FLIGHT SAFETY FOUNDATION
Aviation Mechanics Bulletin

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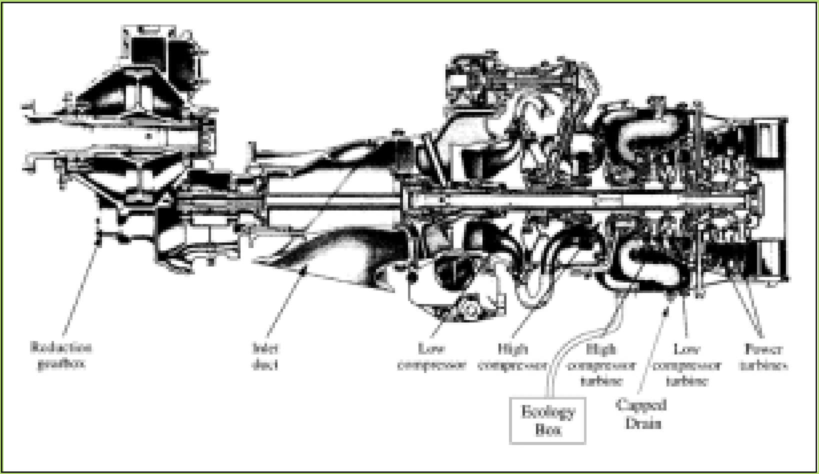

FLIGHT SAFETY FOUNDATION
1947–1997

FLIGHT SAFETY FOUNDATION

Aviation Mechanics Bulletin

Dedicated to the aviation mechanic whose knowledge, craftsmanship and integrity form the core of air safety.

Robert A. Feeler, editorial coordinator

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In-flight Engine Fire Caused By Uncapped Fuel Drain, Prompts NTSB Safety Recommendations

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FSF Editorial Staff

A recent in-flight engine fire involving a twin-turboprop illustrates that diagnosing and correcting a mechanical problem is only the first step in preventing the accident from recurring. The second, and equally important, step is following the proper notification procedures so that personnel can be alerted about accident-causing problems.

After the in-flight engine fire, the operator of the Embraer EMB-120 took the proper action. Not only did it inspect its own fleet — which led to the discovery of two other aircraft with incorrectly installed engine components — but it notified the U.S. National Transportation Safety Board (NTSB), which has recommended that the U.S. Federal Aviation Administration (FAA) issue airworthiness directives (ADs) intended to counteract the possibility of other accidents with EMB-120 fleets equipped with Pratt & Whitney Canada (PWC) PW118B engines.

Shortly after takeoff from San Diego (California, U.S.) International–Lindbergh Field on May 21, 1997, the SkyWest Airlines EMB-120 lost power in the right engine. The fire-warning light illuminated in the cockpit, and flames were seen exiting the right-engine nacelle and exhaust. The fire was extinguished by discharging both of the airplane's fire-extinguisher bottles.

The pilots then observed that there was no pressure in both hydraulic systems. The pilots made an emergency single-engine landing at a nearby military airfield. Because there was no hydraulic pressure, they landed with flaps up.

The NTSB safety recommendation (SR) that resulted from the accident said, "The pilots were unable to use single-engine reverse thrust because of the lack of nosewheel steering, and the hydraulic brakes and the emergency braking system were inoperative."

The runway was 3,660 meters (12,000 feet) long. The airplane touched down in the first 610 meters (2,000 feet), but overran the runway at an estimated speed of 37 kilometers per hour to 56 kilometers per hour (20 knots to 30 knots) and stopped about 397 meters (1,300 feet) beyond the end of the runway. There were no injuries among the two flight crew, one cabin crew and 14 passengers.

Examination of the airplane revealed extensive heat and fire damage to the right-engine nacelle, right wing and right landing-gear well. The engine nacelle around the exhaust pipe was burned through, and a 1.5-meter (five-foot) section of the exhaust pipe was missing. The right-engine hydraulic system pump and tank were destroyed by the fire, and a hydraulic system line for the left engine — which crossed through the right-engine nacelle — was burned through. There was an oval-shaped, 7.6-centimeter by 10.1-centimeter (three-inch by four-inch) hole burned through the web of the right-wing spar aft of the engine, and the right-aileron control cables were also fire-damaged.

