NASA SP-5908 (03)

TECHNOLOGY UTILIZATION

HAND TOOLS

A COMPILATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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TECHNOLOGY UTILIZATION OFFICE 1970
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D.C.

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Foreword

The National Aeronautics and Space Administration has established a Technology Utilization Program for the dissemination of information on technological developments which have potential utility outside the aerospace community. By encouraging multiple application of the results of its research and development, NASA earns for the public an increased return on the investment in aerospace research and development programs.

Presented in this compilation are a selection of new hand tools, modifications of existing tools, and techniques developed in the course of NASA research and development projects. The items are presented in two sections: Mechanical Tools and Electrical Tools. Safety is emphasized, together with ease of operations and use in restricted areas or hazardous environments. The discussions are directed primarily toward the technician engaged in assembly or maintenance of mechanical or electrical equipment.

While it is possible that items similar to some of those included in this compilation have been independently developed by other organizations or personnel, they are all believed to be useful.

Additional technical information on individual tools and techniques can be requested by circling the appropriate number on the Reader's Service Card included in this compilation.

Unless otherwise stated, NASA contemplates 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

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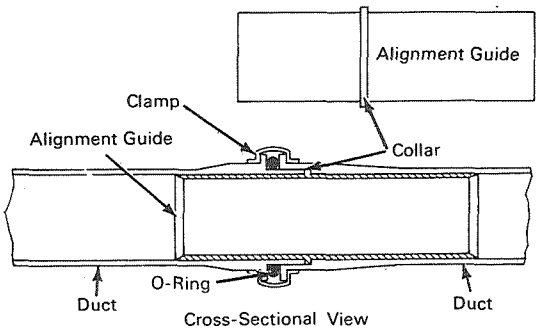
Section 1. Mechanical Tools

FLEXIBLE DUCTING ASSEMBLY GUIDE

Assembly of large flex ducts that must be clamped together has required two technicians, one holding the duct while the other attached the clamp. This guide allows one man to align the ducts and holds them in position while the same person attaches the clamp.



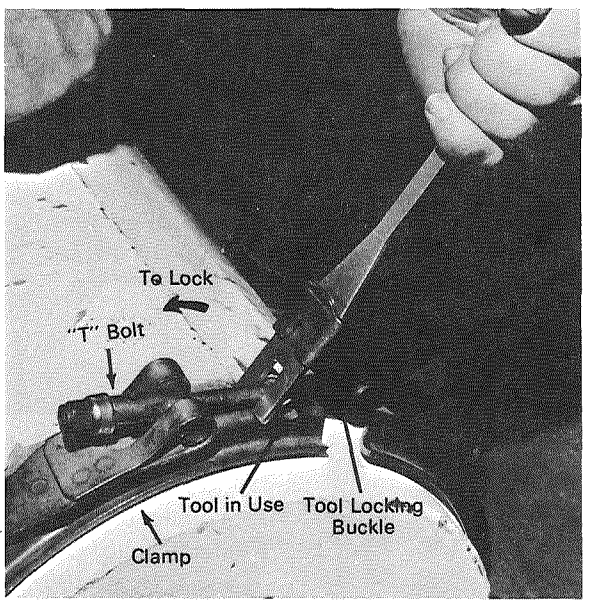
Cross-Sectional View of Alignment Guide in Flex Duct Connection

The guide is a thin-walled tube with its outside diameter matched to the inside diameter of the ducts. If desired, the guide may be used to support internal devices such as a filter or an orifice plate. A collar around the guide serves as a stop, preventing any motion of the guide within the duct.

Source: H. Kaminsky of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10055)

Circle 1 on the Reader's Service Card.

LOCKING TOOL FOR TOGGLE-TYPE CLAMPS



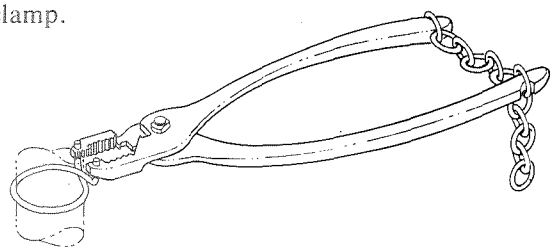
Because of the tight fit of toggle-type, U-band clamps around ducts, locking the clamp is difficult. A screwdriver is normally used to provide the necessary leverage. This technique does not provide a positive grip, and slippage often results, causing delay in assembly or damage to the clamp. A simple fork-shaped tool can be inserted through the clamp's locking buckle and over the "T" bolt, then used as a lever to lock the clamp. The spring-steel tool may be made to fit any size clamp.

Source: H. Kaminsky and C. Glass of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10113)

Circle 2 on the Reader's Service Card.

HOSE CLAMP TOOL

Available hose clamp tools either are difficult to use in confined areas, or they do not provide positive control over the hose clamp. This tool provides positive control over the resistive force of a spring-type hose clamp, is easy to use, and reduces the time required to install or remove the clamp.



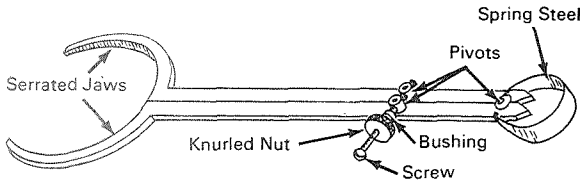
The tool is constructed by modifying a common pair of pliers. First the external parts of the jaws are removed to permit easy operation in close quarters; then a hole is drilled through each plier jaw. Finally, a chain is attached to one handle and a notch is cut into the other. In use, the ends of the hose clamp are pressed through the holes, the handles are compressed until the clamp has opened to the desired diameter, and the tool is locked by setting a chain link into the notch. The clamp is thus retained in an open position, allowing easy manipulation while reducing both the time consumed and the risk of injury.

Source: R. D. Grantham of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10220)

Circle 3 on the Reader's Service Card.

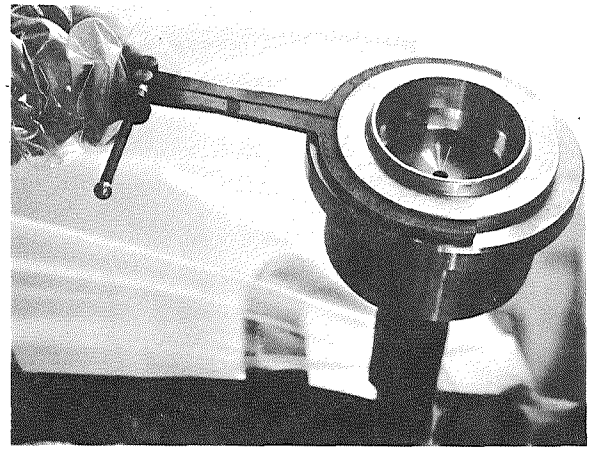
SEALING GASKET INSERTION TOOL

Certain couplings used extensively in high-pressure gas systems have seal rings which must be frequently handled during installation and maintenance. These operations have been performed by hand, resulting in possible injury to fingers, contamination of the system or damage to the expensive, silver-coated rings. Use of a special tool eliminates these problems.



The tool is essentially a modified set of divider calipers, with a semicircular pair of serrated jaws attached to a spring-loaded, screw-type clamp similar to that found on many drafting tools. Jaws of different radius are required for different sized rings.

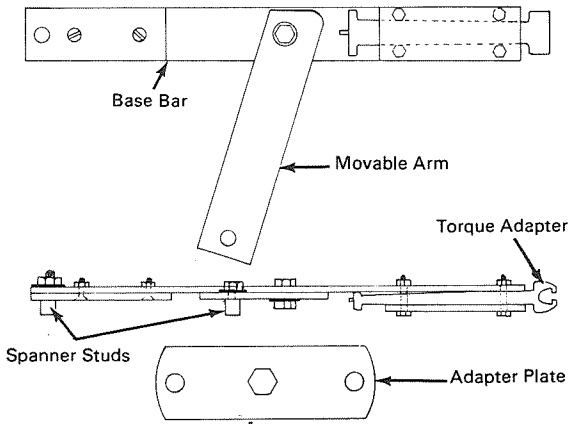
In use, the tool is inserted into the plastic bag containing the clean ring and adjusted to hold the ring securely. It is then withdrawn from the bag and used to insert the ring into the coupling hub. After the other hub is in place, the tool is removed and the coupling clamps are installed.



Source: E. L. Wells and V. C. Jordon of
The Bendix Corp.
under contract to
Kennedy Space Center
(KSC-10038)

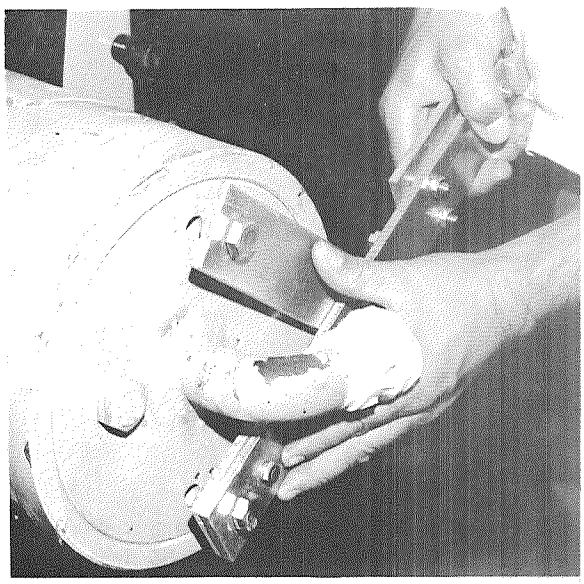
Circle 4 on the Reader's Service Card.

ADJUSTABLE SPANNER WRENCH



The adjustable spanner wrench provides a means for properly installing, removing, or torquing large hydraulic-accumulator end caps which have a boss or fitting in the center. This wrench consists of a movable arm attached to a base bar, connected to a torque-wrench adapter.

