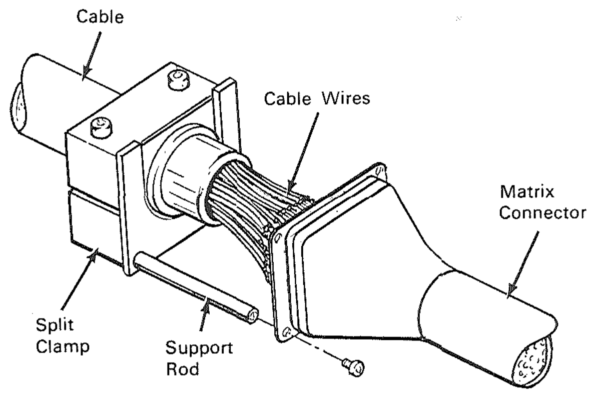
Source: Walter C. Speake of
The Boeing Company
under contract to
Kennedy Space Center
(KSC-10019)

Circle 2 on Reader's Service Card.

CONNECTOR STABILIZING JIG

A stabilizing jig has been constructed that protects multiple wire cable assemblies while handled during inspection, installation, and checkout. This jig assists in the use of a trimming and indexing device used to insert the cable's individual wire terminal pins accurately and smoothly into a matrix type connector.

In operation, the upper and lower support clamp members are secured around the cable and an indexing fixture and trim plate (not shown) are positioned on the support rods (one each side). After the trim operation is performed and the trim plate removed, terminal pins are installed on the wire ends. The matrix connector is then attached to the support rod ends and the terminal pins are inserted. The

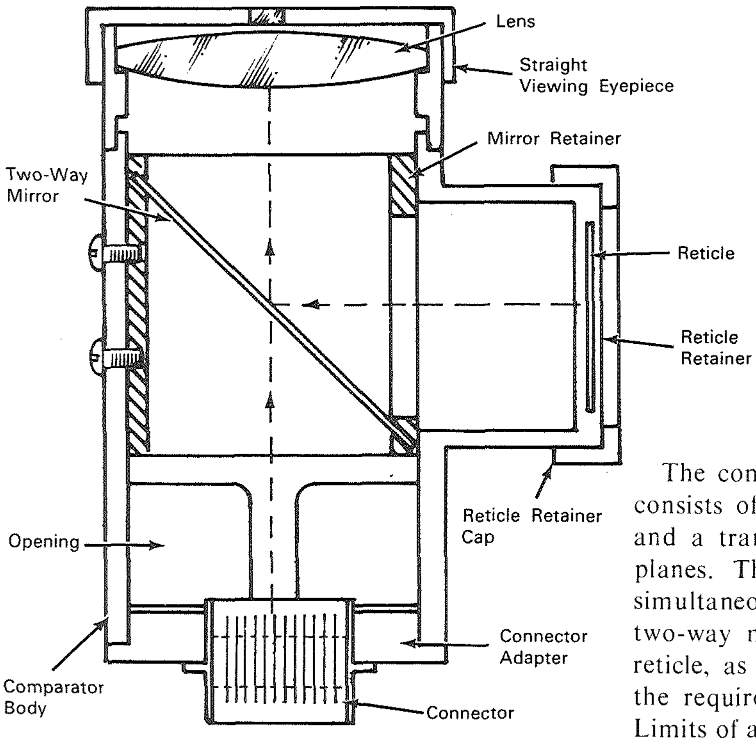


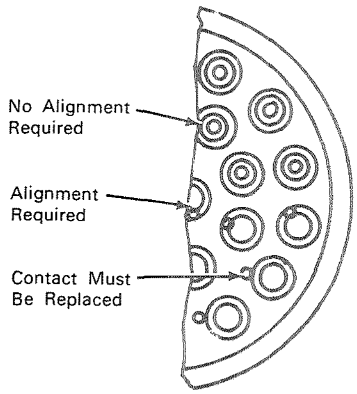
jig formed by the split clamp and support rods gives firm support and guidance during the pin insertion operation, after which the indexing fixture and trim plate are disassembled and removed, the stabilizing jig being left permanently in place.

Source: Boyd K. Barrett of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-17117)

No further documentation is available.

PIN ALIGNMENT COMPARATOR





Multipin connectors are subject to pin damage if carelessly forced into mating sockets, but also may be appreciably damaged if each pin is not within acceptable displacement limits, although care is used in mating. Visual checking will reveal extreme faults such as broken or badly bent pins, but determining precise pin tip location in relation to acceptable limits requires the use of an inspection tool.

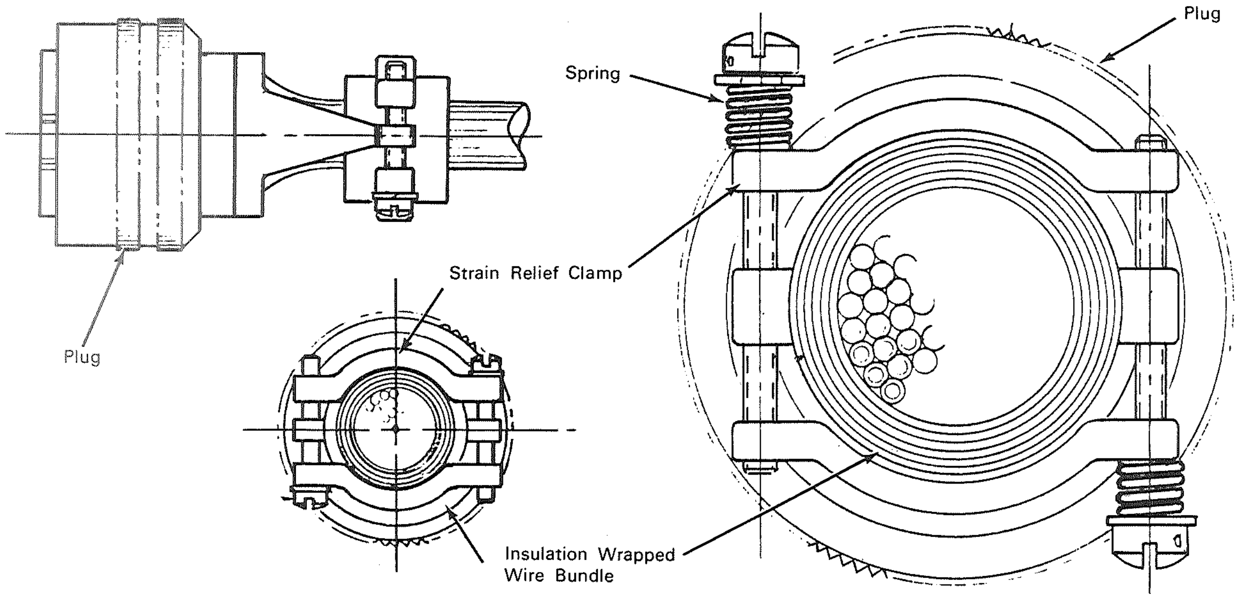
Such a tool is the pin alignment comparator shown in the left figure. With this optical tool, the actual position of the tip of each pin is compared with the desired position and the amount of deviation assessed. If within correctable limits, a pin can be straightened without removal from the comparator.

The comparator, shown in section at the left, consists of a housing for holding the connector and a translucent reticle pattern in orthogonal planes. The reticle and connector are viewed simultaneously through an objective lens and a two-way mirror as shown. The pattern on the reticle, as shown at the right, corresponds with the required pattern of the connector pin tips. Limits of acceptable deviation are outlined by the concentric circles at each pin position. If the pin tip image falls within the inner circle, no straightening is required. If the pin tip image falls between the two circles, straightening will correct the condition, but if the pin tip image falls outside the outer circle, the pin must be replaced. Separate reticles and connector adapters have been made to permit the inspection of a large number of connectors.

Source: Joseph V. Rega, Thomas L. Cornelico,
and Vincent N. DeVito of
Grumman Aircraft Engineering Corp.
under contract to
Manned Spacecraft Center
(MSC-12163)

No further documentation is available.

STRAIN RELIEF CLAMP MAINTAINS CONSTANT PRESSURE



Strain relief clamps are used at the cable output sides of plugs in order to relieve the wear caused by cable "whipping". Since modern soft insulating materials have come into wide use, a phenomenon known as "cold flow" in this type insulation has created a problem where conventional strain relief clamps (left figure) are used. Such clamps are attached and the fastening screws torqued to the proper value and safety wired. Under the soft insulation "cold flow", the insulation tends to migrate from within the clamp confines, since clamp tension remains constant, maintaining an unchanging enclosure.

A new strain relief clamp (right figure) has been designed that incorporates the well known spring-loading principle to maintain constant constraining pressure that overcomes any tendency of the insulation to "cold flow". The springs also act as locking devices thus eliminating the need for safety wiring.

Source: James A. Walling of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16526)

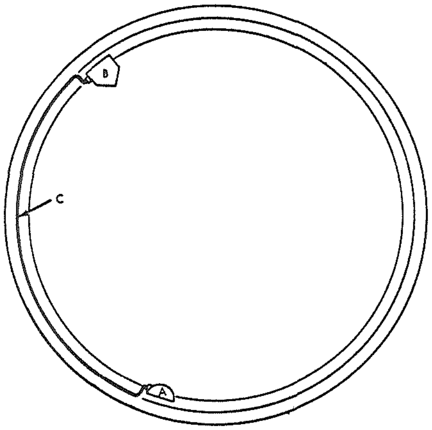
Circle 3 on Reader's Service Card.

