NASA SP-5976 (01)

TECHNOLOGY UTILIZATION

MEASUREMENT, TESTING, AND SAFETY TECHNOLOGY

A COMPILATION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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.

This document is one in a series intended to furnish such technological information. Divided into three sections, this Compilation presents several methods and techniques in the related areas of measurement, testing, and safety. In Section 1 several measuring techniques and devices are described. Section 2 presents a number of testing methods and devices, and Section 3 contains several articles on equipment modifications or procedures that may assist in safety and maintenance.

Additional technical information on individual tools and techniques can be requested by circling the appropriate number on the Reader Service Card included 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 has 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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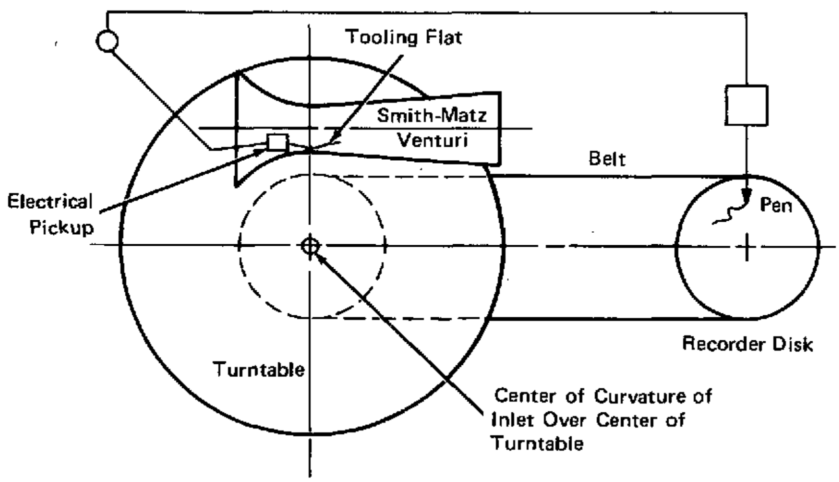
Contents

Section 1. Measurement Technology

MEASUREMENT TECHNIQUE FOR NOZZLES AND VENTURIS



Venturi Measurement Technique

A machine, designed to measure roundness and concentricity of tube fittings, has been adapted (see figure) to measure the deviation and rate of deviation from the ideal shape of the inlet port of a Smith-Matz venturi. Prior methods were restricted to either a subjective evaluation or extensive analysis and were limited to large orifices.

This device consists of a precision turntable, linked by a belt to a recording disk, and a tooling flat with an electrical pickup. The output of the pickup, which is controlled by the position of the tooling flat, goes to a recorder. The venturi is mounted on the turntable with its axis of symmetry in a plane parallel to the plane of the table. The center of curvature of the inlet is positioned over the center of the table. As the turntable rotates, so does the venturi; and the tooling flat detects any deviation from a true torus. The results are stored on the recorder disk.

Source: H. L. Hillbrath and
W. P. Dill of
The Boeing Company
under contract to
Marshall Space Flight Center
(MFS-15304)

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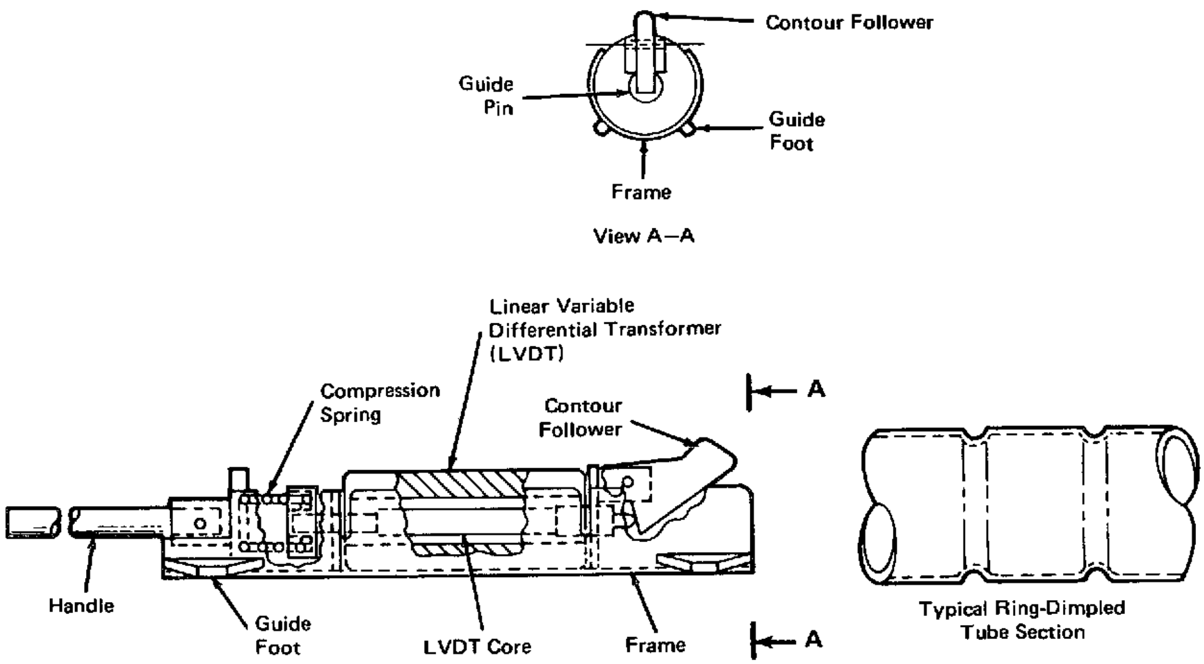
MEASURING DEVICE FOR RING-DIMPLED TUBES



Measuring-Device Assembly and Ring-Dimpled Tube

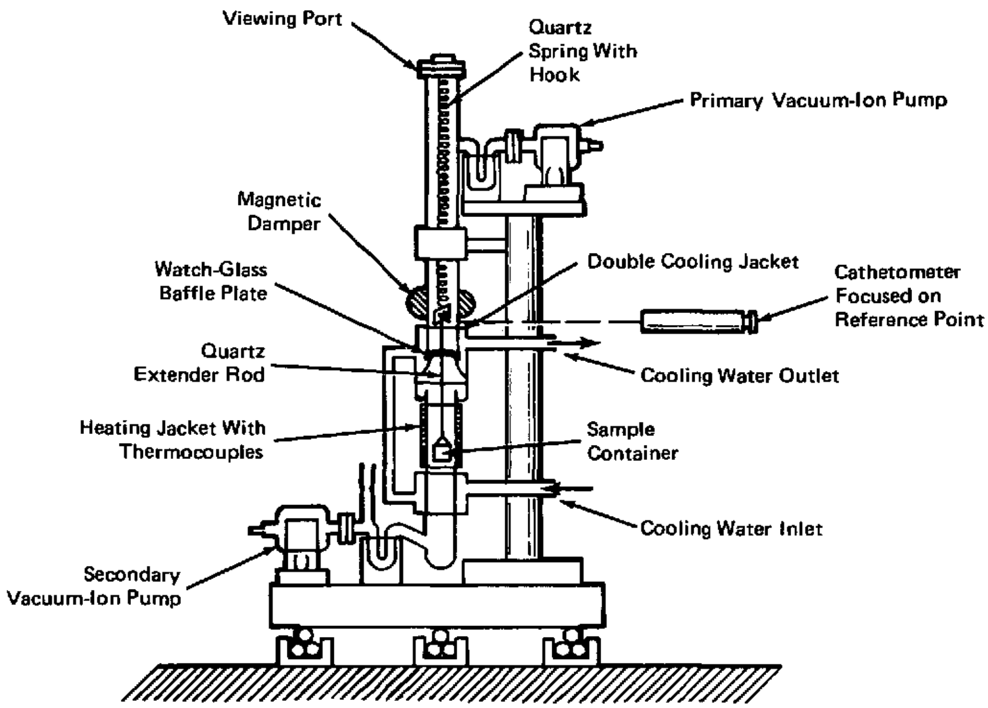
Ring dimpling of tubing optimizes the heat-transfer area in a heat exchanger. The depth of each ring dimple determines the heat-transfer characteristics of a tube. This innovation permits easy measurement of the internal dimensions of ring dimples to within 0.001 inch (0.025 mm).

In this measuring device (see figure), a dc electrical signal is generated through a demodulator circuit by a linear-variable differential transformer (LVDT), as the assembly is pushed through the ring-dimpled tube. As the device is inserted into the tube, the LVDT signal is recorded on a standard recording instrument (not shown). The handle is used to push the device slowly through the tube at a steady rate. As it moves forward, the contour follower is deflected by each ring dimple, causing the guide pin to move the LVDT core a distance proportional to the dimension of the ring dimple. This action produces a signal-level change of approximately 12 mV dc per 0.001 inch of LVDT core travel. The compression spring assures constant contact between the contour follower and the inner surface of the tube. This contact prevents play in the movement of the LVDT core that would produce false readings. Guide feet (see view A–A of figure) projecting from the frame have tapered edges, to assist the unit over each ring dimple while keeping it centered in the tube. Wiring (not shown) between the LVDT and demodulator is routed through the hallow handle.

Source: James N. Deyo and
Donald G. Beremand
Lewis Research Center
(LEW-10392)

No further documentation is available.

ULTRAHIGH-VACUUM QUARTZ-SPRING MICROBALANCE



Schematic of the Microbalance

The selection of lubricants for use at cryogenic temperatures in a high vacuum requires an understanding of their volatility (evaporation rates and vapor pressures). Commercially available instruments used to measure the evaporation rates and vapor pressures of lubricants are very expensive; and they neither dampen nor prevent vibration and spring condensation, nor do they work in a high vacuum.

This ultrahigh-vacuum mass-sorption quartz-spring microbalance (see figure) precisely measures the evaporation rates of oils and greases at various temperatures, by weight loss through free-surface evaporation in an ultrahigh vacuum. The average molecular weight of the lubricant (before and after a test), the temperature, and the evaporation rate are substituted into the Langmuir equation to calculate the vapor pressure.

As shown in the figure, the vertically-positioned glass vacuum chamber has a furnace zone and a water-cooled condensing region. A small quartz sample container is suspended in the chamber on a thin quartz extender rod. The rod is attached to a sensitive pivot-free quartz spring. The sample container is filled with a degassed and, subsequently, helium-saturated test lubricant and is positioned in the center of the furnace region (a heating jacket with thermocouples). The extender rod passes through a perforated removable watchglass baffle plate.

The lubricant is heated by radiation through the glass envelope at the furnace region; and, as evaporation proceeds, the quartz spring contracts. The upward movement of a selected reference point is measured by a cathetometer. The vapor pressure then is calculated by substituting the evaporation rate into the Langmuir equation.

