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TECHNOLOGY UTILIZATION

FABRICATION TECHNOLOGY

A COMPILATION



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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 its research and development, NASA and AEC earns for the public an increased return on the investment in aerospace research and development programs.

This document is intended to supply such technical information. The Compilation is divided into two sections: the first deals with techniques of assembling diverse components into functional assemblies and subassemblies; and the second presents several fasteners and fastening techniques that join components, subassemblies, and complete assemblies to achieve a functional unit. The second section features quick-disconnect fasteners, several interesting devices and methods for attaching sophisticated thermal insulators, and ways of joining and separating objects in the absence of gravity.

Additional technical information on individual devices and techniques can be requested by circling the appropriate number on the Reader Service Card enclosed in this Compilation.

The latest patent information available at the final preparation of this Compilation is presented on the page following the last article in the text. For those innovations on which NASA and AEC have decided not to apply for a patent. A Patent Statement is not included. Potential users of items described herein should consult the cognizant organization for updated patent information at that time.

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

Jeffrey T. Hamilton, *Director*
Technology Utilization Office
National Aeronautics and Space Administration

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Section 1. Assembly Technology

MINIMUM ADHESIVE-WEIGHT, HONEYCOMB-SANDWICH STRUCTURES

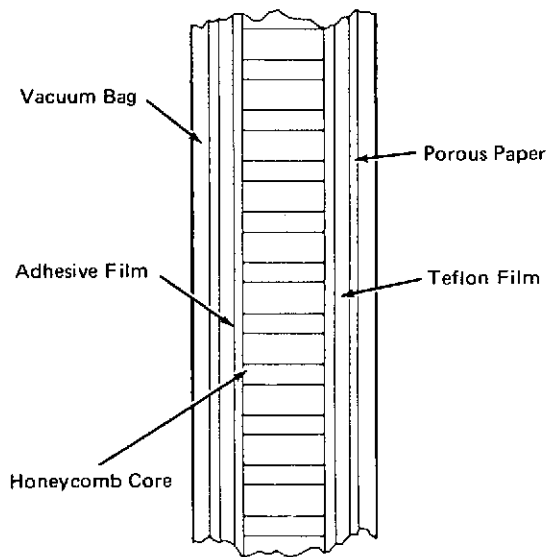
This process provides a uniform, lightweight adhesive coating on honeycomb faying surfaces. Standard bonding methods require continuous adhesive coating of sandwich skins. Since no adhesive coating is needed on skin areas between cell walls, the adhesive material in these areas represents excess weight. The film weights for standard bonding techniques range from 1.44 to 2.08 kg/m² (0.09 to 0.13 lb/ft²).

A lightweight, epoxy system [0.10 to 0.15 kg/m² (0.02 to 0.03 lb/ft²)] was developed for coating the honeycomb cells. This adhesive consists of a film with many holes produced by a frothing process. The film is placed on top of the core (the cells are vertical) and heated. During heating, the film becomes

liquid at the holes and migrates back to the honeycomb-core cells, creating a fillet. This system produces a limited heat-resistance bond at 355 K (180° F) and, due to the random placement of holes in the film, does not produce a uniform fillet coating. Another drawback is that the core can be coated on one face at a time only.

An improved process uses heat-resistant epoxies to uniformly coat all faying surfaces of the core in one operation. A Teflon separator film and vacuum-bag pressure ensure that the adhesive is cured to coat the faying surfaces of the cell walls uniformly. The basic process requires that the adhesive film be tacked on each faying surface of the core and covered with a Teflon film and a layer of fiberglass or porous paper. Next, this assembly is placed in a vacuum bag, the bag is sealed, and a partial vacuum is drawn [84.7 x 10³ N/m² (29 in. Hg)] (see figure for cross section of setup). The vacuum-bagged assembly is placed in a vertical position in a preheated (~150° C or 300° F), air-circulating oven. The core is heated to 145° C (293° F) and then cooled at room temperature. The vacuum bag, paper breather, and Teflon film are removed from the oven. The adhesive will have migrated to the cells to create uniform fillets.

This improved process has been demonstrated with Bloomingdale FM 150-2U, FM 400-U, and Narmco 1114 unsupported adhesive films. The FM 150-2U and FM 400-U adhesives are capable of 180° C (292° F) structural application.

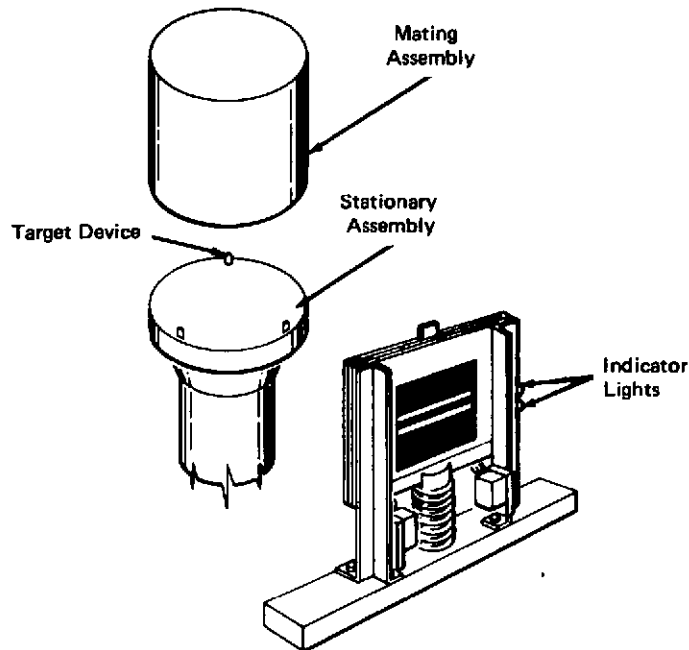


Cross Section: Setup for Fillet-Coating Honeycomb Core With Unsupported Film Adhesives

Source: J. S. Jones of
Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-24408)

Circle 1 on Reader Service Card.

TARGET DEVICE FOR DETERMINATION OF PARALLELISM FOR LARGE ASSEMBLIES



Target Device Provides Visual Determination of Parallelism for Large Assemblies Prior to Mating

Visual-aid target devices assist in the remote mating of large assemblies and permit accurate observations for parallelism of assemblies. The instruments employ a special sighting pattern, based on optical-tooling targets. In addition, two lights, activated by micro-switches, backup the target pattern system (see figure).

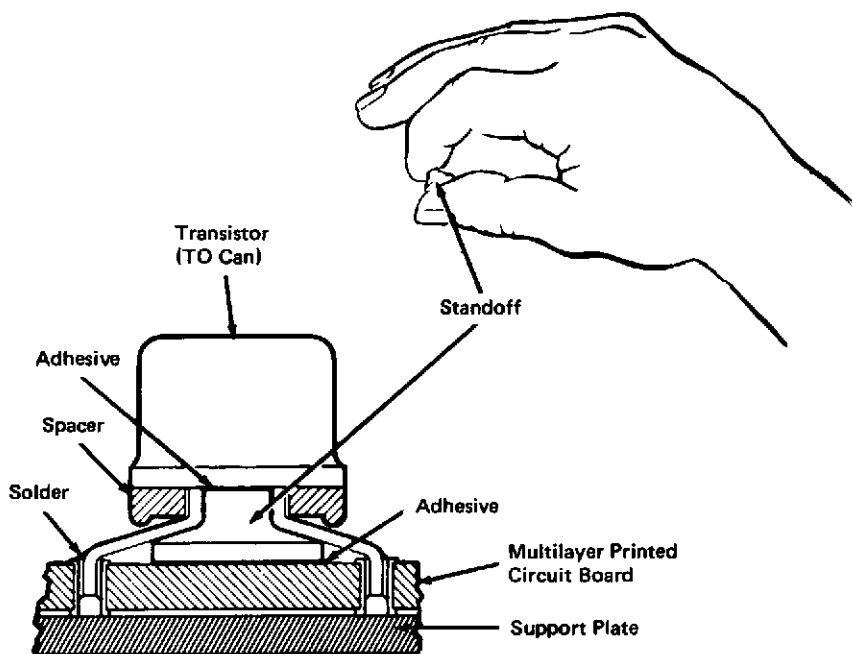
Three targets are placed remotely and are spaced equally on the periphery of the lower stationary assembly. The mating assembly is lowered to contact the top of each target. As the assembly continues downward, observers note the relative position of the movable, centering black bar (on a white background) in the opening of the black facing. As the center position is reached by the bar, the upper indicator light is activated; as the center point is passed, the

lower indicator light glows to signal nonparallelism. Illumination of the three upper indicator lights signifies parallelism to within 0.076 cm (0.03 in.). When the assembly has been lowered and adjusted so that the three targets are properly aligned, the targets are removed and the assembly is lowered into place.