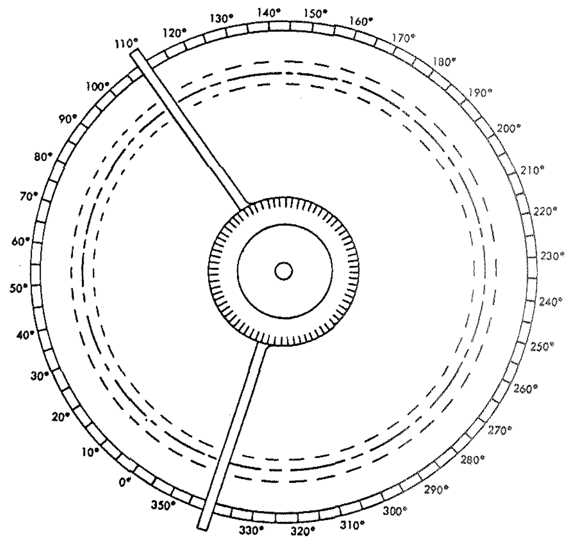
CABLE LENGTH CALCULATOR

To determine the exact length of interconnecting cables between components mounted on a circular structure, cable drawings are bulky and expensive to produce, while full size mockups and templates are not only costly but also require appreciable room for storage.

A cable length calculator has been designed that is scaled to the radius of the structure and is used with a table to convert the arc length to linear measure. A partial segment mockup of the structure determines cable length from the "breakoff" (bends at each end of the arc length), to the component connector.

The left figure shows a diagram of a circular ring structure with components A and B mounted in fixed positions within the ring. Interconnecting cable C is mounted in a tray affixed to one arc of the ring. The calculator, shown in the right figure, has a pair of movable locator arms to pinpoint the degrees of arc between any two posi-





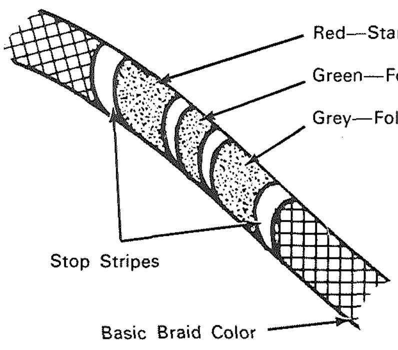
tions. By finding the number of degrees between components A and B, cable length in inches is then determined by using the conversion table previously mentioned. The table converts the degrees, found by the calculator, to the linear length of the arc at the radius of the cable tray. A segment mockup is then used to find the length of the "breakoff" from the cable tray to the component connector. Total length, therefore, is from the connector of component A to the cable tray, the arc length, plus the length from cable tray to connector of component B. The conversion table can be scaled to solve for specific locations where cables are positioned parallel in the cable tray, the outermost cables accordingly being longer than the innermost cables.

Source: J. J. Schneider of
International Business Machines Corp.
under contract to
Marshall Space Flight Center
(MFS-14165)

Circle 4 on Reader's Service Card.

COLOR CODED BRAID FOR WIRE HARNESS IDENTIFICATION

Instructions for Reading Color-Coded Wire Harness: Reading Between Stop-Stripes and Starting With Wide Start-Stripe, Read:



Red—Start Stripe—Indicates FIRST DIGIT IS A TWO 2

Green—Follow Stripe—Indicates SECOND DIGIT IS A FIVE 5

Grey—Follow Stripe—Indicates THIRD DIGIT IS AN EIGHT 8

In this example, the number represented is 258.

Color Code:

0—Black	5—Green
1—Brown	6—Blue
2—Red	7—Violet
3—Orange	8—Grey
4—Yellow	9—White

Notes: 1. Add additional follow stripes when additional digits are required.
2. Basic braid color may denote preceeding series of digits if desired.

A wiring harness identification system has been devised that parallels the standard method for idenfitying electronic resistor values. It is a color coded braid that is installed over cable runs at various selected points within a distribution system to permit engineers and technicians to quickly identify segments of interest while troubleshooting or planning system changes.

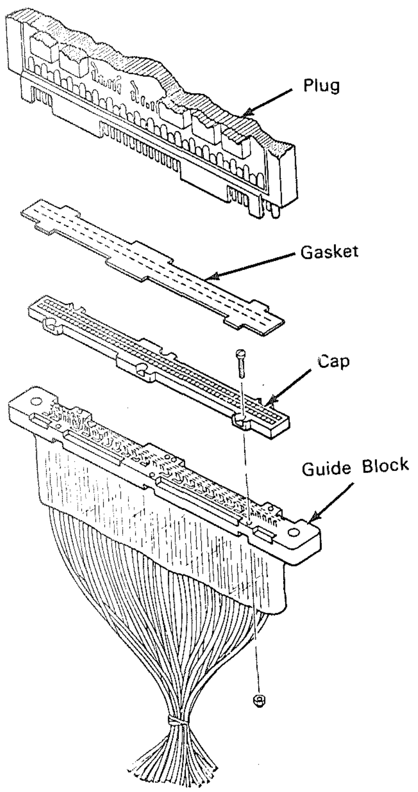
The technique is self evident from the illustration as is its flexibility.

Source: W. E. Norris and P. Jessie of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12738)

Circle 5 on Reader's Service Card.

SEALED CONNECTOR FOR HIGH-HUMIDITY ENVIRONMENT

A simple modification to a standard multi-pin connector has rendered it relatively impervious to the usual moisture problem encountered in a high humidity environment. Normally, during connect and disconnect operations in such an environment, moisture enters and causes contact corrosion, noise in the system, and even loss of signal.



In this modification, the cap and guide block are hermetically sealed with a room temperature vulcanizing compound to prevent moisture from entering the receptacle at the edges. Silicone grease is then injected into each compartment containing female connectors, and a silicone gasket having a slit at each contact location is cemented to the top of the receptacle. The gasket serves the dual purpose of wiping moisture from the pins during the connect operation and wiping and retaining the silicone grease from the pins during disconnect. During connect operation, the spring-loaded contacts of the female plug wipe the pins to remove the silicone grease and thereby provide good electrical contact.

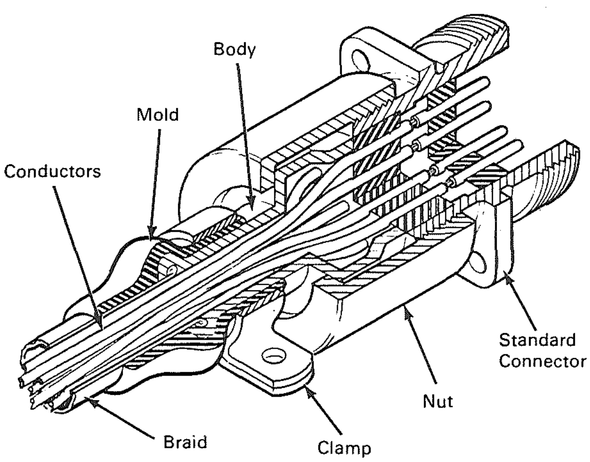
Source: E. J. Struckus of
International Business Machines Corp.
under contract to
Manned Spacecraft Center
(MSC-90833)

No further documentation is available.

ROTATIONALLY-KEYED CONNECTOR ATTACHMENT

In assembling armored cable runs, the polarizing of connectors often presents difficulties with the protective braid. Rotation of plug or receptacle more than 5 degrees can damage the mechanical protection on the harness.

This technique involves a design in which the key of the plug can be aligned with the receptacle by rotation of the member of the connector. By extending the receptacle with a body, as illustrated, a cavity is formed in which slack in the cable wires can be created and stored. The receptacle can then be rotated appreciably without introducing any twisting stress in the armor of the cable. A sufficient length of



the insulated wires is left free of the mold. The mold, body, and nut are then slipped over the wires and the armor braid is attached to the body. After the mold is properly positioned, the clamp is installed, the wires are inserted into the plug and the nut tightened.

Source: I. Bobb of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-13854)

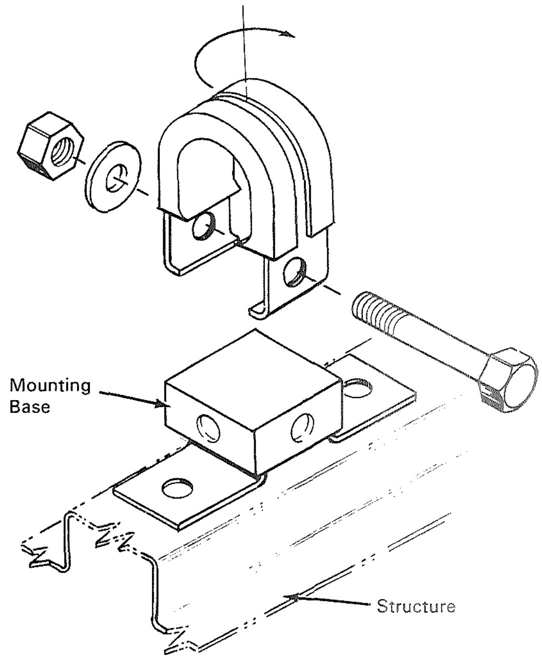
No further documentation is available.

UNIVERSAL IN-LINE CABLE CLAMP

A modification to conventional saddle clamps has been developed that permits the same mounting base to be employed in clamping wires, cables, or tubing through a wide range of sizes. It can be employed in areas where conventional clamps will not fit and, since mounting holes do not vary with clamp size, a full range of sizes may be used for any location. With no change in mounting hole location, the clamp may be attached at 90° to that shown.