Source: M. N. Gardos of
Hughes Aircraft Co.
under contract to
Marshall Space Flight Center
(MFS-22415)

Circle 2 on Reader Service Card.

SIMULTANEOUS MULTIMEASURING CALIPER STANDARD

The simultaneous multimeasuring caliper standard (SMMCS) can make simultaneous measurements of any mechanical part, including both internal and external dimensions. The base of the SMMCS has micrometer adjusting controls on an X-Y positioning platform. All adjusting and measuring devices are attached to a vertical metal column mounted on a movable base. The piece to be measured is placed to the right of the SMMCS, as in Figure 1.

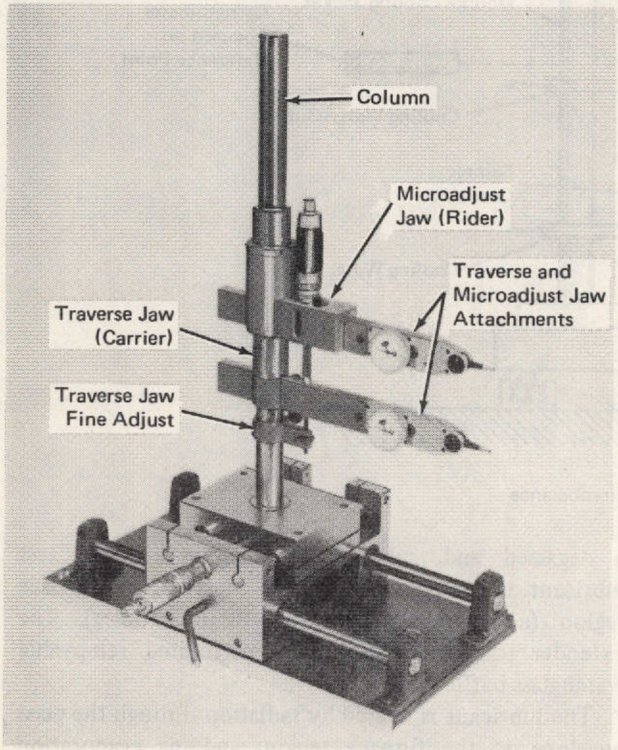


Figure 1. Simultaneous Multimeasuring Caliper Standard (Front View)

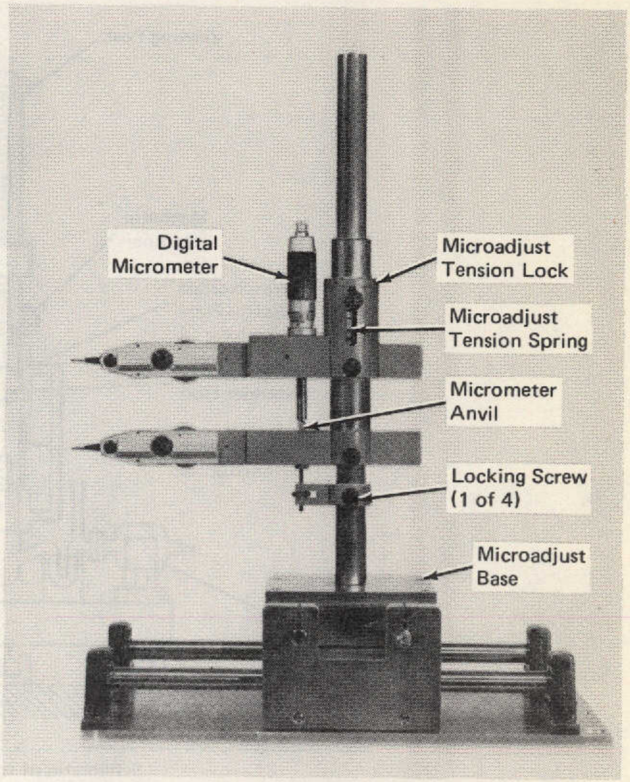


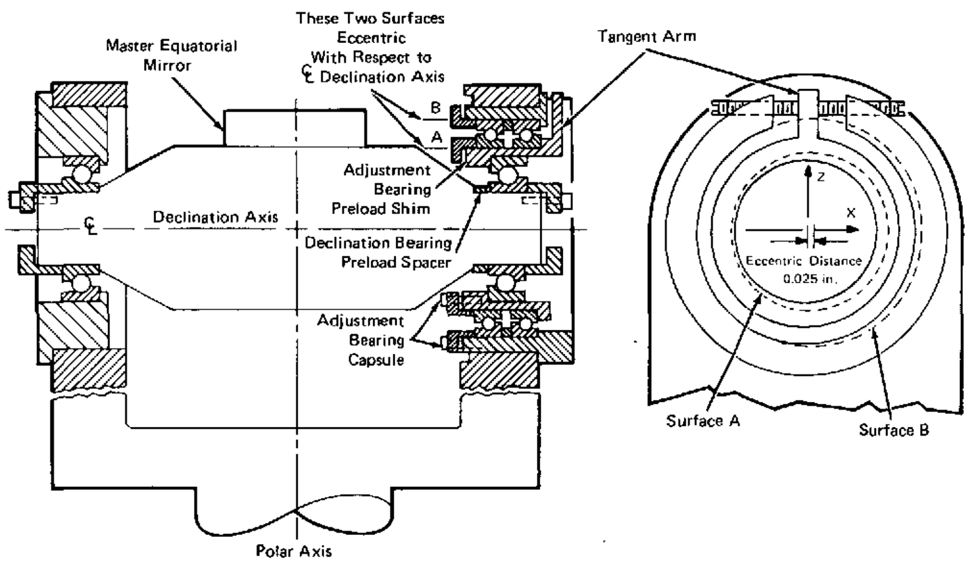
Figure 2. Simultaneous Multimeasuring Caliper Standard (Back View)

In operation, the traverse and microadjust jaws are separated until their attachments fit the subject piece. Either or both of the jaw attachments can be extended or retracted as required, to contact inner and/or outer surfaces. The microadjust base is used to move the jaws in the X-Y plane. The traverse jaw (carrier) is moved in the Z (vertical) plane until its attachment contacts one surface of the subject piece. The digital micrometer is adjusted to bring the microadjust jaw attachment into contact with a second surface. Once the desired contacts have been made, they are maintained by the pressure of the microadjust tension spring (see Figure 2). The microadjust tension lock and the locking screws are then secured, and measurement readings can be taken.

Source: Harry W. Dayton
Langley Research Center
(LAR-11114)

No further documentation is available.

SMALL-ANGLE ADJUSTMENT, WITHOUT PRELOAD RELEASE



Orthogonality Adjustment of Master Equatorial Axes

This technique is used to set shaft angles of an optical instrument used with a 64m diameter antenna, to within a 0.1 arc second tolerance. It involves (see figure) a ball bearing, race-mounted assembly with a center element slightly offset from concentricity. The outer structure of the bearing assembly is cylindrical and concentric with the shaft axis.

The essential features of the adjustment system are shown in the figure. One of the declination-axis angular contact ball bearings is mounted within an auxiliary bearing capsule containing a pair of preloaded angular contact ball bearings. The bearing capsule is mounted eccentrically with respect to the bore of the declination axis bearing. The position adjustment is executed by moving the tangent arm attached to the innermost ring of the auxiliary bearing capsule. The tangent arm is moved by turning two opposing set screws. The amount of the auxiliary bearing eccentricity is 0.025 in. (0.063 cm), and the angular range of the arm is ±10 deg from its neutral position, thus producing a ±0.0045-in. (0.0114-cm) adjustment range in the direction of the x axis. As the two declination-axis bearings are spaced 26 in. (66 cm) apart, the angular adjustment range is ±34 arc seconds. One turn of the tangent arm set screw changes the declination axis angle by 2.10 arc seconds. Adjustment in the direction is accompanied by a displacement in the x direction, but this latter displacement does not affect the orthoganality of the axes.

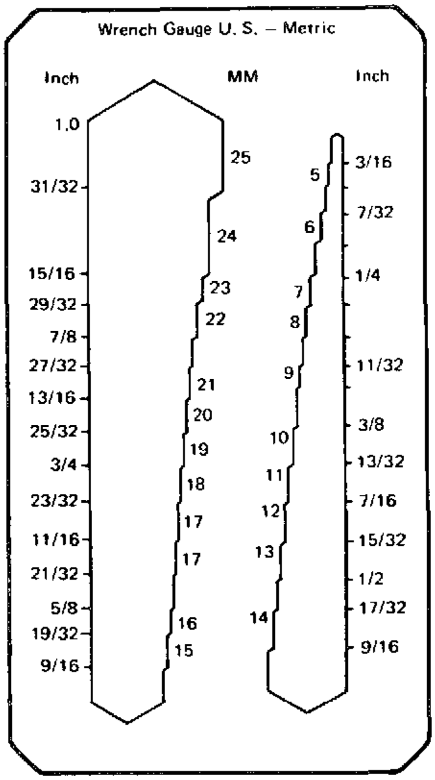
The most significant feature of this design is that the orthogonality adjustment can be made without relieving or changing the preload on the declination-axis main bearings or on any other part of the structure. While observing an alignment autocollimator, the set screws holding the tangent arm can be turned slightly, thus obtaining an orthogonality accuracy equal to the resolution of the autocollimator. Considering the accuracy of the particular autocollimator used for aligning the master equatorial, it is believed that the axis orthogonality error does not exceed 0.15 arc seconds.

The alignment bearing capsule is fabricated by assembling the two auxiliary ball bearings between the inner and outer rings of the capsule and preloading the bearings to 5000 lb (22.2×10^3N) by adjusting the preload shim thickness until a prescribed drag torque is reached. The tangent arm is locked tightly in its neutral position and the open ends of the capsule are temporarily sealed. Then the inner and outer cylindrical surfaces of the capsule assembly are precision-ground to fit the declination bearing and its housing.

Source: Houston D. McGinness of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-10744)

Circle 3 on Reader Service Card.