The wrench is attached to a torque bar and the required torque value is set. An adapter plate couples the spanner wrench and torque bar to a torque calibration bench. The adapter plate must have the same slot configuration as the end plate to be torqued. After calibration, the wrench is inserted in the end cap for use.



Source: R. B. Wood, Jr. and
R. C. Parsons, Jr. of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10140)

Circle 5 on the Reader's Service Card.

TORQUE WRENCH FOR STEEL STRAPPING

Steel strapping is used to secure many items to pallets for shipping and storage. Large workpieces, barrels, drums, crated items, and stacked cartons are typical examples of merchandise strapped to pallets. Although such material is most effectively bound with steel strapping, if the strapping is too tight, it may crush the packaging; if it is too loose, the items can work free and be lost or damaged.

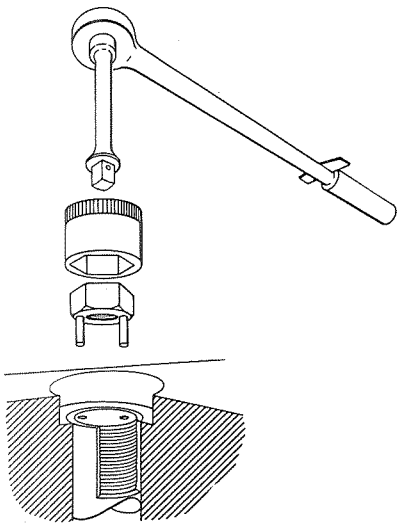
A commercially available torque wrench may be used with standard strapping apparatus to ensure that proper tension is applied to all steel straps. A 100 to 500 ft-lb torque wrench, coupled to the strapping apparatus by a 5/8-in. socket with a 1/2-in. drive, supplies sufficient torque for most uses.

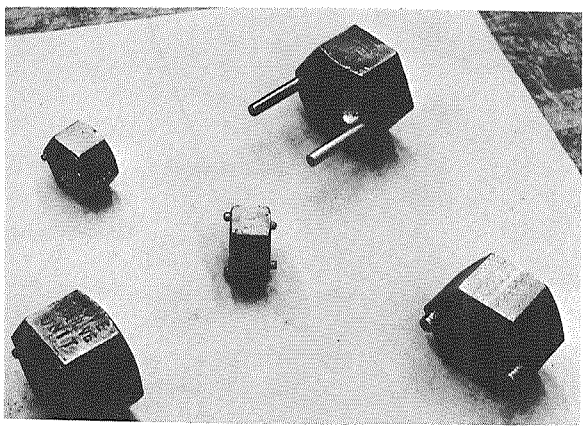
A small amount of experimentation, together with knowledge of the approximate strength of the packages, is sufficient to determine the proper torque level to be applied to any particular palletizing problem.

Source: A. M. Wells, L. D. Truner and
M. M. Bigman of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18253)

No further documentation is available.

SPANNER-FASTENER TORQUE WRENCH





These tools are spanner-type torque wrenches made from different size hex nuts by drilling two holes, 180 degrees apart between the outer thread radius and the outer nut surface. Two carbon-steel pins are then press-fitted into the holes. The nut size, pin length, and hole configuration vary for each spanner requirement.

Even in recessed areas, spanner fasteners can be torqued or removed easily by inserting the tool into the spanner fastener and rotating it with an appropriate socket or torque wrench.

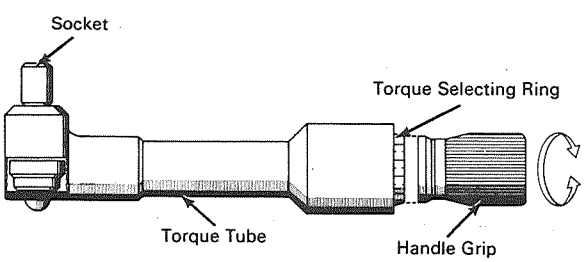
Source: R. B. Wood, Jr. and
R. C. Parsons, Jr. of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10154)

Circle 6 on the Reader's Service Card.

TORQUE WRENCH FOR RESTRICTED AREAS

Another torque wrench has been developed for use in restricted areas where there is insufficient clearance for wrenches employing straight-line leverage or where the torque indicator cannot be read.

The wrench applies torque when the handle grip is twisted. The grip is connected to a worm gear through an adjustable, torque-limiting slip clutch and a torque tube which is supported by radial and thrust bearings to maintain proper alignment of the gears. The worm gear, in the tool head, drives a worm wheel with a short shaft that engages the socket for tightening the fastener. A torque-selection ring on the handle grip is set to the desired value, adjusting the release point of the slip clutch. Maximum torque output is approximately 300 inch-pounds. The length of the wrench handle does not affect the output, since the handle is not used as a moment arm.

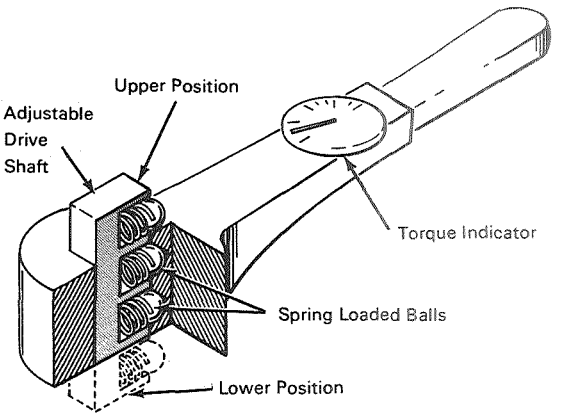


Source: E. R. Fagerberg of
Lockheed Missiles and Space Co.
under contract to
Lewis Research Center
(LEW-90246)

Circle 7 on the Reader's Service Card.

INVERTIBLE-DRIVE TORQUE WRENCH

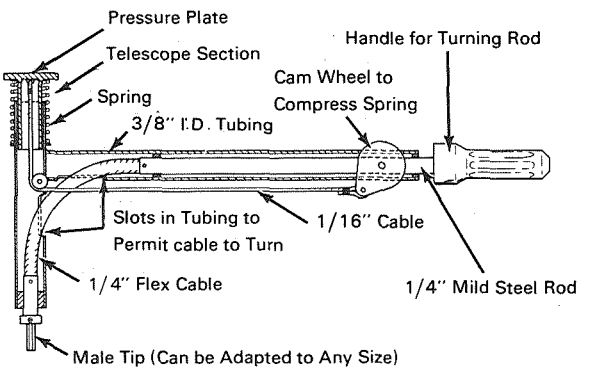
The problem of using ordinary torque wrenches in another common situation has also been solved in a novel way. When using a conventional torque wrench on bolts which project from the underside of a machine, for example, the indicator cannot be read directly; a mirror must be used. The modified wrench provides a means of easily viewing the torque indicator on the wrench, regardless of the orientation of the part being torqued. The wrench has a drive shaft that can protrude from either side of the wrench head. This allows the socket to be placed on either side of the wrench, keeping the torque indicator in view. The shaft has three spring-loaded balls, two of which lock the shaft in position while the third locks into the socket. The wrench can be converted to accommodate the socket on the reverse side merely by pushing the protruding end of the shaft into the shank.



Source: M. DeBarnardo of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-598)

No further documentation is available.

RIGHT-ANGLE WRENCH WITH TELESCOPING PRESSURE PLATE



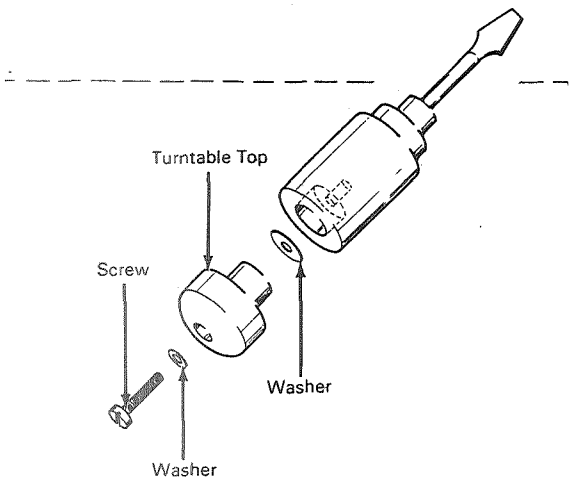
Another wrench has been designed to permit easy installation or removal of threaded fasteners in certain types of confined areas. It has a T-shaped body constructed from 3/8-in. I.D. steel tubing. Torque is coupled from a handle at the end of the stem, through a 1/4-in. steel rod supported on bushings inside the stem, to a 1/4-in. flexible cable. The cable bends through a right angle, passing through adjacent slots in the stem and one arm of the T, and supplies torque to a male coupler. Various attachments may be installed on the coupler to drive different types of threaded fasteners.

The opposite arm of the T consists of a telescoping spring-loaded pressure plate. A steel cable attached to the inner face of the plate runs down the center of the tube, around a pulley, out through the milled slot, and down the stem to a cam attached to the side of the stem. When the cam is rotated to the rear, the pressure plate is pulled toward the stem, compressing the spring. After the tool has been inserted and the driver has been seated on the fastener, the cam is released, the spring relaxes, and the pressure plate is forced against the opposite surface of the confined area. The spring pressure prevents the coupler or the driver from disconnecting while torque is applied to the fastener.

Source: R. S. Richardson of
The Boeing Co.
under contract to
Marshall Space Flight Center
(MFS-15046)

Circle 8 on the Reader's Service Card.