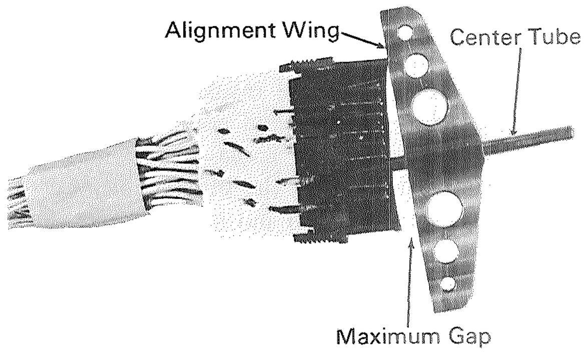
Source: James D. Doyle and Alfred L. Yakel of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16586)

No further documentation is available.



PIN ALIGNMENT GAGE AND STRAIGHTENER

A pin alignment gage and straightener has been produced that permits connector pin alignment determination, and straightening where required, by a quick and easy method that assures good pin alignment integrity. The alignment tool and straightener consists of a wing shaped gage member that has a center channel to receive a center tube (2 are used, 1 for 16 gage pins and 1 for 20 gage pins) that is the straightening medium

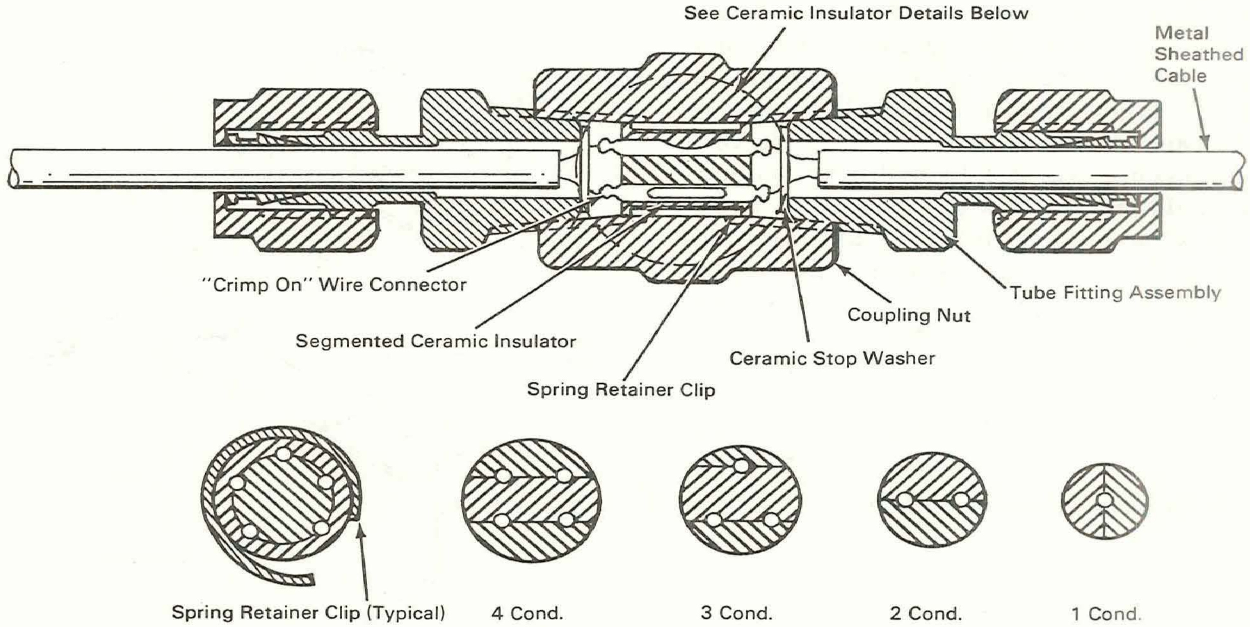


In use, pins out of alignment are identified by visual inspection and the gage and straightener is used to restore them to true alignment in the following manner: The center tube is installed over each bent pin in turn and the alignment wing is slipped down over the center tube. The alignment wing is then rotated until the maximum gap between one edge and the connector shell is obtained. Using the alignment wing as a straightedge, it is rocked back and forth in a seesaw fashion until it bottoms evenly on the connector shell. Held firmly, the alignment wing is then rotated 360° to assure true alignment of the pin.

Source: Clarence R. Badger of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16630)

Circle 6 on Reader's Service Card.

TUBE COUPLING SERVES AS CABLE SPLICE INSULATOR



Metal sheathed multiconductor cables can be joined with commercially available threaded, tapered tube couplings, but individual conductor insulation can easily break down in such usage.

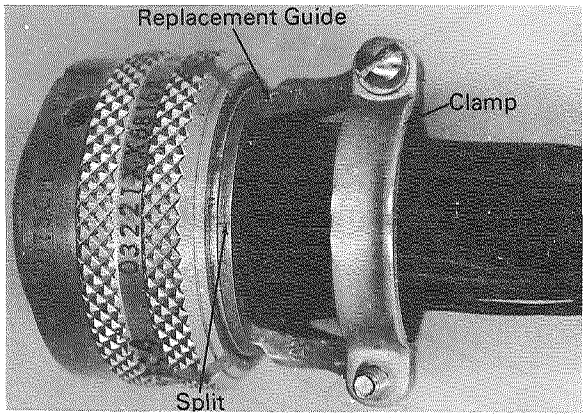
The sketch shows how a standard tube coupling can be used to ensure insulation integrity. The tube fitting assembly and coupling nut are placed over one sheathed cable, and a mating tube fitting assembly over the other cable. Ceramic stop washers are next put in place over the cables and the individual conductors are joined. A segmented ceramic insulator is then positioned around the crimped, insulated joints and a spring loading retainer is clipped around the insulator. The two tube fitting assemblies are then brought together and secured with the coupling nut. The ceramic stop washers prevent splice/insulator motion within the coupling nut.

Source: H. A. Fox of
Aerojet-General Corp.
under contract to
Space Nuclear Propulsion Office
(NUC-10130)

Circle 7 on Reader's Service Card.

REPAIR TECHNIQUE FOR ELECTRICAL CONNECTOR WIRE GUIDES

Many industries that use threaded ring type wire bundle guides may be interested in a new



method of repairing cracked guides. This method uses a split threaded guide and clamp to replace the defective guide, and its split characteristic permits the repair to be made without the expense of connector disassembly.

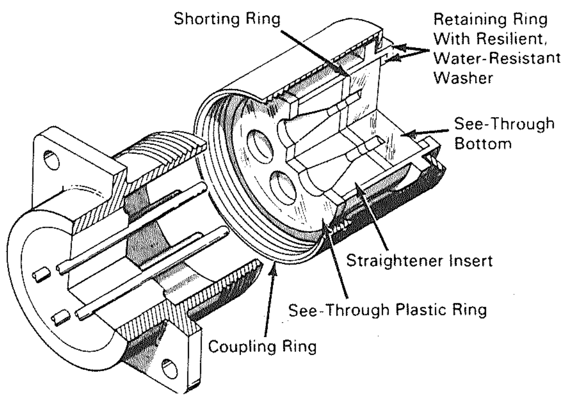
In this technique a standard replacement guide is split with a jeweler's saw or other precision cutting device. The defective guide is removed and the split replacement guide is placed around the wire bundle and screwed into place. When firmly in place, the clamp screws are securely fastened to maintain the split guide's thread integrity.

Source: Maurice A. Vanasse of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15654)

Circle 8 on Reader's Service Card.

SHORTING CAP AIDS IN CONNECTOR PIN ALIGNMENT

An electrical connector cap has been designed to provide pin alignment, protection from



stray voltages, and inspection capabilities. The cap incorporates a plastic straightener insert and a clear plastic bottom for physical and electrical protection to the connector pins. A shorting plate and a second clear plastic plate are attached to the straightener bottom. The holes for the connector pins, expanded at their openings to permit entry of bent pins, extend through the front plate, plastic straightener insert, and shorting plate, terminating in the clear plastic bottom. After being placed on the connector, the cap is secured by a coupler ring which screws onto the connector, forcing the pins into the mating holes.

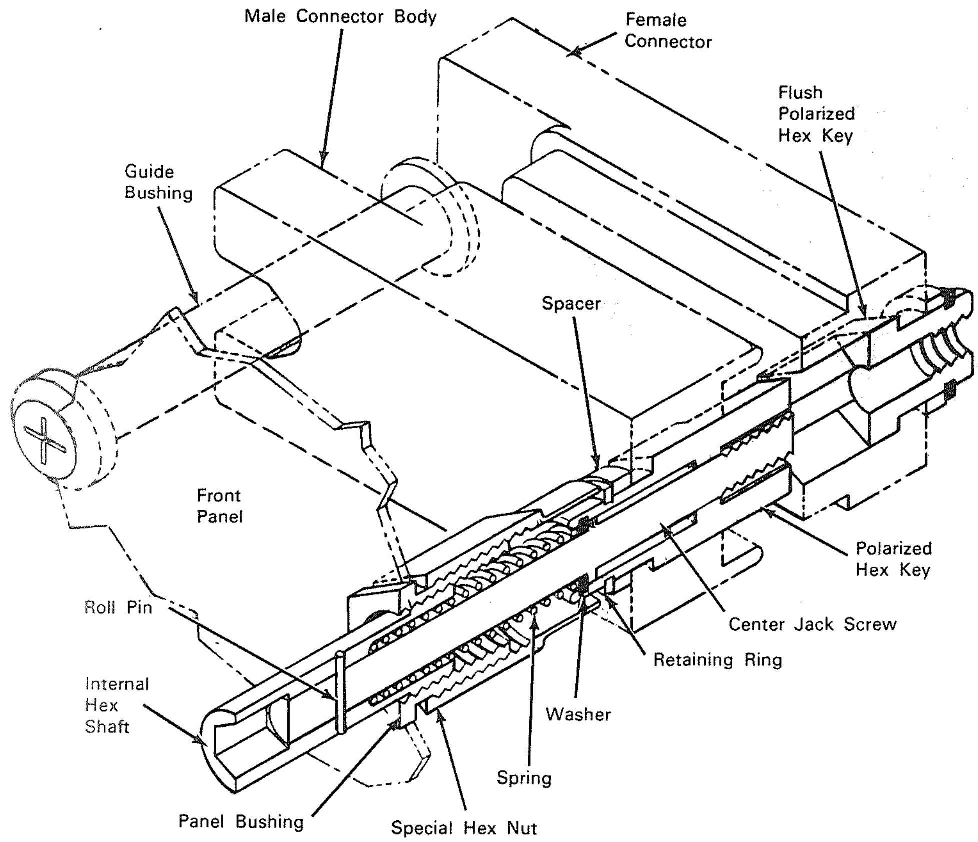
Source: K. Warming and G. A. Peters of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-13111)

No further documentation is available.