WRENCH SELECTION GAUGE



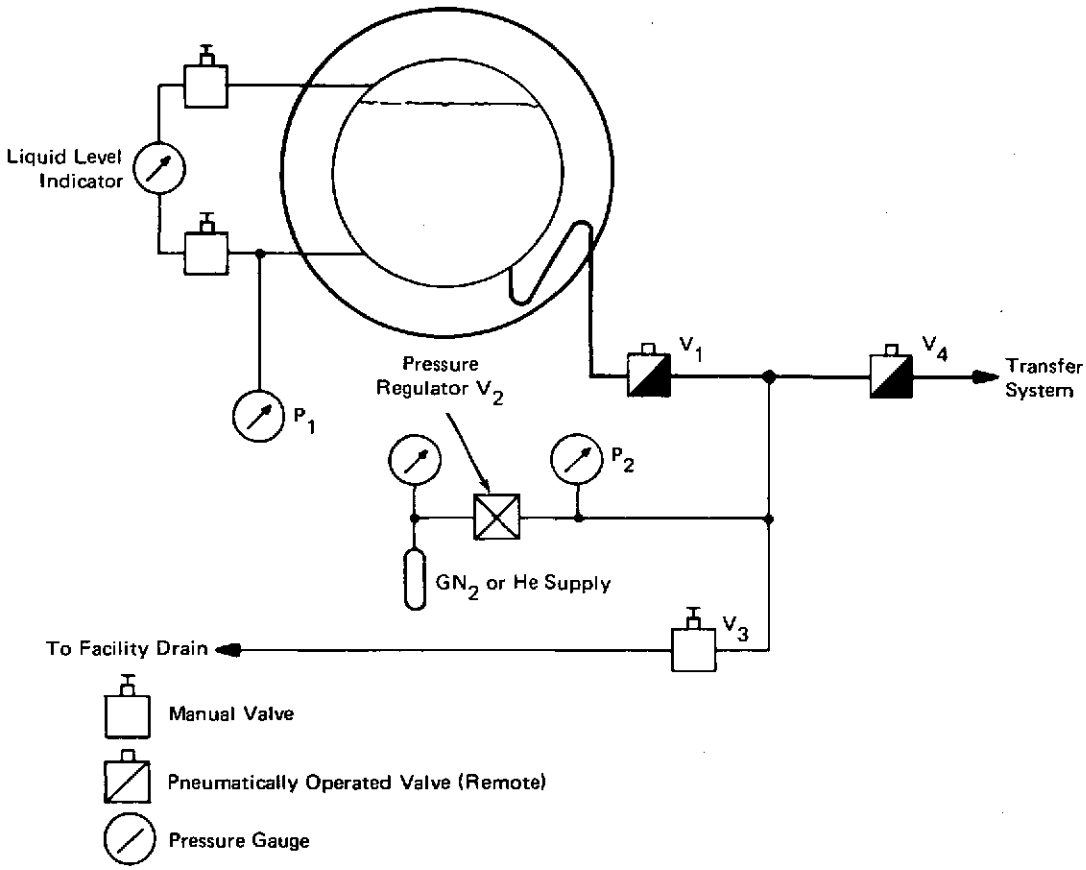
A pocket-sized wrench gauge (see figure) enables the user to determine the bolt-head or nut size in either U.S. or metric units. Thirty-two sizes are provided between 3/16 in. (4.76 mm) and 1.0 in. (25.4 mm). This eliminates the prior practice of trial and error, or the selection of the "nearest fit" of several wrenches when the proper wrench is actually available. Correct size is determined on the wrench gauge by direct readout, a time saving that increases production. This is particularly helpful, in view of the current transistion from the U.S. to the metric scale.

Source: J. H. Kimzey
Johnson Space Center
(MSC-12590)

No further documentation is available.

Section 2. Testing Methods and Techniques

FUNCTIONAL CHECKOUT OF CRYOGENIC-STORAGE-TANK SHUTOFF VALVES



Cryogenic Valve Functional Checkout System

Cryogenic (very low temperature) fluids require sophisticated transfer systems. These include pneumatically operated valves that must be functionally checked at regular intervals. In the past, liquid flow through a system, caused "fluid hammer," a damaging phenomenon, and a loss of liquid.

A new system design (see figure) permits a functional test of the pneumatically operated valves, from fully closed to fully open, without involving the stored cryogenic fluid. Pressure at valve V_1 is equalized by gaseous nitrogen (GN_2). With valve V_4 closed, valve V_2 is opened until pressure P_2 equals pressure P_1. Valve V_1 can then be functionally checked without cryogenic fluid flow.

Source: Bruno Drescher of
The Boeing Company
under contract to
Kennedy Space Center
(KSC-10155)

Circle 4 on Reader Service Card.

PYROTECHNIC PERFORMANCE MONITORING

A study has been made to provide users of pyrotechnic systems with performance comparisons among squibs, initiators, and gas-generating cartridges. Parameters studied included: ignition characteristics, combustion dynamics, and delivery mechanisms.

A dynamic test device (Figure 1) provides information on mechanical energy delivered and combustion dynamics in an actual (gas-generating device) application. A velocity-monitoring fixture (Figure 2) is used in conjunction with the dynamic test device of Figure 1 to measure the force acting on a one-pound piston.

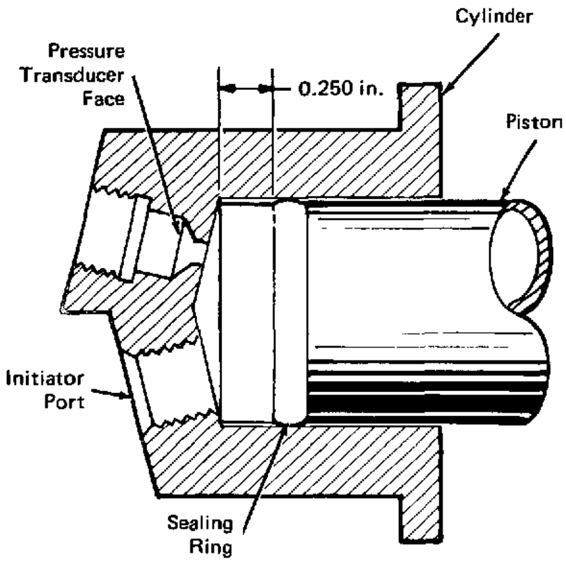


Figure 1. Cross Section of Dynamic Test Device

The internal volume of the dynamic test device is pressurized by firing the gas-generating device, causing the piston to accelerate through a one-inch stroke. Velocity of the piston is measured by recording the time intervals between contacting of the five electrically-charged foil switches by the electrically grounded needle mounted on the forward end of the piston. The functional characteristics of ignition and pressure are also recorded on a high-response magnetic-tape recorder.

A second velocity measurement is obtained by impacting the piston against an energy sensor containing an aluminum honeycomb of known uniform crush strength. The crush strength displacement, multiplied by the known crush strength, provides an energy measurement in inch-pounds.

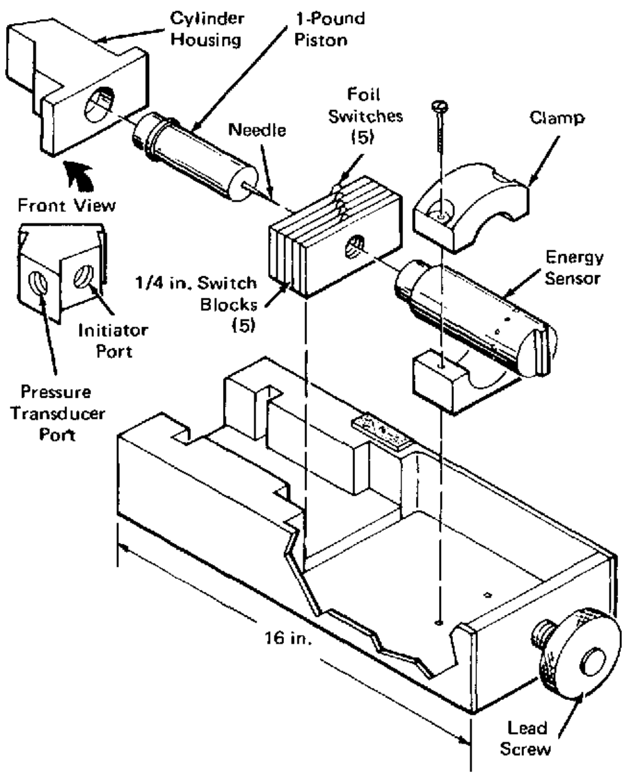


Figure 2. Velocity-Monitoring Fixture for Dynamic Test Device

Source: Laurence J. Bement
Langley Research Center
(LAR-10800)

Circle 5 on Reader Service Card.

PORTABLE HARDNESS TESTER

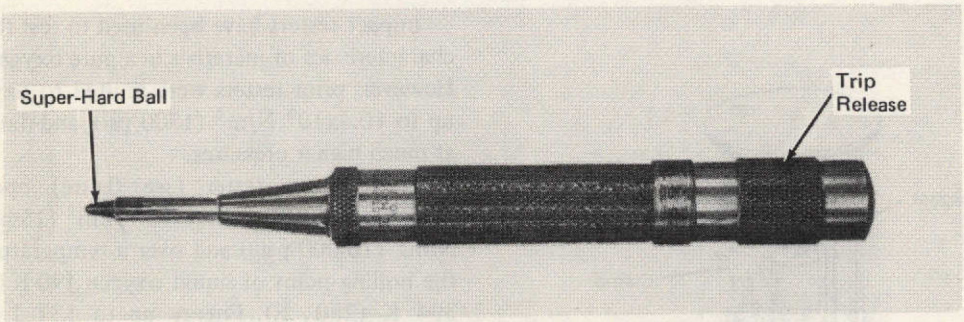


Figure 1. Portable Hardness Tester Showing Spring Loaded Indentor Ball at Tip

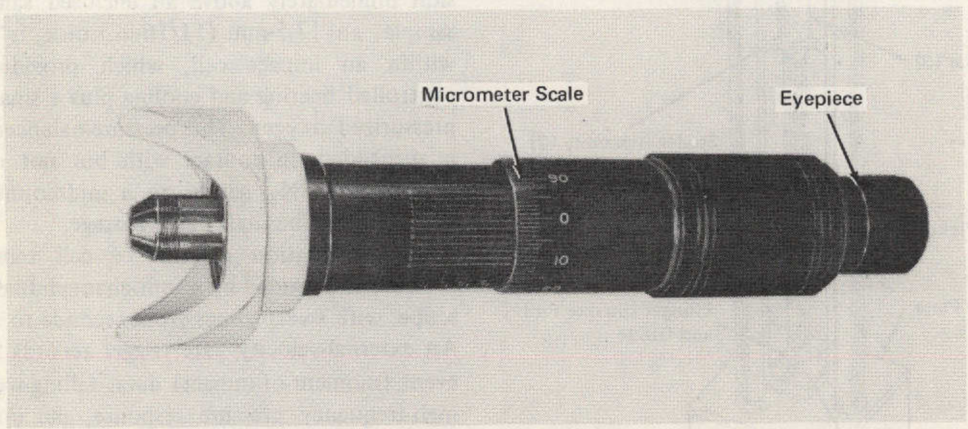


Figure 2. Optical Micrometer Used to Measure Indentor Ball Impression at 100 X.

It is well known in the field of steel metallurgy that a relationship exists between ultimate strength and hardness. This relationship has been investigated for electroformed nickel, in order to evaluate the mechanical properties at various positions in the electroform.