ROTATABLE-TOP SCREWDRIVER



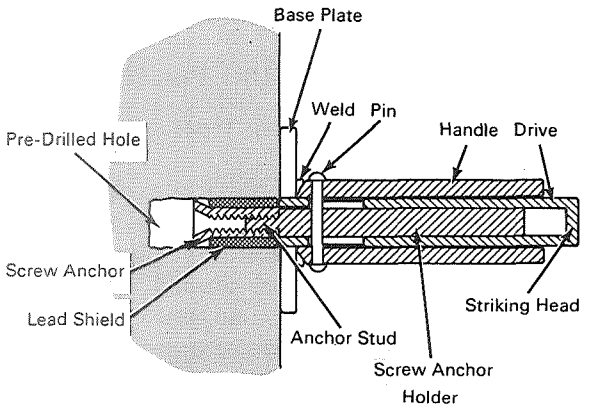
A screwdriver with a rotatable top allows the user to continue to apply pressure to a screw throughout regripping motions, thus reducing the possibility of dropping the screw and allowing the screw to be installed with one hand.

The turntable top, made from polytetrafluoroethylene (PTFE) or nylon material, is held in place by a screw. Two washers provide bearing surfaces for smoother turning.

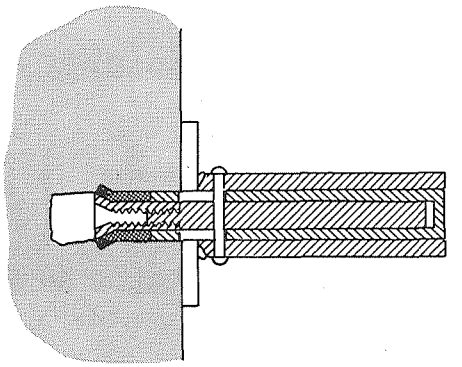
Source: C. H. Keedy of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-14175)

No further documentation is available.

ANCHOR-BOLT INSERTION TOOL



Before Hammer Strike



After Hammer Strike

This tool is used to expand the lead shields on anchor bolts without regard to hole depth. It is particularly useful when installing anchors in concrete block walls where it is difficult to set the shield properly without damaging the wall.

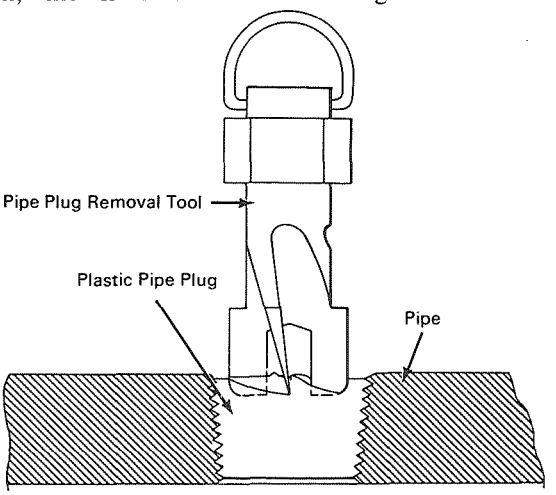
The tool is made of a base plate, an anchor stud, and a sliding striking head. The anchor to be installed is screwed onto the anchor stud, inserted into the pre-drilled hole and set with a single blow on the striking head.

Source: R. Hosler of
Trans World Airlines, Inc.
under contract to
Kennedy Space Center
(KSC-10253)

No further documentation is available.

PLASTIC PLUG REMOVAL TOOL

Threaded holes in the side walls of large diameter pipes commonly are sealed with plastic pipe plugs. These plugs are equipped with Allen wrench fittings for installation and removal. Often, the flats of the wrenching surfaces are stripped, rendering the plug unremovable by conventional means. A tool has been developed to remove these plugs.



The plug removal tool is made of steel. Four tapered cutting edges at one end are formed in a counterclockwise spiral. At the other end of the tool are a striking surface and two devices for rotating the tool: a heavy wire loop (for manual rotation) and a hexagonal wrenching surface.

The tool is used by placing the blades exactly over the plug and hitting the end with a hammer. This drives the blades into the plastic, and the counterclockwise thread allows rotation to force the tool deeper into the plug.

Source: H. W. Krengel and F. W. Strickland of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10396)

No further documentation is available.

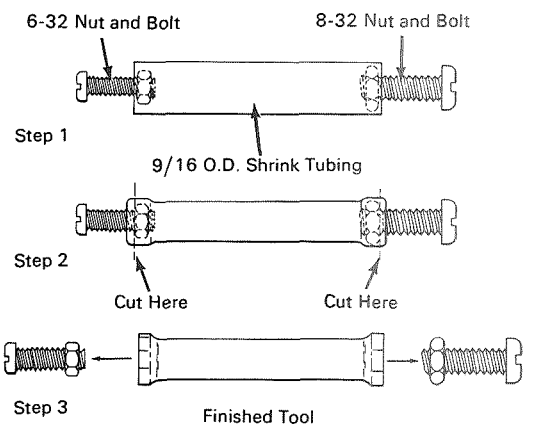
HEX-HEAD FASTENER STARTING TOOL

When hexagonal nuts or bolts are used in confined areas, they cannot easily be started, because conventional tools do not firmly grip them. Fasteners may fall out of the tools and be lost. In critical assemblies, considerable time may have to be spent to retrieve them.

The hex-head fastener starting tool is constructed from a length of plastic heat-shrinkable tubing by placing cap screws on two different nuts to insure alignment, inserting the nuts into opposite ends of the heat-shrinkable tubing, and applying heat to the tubing, causing it to shrink around the nuts. After the tubing has cooled, it is cut flush with the outside edge of the nuts, and the bolts are removed.

Hex-head nuts and bolts may be started very simply with this tool. The fastener is inserted into the formed socket of the tool where it is very firmly held. The tool is then inserted into the confined area and the fastener is aligned and started.

Because the tool has very limited torque capability, it must be removed after the fastener has been started sufficiently. Tightening may then be completed by a conventional tool.

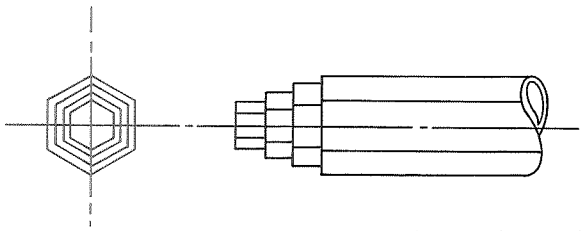


Source: W. M. Miller, Jr. of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10207)

No further documentation is available.

MULTI-SIZE ALLEN WRENCH

Key-type internal (Allen) wrenches are individually sized, hexagonal cross-section rods bent into an L-shape. The proper size wrench to fit an



Allen-key recess must be selected by trial and error.

In order to overcome this problem, a multiple Allen wrench has been conceived. Annular hexagonal sleeves are nested concentrically and spring-loaded, allowing the tool to adapt to a series of Allen-key recesses. The external diameter of each sleeve is sized within a close tolerance of the internal diameter of the next larger sleeve, so that the tool will possess adequate torque resistance.

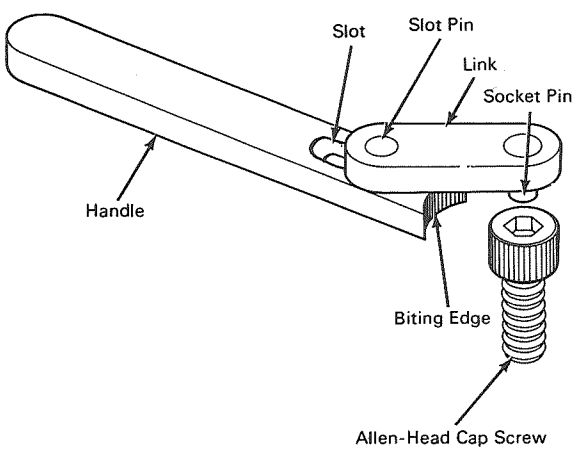
Source: J. A. Richter of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10286)

No further documentation is available.

ALLEN-HEAD CAP-SCREW WRENCH

Another wrench designed for use with Allen-head cap screws is operated as follows: the round socket pin is placed into the screw socket, the handle is pivoted about the slot pin to establish contact between the biting edge and the screw cap, and the handle is rotated to increase the grip at the contact and turn the screw. When the direction of rotation is reversed, contact is broken and the handle can be returned to the starting position without moving the screw. Since the wrench may be rotated through a smaller arc than that allowed by conventional wrenches, this tool is particularly useful for turning cap screws in confined regions.

The wrench may be made as a set of separate handles and links. One link with the appropriate socket pin for each screw size to be accommodated, together with two or three handles with different radii of curvature at the biting edge, will adequately cover a wide range of screw sizes.



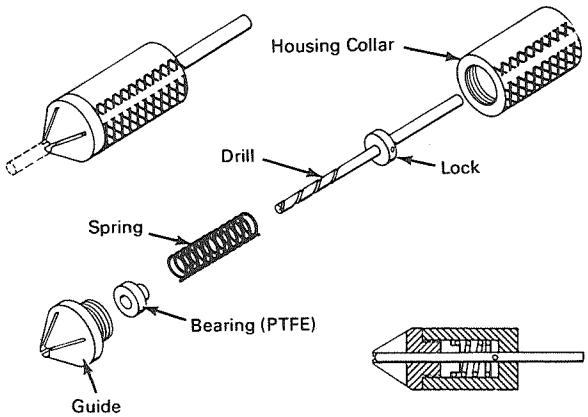
Source: J. J. Gottlieb
Goddard Space Flight Center
(GSC-10610)

Circle 9 on the Reader's Service Card.

DRILL-CENTERING DEVICE FOR COUNTERSUNK HOLES

Effective methods exist for accurately drilling countersunk holes, when the hole and the sink are cut in one operation. However, if the countersink is cut into one piece, and this is later used as a template to drill matching holes in a second piece, no prior technique enables the accurate drilling of the matching holes. This tool ensures accurate positioning of the template and workpiece, so that the drilled holes match the countersunk depressions.