Source: D. W. Graham of
Aerojet-General Corp.
under contract to
AEC-NASA Space Nuclear Systems Office
(NUC-10080)

Circle 2 on Reader Service Card.

A PEDESTAL STANDOFF FOR MOUNTING TRANSISTORS



TO Can with Standoff

A pedestal standoff connects transistors and other related transistor (TO can) devices in blind holes on multilayer printed circuit boards. It provides mechanical support and strain relief for leads as well as a thermal-conduction path for component heat dissipation (see figure). Conventional methods approved by NASA Handbook, "Requirements for Soldered Electrical Connections," NHB 5300.4 are not applicable to the mounting of devices on printed circuit boards where "blind hole" connections are required.

A TO can device is mounted on a pedestal standoff by first installing a regular mounting pad (with a hole in its center) on the base of the device in a conventional manner and then forming a strain relief in the leads. A standoff with a stem, which fits into the hole in the mounting pad, is then bonded directly to the base of the device. The leads are placed in holes in the printed circuit board, and the base of the standoff is bonded to the board.

This mounting method provides a mechanically strong mount with direct thermal coupling from the case of the device to the printed circuit board and support frame. The strain relief compensates for expansion and contraction of the printed circuit board and allows component leads to be uniformly

installed on multilayer boards having blind solder holes.

The standoff material used to meet low heat-dissipation requirements is nylon; beryllium oxide is used when high heat-dissipation is required. These materials electrically isolate the component case from the printed circuit board, allowing circuit lines to be routed under the device.

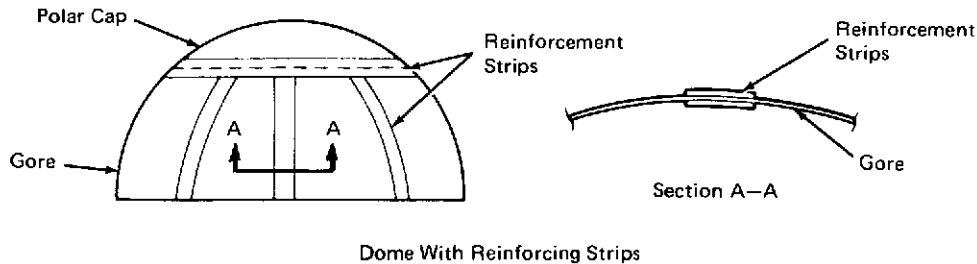
Two sizes in each of the two materials are sufficient for mounting a large variety of devices that fall into the TO-5 and TO-18 general size ranges.

The standoff mounting posts have been used successfully in the Apollo Telescope Mount Digital Computer and in the Workshop Computer Interface Unit which are used in the NASA Skylab Program.

Source: T. S. Murphy, H. L. Townsend and
C. M. Steinberger of
IBM Corp.
under contract to
Marshall Space Flight Center
(MFS-21615)

Circle 3 on Reader Service Card.

ADHESIVE BONDING METHOD OF FABRICATING THIN-SKIN, VACUUM-TIGHT DOMES



An adhesive bonding method has been developed for fabricating thin-skin, vacuum-tight domes for evacuated, multilayer insulation systems. Thin-skin aluminum sections are stretch-formed into gores and a polar cap. The sections are then laid-up on a mandrel and joined together by reinforcing strips of thin-skin aluminum bonded to the gores and cap with a modified epoxy adhesive (see figure). After curing, the assembly is vacuum leak-checked and all leak areas covered with a sealant.

The adhesive bonding method of fabricating thin-skin, vacuum-tight domes provides a tight-tolerance shell contour for maximum structural integrity with a minimum shell weight. Spin-forming the domes and reducing skin thickness by chemical milling is slow and costly. Welding the dome sections together distorts the shell and is more costly than adhesive bonding.

A dome 1.14 m (45 in.) in diameter has been fabricated by adhesive bonding. The skin thickness for this dome is 0.254 mm (0.010 in.). The re-

inforcing strips are 5 cm (2 in.) wide and are the same thickness as the shell. A larger tank would require a thicker skin, e.g., a dome 4.57 m (15 ft) in diameter requires a skin thickness of 0.635 mm (0.025 in.).

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151

Single document price \$15.00
(or microfiche \$1.45)

Reference: NASA CR-121103 (N73-25902), Light-weight Evacuated Multilayer Insulation Systems for the Space Shuttle Vehicle

Source: V. L. Yuhas of
The Boeing Company
under contract to
Lewis Research Center
(LEW-11793)

ANGLED MIRROR SOLVES ALIGNMENT PROBLEMS

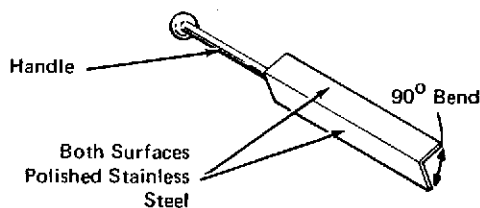


Figure 1. Alignment Mirror

A new mirror technique can be used to align or fit together objects that are not fully visible. Figure 1 illustrates how the polished stainless-steel mirror is used. The mirror is bent at a 90° angle to reflect objects above and below it simultaneously; it is attached to a handle for easy positioning and removal.

Figure 2 shows how a projection and a recess are fitted. As the recessed part is being lowered, the mirror is placed on the projection to be aligned.

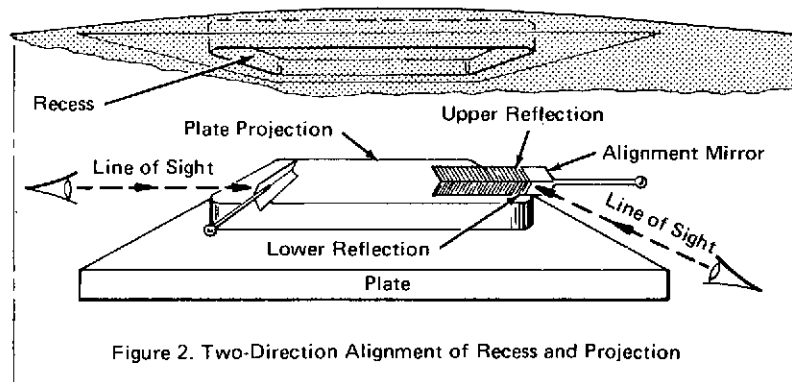


Figure 2. Two-Direction Alignment of Recess and Projection

Images of the recess and the projection may be seen on the horizontal surfaces of the mirror; the projection is reflected on the lower surface, the recess on the upper. The vertical wall of the recess appears as a vertical line on the upper surface, when the mirror is square to the edge. This vertical line must be on the outside of the line displayed by the projection, and adjustments are made until this is apparent from two adjacent sides.