SCREW JACK PERMITS BLIND MATING OF CONNECTOR BLOCKS

In certain communication equipment applications, connector blocks that join separate assemblies must sometimes be mated "blind" due to considerations of space or the configurations of the units involved. When misalignment exceeds a relatively small value, about 0.125 in., connector mating cannot occur.

A jack screw mechanism has been designed that acts as a pin alignment and mating aid where connections must be accomplished "blind". The



jack screw mechanism, connector bodies, and the front panel of a typical electronic unit, with the jack screw mechanism are shown in the retracted position. The polarized hex key is retained in the male connector body by means of a spacer and retaining ring. The center jack screw is inserted into the polarized hex key, and a slip fit washer placed on its shaft; the round end of the polarized hex key is rolled over against the washer to retain the jack screw. A spring is slipped onto the jack screw shaft, the internal hex shaft is placed onto the jack screw and the roll pin is installed, capturing the spring. The special hex nut is placed over the jack screw, and the internal hex shaft of the male connector is inserted through the panel bushing which is threaded into the special hex nut. Attachment of the two connector guide bushings completes installation of the male connector to the front panel.

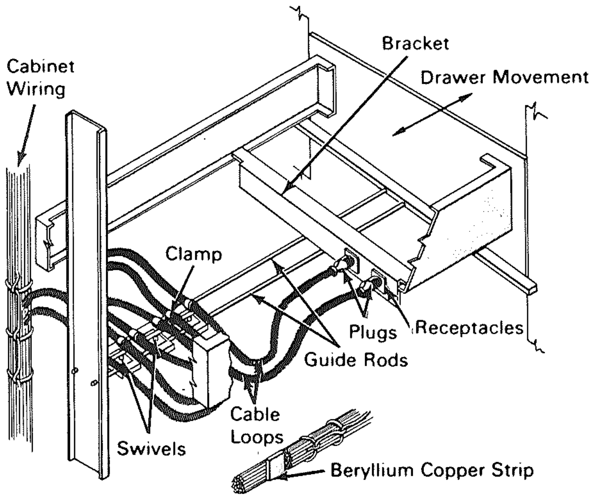
The unit is prepared for mating by turning the internal hex shaft to its counterclockwise limit. The connectors can now be mated by turning the internal hex shaft clockwise until the threads in the panel bushing are cleared and the shaft begins to slip. At this point, the internal hex shaft is pushed in approximately 1/8 in. and turning resumed until mating is completed. In disengagement, the spring permits continuous counterclockwise turning of the internal hex shaft to completion.

Source: J. Lee Rose of
North Amercian Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-90661)

Circle 9 on Reader's Service Card.

COMPACT RETRACTOR PROTECTS CABLE LOOPS

A core and swivel retractor mechanism, combined with cable stiffeners, permit cabinet-



mounted electronic equipment drawers to be opened with power on for testing and troubleshooting, without cable chafing.

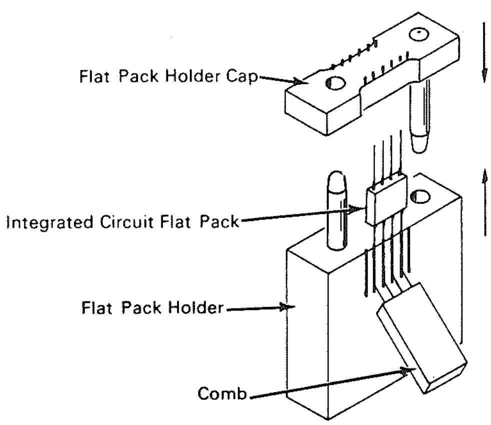
Connector receptacles are attached to a bracket fastened to the bottom of the equipment drawer. The cabinet wiring harness cables plug into these connectors. The cables are looped through cable clamps mounted on plastic swivels that slide on stainless steel guide rods to enable the cable loops to pay out and retract as the drawer is opened and closed. The cables are laced onto continuous beryllium copper strips to prevent sagging.

Source: North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-90561)

Circle 10 on Reader's Service Card.

DEVICE BENDS FLAT PACK LEADS TO PRECISE ANGLES

A holder has been designed to receive the leads of integrated circuit flat packs, for quick and accurate bending, to prepare them for mount-



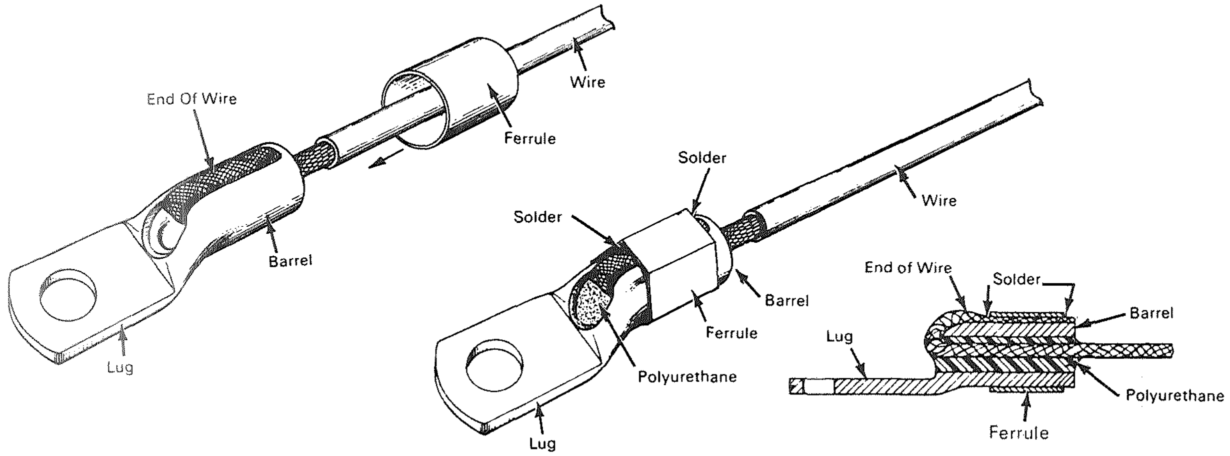
ing on printed circuit boards in high density packaging.

The integrated circuit flat pack is placed on the holder and the leads are aligned in the grooves of the holder. The pins of the flat pack holder cap are aligned with the holder and the two parts are brought together to hold the integrated circuit flat pack firmly in place. The leads of the integrated circuit flat pack, which are sticking out at right angles from the holder are initially bent down into the flat pack holder grooves by finger pressure. The final bending is done by inserting the lugs of the comb into the flat pack holder grooves and combing downward over the flat pack leads, thus making the required bend. The procedure is then repeated on the opposite set of flat pack leads.

Source: C. H. Koster of
Lockheed Electronics Co.
under contract to
Manned Spacecraft Center
(MSC-13489)

Circle 11 on Reader's Service Card.

AN IMPROVED METHOD FOR ELECTRICAL CABLE TERMINATIONS



Cable terminations are normally made by crimping the barrel of a lug to clamp the wire cable within it. This method causes residual strains in the joint and prevents inspection of the joint after sterilization. An improved method uses a standard terminal lug with a braided wire passed through its barrel and lapped over its upper surface. A ferrule (bushing) is installed over the barrel and swaged into a hexagonal shape, clamping the wire end between the lug barrel surface and the ferrule. The wire end and ferrule are soldered to the barrel and space left within the barrel is filled with polyurethane. The figure illustrates, from left to right, the sequence of operation that results in the finished product, shown in cutaway at the right.

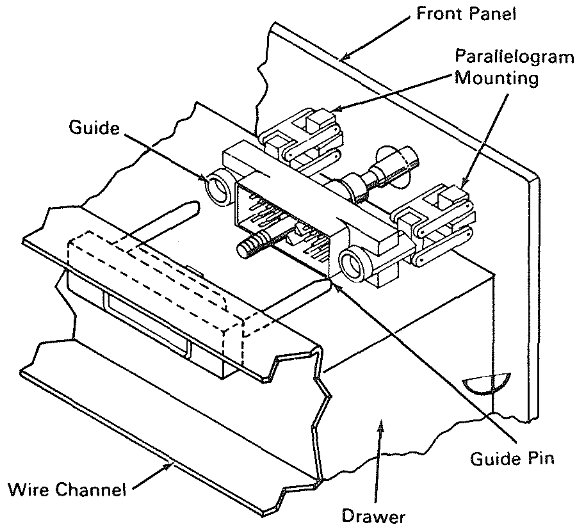
Source: Charles D. Baker of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-10694)

Circle 12 on Reader's Service Card.

FLOATING DEVICE ALIGNS BLIND CONNECTORS

In rack-mounted electronic equipment, a misalignment between male and female connectors often builds up to an out-of-tolerance condition through cabinet sagging, channel warping, and the like. In such a situation, connector mating will at least result in pin damage, and is often impossible to accomplish.