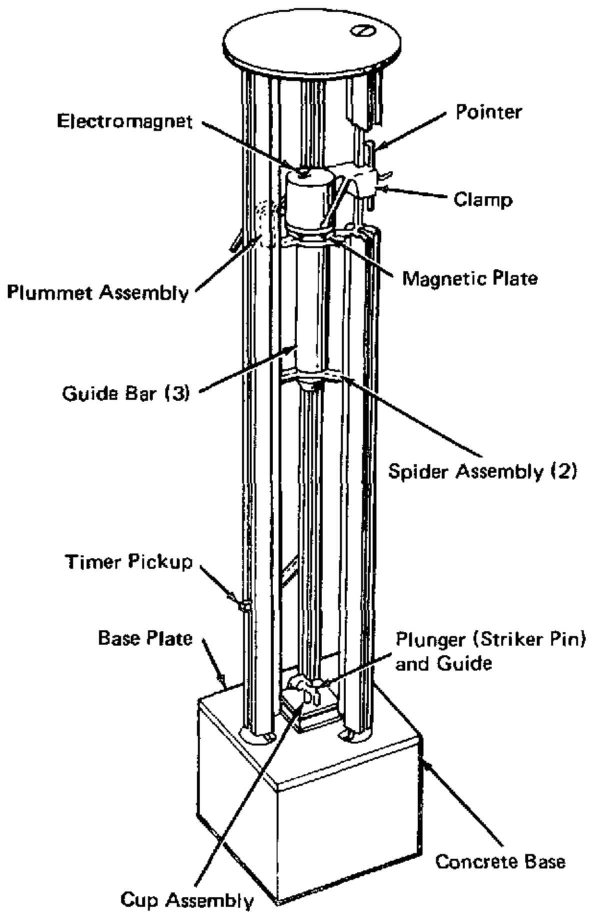
A portable hardness tester (Figure 1) was developed to determine the strength properties of irregularly shaped components of electroformed nickel (EFNi). Portable Brinell testers leave unacceptable large surface impressions, and other portable testers are not useful with irregular shapes.

The portable tester is hand held at right angles to the surface of the test item. When a trip release is operated, a calibrated spring drives a 1/16-in. (1.59-mm) super-hard metal ball into the surface of the test specimen, leaving a circular impression approximately 0.030 to 0.037 in. (0.76 to 0.94 mm) in diameter. An optical micrometer (Figure 2) with a magnification power of 100 is then used to determine the precise diameter of the impression on the surface. The diameter of the impression is compared to a conversion chart (prepared from standard-hardness test blocks), and both the yield and ultimate strengths of the component area under test are determined.

Source: E. F. Green of
Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-19167)

Circle 6 on Reader Service Card.

HIGH-PRESSURE-OXYGEN IMPACT TESTER



High-Pressure-Oxygen Impact Tester

Impact testers have been used to test the combustion characteristics of materials in a pure oxygen atmosphere. However, prior testers were limited to oxygen pressures up to 10.4×10^6 N/m^2 (1500 psi), and data were needed at much higher pressures.

This impact tester (see figure) operates over a pressure range from 10.4×10^4 N/m^2 (15 psi) to 6.9×10^7 N/m^2 (10,000 psig) and over a temperature range from the boiling point of liquid oxygen [90 K (−297° F)] to 394 K (250° F). Energy up to 137 J (100 ft-lb) is supplied when a falling weight impacts the end of a striker shaft, with its tip in pressure-balanced suspension immediately above an enclosed sample. The test sample, an 17.5-mm (11/16-in.) disk, is held in a cup within an impact cell, which provides transducer-controlled heating and cooling plus a small area for the pressurized oxygen. The pressure-balanced striker shaft is suspended, in contact with but not resting on the sample, by GN_2 acting on a midmounted diaphragm that contacts the shaft guide passage.

Instrumentation readout of cell temperature and pressure is provided by a four-channel dual-beam oscilloscope, with sweep times from seconds to microseconds. An external-velocity gate trigger records instantaneous-event (moment-of-impact) data, falling-weight velocity, high-frequency pressure response, and impact-load cell response. This analog output is recorded on film from the oscilloscope display.

Source: G. A. Hood and F. A. Raniere of Rockwell International Corp. under contract to Marshall Space Flight Center (MFS-19162)

Circle 7 on Reader Service Card.

BURST ENERGY REDUCED DURING PRESSURE TESTS: A CONCEPT

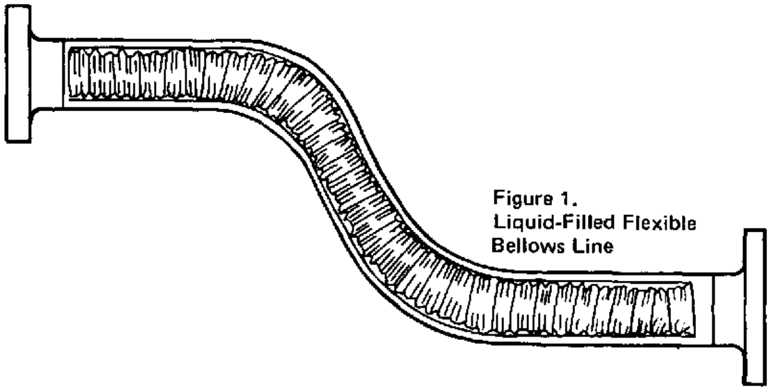


Figure 1.
Liquid-Filled Flexible
Bellows Line

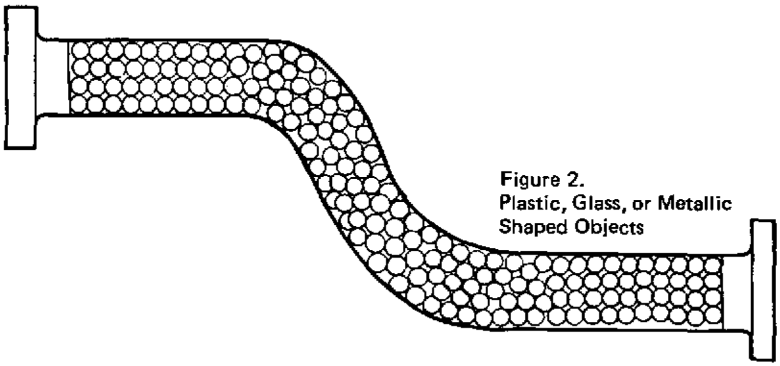


Figure 2.
Plastic, Glass, or Metallic
Shaped Objects

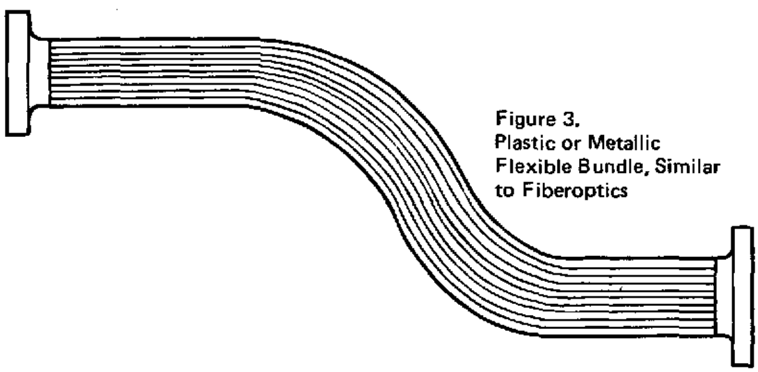


Figure 3.
Plastic or Metallic
Flexible Bundle, Similar
to Fiberoptics

Burst energy tends to build up in elbows and T's subjected to high internal pressures. Volume reduction has been used to reduce this burst energy to a safe level.

Figure 1 illustrates a flexible bellows filled with an incompressible liquid. This achieves volume reduction, while permitting the pressurized fluid to pass around the bellows. In Figure 2, the pipe is filled with plastic, glass, or metal spheres to effect volume reduction. Figure 3 shows the use of a plastic or metallic flexible bundle to achieve volume reduction.

These three concepts would enhance safety and avoid the loss of valuable fluids.

Source: G. H. Burow and F. A. Hunter of
Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-19154)

Circle 8 on Reader Service Card.

VENT LINE RELIEF-VALVE FITTING: A CONCEPT

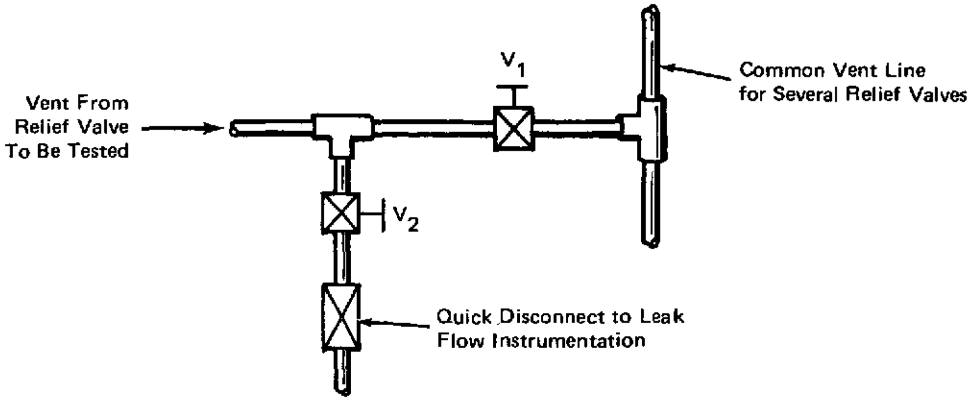


Figure 1. Presently Used Leak Test Connections.
(Typical for Each of Several Relief Valves)

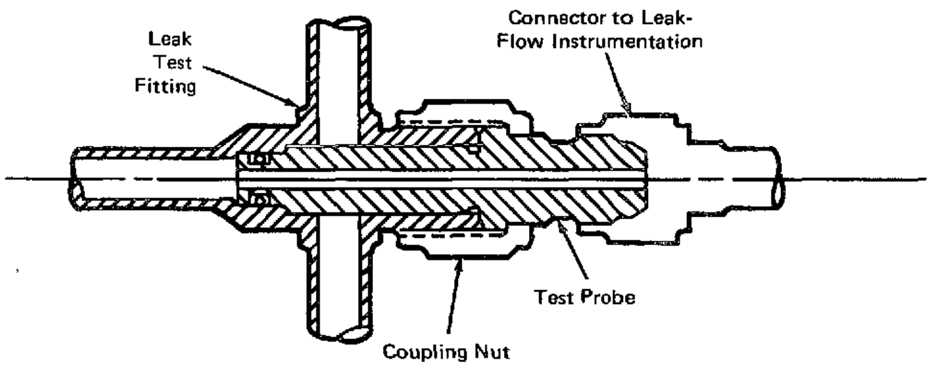


Figure 2. Proposed Leak Test Fitting and Probe

Relief valves connected to a common vent line were previously leak tested by the setup illustrated in Figure 1. In normal operation, valve V_1 is open and valve V_2 is closed, connecting the relief valve to the common vent line. Leaks were detected by closing valve V_1 and opening valve V_2, connecting the relief valve through the quick disconnect to instrumentation for measuring leak flows.