The drill-centering device consists of a housing, a guide, a bearing, and a spring, mounted on the shaft of a 1/8-in. pilot drill. The spring exerts pressure on the tapered guide so that normally the tip of the drill is recessed within the guide.



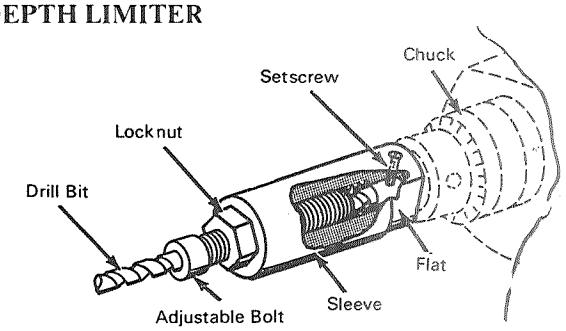
After the template and the workpiece are aligned, the two are positioned on the drill press so that the tapered guide fits into the center of the countersink on the template. As the drill is lowered, the spring is compressed and the pilot drill extends through the center of the guide to contact the workpiece.

Source: F. Z. Vogedes of
The Bendix Corp.
under contract to
Kennedy Space Center
(KSC-10232)

Circle 10 on the Reader's Service Card.

HAND DRILL HOLE-DEPTH LIMITER

An adjustable adapter has been developed to limit the depth of a hole bored with a hand drill. The adapter may be made to fit different diameter bits. A cylindrical sleeve is secured to the chucked bit by a setscrew which is tightened against the shank of the bit. A hollow bolt with a squared-off shoulder is screwed into the end of the sleeve so that it surrounds the drill bit. The bolt may be adjusted to expose a measured length of the bit, then secured by tightening a locknut against the sleeve. The shoulder of the bolt limits the penetration of the bit into the material being drilled. Flats on the cylindrical sleeve permit two wrenches to be used for tightening and loosening the locknut.



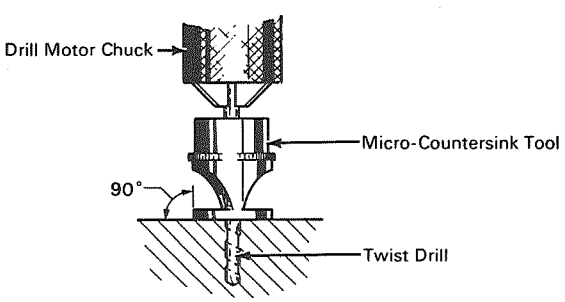
Source: North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-0346)

Circle 11 on the Reader's Service Card.

HAND DRILLING TRUE PERPENDICULAR HOLES

This innovation provides a simple and inexpensive technique for holding a hand drill perpendicular to the surface being drilled.

The countersink cutter is removed from a micro-countersink tool and a drill bit is inserted. The tool is then pressed firmly against the surface of the material to be drilled. As the drilling proceeds, the micro-countersink tool telescopes, allowing the drill to penetrate the material and holding the drill perpendicular to the surface.

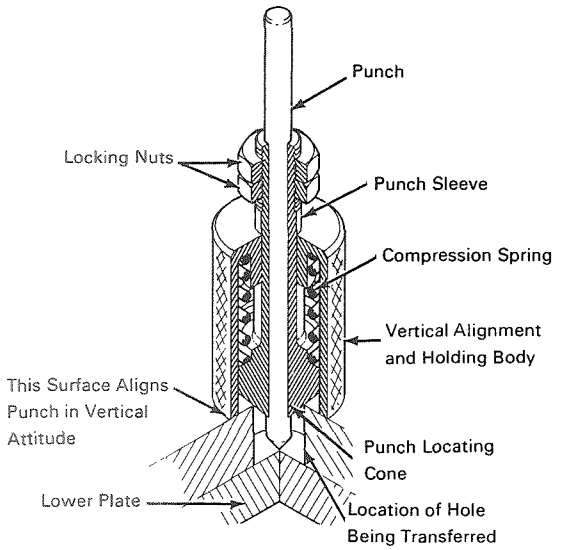


Source: R. H. Wagstaff of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16437)

No further documentation is available.

SELF-ALIGNING TRANSFER PUNCH

Commerically available transfer punches have tapered noses to locate the center of a hole being transferred. However, when the punch is hand held, there is no assurance that the axis of the punch is normal to the plate containing the reference hole.



This innovation automatically holds the transfer punch perpendicular to the surface of the reference plate, as well as central with respect to the locating hole. The outer gripping body of a spring-loaded, cone-nosed transfer punch has been bored so that it can be brought down flush with the surface of the reference plate. The cone portion of the punch locates the center of the reference hole. With the punch so located, it can be struck with a hammer, accurately transferring the true hole location to the workpiece.

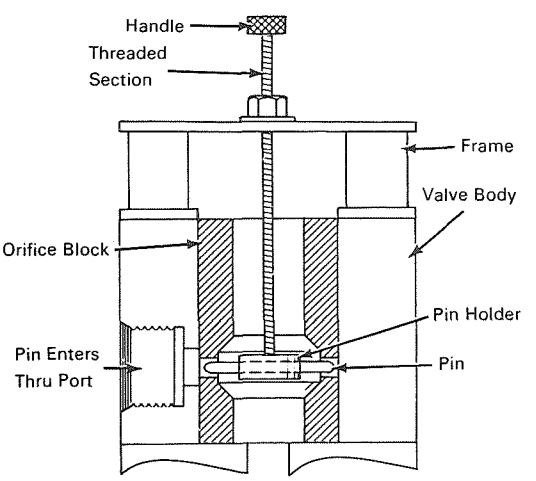
Source: H. Greenstreet of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-14276)

No further documentation is available.

ORIFICE BLOCK REMOVAL TOOL

In servicing solenoid valves, it has been found that orifice blocks are frequently frozen in the valve. To remove these blocks, a drive punch was inserted into the valve input or outlet port, and the orifice block was jarred loose by hammering on the punch. Consequently, many orifice blocks and valves have been damaged when the punch slipped.

The orifice block removal tool, which solves this problem, consists of a frame, a threaded stud with a pin holder welded to one end and a handle on the other end, a nut and washer, and a pin that is rounded on each end. The frame rests on the solenoid valve body and the stud is lowered into the orifice block until the pin holder is in line with a port. The pin is inserted through the port and then the nut on the frame is tightened. Because the pin has rounded ends and fits loosely in the pin holder, it will center itself, preventing damage to the valve during extraction. The nut is tightened until the orifice block is freed.



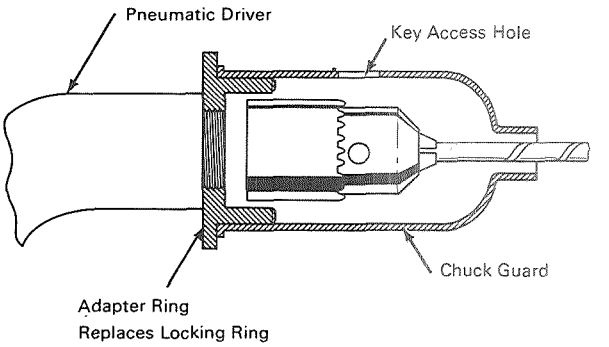
Source: J. T. Deitz of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10134)

Circle 12 on the Reader's Service Card.

CHUCK GUARD

The device is a stationary guard for the rotating chuck of a power hand drill. When drilling through a densely packed panel, the guard protects nearby components and the panel surface from damage by inadvertent contact with the chuck.

The guard consists of a sleeve of semi-rigid plastic material, such as polyethylene, mounted on the body of the drill. The illustration shows a guard for an air-driven drill. An internally threaded adapter ring replaces the normal locking ring, through which the chuck drive-shaft emerges, on the threaded stub in the drill handle. The adapter ring has a shoulder which surrounds the chuck and over which the protective guard is slipped. The diameter of the outer end of the plastic guard, through which the drill protrudes, is reduced. As a precaution, all edges of the holding fixture are rounded.



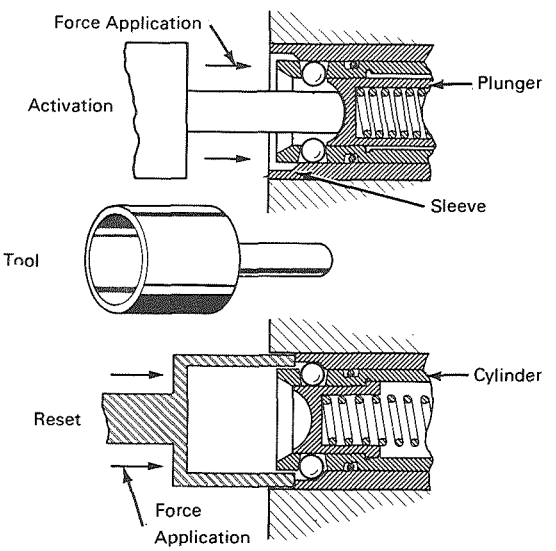
Source: W. W. Voorhest and E. C. Futterer of
Grumman Aircraft Engineering Corp.
under contract to
Manned Spacecraft Center
(MSC-12252)

No further documentation is available.

BALL LOCK TESTING TOOL

To test-activate ball lock holding devices, it has been necessary to use common hand tools, which often damaged the mechanism.

A simple and inexpensive tool has been made to test-activate and deactivate a ball lock holding device conveniently, without damage to the mechanism.



The end of the tool used to activate the mechanism is a solid rod with a rounded end. The rod diameter is slightly smaller than the separation between the balls in the activated position. The surface at the end of the rod closely approximates the curvature of the plunger. The other end of the tool is a hollow cylinder with an outer diameter slightly smaller than that of the sleeve, an inner diameter large enough to pass the mechanism cylinder, and a depth that will allow the full stroke of the device.