When the NTSB disassembled the engine, investigators discovered that the first-stage power-turbine (PT) disk front face had been burned at the counterweight flange by an intense oil-fed fire. The first-stage PT disk was still intact, but two blade-retaining lugs were elongated coincident with a continuous sector of five first-stage blades that had come out of their blade slots. All of the remaining first-stage PT blades were fractured crosswise just above the blade-root platform.

The second-stage blades were also fractured at varying heights above the blade-root platform, but the blades were not burned. Furthermore, all of the high-pressure turbine (HPT) and low-pressure turbine (LPT) blades were intact and showed no indications of having been burned.

The SR said, "The lack of scorching of the HPT, LPT and second-stage blades suggests that there was not a torching effect from the fuel nozzles through the turbines that could have also burned through the exhaust pipe."

The NTSB concluded that "the extensive damage ... to the right-engine nacelle, wing and landing-gear well could not have been caused by the initiating oil-fed fire."

The gas-generator case on the PWC PW100 series engines has two drain plugs (Figure 1, page 3) — one at the front of the case and one at the rear of the case — to drain from the fuel manifolds the unburned fuel that has drained back through the lowest fuel nozzles into the gas-generator case. The drains are intended to prevent pooling of fuel in the bottom of the generator case, which could cause internal engine fires or hot starts.

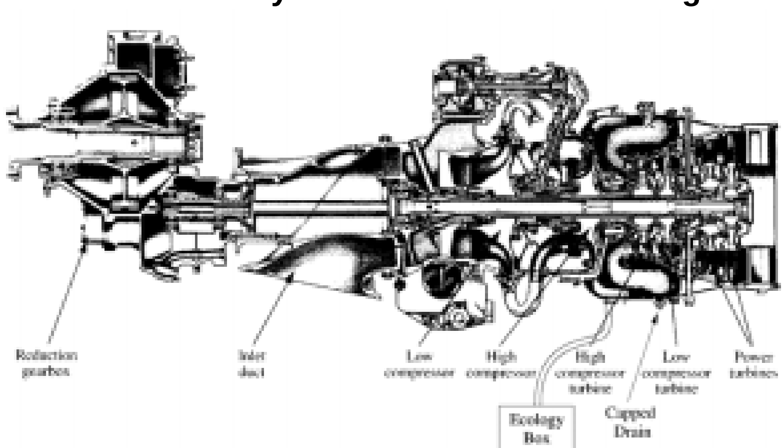
The forward drain plug is connected to a drain line that leads to an "ecology" tank that collects and stores fuel or oil that has leaked from the engine, rather than venting the liquids into the atmosphere or draining them onto the ground. The ecology tank is emptied into another container on the ground for proper disposal. The aft generator-case drain plug is normally capped.

Each drain plug has a seal that closes to prevent air leakage when the case is pressurized, and opens after engine shutdown when the pressure inside the case returns to ambient levels.

The SR said, "During the disassembly of the engine, it was noted that the forward drain plug had the drain line that would have been routed to the ecology tank. But the aft drain plug did not have the cap attached, and the threads of the plug were not damaged. Thus, the [NTSB] concluded that the cap had not been installed before the engine failure.

"Therefore, when the engine failed and shut down because of the oil-fed fire, the unburned, residual fuel in the fuel manifolds would have drained back

Pratt & Whitney Canada PW100 Series Engine



Source: Pratt & Whitney Canada

Figure 1

through the fuel nozzles into the gas-generator case and then out through the drain plugs at the bottom of the case. Because the airplane was climbing in a nose-high attitude, the fuel would have drained rearward through the [uncapped] aft drain plug and onto the deck under the engine ... [where it] could have been ignited by the heat from the hot exhaust pipe in the aft section of the engine nacelle."

After this incident, the operator inspected its fleet of 50 EMB-120 airplanes and found two other airplanes with PW118 engines that were missing caps from the gas-generator case aft drain plugs. The operator informed the NTSB that it had immediately installed caps on the aft drain plugs on those two engines. The NTSB subsequently contacted the maintenance departments of two other major EMB-120 operators and requested that they inspect their fleets to ensure that the gas-generator case drain plug not connected to the drain line for the ecology tank was capped off. Those inspections did not reveal any aircraft with uncapped drain plugs.