To overcome this problem, a panel-mounted connector has been designed to move freely in the vertical, by the action of a parallelogram mount. A portion of the guide pin bushing is replaced by a parallelogram-type mechanism attached to the front panel. The ends of the guide pins are tapered, and the holes in the guide bushings are beveled to allow for the misalignment. The connector guide is allowed to move up and down a total of 0.190 in. while remaining perpendicular to the front panel.



The amount of vertical travel is determined by the angle on the parallelogram-type base. As the drawer is moved in, the guide pins engage the guides and align the connector up or down before the center screw engages the mating connector, thus ensuring proper engagement.

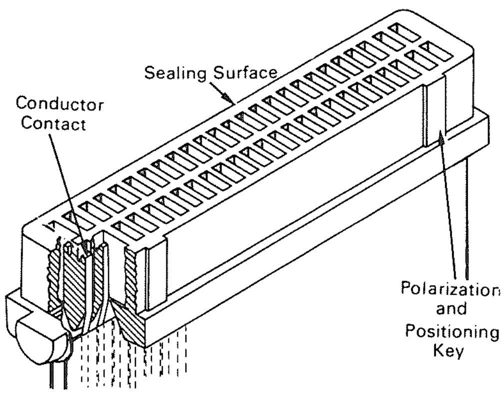
Source: James E. Ressel of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-90256)

No further documentation is available.

Section 2. Special Purpose Connectors

FLAT CONDUCTOR CABLE CONNECTOR FEATURES CONTACT SEPARATION SEAL

Users of flat conductor cables will be interested in a new cable connector in which each pair of contact elements is isolated by plastic



cells and the mating interface sealed by an elastic gasket. Thus insulated, the connector may be operated under high vacuum up to 600 V ac without electrical leakage or intercontact ionization. Additional advantages are gained by the recessing of the contact surfaces in individual ceels. This prevents accidental shorting against metal objects, makes the plug relatively shockproof, and prevents contact contamination through handling.

The female plug half of the connector, shown in the figure, has grooves, partitions, and positioning keys to aid in mating. After stripping, inserting, and securing the flat conductor cable leads, the rear of the plug is potted to provide stress relief for the cable and a moisture seal for the connection.

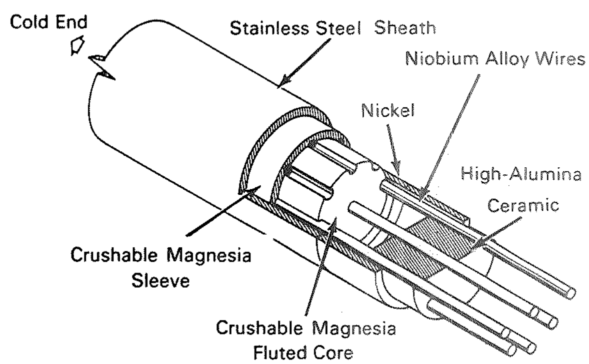
Source: W. Angele
Marshall Space Flight Center
(MFS-20757)

Circle 13 on Reader's Service Card.

CABLE IS PROTECTED FROM HIGH TEMPERATURE ENVIRONMENT

An air-environment test chamber, operated at 1800°F, required a nine-conductor cable, capable of bending flexure up to 60°. It was also required that cable diameter not exceed 0.375 in.

A ceramic-insulated, swaged stainless steel sheath cable with a protective internal atmosphere has been designed to meet these requirements. Internal insulation consists of a two-piece crushable magnesia ceramic. One piece is a sleeve that fits over the other, a fluted piece in which nine 0.017-in. diameter niobium alloy wires are posi-



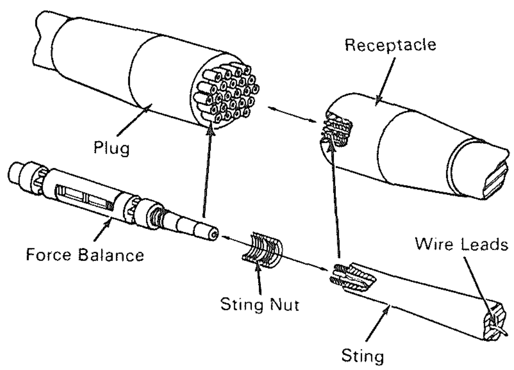
tioned. This ceramic/wire assembly is placed in a stainless steel sheath, and high-alumina content ceramic plugs are brazed to the wire leads at each end and short nickel sleeves brazed to the plugs. The assembly is pressure purged with argon, and the nickel sleeve is then TIG welded to the stainless steel sheath. A miniature multipin connector at the cold end of the cable provides connection to a standard flex cable. The argon purge prevents oxidation and embrittlement of the wires during TIG welding.

Source: R. E. Eugdahl et al, of
Consolidated Controls Corp.
under contract to
Lewis Research Center
(LEW-10149)

No further documentation is available.

A MINIATURE 1/4-INCH DIAMETER 24-PIN CONNECTOR

A miniature connector has been developed to eliminate the time consuming task of individual hookup procedures involved in connecting numerous force balances used in wind-tunnel testing. An injection-molded male plug is installed in the tapered end of a strain-gage balance. The receptacle, also injection molded, is fitted with standard "twist-pin" contacts and attached leads and is routed through the wind tunnel sting and support structure to complete the connection to the instrumentation system. These connectors are capable of operating through a temperature range of −65° to +300° F and provide positive connection in applications where space is at a premium.



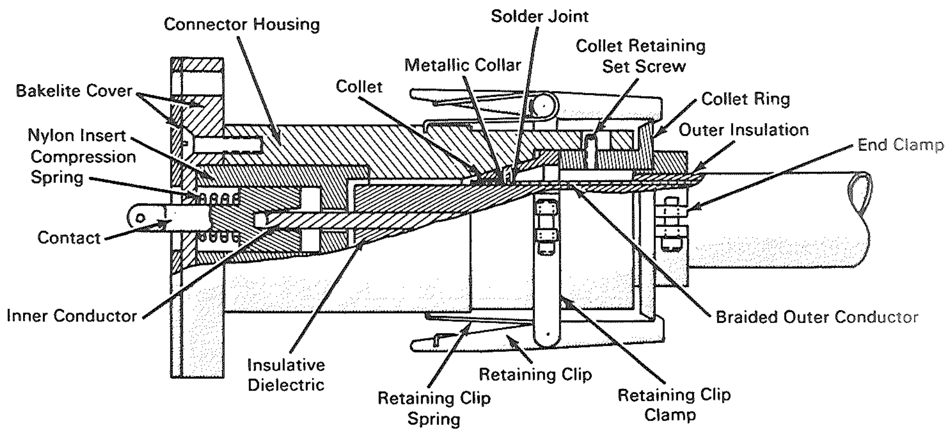
Source: W. R. Phelps
Langley Research Center
(LAR-10607)

No further documentation is available.

PLUG-IN SOCKET FOR COAXIAL CABLES

A socket has been designed and fabricated that will receive and retain a coaxial cable end while making an electrical connection between an external contact and the inner cable. The coaxial cable may be removed and reinserted with ease.

Near the center of the socket housing, a collet with flexible fingers is held in place by a collet ring. The coaxial cable end is dressed so a length of the center conductor extends and the braided outer conductor is slightly stripped back from the end of the inner insulator; a metal collar is soldered to the outer conductor end. A clamp with two retaining clips is placed over one end of the socket housing and an end clamp is placed around the cable. When the coaxial cable is moved into the socket, the inner conductor extends all the way into the spring-loaded contact and the collar lines up with the collet. The end clamp is moved forward against the collet ring and tightened. The cable is then pushed farther into the connector, forcing the collet ring and collet inward, causing the collet to clamp against the collar The compression spring allows the contact to move with the inner conductor. The retaining clip clamp is moved so the retaining clips will restrict movement of the collet ring. The retaining clip clamp is securely tightened and small holes are



drilled to receive the retaining clip spring ends.

The coaxial cable, now securely held in the socket, can be removed simply by pressing the ends of the retaining clips free of the collet ring. The cable is reinserted by pressing it into the socket until the retaining clips fit over the collet ring flange.

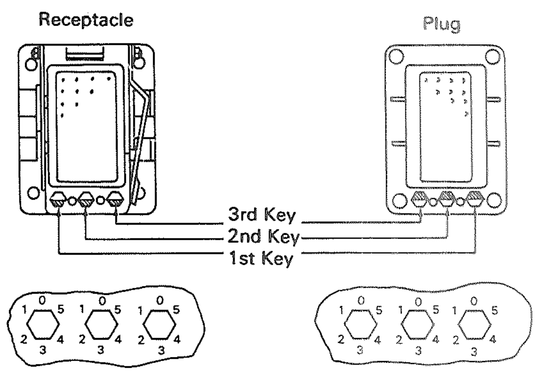
Source: J. Van Loon and D. Mitchel
Argonne National Laboratories
(ARG-90009)

Circle 14 on Reader's Service Card.

POLARIZING KEYS PREVENT MISMATCH OF CONNECTOR PLUGS AND RECEPTACLES

In connector patching for instrumentation involving several thousand leads, the danger of mating the wrong plug and receptacle is always present. To prevent such mismating, a system of polarizing keys as integral parts of plugs and receptacles has been devised.

Plugs and receptacles have been designed with keying provisions that permit the mating of a large number of connectors with no possibility of a mismatch. Each receptacle and plug incorporates three polarizing keys that must mate in a complementary mode before the connector pins and sockets will engage. Each of the three keys in each unit may be oriented in any one of six selected positions. This provides a total of 216 different keying arrangements. Thus, using receptacles having 128 patch sockets, the system will accommodate a total of 27,648 patch leads without the possibility of a plug-to-receptacle mismatch.