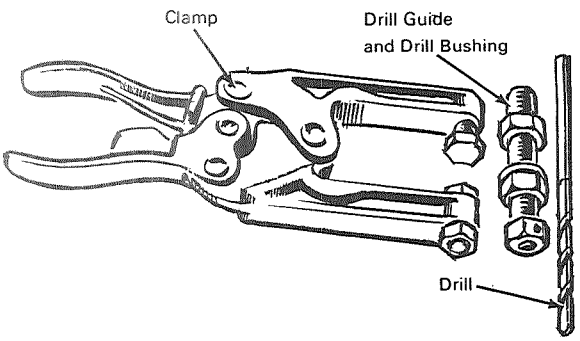
In use, the solid end of the tool is placed into the mechanism. An inward push trips the device so that the balls move to their innermost, locked position. To reset the device, the other end of the tool is placed in alignment with the sleeve and pushed, resetting the lock.

Source: G. J. Benedict of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10360)

No further documentation is available.

DRILL JIG

The drill jig is a Nu-Vise or similar clamp with the standard clamping posts removed and replaced by a drill bushing and guide. The bushing and guide arrangement is secured to the clamp by two locknuts.

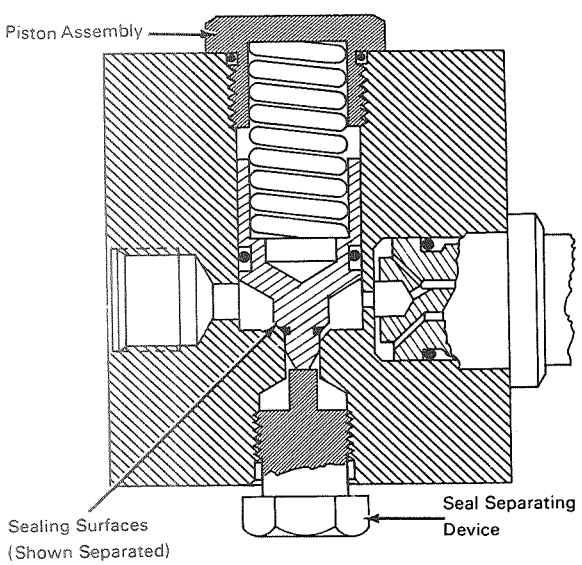


The prior method used from one to four clamps to hold the drill bushing in place while drilling. Since the bushing did not have a guide, a second operator was required to sight-in the drill.

Source: J. H. Long and H. T. Greene of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-12605)

Circle 13 on the Reader's Service Card.

RELIEF VALVE DISASSEMBLY TOOL



Each time a relief valve is disassembled conventionally, the soft metal seat of the seal is damaged by the rotation necessary to remove the piston assembly.

A tool has been designed that may be screwed into the valve output port to separate the sealing surfaces before disassembly. When the piston assembly is unscrewed, the sealing surfaces are not in contact and cannot be scored. By leaving this device in place, the reassembly can also be made without seal contact.

Source: P. E. Weaver of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10098)

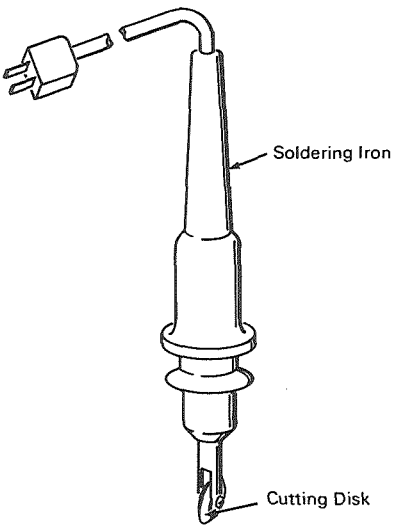
Circle 14 on the Reader's Service Card.

CUTTING TOOL FOR SYNTHETIC MATERIALS

For working with synthetic materials, several specialized tools have been developed to replace common tools, doing the same job better or more efficiently. The first replaces an ordinary knife, either cold or externally and intermittently heated.

To cut large sheets of certain synthetic materials economically and cleanly, a pencil-type soldering iron has been modified to accommodate a cutting disk.

An axial slot is machined in the soldering iron tip and a hole is drilled through both sides of the slot. A stainless steel rotary cutting disk is attached to a shaft that rotates in a rapid heat-transfer



bushing mounted in the hole. With electric power supplied to the soldering iron, the cutting disk may be pressed into the material and rolled, cutting the desired configuration without leaving frayed or jagged edges.

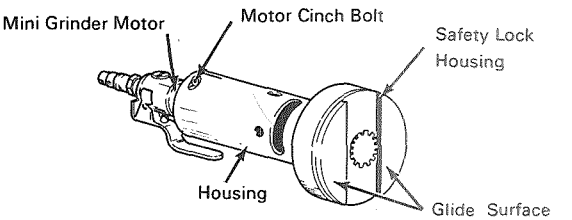
A soldering iron may also be modified to accommodate various types of fixed cutting blades by machining an axially-threaded hole into the heating element tip.

Source: W. G. Schafer, Jr. of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-725)

Circle 15 on the Reader's Service Card.

PLASTIC FOAM GLUELINE TRIMMER

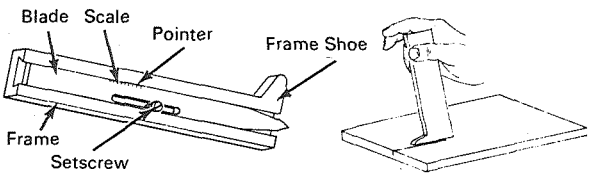
Another tool innovation applied to synthetic materials successfully performs an operation for which razor blades were previously used. The glueline along a plastic foam-to-foam interface may now be trimmed by means of a hand-held power tool equipped with a mushroom-type cutter. The cutter is mounted concentrically with a slotted disk so that it cannot extend beyond the glide surface of the disk. Thus, the surface of the disk allows a flush trim and diminishes the possibility of cutter damage to surrounding areas. The slot edges define the maximum width of the trimmed glueline.



Source: A. C. Miller and W. S. Stiles of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16486)

No further documentation is available.

ADJUSTABLE DEPTH CUTTER



An adaptation of a standard case cutter may be used to cut aluminum honeycomb or other soft materials to a calibrated depth.

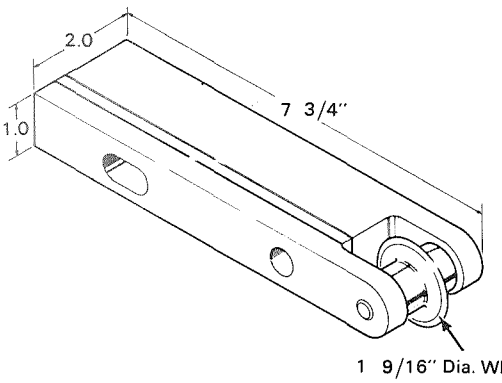
The knife consists of a frame which holds a standard, commercially available blade, attached by a setscrew which rides in a slot in the blade. A scale on the blade aligned with a pointer scribed on the frame, indicates the length of the blade which protrudes beneath the shoe on the bottom of the frame. By loosening the setscrew, the blade can be moved within the frame. Then the setscrew is tightened to maintain the selected depth during cutting.

Source: J. A. Rauschl of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-90475)

No further documentation is available.

TACK-WELD CUTTER

This tool is designed to cut tack welds for which the offset or the gap between the welded parts exceeds the weld specification tolerances.



Previously, cutting was done with a saw blade or a rivet gun and chisel, which left the weld area dirty. This innovation leaves the area clean and ready for retacking.

The cutter, a 1 9/16-in. diameter wheel, is mounted on the weld skate (or saw) track and aligned with the center of the tack to be cut. The cutting depth is adjusted as the cutter is run across the tack, until the tack is broken.

Source: Z. Y. Jaime of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-16440)

No further documentation is available.

CIRCLE AND CURVE SCRIBER

This device is designed for scribing circles or arcs concentric with a machined circle or arc. The circle scriber consists of a long bolt with a stylus attached to one end, threaded through a locating fixture so that the bolt adjustment determines the radius of the circle to be scribed.

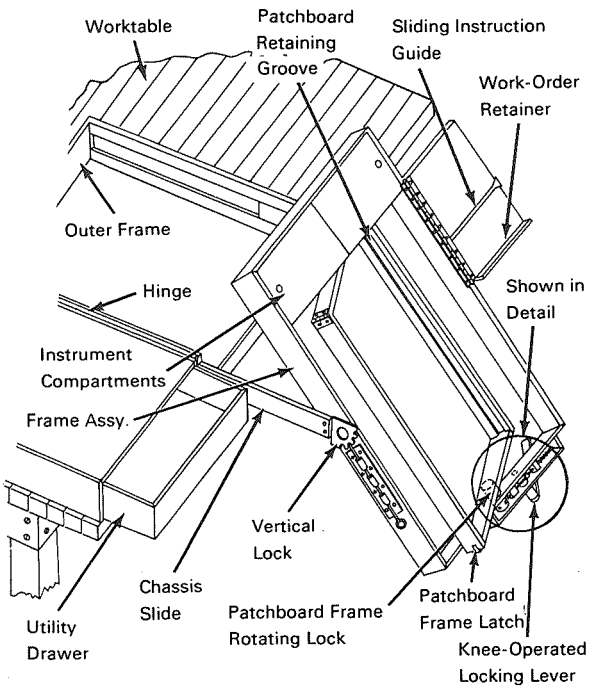
The locating fixture is a block of metal with flat, parallel upper and lower surfaces. It contains a threaded hole parallel to the upper surface, through which the bolt passes, and two pairs of holes bored prependicularly through the surfaces, to fit a pair of dowel pins. The pins may be placed in either the outer or inner pair of holes to adapt the locator for scribing around machined curves of larger or smaller radius, respectively. Scribing is done by moving the locating fixture along the machined curve, keeping both dowel pins in contact with the curve. Circles may be easily scribed in this manner on the faces of large flanges, such as those involving heavy-process or transfer piping and storage or reactors vessels, without resorting to lengthy procedures or complex apparatus.