The angled mirror is useful for a variety of contours. Only the number of views needed to

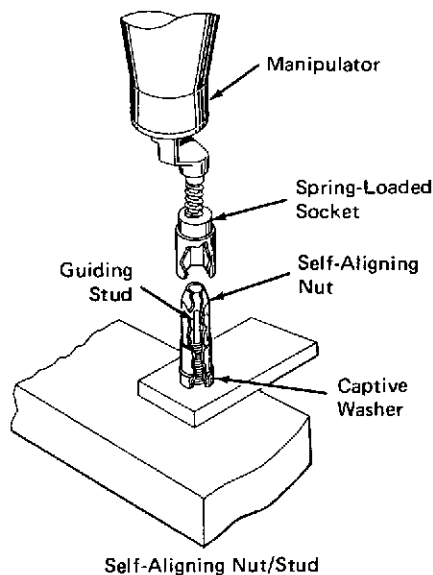
verify alignment changes. For identical repeated operations, guidelines can be marked on each mirror surface.

Source: F. A. Raines of
The Boeing Company
under contract to
Kennedy Space Center
(KSC-10696)

No further documentation is available.

SELF-ALIGNING NUT/STUD ELIMINATES CROSS-THREADING PROBLEMS FOR REMOTE APPLICATION

In order to provide a nut and washer that can be emplaced remotely and/or removed from a stud or captive bolt without cross-threading, a nut was fabricated with a close-tolerance mouth which rides on



Self-Aligning Nut/Stud

the pilot shank of the stud. The close tolerance on the nut automatically aligns the longitudinal axis of the stud, prior to thread engagement. A captive washer is an integral part of the nut.

The nut and captive washer are positioned by a manipulator (see figure) on a special stud that has three flats on the protruding guiding shank to prevent binding of the nut. The nut is tightened with a remotely operated wrench having a spring-loaded deep socket to prevent excessive downward force from damaging the initial thread.

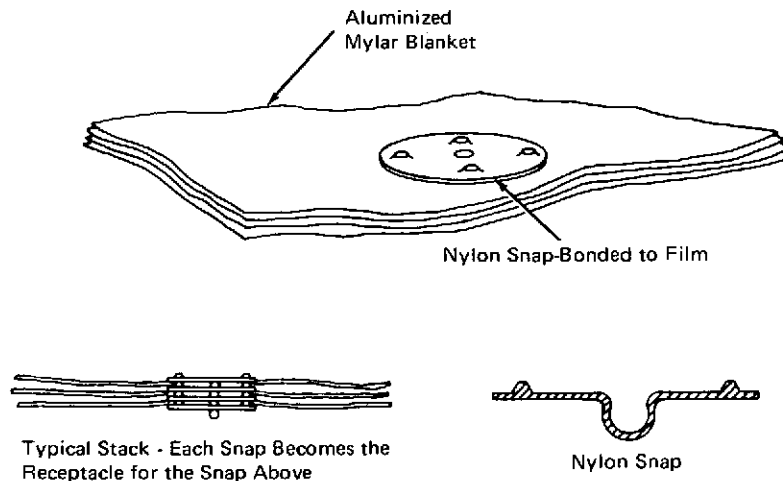
The nut assembly is removed by reversing this procedure. The nut may be made self-locking by the insertion of a fiber or nylon plug in the threads.

Source: H. H. Christopherson and R. Paus of
Aerojet-General Corp.
under contract to
AEC-NASA Space Nuclear Systems Office
(NUC-10085)

Circle 4 on Reader Service Card.

Section 2. Fasteners and Fastening Techniques

ATTACHMENT OF HIGH-PERFORMANCE INSULATION



Attachment Method for High-Performance Insulation

A formed nylon snap for attaching layers of high-performance insulation (HPI) (aluminized Mylar blankets) permits easy removal or replacement of the insulation. The snap is bonded to the Mylar fabric with an adhesive, and a hole is punched through the fabric to permit the male detent to protrude through. The detent snaps directly into the socket of the fastener and is attached to the HPI fabric layer stacked beneath. Fastener location on the fabric depends upon the size, contour, and shape of the surface requiring insulation. The insulating effectiveness of the blankets depends upon the gaps between the layers of fabric. To maintain the required gaps, each

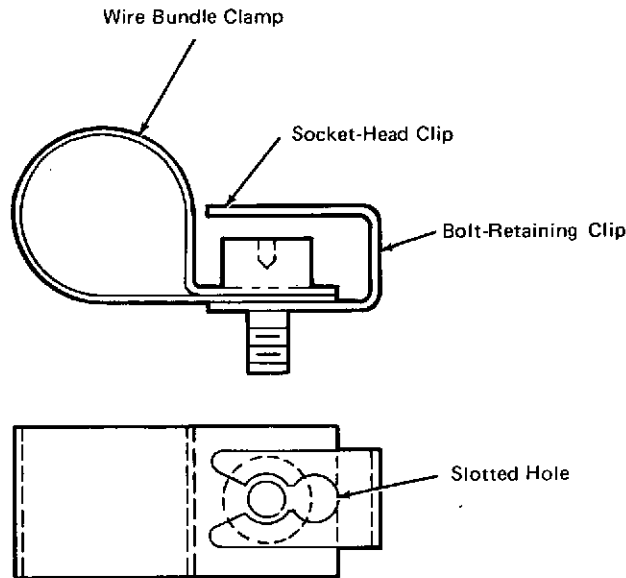
fastener has four pads which act as standoffs to separate the layers (see figure).

The fasteners are a permanent part of each Mylar fabric-layer assembly. When one HPI fabric layer is removed, the fasteners of that layer are pried apart from the fasteners in the other layers.

Source: R. D. Monroe of
Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-24184)

Circle 5 on Reader Service Card.

BOLT-RETAINING CLIP



Typical Application of Bolt-Retaining Clip

Fastening bolts are normally captivated (held secure) by a specially designed collar that is trapped in a recess in the equipment. A new bolt-retaining clip requires only standard, socket-head cap screws and does not involve any equipment modification or special design. The clip is simple, inexpensive, lightweight, and needs no special tools for installation or removal. Application of the clip to existing and new equipment installations permits selective captivation and reduces the cost by several orders of magnitude over the integral captivation/special-design approach.

The bolt-retaining clip is designed to captivate fastening bolts on equipment, wire bundle and tubing clamp installations (see illustration), and similar uses. The captivation of fasteners is necessary wherever loose fasteners pose hazards to people or equipment.

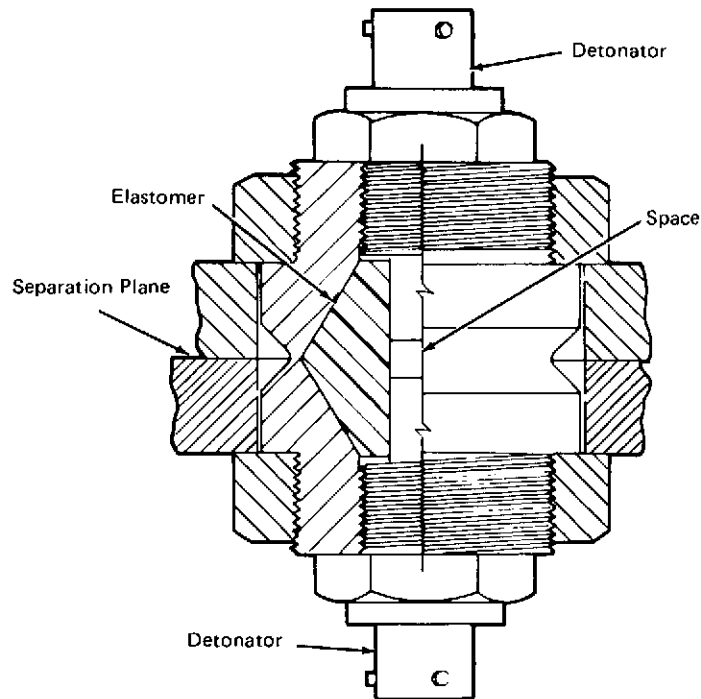
The bolt-retaining clip is a small sheet-metal channel with a round hole in one flange and a

specially slotted hole in the other flange, directly opposite the round hole. The specially slotted hole secures the retaining clip to the bolt. The round hole provides access to the head of the bolt for torquing. After placing a mounting bolt in the hole in a mounting flange, the flange of the retaining clip with the specially slotted hole is snapped into place around the bolt shank and under the mounting flange. The opposite flange on the retaining clip then traps the bolt in its mounting hole.