Source: A. Chiapuzio of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-90443)

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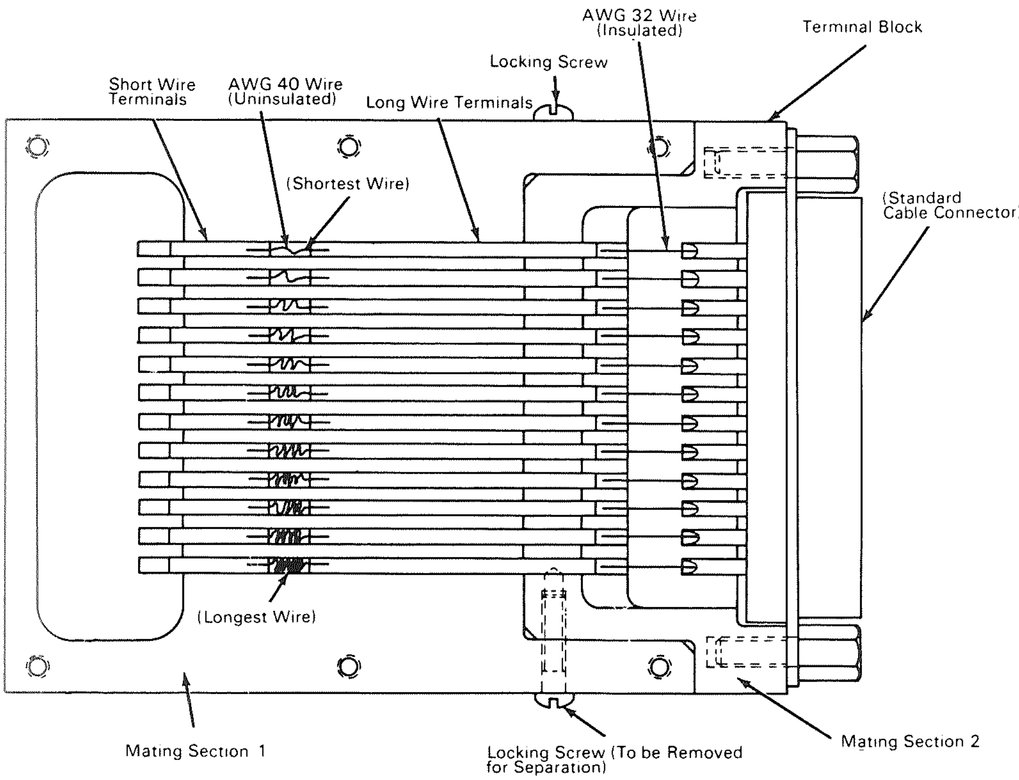
ONE-SHOT ELECTRICAL CONNECTOR HAS SMOOTH BREAKAWAY



A one-shot, breakaway multiconductor cable connector has been developed for use where a system must be hard-wired up to a point in time and then disengaged to continue its activity by transmitted rf. The connector is manufactured to very fine tolerances in the area of uniform, low-friction disengagement of mating pins and receptacles to prevent binding or wedging.

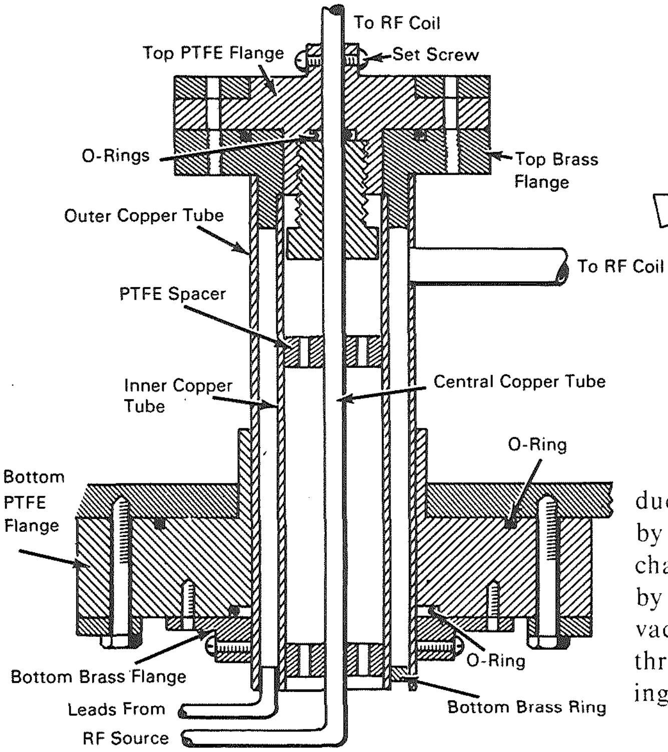
The connector is connected conventionally with the exception that small-diameter interconnecting wires, of graduated lengths from top terminal to bottom terminal, are welded to neighboring pin and cable terminations. As mating section 1 and mating section 2 are pulled apart during separation, the small-diameter wires are broken in turn, starting with the shortest and ending with the longest, by a constant applied force. Thus friction binding or wedging is eliminated and excellent electrical interconnection is provided until the planned instant of disconnect. Conducting wires are nonductile without excessive brittleness so they will snap apart under the applied force.

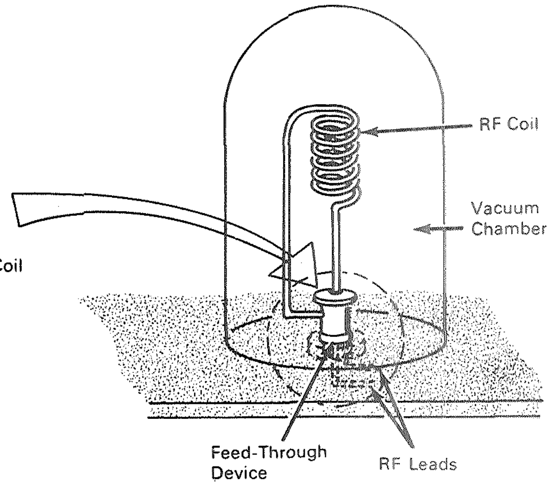
Source: L. Katzin of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11140)

Circle 16 on Reader's Service Card.

FEEDTHROUGH CONNECTOR COUPLES RF POWER INTO VACUUM CHAMBER

A feedthrough device of silver soldered copper tubes, polytetrafluoroethylene (PTFE) electrical insulators, and conventional O-ring seals has been designed to connect rf power to an rf coil operating in a vacuum chamber environment of 10^{-4} to 10^{-5} Torr. The basic device is an annular cylindrical cavity formed by silver soldering copper tubes, one within the other,



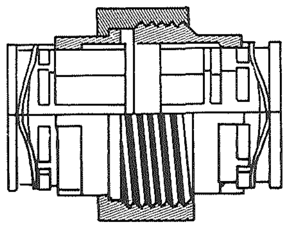


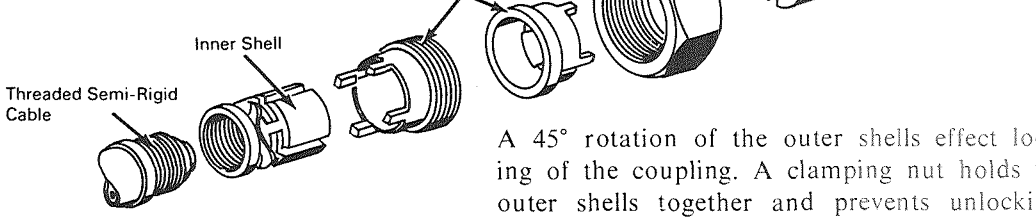
to upper and lower brass flanges. The top brass flange is surmounted by a PTFE flange that is vacuum sealed by O-rings and supports and electrically insulates the central tubular conductor, which is secured to the PTFE flange by set screws. The device penetrates the vacuum chamber and is electrically insulated from it by a bottom PTFE flange fitted with O-rings for vacuum sealing. Suitable fluids can be circulated through the tubular system for necessary cooling.

Source: C. L. Grandy of
Westinghouse Astronuclear Laboratory
under contract to
Space Nuclear Propulsion Office
(NUC-90096)

Circle 17 on Reader's Service Card.

CONNECTOR ACTS AS COAXIAL CABLE QUICK COUPLING





A quick-coupling connector has been designed with inner shells threaded to coaxial cable ends and with outer shells having fingers that register in channels machined in inner shells. A 45° rotation of the outer shells effect locking of the coupling. A clamping nut holds the outer shells together and prevents unlocking.

Each inner shell has 4 L-shaped channels machined axially at 90° intervals and each outer shell has four fingers machined at 90° intervals. In assembly, the inner shells are threaded onto the two cable ends and the outer shell fingers are slipped into the inner shell channels until they bottom, at which time the outer shells are rotated 45°, locking them to the inner shells. The clamping nut is brought into engagement and forces the inner shells together, making a good electrical butt-joint connection. An air transition exists at the butt-joint to allow trapped air to escape.

The connection yields a very low voltage standing wave ratio of less than 1.02 over the S-band frequency range with an insertion loss of less than 0.01 dB.

Source: Albert G. Brejcha, Jr. of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-90803)

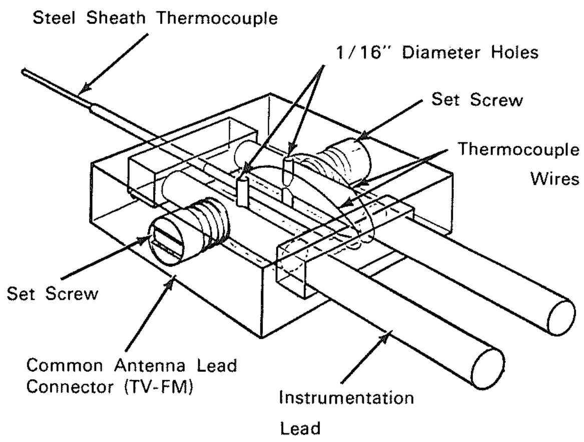
Circle 18 on Reader's Service Card.