This innovation is a novel Tee-connector (Figure 2) which replaces the series of valves in Figure 1. The connector is sealed with a cap (not shown) which is held in place by a coupling nut. For relief-valve leak testing, the seal cap is replaced with a test probe as shown in Figure 2. This probe penetrates the Tee and isolates the common vent line from the relief valve, directing any leakage to the leak-flow instrumentation.

Source: W. E. Wiley of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-17783)

No further documentation is available.

SUPPORT CLAMP FOR TUBE ASSEMBLY TESTING

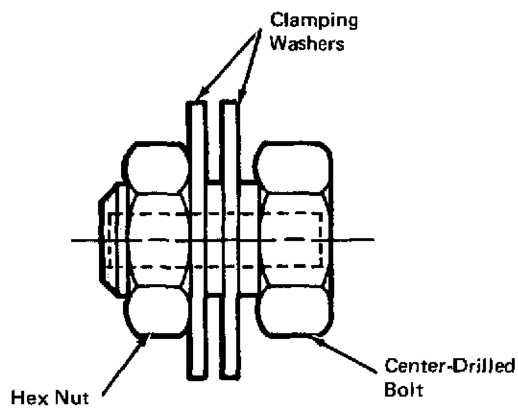


Figure 1. Clamp Assembly

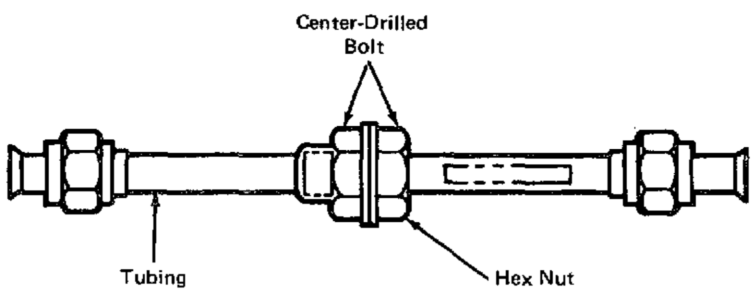


Figure 2. Clamp in Place on Tubing

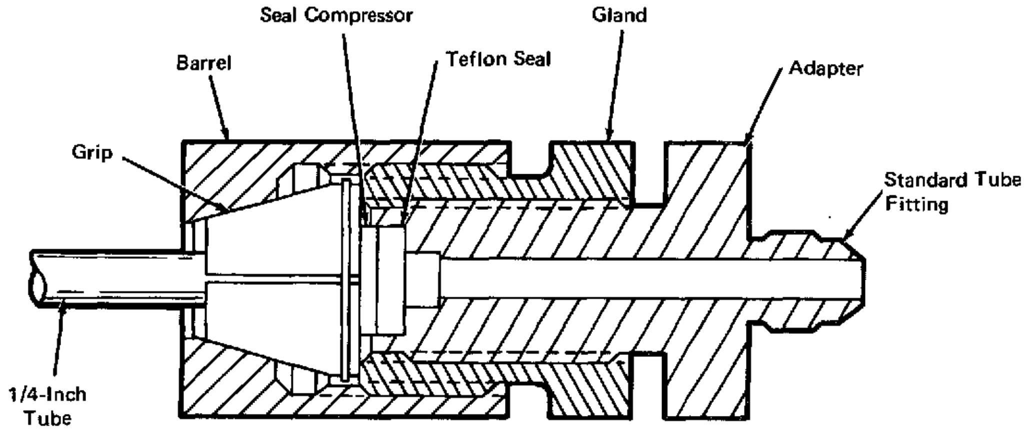
A simple tube-support clamp is useful for making temporary runs of fluid lines during a system mockup and test. The clamp consists of a center-drilled bolt, two clamping washers, and a hex nut. The bolt is drilled out to contain the O.D. of the tubing; the clamping washers are placed over the bolt threads, and the hex nut is run up on the bolt but is not tightened. This assembly (see Figure 1) is then slid over the tubing (see Figure 2) and is forced into an open-end slotted support bracket. The hex nut is then turned to force the clamping washers against the opposite faces of the support bracket.

This clamp could be useful in passing tubing through sheet-metal members in automobile body assemblies.

Source: R. A. Bender of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-17603)

No further documentation is available.

PRESSURE-TEST ADAPTER FOR UNFINISHED TUBING



Pressure-Test Adapter

In high-pressure tubing systems, brazed joints are better than fittings. For system checkout, however, the tube ends are flared and temporary fittings are used. After testing, the flares are removed and the joints are brazed. This method is time consuming and expensive.

This quick-use device (see figure) adapts to bare unfinished tubing for checkout at very high pressures [up to 12.4×10^7 N/m^2 (18,000 psi)].

The figure shows a compression fitting of a split-grip and compression gland that grips a standard unfinished (not flared) tube and mates it with a standard tube fitting. Tightening the gland compresses the Teflon seal against the seal compressor, driving the split grip against the barrel, which constricts the grip around the unfinished tubing. When submerged in water and filled with 6.9×10^7 N/m^2 (10,000 psi) of helium, flowing at 10^3 cm^3/s (STP) (61 in.^{3}/s), the joints do not leak.

Source: G. R. Taylor of
McDonnell Douglas Corp.
under contract to
Marshall Space Flight Center
(MFS-21439)

Circle 9 on Reader Service Card.

LIQUID-CRYSTAL TAPE FOR THERMOGRAPHIC TESTING OF BONDED STRUCTURES

Tape containing liquid crystals in a protective matrix, backed and supported by black plastic film, has been used successfully in thermographic testing of bonded structures. The composition of the liquid crystal is varied to provide ranges of sensitivities of thermographic response. The black film improves color display by reflected light.

In this test procedure, selected bonded panels, fabricated with specific built-in defects, were treated with liquid crystal tape on both sides, were heated to various temperatures, and then were photographed. Each panel was photographed with a copying camera with its axis perpendicular to the panel. The panels were irradiated by four quartz-iodide lamps. The lamps were in reflector mounts and were rated at 650 watts each, with a color temperature of 3200 K.

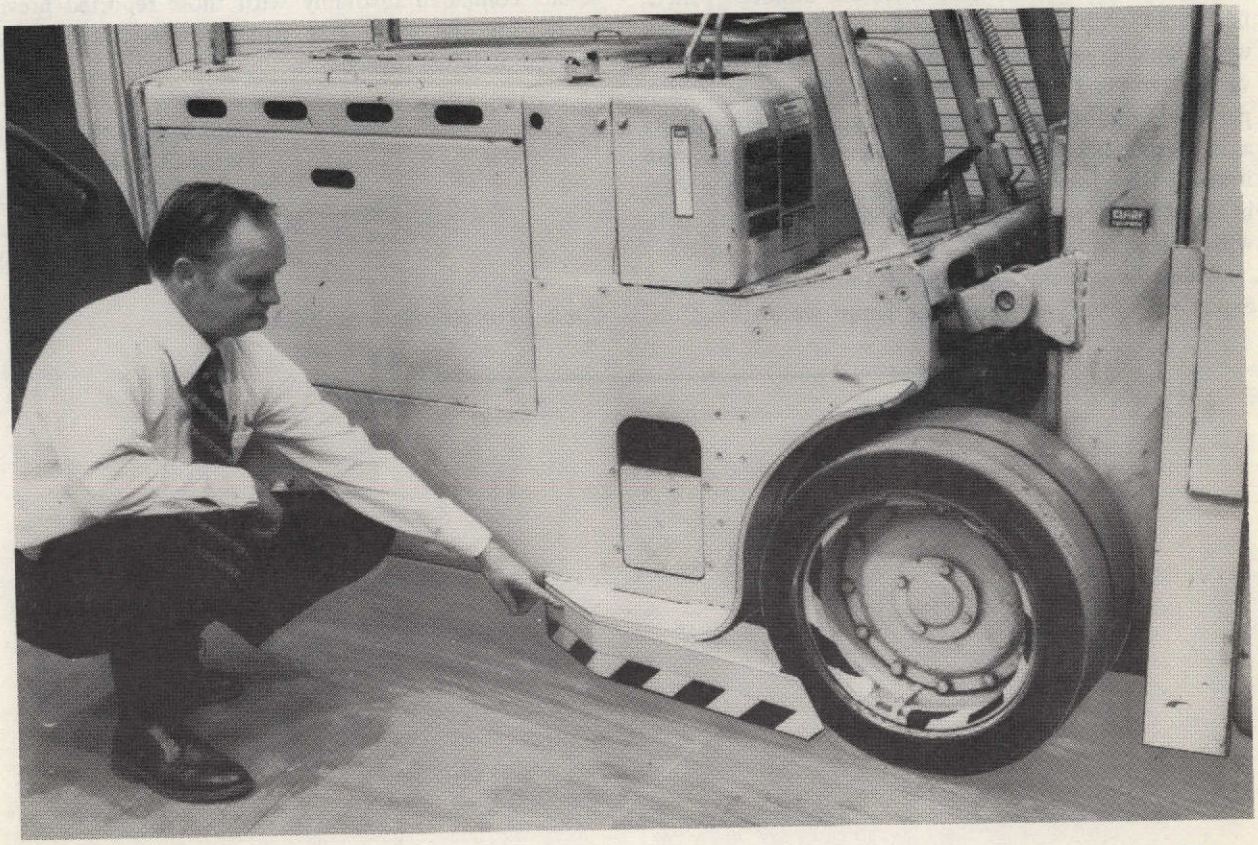
When the camera was focused and the aperture and exposure controls were set, the lamps were turned on, and a stopwatch was started. At suitable times, photographs were taken as the face of each panel heated up through the color-transition range of the liquid crystal tape. The irradiation time for each photograph was recorded. After one face of a panel was photographed, it was allowed to return to room temperature; and the procedure was repeated for its reverse side. The test results compared favorably with those reported previously, for the same test panels coated directly by sprayed-on liquid crystals.

Source: M. L. Tanzer of
Hoffman-La Roche, Inc.
under contract to
Marshall Space Flight Center
(MFS-22441)

Circle 10 on Reader Service Card.