Source: B. W. Council, Jr., of
McDonnell-Douglas Corp.
under contract to
Marshall Space Flight Center
(MFS-21906)

Circle 6 on Reader Service Card.

FRANGIBLE LINK WITH REDUNDANT EXPLOSIVE CHARGES AND SINGLE SEPARATION PLANE



Frangible Link Cross Section
(Threaded Explosive Bolt Configuration)

A new explosive-operated, frangible link has been developed and qualified for use in a spacecraft retention-and-separation system. This device uses a molded-in-place elastomer (see figure) to transmit pressure and shock from either, or both, of two explosive charges to a weakened portion of the fastener. A single separation plane prevents fragmentation of the fastener and possible damage to sensitive components.

The frangible link is basically a fastener having a through bore with explosive detonators at each end. A V-shaped trough is cut into both sides of the housing so that the pieces are radially aligned, thus forming a plane with a significant reduction in cross-sectional area. A hollow elastomer ring is molded into the internal trough to form a small cylindrical space between opposing faces of the two detonators. Ignition of either detonator produces a gas pressure within this space. The pressure acts

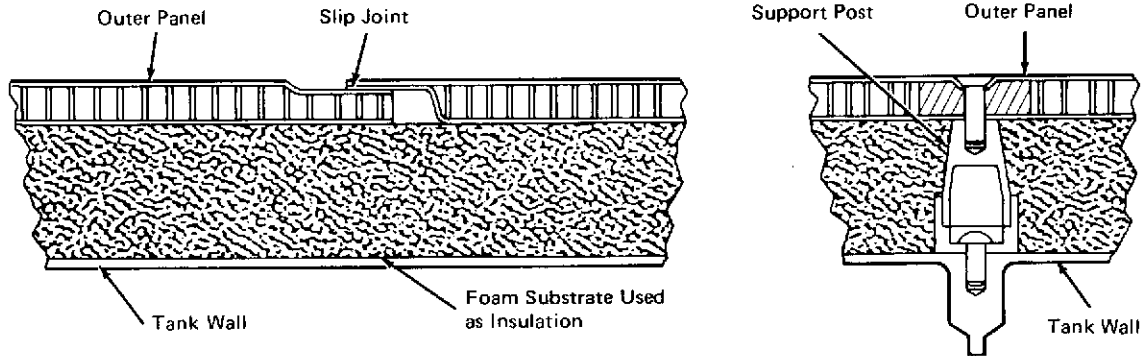
through the elastomer to exert a tensile force along the axis of the fastener, causing structural failure at the plane of minimum cross-sectional area.

The two detonators produce high reliability in operation by providing redundancy. A separation is characterized by a clean break in a single plane and the substantial absence of hard fragments from the fastener. This device is a major improvement in explosive fastener technology and should be of interest to all manufacturers and users of such equipment.

Source: D. W. Murphy of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-11849)

Circle 7 on Reader Service Card.

IMPROVED SUPPORT FOR CRYOGENIC TANK-PROTECTIVE PANELS



Post Support and Slip-Joint Method of Support

This innovation is an improved method for supporting insulating panels that protect the cryogenic tanks of the Saturn boosters from boost erosion and meteoroid damage. The previous method, using outer panels and support posts with foam insulation, is satisfactory only for the brief period of boost of Apollo lunar missions. The support for the foam substrate (see figure) is provided by eight tank-to-panel support posts positioned on the centerline of each 1.5- x 1.5-m (5- x 5-ft) panel. In this method, the panel edges are left unsupported and are closed by an overlapping slip joint.

Space missions of extended duration require improved outer-protective panels for the foil multilayer insulation of the cryogenic tanks. The improved support developed for this cryogenic tank insulation uses clamping strips, corner plates, and support posts. By using prestressed edge strips with corner plates to provide support and closure at the panel edges, only five tank-to-panel support posts are required for each 1.8 x 3.7 m (6- x 12-ft) panel.

Since the aerodynamic boost forces are known, strips and plates can be designed to provide the clamping force required to resist the boost forces and yet insure free movement of the tank during thermal expansion and contraction.

The improved method reduces manufacturing costs because it eliminates the expensive edge-finish needed for the slip joint, requires fewer insulation-penetrating posts per unit of area, and has a more reliable seal against hot-air intrusion produced by friction heating during boost.

Source: W. J. Dailey of
Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-24163)

Circle 8 on Reader Service Card.

POSITIVE-LOCKING, QUICK-DISCONNECT COUPLING

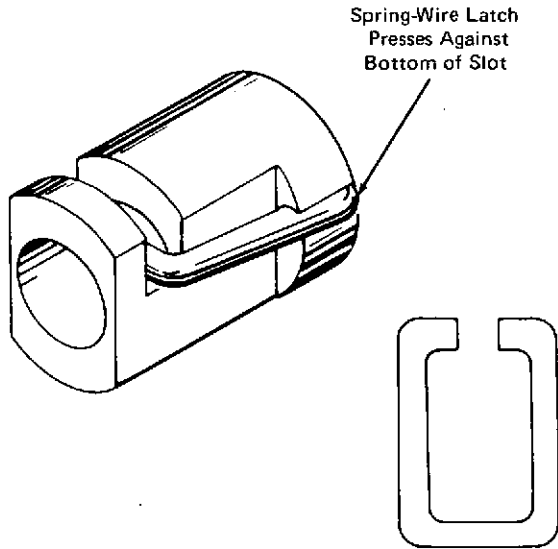


Figure 1. Female Assembly of Quick-Disconnect Coupling

This innovative design is a two piece, quick-disconnect coupling with a positive-locking mechanism. A spring-wire latch (see Figure 1) which fits into a notch secures the ends of the coupling. The coupling is disengaged by rotating the male end of the coupling a quarter turn with respect to the female end, thus disengaging the spring-wire latch from the slot of the male end of the coupling (see Figures 2 and 3).

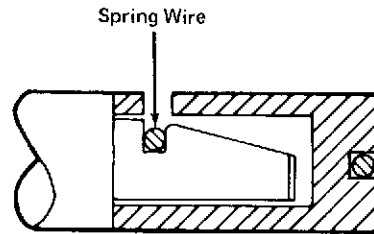


Figure 3. Spring-Wire Latch Is Engaged in Slot of Male End of Coupling

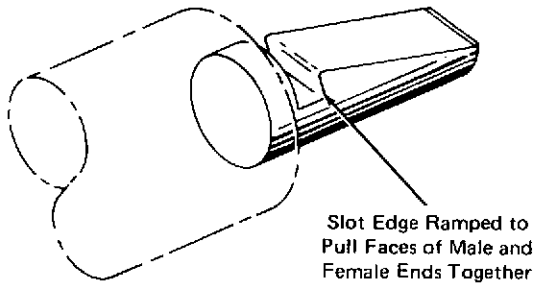
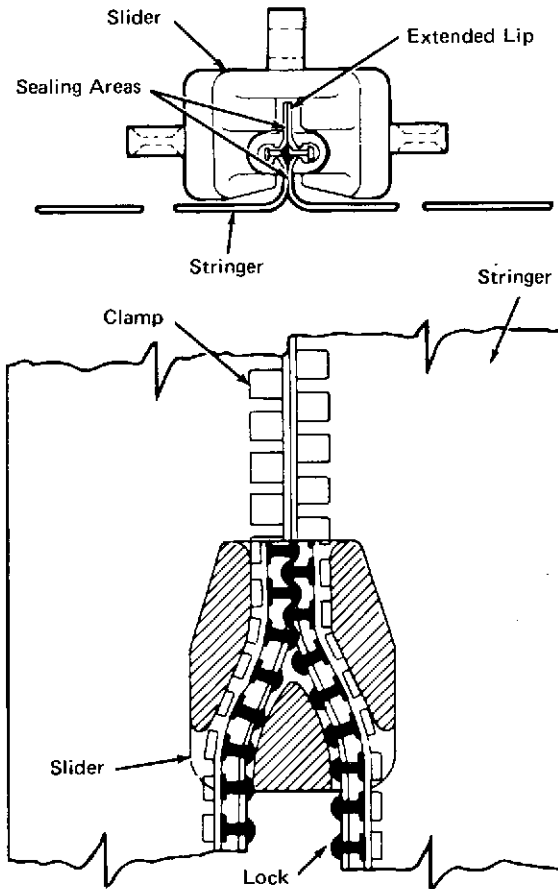


Figure 2. Male End of Quick-Disconnect Coupling

Source: M. C. Costes
 Marshall Space Flight Center
 and G. T. Cohon of
 University of Alabama
 under contract to
 Marshall Space Flight Center
 (MFS-21007)

Circle 9 on Reader Service Card.