Section 3. Adapters and Modifications

MODIFIED RF ANTENNA LEAD CONNECTOR USED FOR LABORATORY INSTRUMENTS

Laboratories performing high-temperature testing on a variety of items use numerous thermocouples which must be compatibly connected to instrumentation. Thermocouple lead wires are quite fragile and cannot have stresses placed on them in the connection process. To protect them, standard TV-FM connectors have been modified as shown in the sketch.

Two small holes are drilled for set screws to enter the connector block from either side where the ribbon antenna leads would normally enter the connector. An additional hole is drilled parallel to these, and equidistant between them. The metal sheath of the thermocouple is cemented into this hole. The two thermocouple leads are then inserted into the two previously drilled holes. The instrumentation leads are inserted into the two lead holes provided and the set screws are tightened so the instrumentation leads are firmly clamped between the setscrew and the thermocouple leads.

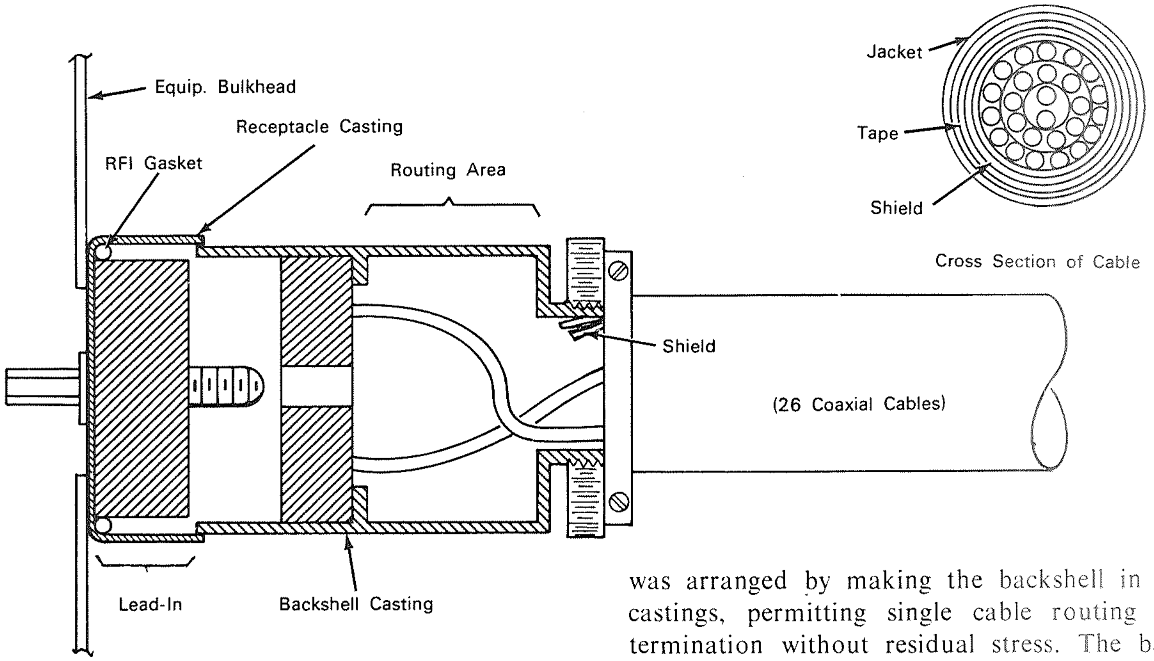


Source: R. W. Skoff of
Westinghouse Astronuclear Laboratory
under contract to
Space Nuclear Propulsion Office
(NUC-10106)

Circle 19 on Reader's Service Card.

BACKSHELL FOR COAXIAL CABLE SHIELDING

Because of its rigidity, size and large bending radius, a coaxial cable bundle is very difficult to shield from radio frequency interference (RFI). In one application, 26 pairs of coaxial cables were successfully terminated to a connector by means of a modification to a standard connector block that achieved RFI integrity of the complete system.

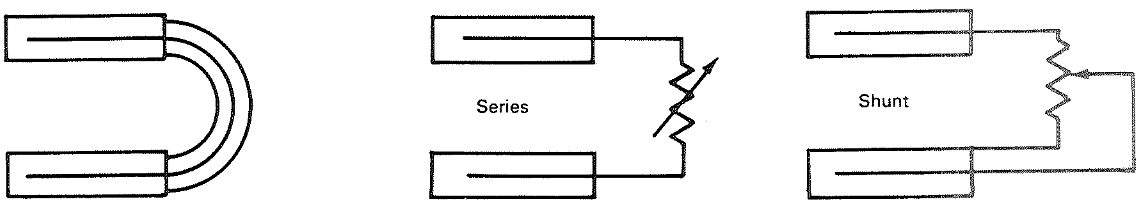


A receptacle casting was designed to provide a lead-in for a backshell and also an RFI attenuating overlap backed up by a RFI gasket. The cable was divided into three runs, as shown in the cross section, with each run rotating with a different pitch. With random location in the bundle and specific location in the connector, the cables were capable of being routed and dressed within the backshell. This was arranged by making the backshell in two castings, permitting single cable routing and termination without residual stress. The backshell halves are held together with a dual purpose clamp that secures the outer braiding and provides mechanical stress relief.

Source: K. C. Gaspar of
Radio Corp. of America
under contract to
Marshall Space Flight Center
(MFS-91384)

No further documentation is available.

LOOPING PLUG INCORPORATES SIGNAL LEVEL ADJUSTMENT



Standard Looping Plug

Level Adjust Looping Plug

A looping plug is normally used to patch one cable into another at an interchange point (patch panel) and, normally is only a direct connector that has no influence on signal amplitude. However, it would be convenient if a means were available to adjust signal amplitude within the system, other than within the receiving equipment.

A looping plug has been designed to incorporate a miniature potentiometer that permits signal level adjustment at the point of patching. The standard looping plug is machined to accept a miniature potentiometer which can be used to adjust playback of recorded information in any area-studio, tracking facility (visual display), or communications situation where incoming signal level adjustment is required.

Source: Donald F. Tinari
Goddard Space Flight Center
(GSC-10876)

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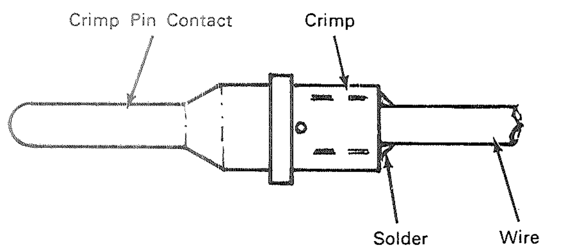
PIN CRIMP TECHNIQUE PREVENTS VOLTAGE DROP

Electrical connector crimp pins are normally crimped onto wire leads and then inserted into the connector. When liquified potting compound



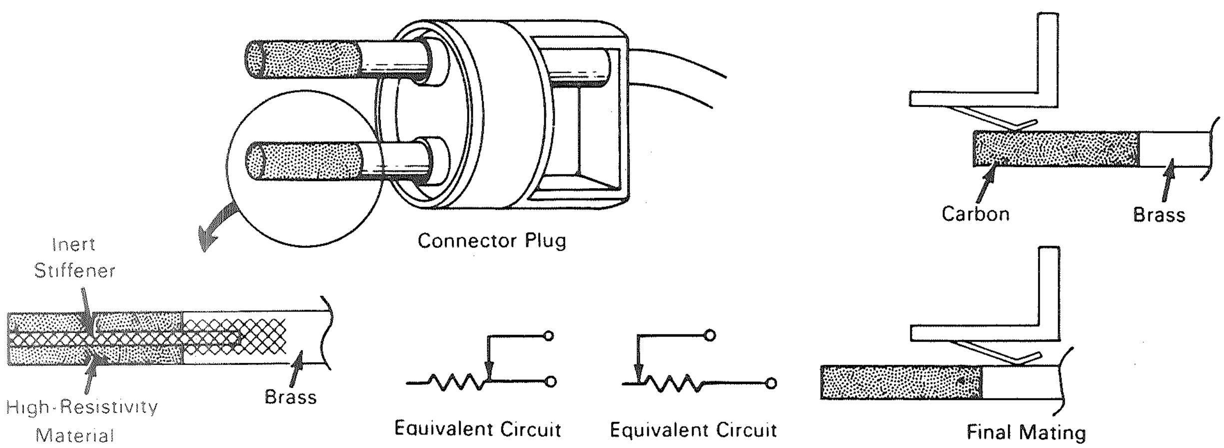
is applied to encapsulate the module, some material tends to run inside the crimp on the pin barrel, causing a voltage drop. This has resulted in rejection of modules after quality control inspection and test.

This difficulty has been overcome by soldering the area of joining between the wire lead and crimp. With this joint properly soldered, potting compound is unable to enter the area between the wire and pin barrel.

Source: R. Shepard and J. Leapoldt of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12889)

Circle 21 on Reader's Service Card.

DESIGN CONCEPT FOR NONARCING ELECTRICAL CONNECTOR



A connector plug, as illustrated in the sketches, would automatically minimize arcing during mating and demating. This plug incorporates a high-resistivity outer sheath, such as a carbon rod with an appropriate inert binder, as an extension to the regular pin contact. As the plug is inserted into a receptacle, the high-resistivity sheath limits the current to below the arcing level. On continuing the insertion, less and less of the sheath is placed in series with the line current, until, with the "bottoming" of the brass base, the circuit is completed and maximum current flows. On withdrawal of the plug, the process is reversed so that arcing is minimized (minimum current flows) at the instant of demating.