Section 3. Safety and Maintenance Engineering

SAFETY GUARD FOR FORK-LIFT TRUCK



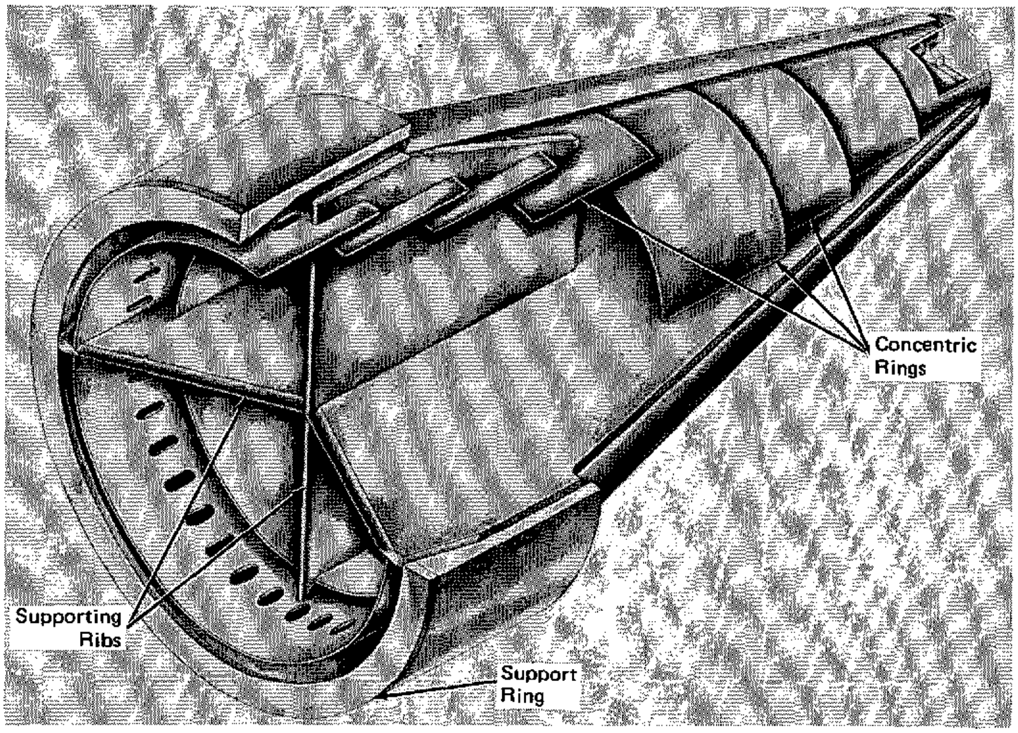
A widely used fork-lift truck has forward wheels that extend 7 in. (18 cm) beyond the vehicle body. Because of this, someone standing near the truck is in danger of having his feet run over when the truck changes direction. The situation is serious because fork-lift trucks are normally operated in noisy areas requiring someone who is giving instructions to the operator to be near the vehicle.

The safety guard shown in the figure works much like a "cow catcher" and pushes a bystander's foot outside the sweep of the forward wheel if he is too close to the vehicle, as it moves in reverse. The guard illustrated is rigid metal for use on level surfaces, but a strong, flexible nonmetallic guard could be used on uneven surfaces.

Source: E. J. Skolka and E. B. Cutright
Goddard Space Flight Center
(GSC-11751)

No further documentation is available.

PIPELINE BOLT-AND-NUT TRAP



Pipeline Bolt-and-Nut Trap

This pipeline trap is designed to operate under pressures to 12.4×10^6 N/m^2 (1800 psi) and at fluid velocities to 45 m/s (150 ft/s).

The trap basically consists of concentric rings, welded to supporting ribs, which in turn are welded to a support ring that is recessed into a special pipe flange.

Commercially available strainers for pipelines are not suitable for service where bodies 5/16 in. (7.9 mm) and larger are to be restrained at high pressures and velocities. Under these conditions, such metal bodies smash through any conventional-type strainer. Limitations imposed upon the design of a suitable trap include the following: (1) The pipe size may not be enlarged, in order that the trap may readily be removed to restore an unencumbered straight pipe run; (2) Flow restrictions causing an increase of fluid velocities have to be held to an absolute minimum; and (3) Length of the trap has to be as short as feasible to fit the limited available space in the compact pipeline.

All of the above-listed design-criteria objectives have been accomplished in this novel pipeline bolt-and-nut trip (see figure) consisting of concentric rings, welded to supporting ribs, which in turn are welded to a support ring that is recessed into a special pipe flange. Slots in the concentric rings are used to offset the loss in flow area resulting from the thickness of the rings and the supporting ribs.

This device may be of interest to industries utilizing high-speed fluid transportation, for preventing damage by stray solid objects.

Source: Leo Berner of
Aerojet-General Corp.
under contract to
Lewis Research Center
(LEW-90558)

No further documentation is available.

TANK MOUNTING SYSTEM

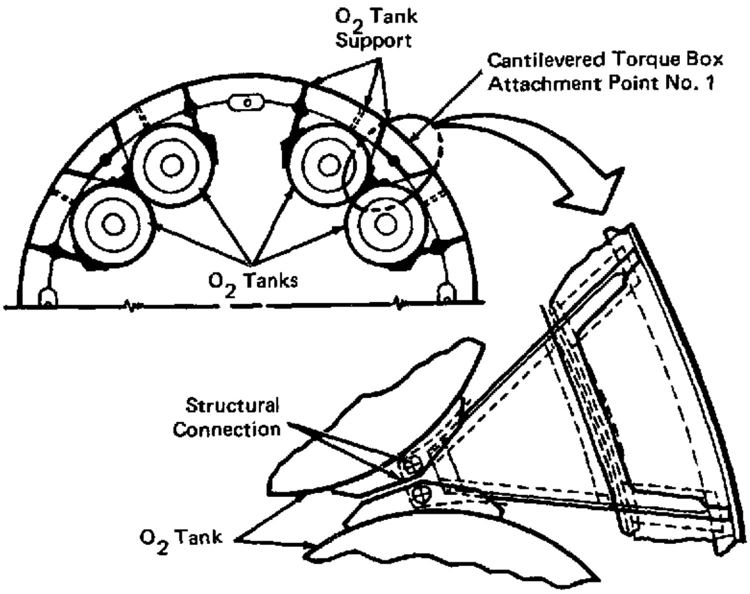


Figure 1. Function of Cantilevered Torque Box

Pressurized liquid-oxygen tanks require a mounting system that absorbs the expansion and contraction of the tanks, without placing large stresses on the tanks. In this way, a tank carries only its own load, and no loads are directed to the tank(s) through the support structure. A new three-point attachment system divides the load, so that two of them allow displacement of the tank and the third transfers the tank load to a primary path.

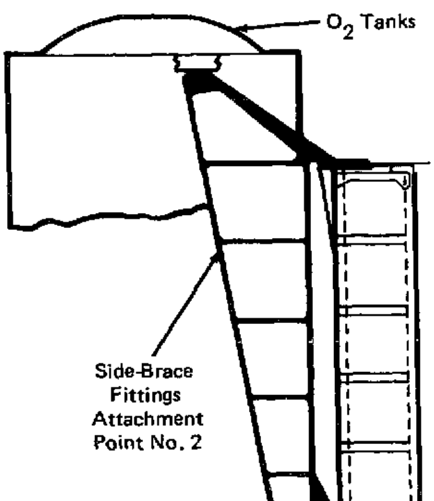


Figure 2. Machined Swing Fitting

The tank is mounted through three attachment points. The primary load is carried by a cantilevered torque box (Figure 1) that absorbs loads in all directions. The second attachment point (Figure 2), a machined swing fitting, carries loads in two directions, thereby reducing further loads that would otherwise be imposed upon the tank. The third attachment point (Figure 3), a rigid link with bearings at each end, permits displacement of the tank during pressurization.

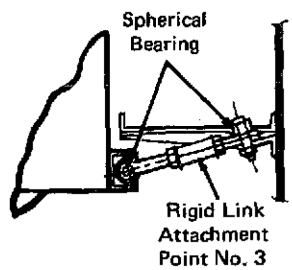


Figure 3. Rigid Link With Bearing

Source: P. J. Bergmann, Jr., and J. F. DeBold of McDonnell Douglas Corp. under contract to Marshall Space Flight Center (MFS-22374)

Circle 11 on Reader Service Card.

CONCEPTS FOR TRANSFERRING HAZARDOUS FLUIDS SAFELY

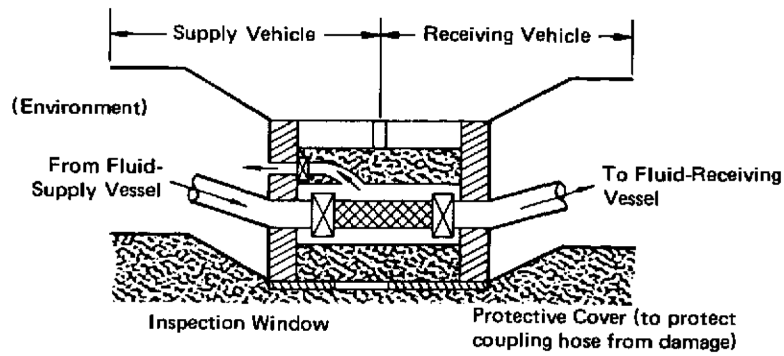


Figure 1. Double-Walled Transfer Couples

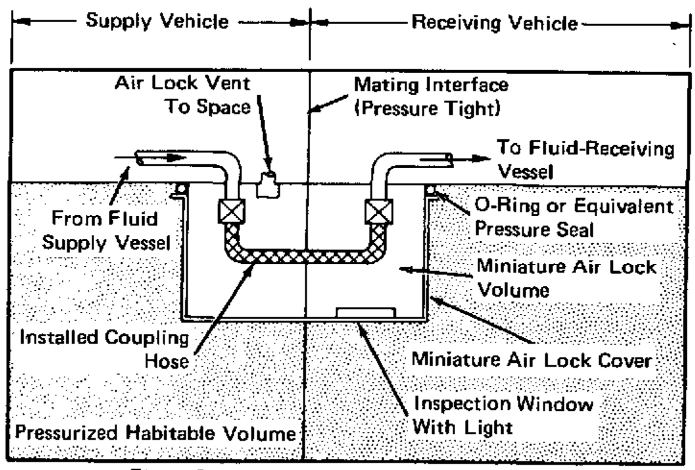


Figure 2. Hazardous-Fluid Transfer Air Lock

Two concepts have been considered for the safe transfer of hazardous fluids between two vehicles in space. The first involves double-walled coupling; and in the second, the problem is approached with a miniature air lock.

The double-walled transfer coupling (Figure 1) is housed in a vent chamber, which is common to both vehicles. Once coupled, operation of the double-walled section can be observed through the inspection window located in the vent chamber protective cover. Failure or unacceptable leakage in the inner line can be observed on instruments in either of the two vehicles; and the hazardous fluid will vent through the check valve in the chamber wall. Valves in the two vehicles can be closed, and the vent chamber can be purged with an inert gas to remove any residual hazardous fluids. Repairs can be made then to a defective part.