PRESSURE-SEALING ZIPPER SLIDER



Pressure-Sealing Zipper

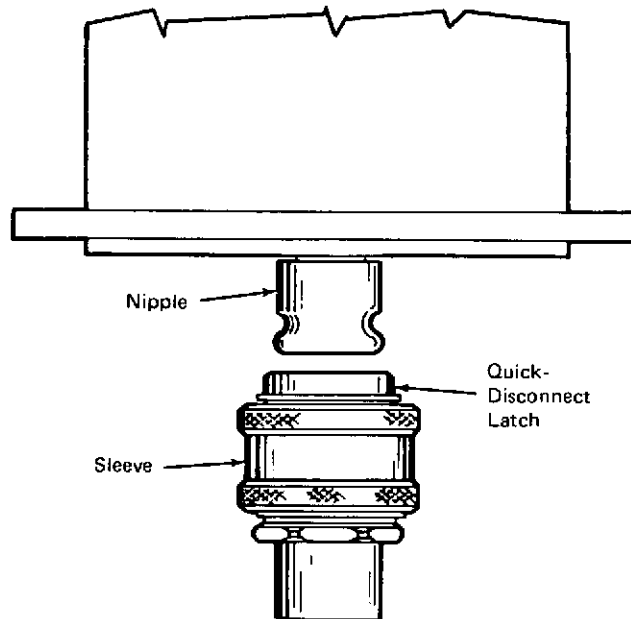
The space suits of Apollo astronauts have been fitted with new zipper fasteners since the previous ones proved to be unreliable. This unreliability stemmed from the zipper slider, which was apt to hang in the chain elements and allow the sealing lips to fold when the chain was closed. Eventually this led to irreparable damage in the fastener and fracturing of the pressure seal. The fault occurred because the chain roll was controlled by an extension of the pressure-sealing lip above the clamps. The lanyard to pull it closed was attached to the slider and caused it to dive forward in the closure run.

With the new zipper (see figure), clamp guides in the slider cam the zipper clamps into place as the machine-finished slider moves over them. Also, the lanyard has been repositioned so that the slider does not dive forward when the zipper is closed.

Source: R. H. Wood of
ICL Industries, Inc.
under contract to
Johnson Space Center
(MSC-13820)

Circle 10 on Reader Service Card.

QUICK-DISCONNECT LATCHING MECHANISM



Unlatched Quick-Disconnect Latching Mechanism

Quick-disconnect couplings are normally used in pneumatic and hydraulic systems to rapidly connect and disconnect pressure tubing. A basic quick-disconnect coupling has been adapted as a quick-disconnect latching mechanism for the Apollo Telescope Mount. It can be easily adapted to commercial and industrial systems.

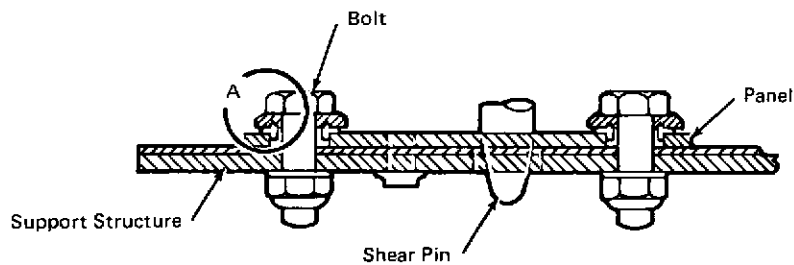
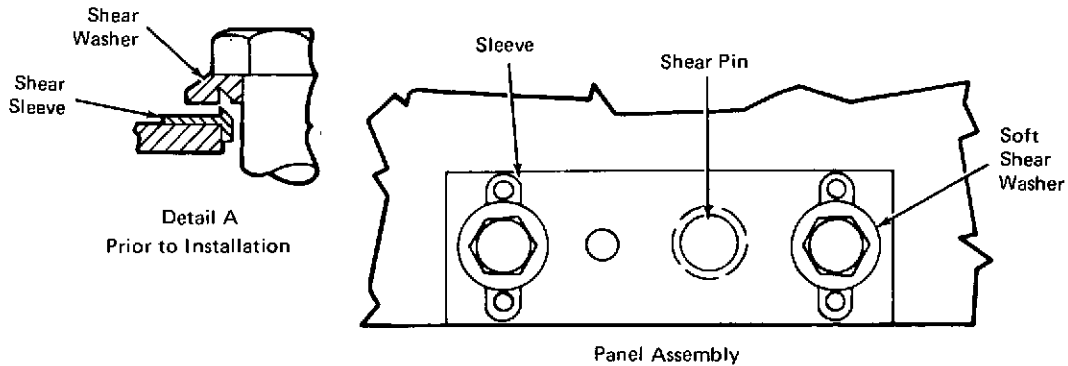
The disconnect features fast, low-force operation of a push-pull nature and can be manipulated with one hand. The device is held together by close-tolerance cylindrical fits and by a series of steel balls in the coupler half. When the assembly is pushed together, the steel balls fall into a detent in the nipple (see figure) and are locked into place by a spring-loaded outer sliding sleeve. To disconnect the mechanism, the outer sliding sleeve is pulled back to release the balls from the detent, and the assembly is easily pulled apart.

These quick-disconnects have been used in systems with pressures up to $21 \times 10^6 \text{ N/m}^2$ (3000 psi), thus permitting their use in adapting quick-disconnect spark plugs to the engine blocks of race cars. Other possible uses include disconnects for gas-tank filler nozzles, service-station pump hoses, plumbing-line connections, and aircraft cargo-retention lines.

Source: D. R. Refert of
McDonnell-Douglas Corp.
under contract to
Marshall Space Flight Center
(MFS-22217)

Circle 11 on Reader Service Card.

INTERCHANGEABLE SHEAR FASTENER



Panel Installed With Interchangeable Shear Fastener

A new, shear-load bearing fastener has been developed for use with interchangeable panels. Present techniques for transferring shear loads across panels use riveted fasteners that are suitable only with noninterchangeable panels. The panel and support structure are drilled in-line and bolted together, making the panels noninterchangeable. An alternative technique, the use of a heavy massive frame structure with non-load-bearing fasteners, is costly and inefficient.