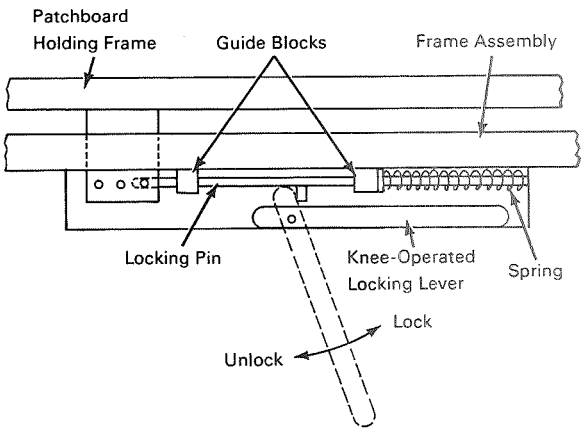
Source: J. S. Reti of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18518)

No further documentation is available.

Section 2. Electrical Tools

PATCHBOARD-HOLDING WORKBENCH





Detail of Patchboard Frame Rotating Lock

In modifying patchboards, the standard procedure has included hand manipulation of the boards, a time-consuming, difficult, damage-producing technique. To relieve these problems, a tool has been designed to hold the board while modifications are made.

The patchboard-holding workbench consists of two drawer-sized units connected by a piano hinge. The lower compartment contains a storage and utility drawer. The upper compartment stores the patchboard-holding fixture. The major components of the fixture are the outer frame, the chassis slide assembly, the frame assembly, and the patchboard-holding frame.

When a patchboard is to be modified, the patchboard-holding fixture is opened. The frame assembly is extended, tilted, and locked in one of four vertical orientations; the patchboard frame rotation-locking mechanism is released; the patchboard holding frame is rotated, unlatched and opened; and the patchboard is placed in the holding frame. With both hands free, modifications can then be performed easily by the technician.

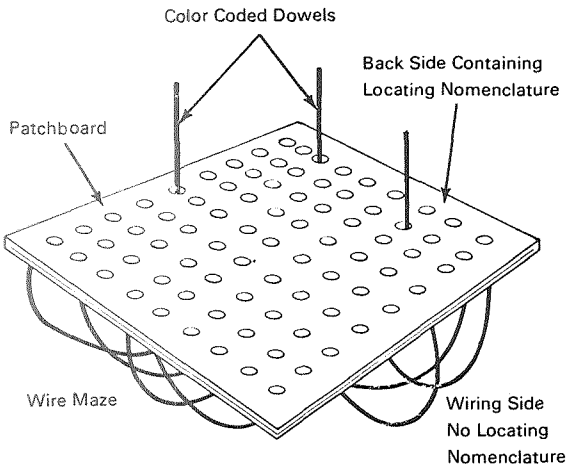
A work-order holder retains the paperwork nearby. A sliding instruction guide allows the order to be followed. To permit work on both sides of the board, the patchboard holding frame may be rotated. A knee-operated rotation-locking mechanism secures the board in any position.

Source: J. R. Cole of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10260)

Circle 16 on the Reader's Service Card.

PATCHBOARD PIN LOCATOR

The method now used to modify patchboards is to locate the pin by letter, number, or color on the pin side of the board. It is then turned over and a new wire is inserted in the identified location. Since most boards contain a tightly packed maze of wiring three to four inches thick, it is ex-



tremely difficult to identify the correct location requiring the additional wiring.

A simple technique has been developed for readily identifying locations on a patchboard for the insertion of additional wiring. The locations to be wired are located normally, by designation code on the blank side of the board. A long dowel is then inserted into each position to be modified and pushed until it protrudes through the wiring maze. The wiring is then parted and a patch inserted into the locations identified by the dowels. For major patchboard modifications, the dowels may be color-coded to separately identify each new patch to be installed. This simple technique allows much more rapid and more accurate completion of patchboard modifications.

Source: K. E. Sparling of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10026)

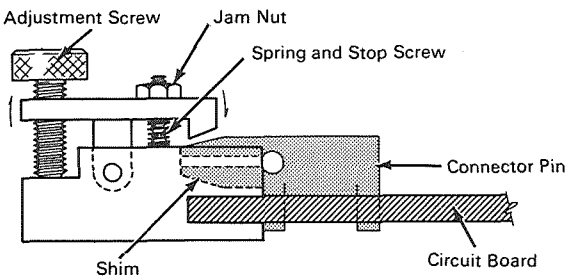
No further documentation is available.

SPRING TENSION RESTORER FOR CIRCUIT BOARD CONNECTOR PINS

Spring-type electronic circuit board connector pins may lose their gripping power after repeated coupling and uncoupling. A tool has been constructed to restore the gripping tension of prongs which have not been stressed beyond their elastic limit. First a steel gage pin is used to determine whether or not the connector is repairable. If the pin fits into the hole at the root of the slot between the prongs, the connector must be replaced; if not, the connector may be repaired.

The spring tension restorer may be used on pins which are mounted on the circuit board. The tool slides over the edge of the board with the connector prongs fit into slots to prevent side distortion. A steel shim on the tool slips between the lower prong and the circuit board to prevent downward deflection of the prong. A rocker arm pushes down on the upper connector prong when the knurled adjustment screw on the other end of the arm is turned in against the solid surface. The arm is prevented from over-deflecting the prong by a preset stop screw.

This tool may be modified to restore the gripping capability of various similar electronic circuit board connectors.

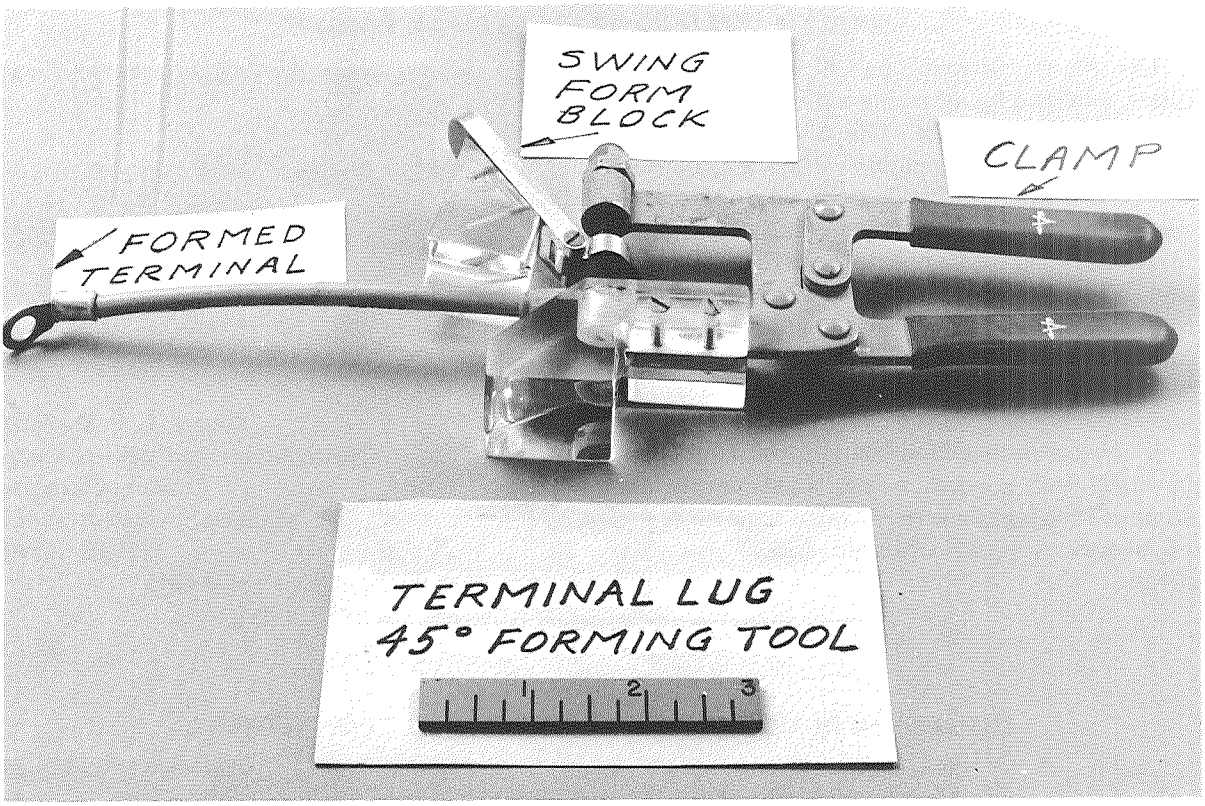


Source: W. C. Johnson of
North American Rockwell Corp.
under contract to
Marshall Space Flight Center
(MFS-18168)

No further documentation is available.

LUG-BENDING TOOL

Designed for uniformly bending lug terminals on prefabricated electrical cables, this tool is a modification of a standard tooling toggle clamp. A centering anvil made of clear plastic is added at one jaw of the clamp to hold the lug; the mating jaw is rubber padded to avoid damage while the



lug is securely held. Two forming blocks, also of plastic, are attached to the clamp. One is rigidly mounted; its position determines the angle to which the lug will be bent. The other, grooved to accommodate the cable, is pressed down toward the fixed block while the lug is clamp held, thereby forming the predetermined angle.

Previously, lug bending in the field was done either manually or with two pairs of pliers. Hand bending did not produce a flat terminal surface while use of pliers often damaged the surface. Neither method yielded accurate bend angles.

Source: E. J. Casey of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15515)

Circle 17 on the Reader's Service Card.