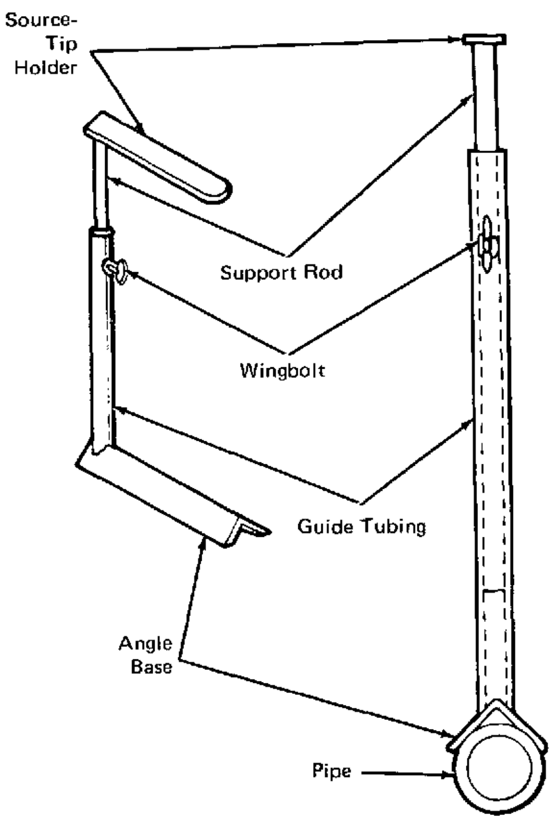
The hazardous-fluid transfer air lock (Figure 2) does not employ a double-walled coupling, but it includes a conventional flex line and depends on the action of the air lock volume and a vent valve into space. This innovation can accommodate any leakage or complete rupture that may occur within the air lock. Activity within the air lock can be seen through an inspection window. As in the double-walled device, shutting off the supply and receiving valves and purging the air lock with an inert gas permits repairs to any defective part.

An interesting aspect of these two concepts is their adaptability to undersea research, an area of increasing development.

Source: R. E. Altenbach of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-17968)

No further documentation is available.

RADIOGRAPHIC-SOURCE-TIP STAND



Radiographic-Source-Tip Stand

Radiographic inspection is used to detect flaws in metal pipes, tubes, elbows, and similar parts. Under typical field conditions, it may be difficult to position the radiation source in correct relationship to the subject and film. Floor stands in general use are heavy, bulky, and frequently require two men to adapt them for best results.

A radiographic-source-tip stand (see figure) can be used by one man. It is simple and lightweight. The angle base of the holder is taped to the pipe near the area to be inspected. The source-tip holder is positioned by loosening the wingbolt and sliding the support rod up or down in the guide tubing with proper rotation. The wingbolt is tightened when the correct position is reached.

Source: Ralph E. Peterson of
Bendix Corp.
under contract to
Kennedy Space Center
(KSC-10549)

No further documentation is available.

PROTECTIVE COATING FOR LIGHT BULB BASES

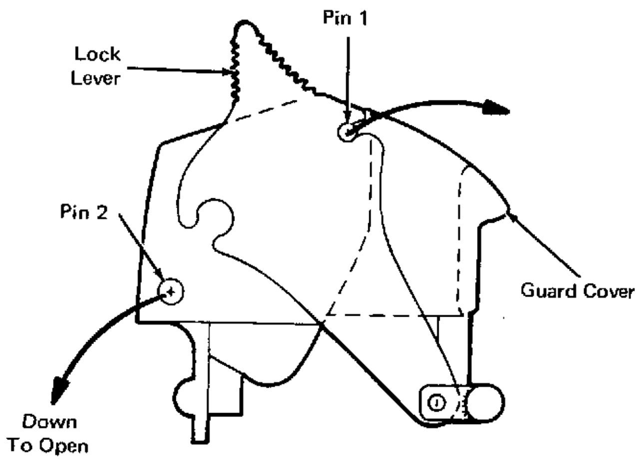
The vitreous insulator bases of single- and double-contact light bulbs are brittle and easily cracked or chipped during shipment and installation. This is a serious problem in a zero-gravity environment where free particles cannot be tolerated.

A protective coating of an epoxy sealant has been used to protect vitreous insulation from cracking and chipping. This technique should be useful in other applications where insulator damage must be avoided.

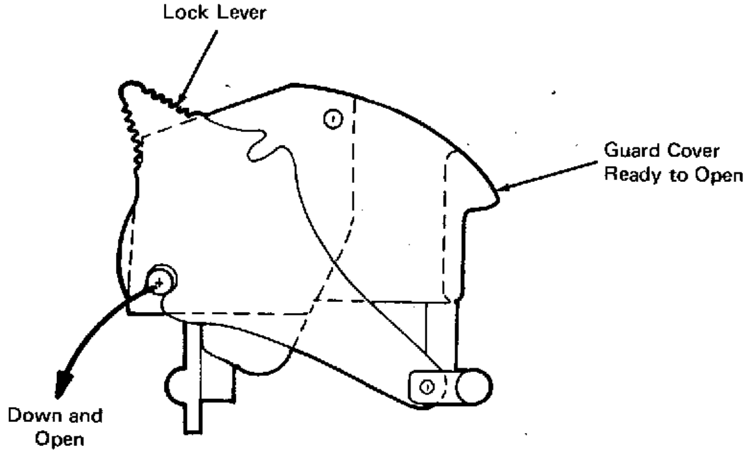
Source: L. D. Menges of
McDonnell Douglas Corp.
under contract to
Marshall Space Flight Center
(MFS-22421)

Circle 12 on Reader Service Card.

TOGGLE SWITCH SAFETY GUARD



Position 1



Position 2

Toggle Switch Safety Guard

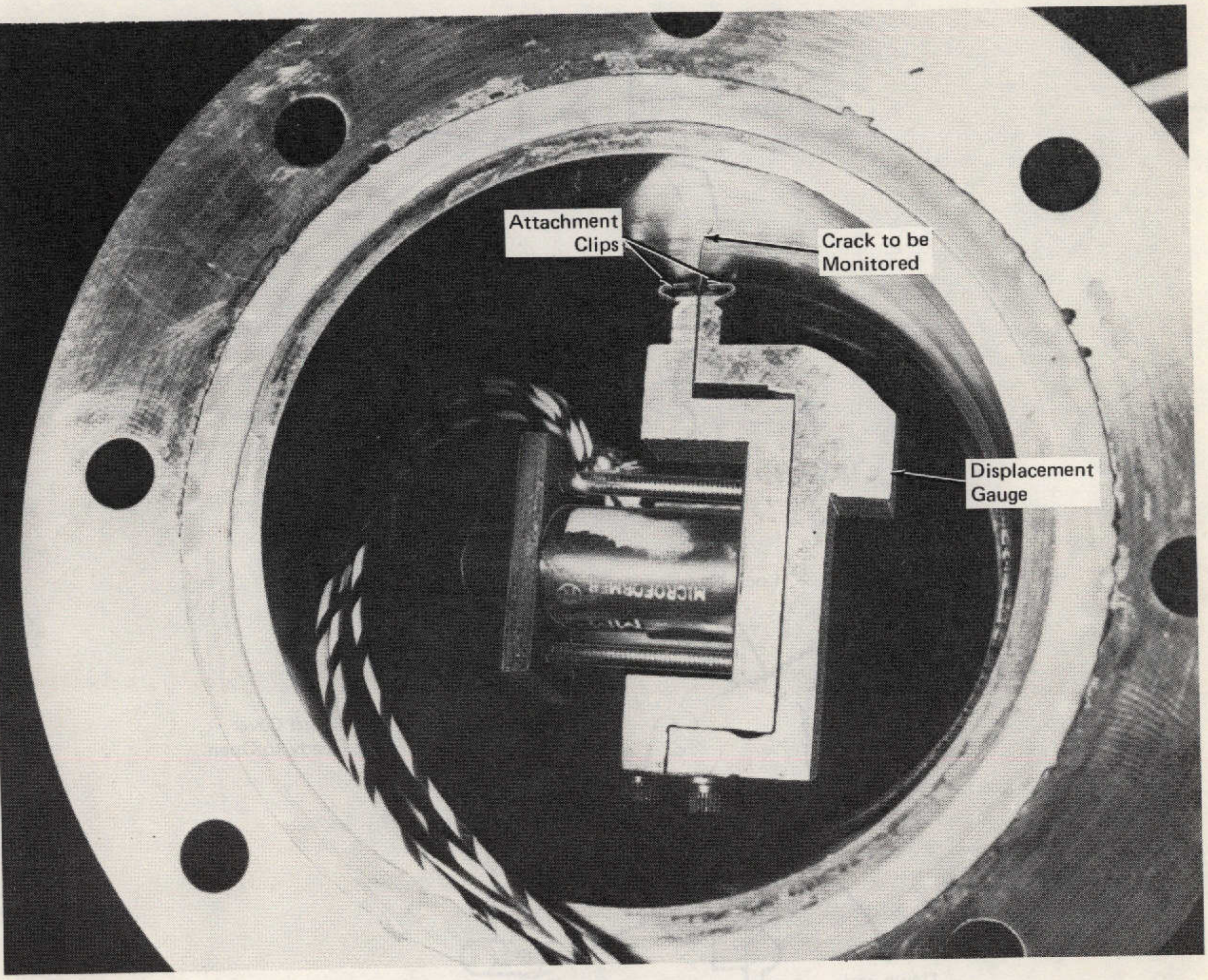
This safety guard may be used with critical switches, to prevent them from being operated by mistake. In position 1 in the illustration (toggle on or off), the lock lever engages pin 1, and the guard cover cannot be moved on its pivot at pin 2. Moving the lock lever to position 2 releases the guard cover, allowing it to be raised on its pivot (at pin 2) to uncover the toggle.

Compared to key-operated guards, this guard provides the extra safety of one additional operation. The toggle switch is just as accessible, but the operator is put on notice that it is a critical switch.

Source: P. J. Rossi
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-15638)

No further documentation is available.

PREDICTING CRACK PROPAGATION IN PRESSURIZED LINES



Crack Propagation Test Setup

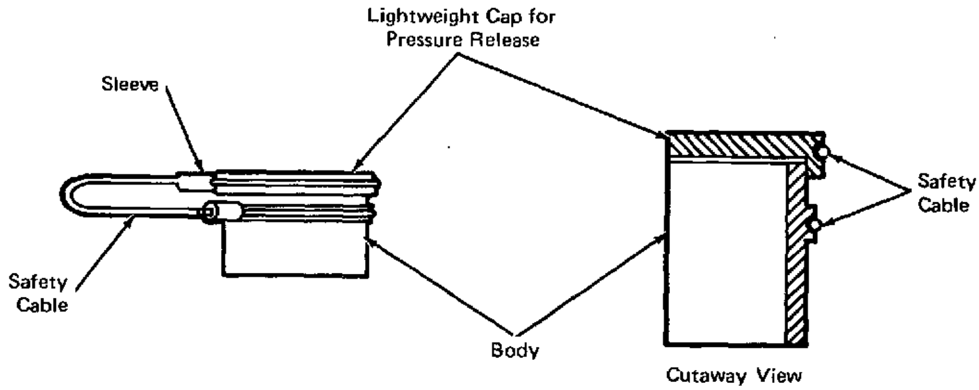
Surface-crack propagation in pressurized lines can now be predicted more accurately than by previous methods. Test samples of a 6.0-m (20-ft) length of Inconel 718 pipe 7.6 cm (3 in.) in diameter, welded to stainless-steel 321 flanges, have been monitored for weld-crack propagation under simulated operational conditions of pressure and temperature.