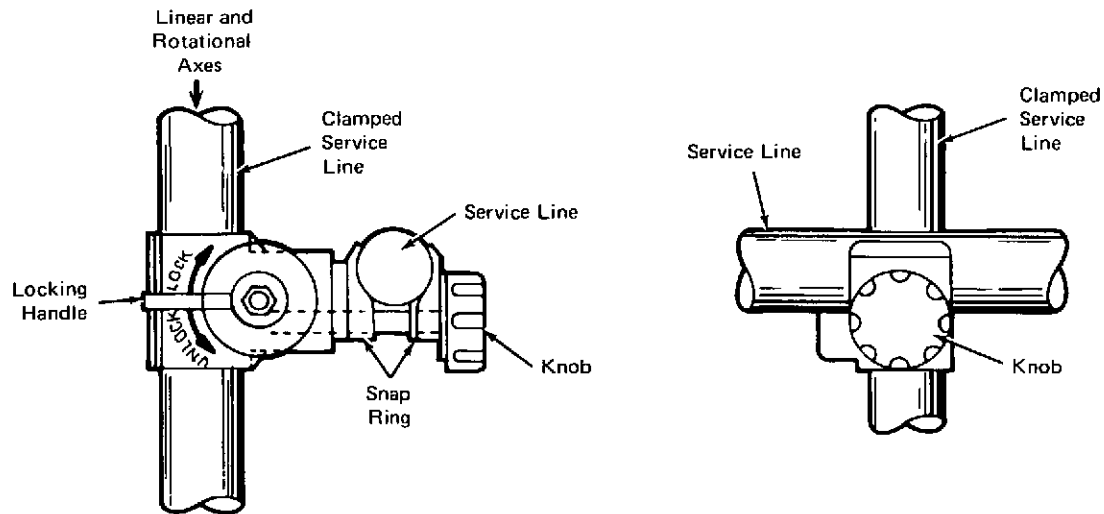
The parts used in the interchangeable shear fastener (see figure) are standard except for the shear sleeves and the soft shear washers. The shear sleeves are attached to the panel, which has close-tolerance holes that accept the shoulders on the sleeves as shown. The shoulder provides a shear path for the load. The fixed structure has normal close-tolerance shear holes for standard bolts. The panel is located on the

support structure by means of a shear pin, and the washer is pressed down into the brinelling lip on the sleeve by tightening the bolt. Once the washer is seated, the shear path is complete. A 0.79-cm (5/16-in.) diameter bolt is capable of transferring a shear force in excess of 6700 newtons (1500 pounds). Since the washers are purposely brinelled during installation, new washers must be used each time the panel is reinstalled.

Source: R. Y. Hernandez and W. Akle of
McDonnell-Douglas Corp.
under contract to
Marshall Space Flight Center
(MFS-21191)

Circle 12 on Reader Service Card.

TWO-AXIS SINGLE-ACTION CLAMP



Two-Axis Single-Action Clamp

An adjustable, line-clamping and supporting device allows simple and rapid one-handed operation by servicing personnel, rigidly supports servicing lines, and adjusts to positional differences of the servicing lines caused by accumulated tolerances.

The clamp allows free linear motion along two axes and rotational motion about one of these axes (see illustration). The rotational motion is slightly restrained by spring force. After the clamp is placed in the proper position, the locking knob is turned 90°, locking the device in place and providing a

rigid support for the item being clamped. The clamp is easily released by twisting the locking knob 90° in the opposite direction.

Source: J. L. Schmidt of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-17091)

Circle 13 on Reader Service Card.

A REMOTE COUPLER FOR HOSTILE ENVIRONMENTS

A new coupler provides a remotely operated connection between two bodies in a hostile environment. The coupler makes a satisfactory connection between bodies with misalignment angles of as much as 30 degrees, minimizing the maneuvering necessary to achieve connection.

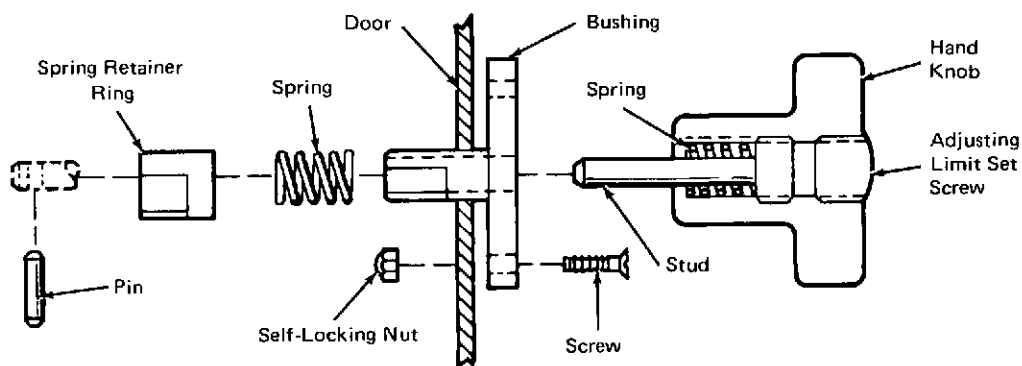
The coupler consists of a male latching mechanism and a funnel-shaped female target. The design ensures that all latches will engage if any one latch engages. The coupler is simple to construct, is safe in operation, and requires little power to operate. It is

ideal for operation in space or under water. It can be used to couple two objects, or, when attached to a manipulator arm, it can be used to grasp and stabilize other objects.

Source: J. L. Phillips
Johnson Space Center
(MSC-12470)

Circle 14 on Reader Service Card.

ADJUSTABLE-PRESSURE DOOR CLAMP



Adjustable-Pressure Door Clamp

A fast-acting externally-adjustable door clamp can be used in pressurized systems. The sealing pressure of the door or cover, once adjusted, will remain constant, even after repeated opening and closing. The clamp is fastened to a door or cover by a flange on the bushing (see illustration). When the door is closed against the seal on the door case, sufficient pressure is exerted in latching the door to allow pressurization of the closed compartment.

To set the pressure on the seal, the door is closed and the hand knob turned clockwise. The pin moves 90° until it stops against the bushing under the projection of the door case. Continued turning of the hand knob draws up the pin to squeeze the seal.

When the desired sealing pressure is attained, the set screw is tightened to lock the stud in place. To unlatch the door the hand knob is turned counterclockwise until the pin is rotated 90°, allowing the door to be opened.

Source: L. L. Turk of
General Electric Co.
under contract to
Marshall Space Flight Center
(MFS-21425)

Circle 15 on Reader Service Card.

HOLSTER LOCK SECURES REVOLVER

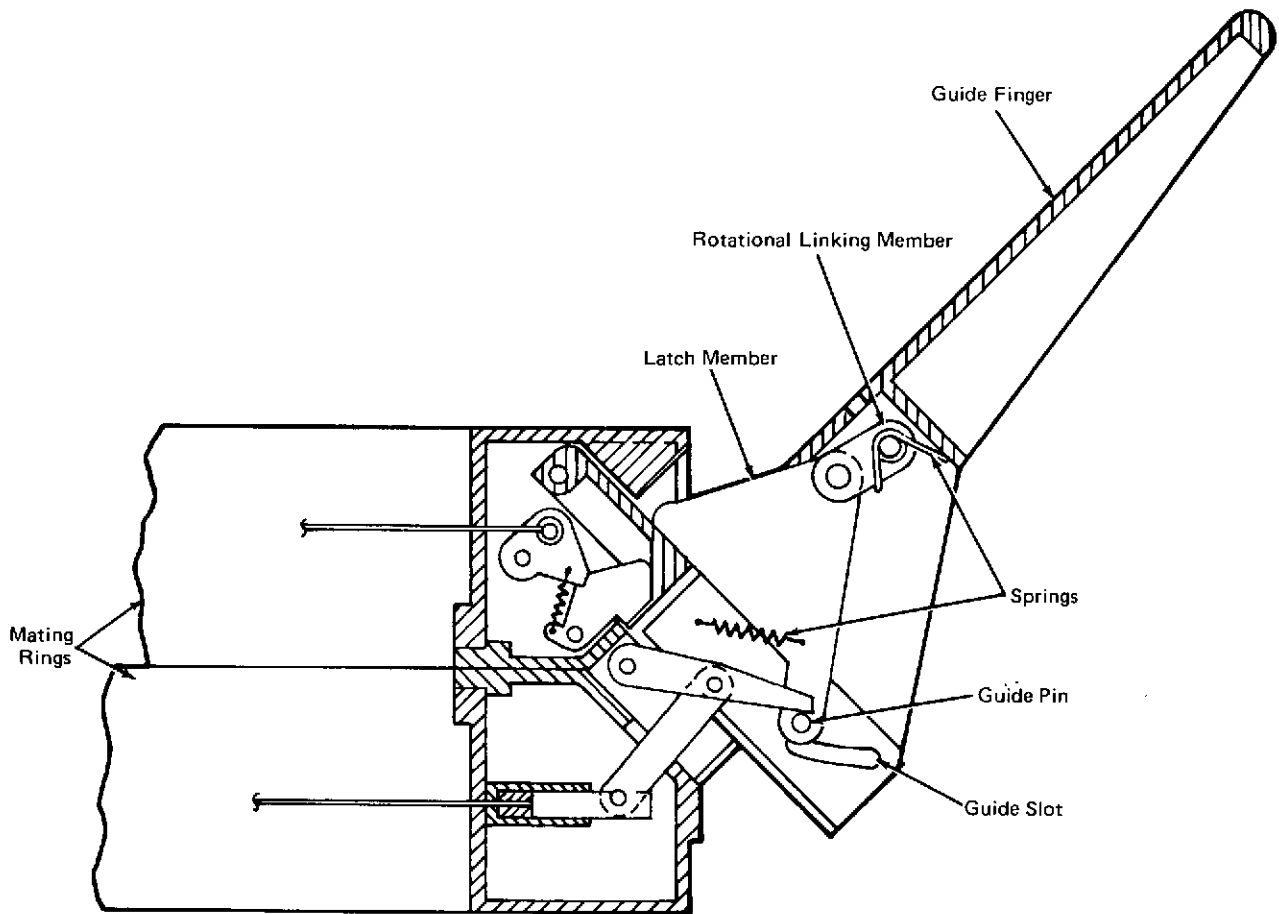
Standard police holsters can be inexpensively modified to include a lock which prevents a suspect or bystander from snatching the pistol from the holster. The device consists of a plastic structure that fits down into the bottom of the holster. The mechanism is securely fastened to the holster with a nut and bolt. The top of the plastic structure has a notched hole to accept the barrel and barrel sight of the revolver. To insert the revolver into the holster, the barrel sight must be aligned with the slot, the barrel inserted, and the revolver rotated 90 degrees. Before it can be removed, the revolver must be rotated 90 degrees to align the barrel sight with the slot.