ELECTRICAL CABLE BANDING TOOL

Manufacturing specifications often require that electric wire bundles and harnesses be collectively wrapped with non-metallic straps. This can be difficult to accomplish in confined areas. One

type of standard technician's soldering aid may be used to overcome such problems. It consists of a rod, bent and slotted at each end. After the strap is inserted on one side of the wire bundle, the tool is passed behind the bundle from the other side, to engage the strap in the slot. With a slight twist of the tool, the strap is held in the slot while the tool is withdrawn, completing the operation.

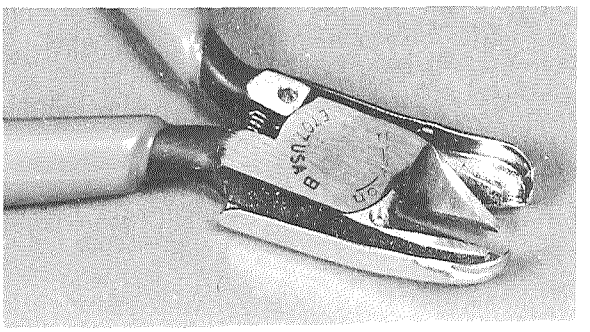
Source: R. L. Durham of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10139)

Circle 18 on the Reader's Service Card.

SPOT TIE CUTTER FOR ELECTRICAL CABLES

The spot tie cutter is a pair of diagonal cutting pliers, modified by attaching a thin guard plate to the back of each blade. This allows removal of spot ties from cable assemblies without damage to the cable insulation. Previously, cutter tools were used with a protective finger which had to be inserted, often with great difficulty, between tie and cable. The tool equipped with guard plates, on the other hand, is easy to use as a spot tie cutter, and furthermore, the plates do not interfere with normal cutter uses and reduce the hazard of accidental injury.

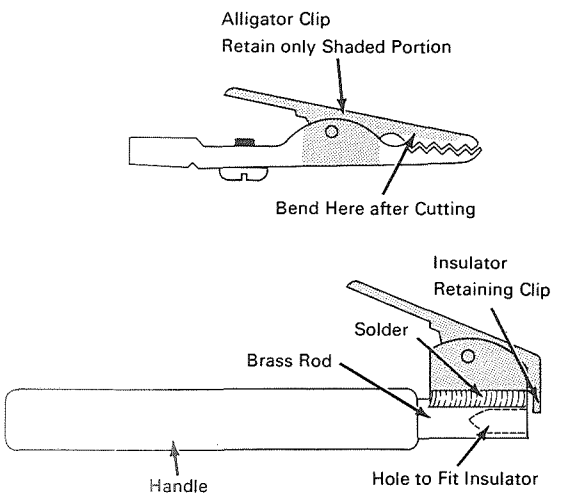
As an additional modification, the cutter can be made with a notch in the blades to prevent complete cutting of the tie. Manual removal of the tie avoids dropping it inside critical assembly areas.

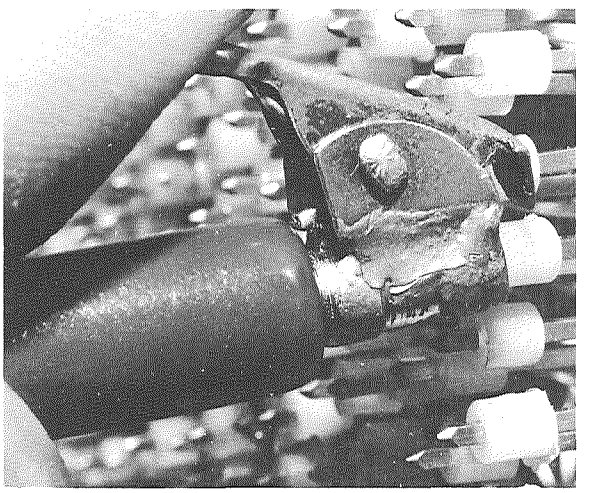


Source: L. P. David of
North American Rockwell Corp
under contract to
Manned Spacecraft Center
(MSC-15590)

Circle 19 on the Reader's Service Card.

INSULATOR REMOVAL TOOL FOR WIRE-WRAP CONNECTORS





When electronic equipment with wire-wrap connectors is modified, it is difficult to remove or install the plastic insulators which prevent short circuits between the pins. The only common tool which can manipulate these insulators easily is a pair of needle-nose pliers. If the pliers slip during the process, the jaws mar the surface of the insulator. Also, the pressure applied to grip an insulator often cracks it, necessitating replacement. A tool has been developed that easily removes and installs the plastic insulators. With this tool, wire connection time is greatly reduced and damage to the insulators is eliminated.

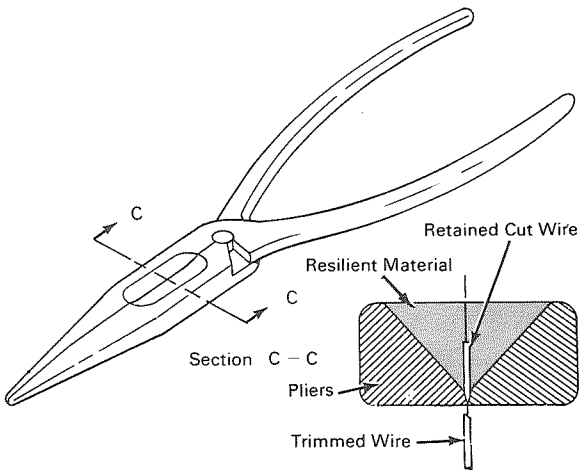
The insulator removal tool is constructed from a test-probe handle, a modified alligator clip, and a length of brass rod. To operate, the retaining clip is depressed, the tool is slipped over the insulator, the retaining clip is released, and the insulator is removed by pulling the tool along the terminal axis of the connector pin. The tool removes the insulator by applying pressure from below, thus preventing damage to the insulator.

The tool retains the insulator after removal, preventing its loss. The insulator is easily reinstalled by reversing the above procedure. This tool also positions all insulators at the same depth on the connector pins, assuring uniform separation.

Source: W. M. Miller, Jr. of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10206)

Circle 20 on the Reader's Service Card.

CUTTING PLIER MODIFICATION TO RETAIN TRIMMINGS



When a wire is trimmed with cutting pliers, the free end is often propelled from the pliers, causing a safety hazard to nearby personnel and a mechanical hazard to nearby equipment. Pliers can be simply modified to retain the trimmings by filling the cutting depression with a resilient rubber material.

Source: R. B. Wood, Jr. of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10110)

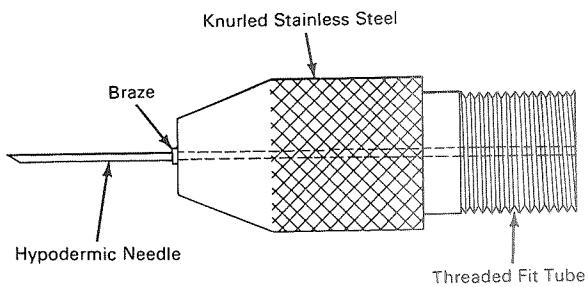
Circle 21 on the Reader's Service Card.

POLYURETHANE NEEDLE-INJECTION ADAPTOR

Polyurethane potting compound is used extensively to protect electrical cable connectors. Air pockets or voids which are frequently left by the molding process represent potential sources of failure. This adaptor provides a means for eliminating this problem by injecting polyurethane compound into the voids. The adaptor fits a standard compound tube and gun assembly.

Normal procedure has been to cut back the polyurethane and repeat the entire molding process. This method is costly in time and material. The adaptor eliminates most of the cutting and reworking.

The adaptor can be made in a variety of styles and materials, chosen to fit the particular application. Stainless steel has been used in this design, to give corrosion resistance. The adaptor may be easily machined on a lathe; the needle can be brazed onto the fitting. Knurling facilitates hand tightening onto the plastic compound tube.

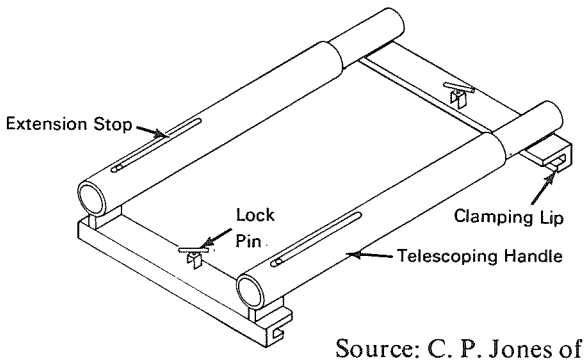


Source: W. E. Karr of
The Bendix Corp.
under contract to
Kennedy Space Center
(KSC-10124)

Circle 22 on the Reader's Service Card.

BATTERY HANDLING TOOL

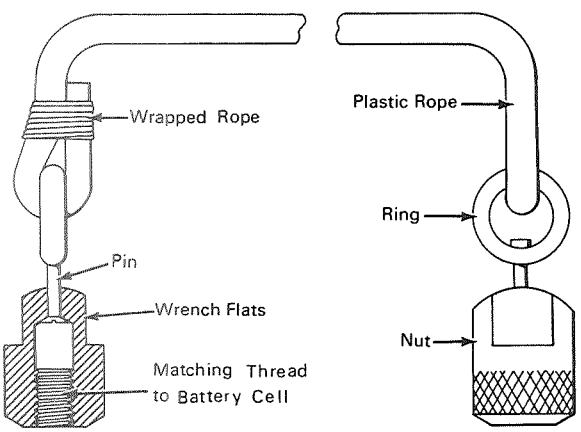
Manipulation of heavy battery modules in confined areas is very difficult, in part because of the lack of convenient hand grips on the battery case. A tool has been developed to provide such grips. It consists of two tubular, telescoping handles welded onto two J-cross-section bars to form a rectangle. The tool is placed on the battery module with the handles extended to allow the shorter lips of the bars to clear the mounting flanges of the battery case. The handles are then telescoped together until the flanges are securely held within the notch of the J-bars. Two lock pins are then depressed, locking the tool onto the battery case. So secured, the telescoping handles provide convenient hand grips by which the battery may be easily carried.