Dye penetrant is used initially to locate a surface crack. A displacement gauge (see figure) is then placed over the crack and held in place by clips that are spot welded to the pipe surface on either side of the crack. The line is pressurized, in a test setup, to its normal operating pressure; and crack behavior is recorded on a strip-chart recorder which receives signals from the displacement gauge. This technique could be used to continuously monitor large storage vessels, so that repairs to propagating cracks could be optimally scheduled.

Source: R. E. Brady of
Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-24053)

Circle 13 on Reader Service Card.

OVERPRESSURE SAFETY CAP FOR HELIUM LEAK DETECTOR



Overpressure Safety Cap

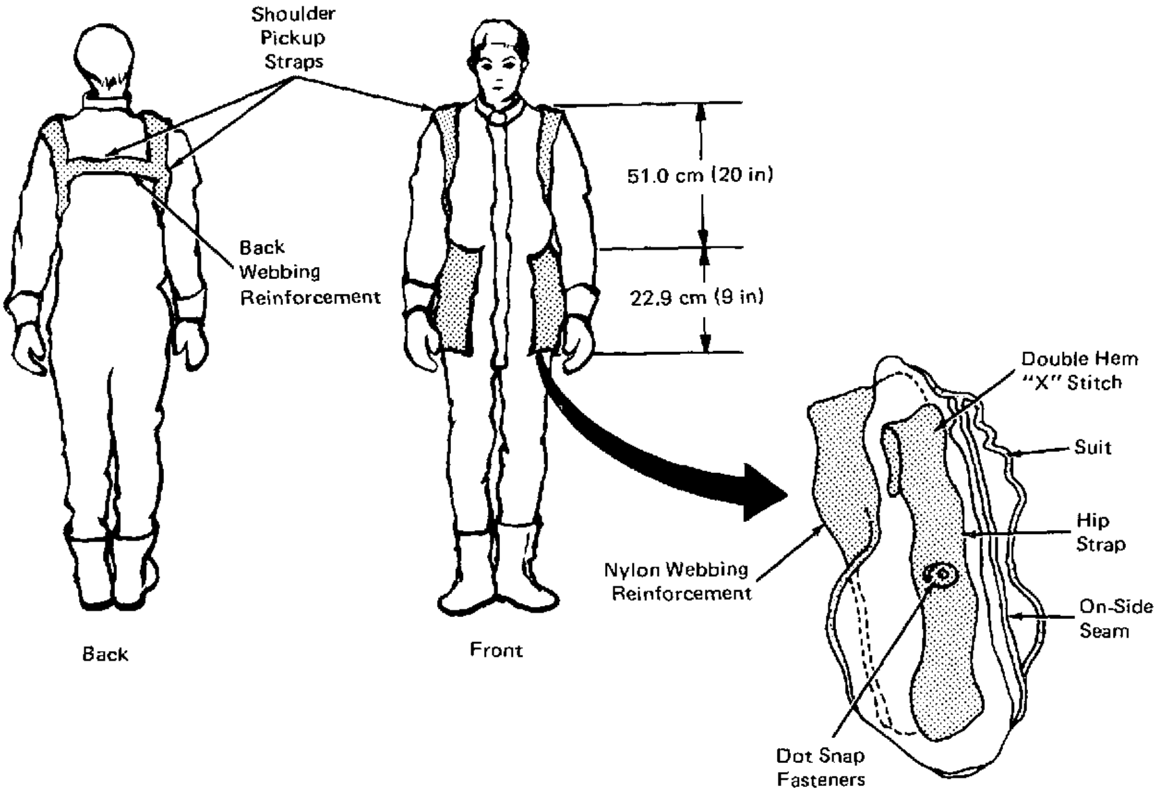
Mass-spectrometer helium leak-test units have a large alternate inlet used with special large-chamber tests, in addition to the smaller line connections used for most tests. Rupture of a defective burst disk in the smaller line can apply as much pressure as 2.07×10^6 N/m^2 (300 psi) to the system, and may often project the heavy alternate-inlet closure cap into the test area at high velocity.

An overpressure safety cap can be used in place of the previous cap to avoid the danger of personal injury and equipment damage. The lightweight cap (see figure) is conventionally fastened to the inlet body. A safety cable is fitted in slots around the cap and the inlet body, respectively; and is held in place by two restricting sleeves. When overpressure forces the lightweight cap from the inlet body, the safety cable restricts cap movement to the length of the cable between the restricting sleeves.

Source: K. R. Hubbs of
Rockwell International Corp.
under contract to
Johnson Space Center
(MSC-17172)

No further documentation is available.

COVERALL SAFETY STRAPS FOR PERSONNEL RESCUE



Coverall Safety Straps

Nylon safety straps sewed to workers' coveralls (see illustration) aid rescuers in removing disabled wearers from dangerous environments. The tape used for these straps is 2.54 cm (1 in.) wide, type 2 MIL-T-5038 nylon. The straps are so placed that, regardless of the position of the wearer, the rescuer can always use one or more to effect rapid movement of the subject.

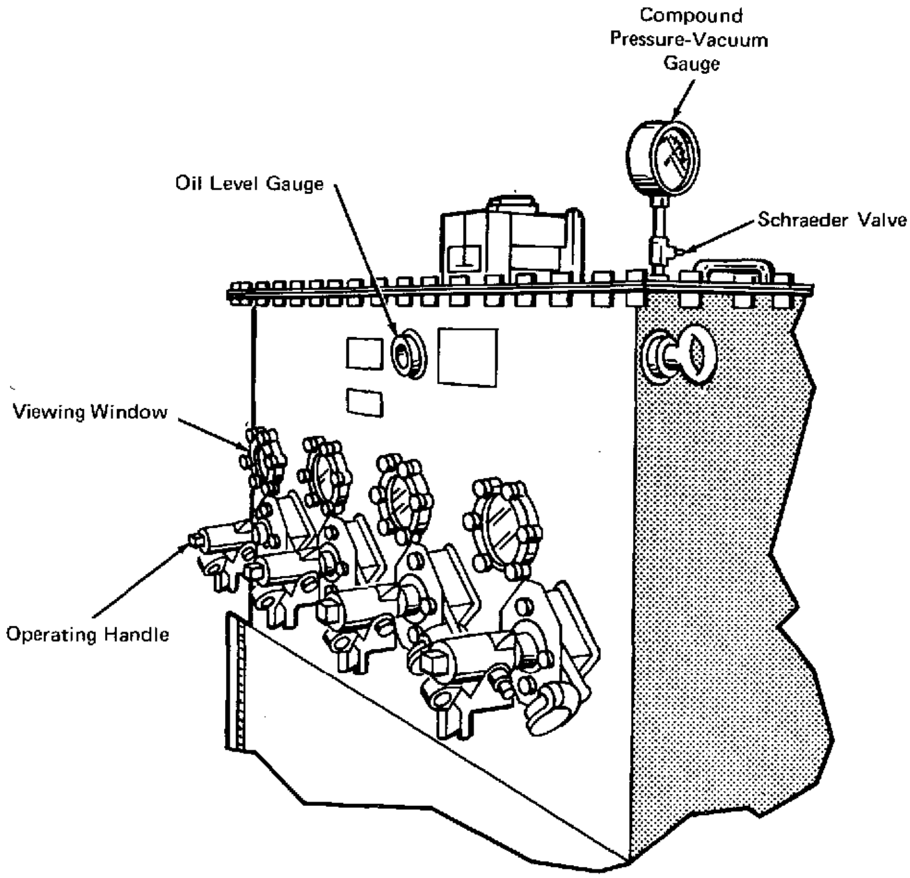
Shoulder pickup straps are sewed around and under the arms, giving good support of the subject's body in an upright carry. The back webbing reinforcement joins the shoulder straps, and together they mechanically force the shoulders and front of the garment to share the load in a facedown horizontal carry. Tapes 22.9 cm (9 in.) long are attached to each side of the garment on each of the vertical side seams, about 51.0 cm (20 in.) down from the tapes of the shoulders. These support the hips in a horizontal carry as the subject rests on either side.

With this safety strap arrangement, a subject wearing difficult-to-handle coveralls can be grabbed with confidence from any angle of approach. He can be moved readily to a more favorable treatment position in case of serious injury. Two to six people can use the straps to share the load in a manner that avoids the aggravation of severe injuries such as fractures, hematomae, or internal damage.

Source: Henry M. Waddell, Jr., of
Rockwell International Corp.
under contract to
Kennedy Space Center
(KSC-10815)

Circle 14 on Reader Service Card.

GAS CHARGING OF OIL-FILLED BREAKER SWITCHES



Gas-Charging Arrangement for Oil-Filled Breaker Switches

Dry nitrogen gas has been used to maintain pressure on oil-filled breaker switches. Pressure above the oil is required to ensure complete immersion of the switches, to prevent arcing during operation. Periodically, the switches are cleaned and purged with nitrogen, refilled with fresh oil, and repressurized with nitrogen. This is done by installing a permanent hose-and-valve arrangement in the pressurized tank gaugeline.

This method uses a Schraeder valve, which is generally used to inflate automobile tires, in the tank gaugeline (see figure). The method permits the use of a portable gas bottle and hoses to pressurize, purge, and repressurize the breaker-switch tank.

Source: F. M. Hoog of
Trans World Airlines
under contract to
Kennedy Space Center
(KSC-09981)

No further documentation is available.

Patent Information

The following innovations, described in this Compilation, have been patented or are being considered for patent action as indicated below:

Simultaneous Multimeasuring Caliper Standard (Page 4) LAR-11114

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
Langley Research Center
Code 456
Hampton, Virginia 23665

Pyrotechnic Performance Monitoring (Page 8) LAR-10800

This invention has been patented by NASA (U.S. Patent No. 3,670,559). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Langley Research Center
Code 456
Hampton, Virginia 23665

High-Pressure-Oxygen Impact Tester (Page 10) MFS-19162

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
Marshall Space Flight Center
Code CC01
Marshall Space Flight Center, Alabama 35812