With this device, the time required by an officer to draw his revolver will be approximately one-half second longer than without the device. The lock can be made in a range of sizes to fit various types of holsters, and with a range of cutouts to accommodate configurations of barrel ends.

Source: H. L. Martin
Marshall Space Flight Center
(MFS-21398)

Circle 16 on Reader Service Card.

DOCKING-SYSTEM CAPTURE LATCH



Capture Latch

The latch of this new spacecraft, capture-latching system will either lock or collapse depending on direction of the load. The capture-latching system makes the initial connection between two spacecraft being linked or docked in space and maintains this connection until their relative motion is damped and the two can be drawn together.

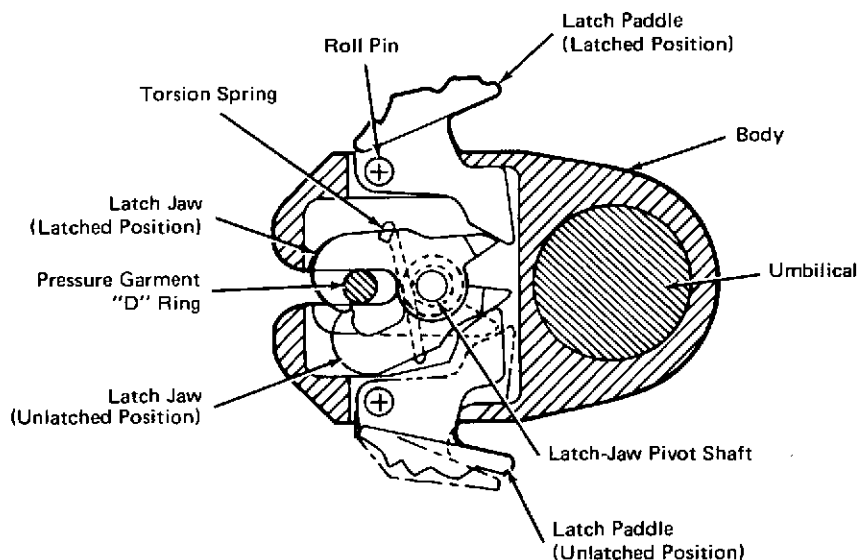
The latching mechanism (see figure) has a latch member attached to a housing by a linking member that is pivotally attached to both the housing and the latch member. The latch member collapses as the mating surface (opposing ring) slides down the finger. When the ring clears the tip of the latch member, the latch member returns to its original position, trapping

the latch surface of the mating ring. The latches resist uploads parallel to the guiding surfaces. Should the direction of the load rotate and the mating rings misalign (i.e., the docking mechanism is not fully seated), the latches will collapse and enhance separation.

Source: L. P. Ratcliff
Johnson Space Center
(MSC-12549)

Circle 17 on Reader Service Card.

UMBILICAL/TETHER-ATTACH FITTING



Umbilical/Tether Latch Mechanism Attach Fitting

This innovation simplifies attaching and disconnecting tether and umbilical lines. The present tether "hook" is extremely difficult to manipulate when the operator is wearing a fully pressurized suit. The hook attachment requires a minimum length of eight inches from the tether egress point on the umbilical to the pressure-garment "D" ring. A service loop is required for the length of the hook to protect against loading the umbilical. This service loop increases the dimensional envelope of the crewman and creates a potential snagging hazard. The tether-hook attach device has two points at which a single point failure could occur.

The new umbilical/tether attach fitting (see figure) uses an overcenter, spring-loaded, interlocking double-hook with individual latch-jaw activation. Any one of the latch-jaw hooks will withstand the umbilical/tether design load, thus giving the fitting an inherent

safety factor of four. A ten-pound force on the latch paddle will depress the torsion spring and secure the latch. The double-latch mechanism provides a positive lock against accidental activation and requires only a simple hand squeeze to operate. This tether attachment also provides umbilical restraint and minimizes the crewman's dimensional envelope, which reduces the potential snagging hazard and increases crewman mobility.

Source: W. W. Chamberlain II and
J. R. Abbott of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-17605)

No further documentation is available.