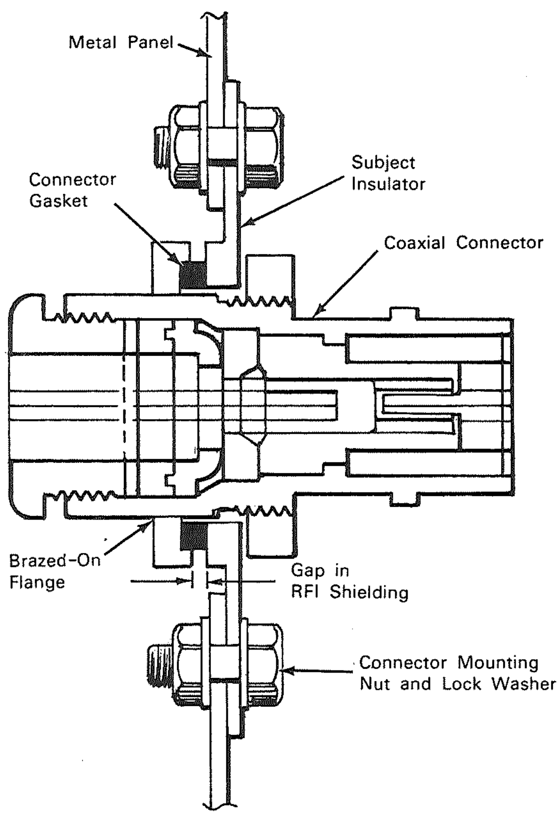
The carbon rod can be made very hard and would be machinable. However, since such a rod has very little shear strength, an inert stiffener would be required as shown in the sketch.

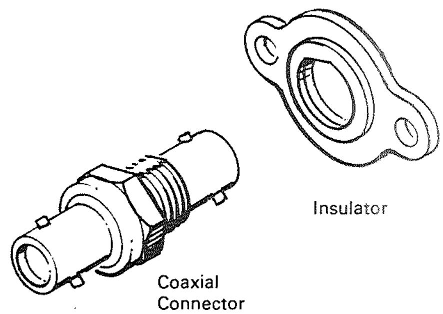
This connector would be useful in atmospheres containing explosive or combustible gases or vapors. It would also reduce erosion at the contact surfaces in cases where mating and demating are performed frequently.

Source: R. E. Holmen of
McDonnell Douglas Corp.
under contract to
Marshall Space Flight Center
(MFS-14937)

No further documentation is available.

INSULATOR FOR COAXIAL CABLE FEEDTHROUGH CONNECTORS





A plastic insulator has been designed and manufactured that permits mounting a coaxial feedthrough connector to an equipment panel, without grounding the coax outer conductor to the panel, and at the same time preserves radio-frequency interference (RFI) shielding integrity. Previous methods involved either mounting on phenolic panels that introduced significant gaps in RFI shielding, or on metal panels that introduced ground loops that resulted in signal degradation.

This insulator, shown in the sketch, is either riveted or bolted to the panel and keyed to the connector to prevent rotation. It will remain attached to the panel in correct position when the connector is removed for equipment servicing. The gap in RFI shielding is reduced to insignificance. It has been manufactured in three sizes to fit standard panel cutouts.

Source: Felix Rubio of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12836)

Circle 22 on Reader's Service Card.

CABLE SHIELDING BY ELECTROLESS PLATING

In shielding flat conductor cables against radio frequency interference, ordinary screenwire or perforated foil has previously been laminated to the cable. The adhesive used has tended to act as insulation, at times preventing a good electrical connection. When the adhesive is removed from between the conductors, the shield makes contact only from the pressure of the laminating process, which pressure is then released.

Shielding has now been accomplished by electroless plating using plating solutions of nickel and nickel/iron. The cable insulation is chemically treated with an appropriate etching solution to clean, degrease and scuff the surface in order to increase the strength of the shield-to-surface bond. After the surface treatment, the insulation is washed in distilled water and then immersed in the electroless plating solution. The plating solution must be carefully chosen as to its relative acidity or alkalinity in order to be compatible with the insulation under treatment. It is important that the shield be connected to the ground conductor in order to centralize the ground and thus prevent ground loops in the system.

Source: Bobby W. Kennedy and Wilhelm Angele
Marshall Space Flight Center
(MFS-13687)

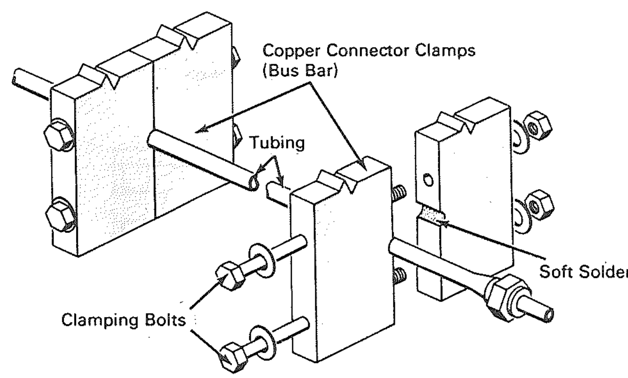
Circle 23 on Reader's Service Card.

CLAMP PROVIDES EFFICIENT CONNECTION FOR HIGH-DENSITY CURRENTS

To investigate very high heat transfer rates, it was necessary to provide 7000 amperes of current to a section of 0.250-inch o.d. × 0.020-inch wall, type 347 stainless steel tubing, containing hydrogen gas at 1500 psi pressure. Fusion-bonded (welded or brazed) electrical connections could not be used because of the degradation of the physical properties of the stainless steel specimen. Ordinary clamped connections were subject to high resistance problems and capacitive arcing across minor surface imperfections.

An electrical connector clamp has been designed (bus bar) that provides essentially 100 percent contact-surface efficiency through the use of a cold-flowed lead solder film between the faying surfaces of the clamp and tubing. The film provides the electrical equivalent of a fusion bond without significantly degrading the grain structure of the materials, and permits disassembly and reuse of the components.

The clamps are fabricated from 0.5-inch copper plate to fit the tubing, with 0.002-inch diametral interference. The faying surfaces in the clamp bore are flash tinned with soft solder, resulting in a coating of approximately 0.001-inch thickness. After the tubing is inserted, tightening of the clamping bolts against this total of 0.004-inch diametral interference forces



cold flow of the soft solder, which completely fills all interfacial voids at the faying surfaces. Although there is limited industrial requirement for current densities of this magnitude (17,500 amperes per square inch), significant benefits in reduced power losses and contact surface protection can be realized at the lower current densities used in such processes as electroplating, electric resistance welding, and electrochemical machining.

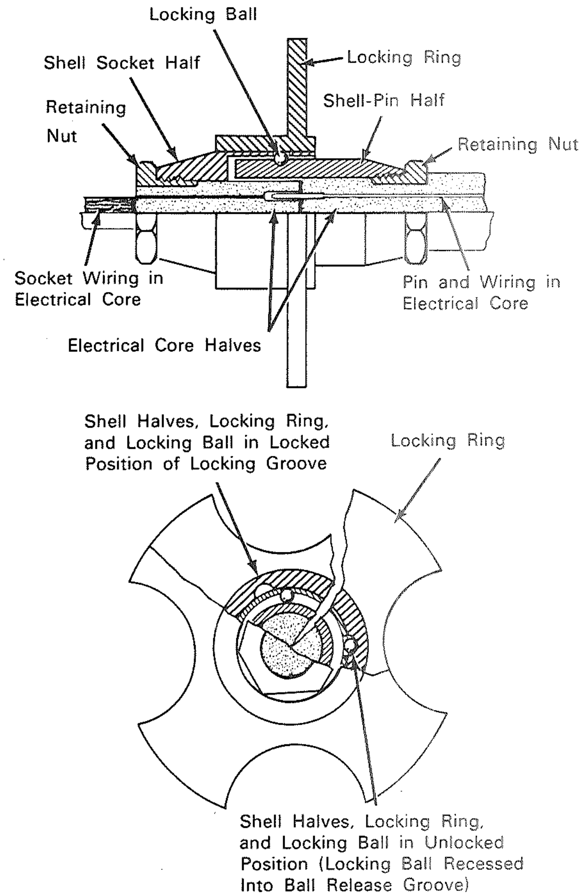
Source: D. M. Trebes and J. R. McCarthy of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12417)

No further documentation is available.

CONNECTOR MOUNTING SHELL IS EASILY OPENED OR CLOSED

A low torque ball-lock shell has been developed for locking together the two halves of an electrical connector so it can be mated or demated with minimum effort. This enables personnel wearing protective clothing (heavy gloves, for instance) to easily actuate the connector to the open or closed position. Interference type ball locks provide positive joining of the two halves of the connector.

The interior of the locking shell assembly shown in the sketch is designed to receive and retain cores of many different configurations and sizes. The cores provide insulation and support for the wiring, conductor pins, and conductor sockets. Locking of the shell is achieved through an interference loading of the locking balls into a locking groove in the pin half of the shell by counterclockwise rotation of the locking ring. Opening is achieved by clockwise rotation of the locking ring which places a release groove in the locking ring to be positioned over the locking ball. When the two halves of the connector are separated, the locking balls retract into the release grooves of the locking ring.



Source: E. M. Tucker
Manned Spacecraft Center
(MSC-90541)

No further documentation is available.

NASA-Langley, 1971

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