Source: C. P. Jones of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10138)

No further documentation is available.

BATTERY CELL HANDLING TOOL



Nickel cadmium batteries are composed of multiple cells packaged in a holding case. Because of the packaging restrictions, it is difficult to remove or install individual cells using conventional tools. However, a simple solution is provided by this tool, which permits a handle to be attached to one cell, greatly reducing the possibility of injury to personnel or damage to the battery.

The battery cell handling tool is assembled from two plastic nuts, two swivel pins, two eyelets, and a length of plastic rope. The plastic nuts are internally threaded to fit the battery cell terminals, equipped with wrenching flats, and bored to allow the swivel pins to be inserted. The pins are headed after being passed through the tops of the nuts and eyelets, and plastic rope is attached to the eyelets as a handle.

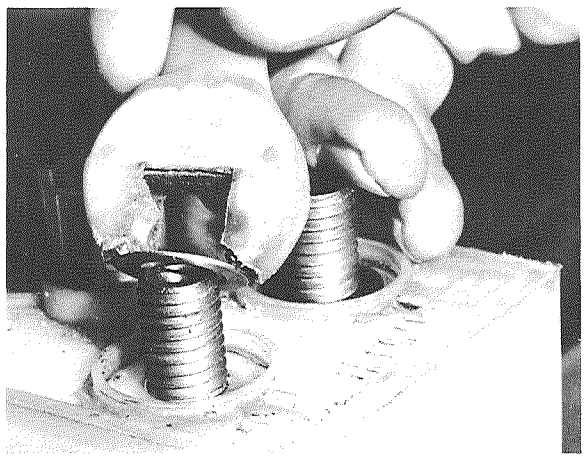
Use of this tool permits easy manipulation of the battery cells.

Source: J. Harris of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10150)

No further documentation is available.

BATTERY TERMINAL WASHER REMOVAL TOOL

Because of accessibility limitations around battery terminals, it is often difficult to remove the terminal washers during servicing or cleaning. A washer removal tool was made by using heat-shrinkable tubing to attach a small horseshoe magnet to an insulated handle. The size of the



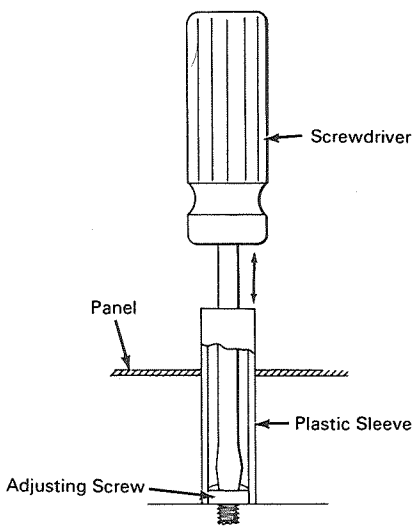
magnet and the handle vary with the requirement. However, a simple bar magnet is inadequate, since it does not provide the required symmetrical force to remove the washer. Since the tool is completely covered with non-conductive material, it presents no electrical safety problem if accidentally dropped across two battery terminals.

Source: L. W. Rabb of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10171)

Circle 23 on the Reader's Service Card.

SCREWDRIVER MODIFICATION FOR ENGAGING RECESSED SCREWS

When instrument-adjusting slotted-head screws are placed behind panels, it is difficult to engage a screwdriver through the panel openings. Keeping the screwdriver centered during adjustment can be even more difficult. A tool has been developed that easily engages, disengages, and maintains its position during adjustment.



A plastic sleeve about three-quarters as long as the screwdriver shaft is installed on the screwdriver. The diameter of the tubing is determined by the size of the screw heads. In use, the screwdriver engages the recessed adjustment screw, then the plastic tubing is forced over the screw head. Thus secured, the adjustment is completed with less difficulty and loss of time.

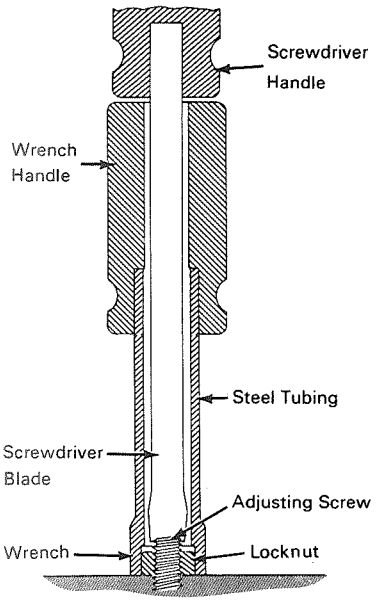
Source: D. E. Peeples of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10141)

No further documentation is available.

ADJUSTMENT-SCREW LOCKING TOOL

Adjustment screws are normally locked in place with a hexagonal locknut. After the adjustment is made, it is difficult to tighten the locknut without disturbing the adjustment. A combination tool has been developed to maintain the adjustment while the locknut is being tightened. This tool saves time by eliminating the need to readjust instrument settings.

The adjustment-screw locking tool consists of a long-shafted screwdriver and a hexagonal locking tool which is made from a hollow hexagonal socket, a length of steel tubing, and a hollow plas-



tic screwdriver handle. The tubing is welded to the socket, and the free end of this assembly is glued into the hollow plastic handle. The screwdriver shaft passes through the locking tool, completing the assembly.

In use, the hexagonal socket engages the locknut and the screwdriver blade engages the adjustment screw. The locknut is loosened and the screw is adjusted. When the adjustment is completed, the locknut is tightened with the locking tool while the screwdriver prevents the adjustment screw from moving.

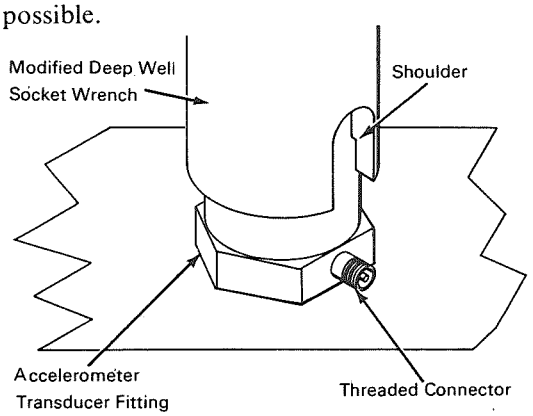
Source: S. L. Steele of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10146)

Circle 24 on the Reader's Service Card.

TRANSDUCER FITTING WRENCH

Accelerometer transducer fittings often have a cylindrical case with a threaded connector projecting from one face of a hexagonal base nut. Normal methods of tightening such fittings, by means of a deep-well socket wrench or a crowfoot wrench, are not acceptable. A deep-well socket hits the projecting lead before usable engagement is made, causing probable damage to the lead. A crowfoot wrench cannot be used in restricted areas. This problem has been overcome by modifying a deep-well socket wrench.

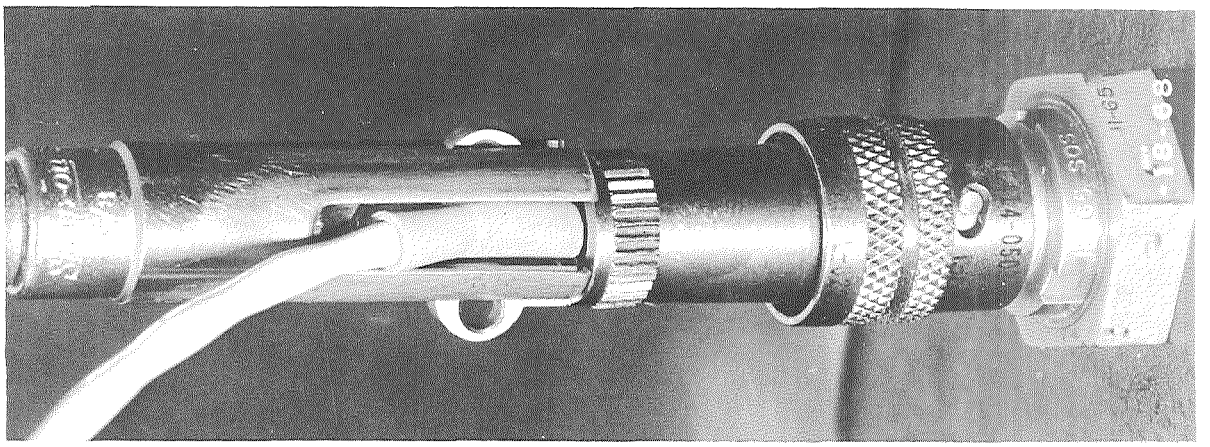
The part to be modified, an S-201 snap-on, twelve-point, deep-well socket, has the required internal clearance for the transducer case and a shoulder to limit the engagement of the socket. It is modified by cutting a slot in the casing with a small-diameter grinding wheel. The slot is cut using one of the twelve points of the socket as a center line, so that the slot is in line with that portion of the wrench which engages one hexagonal flat of the transducer nut. The depth and width of the slot are cut so that, for the particular transducer fitting, no contact with the threaded connector is possible.



Source: E. A. Zeak, Jr. of
The Boeing Co.
under contract to
Kennedy Space Center
(KSC-10382)

No further documentation is available.

ELECTRICAL-CONNECTOR WRENCH



In a manner similar to the preceding item, a standard socket wrench may be slotted to accommodate the configuration of an electrical connector back shell. It permits torquing of the connector without interfering with the protruding wires and insures positive grounding of the electrical shield to the connector shield.

Source: R. L. Jensen and C. C. Zell of
North American Rockwell Corp.
under contract to
Manned Spacecraft Center
(MSC-15049)

No further documentation is available.

NASA-Langley, 1971

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