FASTENERS FOR HIGH-PERFORMANCE INSULATION

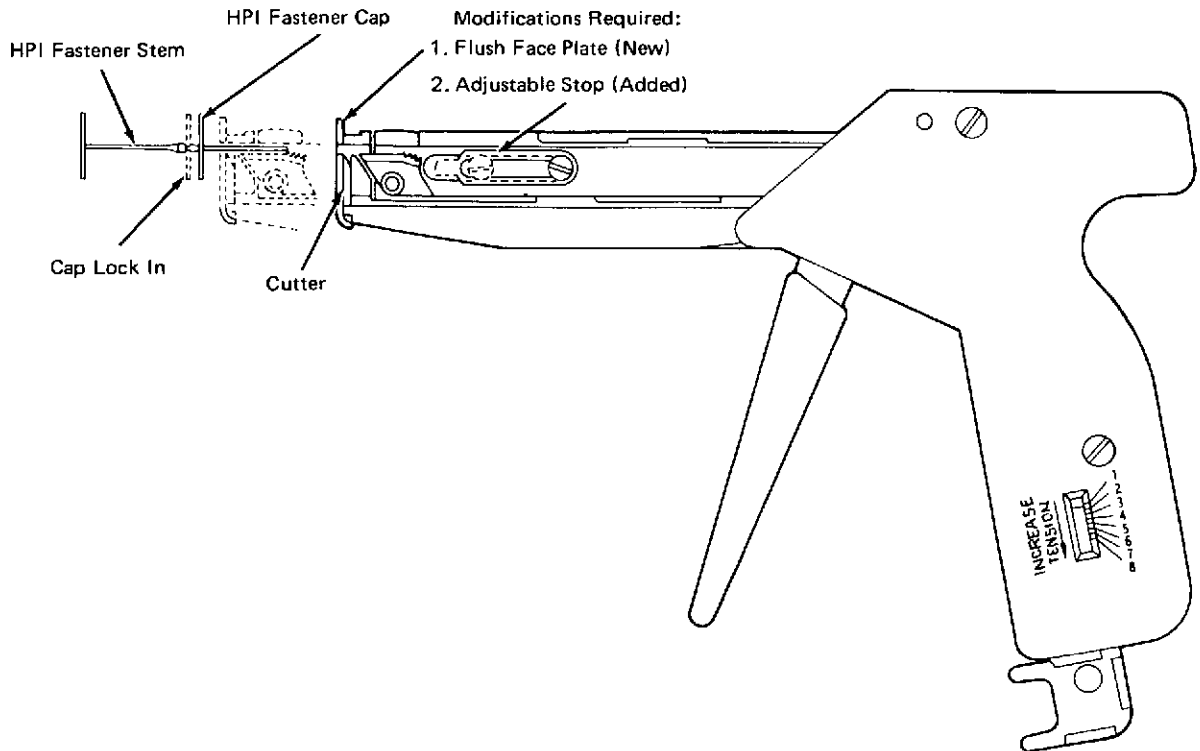


Figure 1. Modified Panduit Fastener Gun and Two-Piece HPI Fastener

The multilayer construction of a high-performance insulation (HPI) system requires some means of holding the many layers of reflective sheets together. Previously, HPI layers have been held together by heat-sealed plastic fasteners. These are thread-pushed through the HPI structure and hand-tied on top. Such methods are costly and time-consuming; heat-sealing is hazardous and provides a somewhat weak fastening, and hand-tying the threads does not allow the thickness of the HPI panel to be controlled. The new method for fastening HPI layers involves predrilling holes in the HPI structure and then using either a

two-piece, plastic fastener and a modified Panduit gun (see Figure 1) or a one-piece, nylon, garment-industry fastener system (see Figure 2).

To install the two-piece (stem and cap) fastener, the stem is inserted into the predrilled hole in the HPI, and the cap is pushed over the protruding end. A modified Panduit fastener gun is then used to force the cap over the enlarged boss into the slotted recess and to trim off the excess length of stem.

The one-piece nylon fasteners are installed by either a tool called the "Swiftacher", for large fasteners used for the thicker HPI panels, or by a

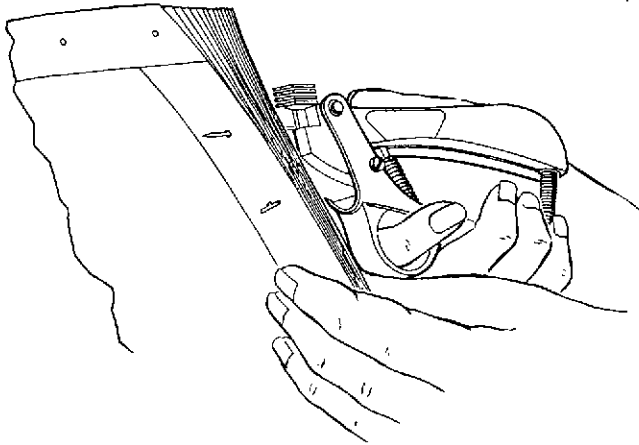


Figure 2. "Swiftacher" Inserts One-Piece Nylon Fastener

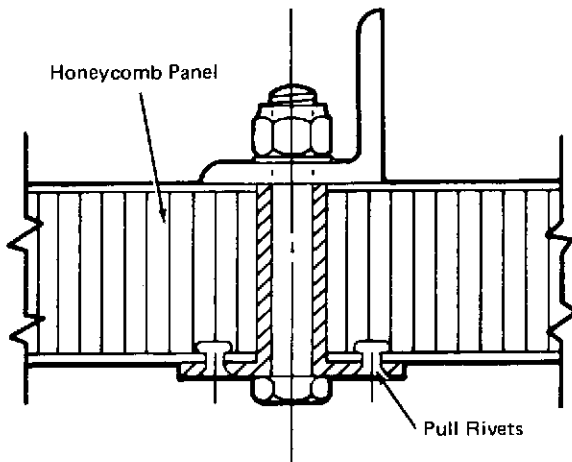
"Buttoneer", for the smaller range of fasteners used for thin panels. The one-piece fastener methods use commercially available fasteners and do not require any tool modification.

Source: D. Rossello of
McDonnell-Douglas Corp.
under contract to
Marshall Space Flight Center
(MFS-21440, 21427)

Circle 18 on Reader Service Card.

SIMPLIFIED, HONEYCOMB PANEL SPACER AND ATTACH FITTING

This innovation is a simplified and easily installed one-piece honeycomb panel spacer and attach fitting utilizing standard pull rivets. Old methods for installing hard points in honeycomb panels included



Simplified, Honeycomb Panel Spacer and Attach Fitting

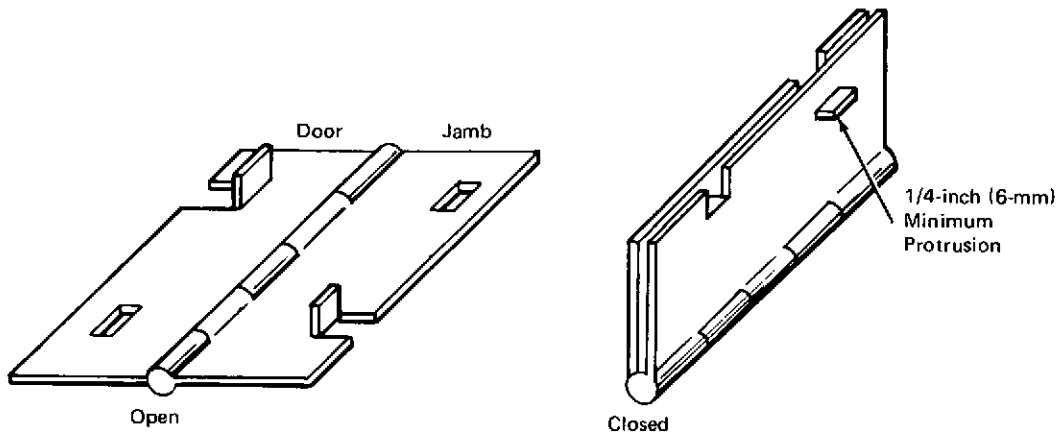
the crimping of fasteners on the face sheets (a high failure rate process) or the bonding of inserts into the panel (a time-consuming process).

The new spacer (see figure) uses a shallow-headed, one-piece combination spacer-and-support. The honeycomb panel is installed with standard pull-rivets. This method of installation allows attachment from one side of a honeycomb panel. The spacers can be adapted for variations in load and panel thicknesses. With this new method, manufacturing time is reduced because there is no bond and cure cycle, and there are no part failures due to peening cracks during installation.

Source: G. W. Ellis of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-17658)

Circle 19 on Reader Service Card.

SELF-LOCKING SECURITY HINGE



Self-Locking Security Hinge in the Open and Closed Positions

This self-locking security hinge gives added security to externally hinged doors. The strongest door with the best lock can be opened by an intruder who can remove the pins from the hinges and pull the door out of its frame. The self-locking hinge shown in the figure prevents an intruder from forcing a door open, even though the pin is removed.

The hinge has two tabs that protrude through each hinge half when the door is in the closed position. These tabs effectively lock the hinge and are not accessible from the outside. The hinges are installed by conventional procedure and require no special tooling. The only additional step involves routing out

enough wood from the door and jamb to allow full recess of the tabs when the hinge is in the closed position.

The hinge can be used on doors and cabinets, is easy to manufacture, and eliminates the need for sophisticated locking devices.

Source: F. Drury and D. J. Sharp
Kennedy Space Center
(KSC-10756)

No further documentation is available.

Patent Information

The following innovation, described in this Compilation, is being considered for patent action as indicated below:

Docking-System Capture Latch (Page 16) MSC-12549

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Johnson Space Center
Code AM
Houston, Texas 77058