The SR said, "However, the [NTSB] is concerned that other PW100 series turboprop operators, domestic and foreign, may have gas-generator drain plugs missing that could cause in-flight fire hazards to the airplane. The [NTSB] is aware that on June 4, 1997, Embraer issued Alert Service Bulletin No. 120-72-A005 to alert operators that the cap should be installed on the gas-generator case drain. Nevertheless, the [NTSB] believes that the [FAA] should issue an [AD] to require an immediate one-time inspection of all PWC PW100 series turboprop engines to ensure that the gas-generator case drain line and the plug are correctly installed."

The EMB-120 *Powerplant Buildup Manual* provides the instructions on external components and parts that must be installed on a PW100 series turboprop engine before an operator installs the engine in an EMB-120 airplane. (The accident occurred on the day after the engine had been installed in the airplane.)

Task 71-00-00, Subkit No. 16, of the *Powerplant Buildup Manual* shows the drain lines and plugs that should be installed on the engine for installation into the airplane. But, the SR said, the instructions consist of only a single drawing that shows the drain lines and plugs and a list that identifies each part; no text or supplemental illustrations show where each individual line and plug should be installed on the engine.

"The [NTSB] is concerned," the SR said, "that without clearly defined instructions that include text and illustrations, [the] drain lines, caps and clamps could be installed incorrectly or not [be] installed at all after engine maintenance by the operator, thus creating a fire hazard to the airplane.

"Therefore, the [NTSB] believes that the FAA should require Embraer to revise the engine installation instructions in its *Powerplant Buildup Manual* to clearly define, with illustrations and text, where all of the required lines and plugs must be installed on the PWC PW100 series engines for installation on an EMB-120 airplane."

PW100 series turboprop engines are also used on the Avions de Transport Regional ATR-42, De Havilland DHC-8, Dornier 328-110 and 328-120, Fokker 50 and the British Aerospace Jetstream ATP. Because of concern that the engine-buildup instructions may also be inadequate for these airplanes, the SR recommended that the FAA review all of the PW100 series turboprop engine-buildup instructions for installing the engine on airplanes other than the EMB-120 to ensure that the instructions are clear and unambiguous; and require the manufacturers to revise the instructions, if necessary.

The SR said, "Therefore, the [NTSB] recommends that the [FAA]:

- "Issue an [AD] to require an immediate one-time inspection of all Pratt & Whitney Canada PW100 series turboprop engines to ensure that the gas-generator case drain line and the plug are correctly installed. (Class I, Urgent Action) (A-97-38);
- "Require Embraer to revise the engine installation instructions in its *Powerplant Buildup Manual* to clearly define, with illustrations and text, where all of the required lines and plugs must be installed on the Pratt & Whitney Canada PW100 series engines for installation on an EMB-120 airplane. (A-97-39); [and,]
- "Review all of the Pratt & Whitney Canada PW100 series turboprop engine-buildup instructions for installing the engine on airplanes other than the EMB-120 to ensure that the instructions are clear and unambiguous; and require manufacturers to revise the instructions, if necessary. (A-97-40)."

The FAA responded to NTSB Safety Recommendation A-97-38 by issuing AD 97-17-05, requiring a visual inspection of the two gas-generator case drain ports to ensure that they are connected to drain lines or capped in accordance with the procedures set forth in PWC Service Information Letter no. PW100-003, dated June 18, 1997.

In response to NTSB Safety Recommendation A-97-39, Embraer revised its *Powerplant Buildup Manual* and

Maintenance Manual to define where required lines and plugs must be installed on PWC PW100 series engines for installation on the EMB-120. The *Powerplant Buildup Manual* illustrations were expanded to show where the drain lines and plugs should be installed on the combustion chamber aft drains. The *Maintenance Manual* was revised to expand the text instructions for the engine forward, center and rear section drains.

In response to NTSB Safety Recommendation A-97-40, PWC reviewed the instructions for continued airworthiness, including the parts list, maintenance manual and powerplant buildup instructions and concluded that suitable instructions are in place to address the recommendation.♦

Editorial note: This report is based on NTSB Safety Recommendations A-97-38 through A-97-40, dated June 13, 1997.

NEWS & TIPS

Maintenance Management Seminar/ Workshop Set

An Aircraft Maintenance Management Seminar/Workshop will be held at Clearwater Beach, Florida, U.S., Jan. 13–16, 1998. The organizer, Transportation Systems Consulting Corp., says that emphasis will be on "cost-saving management techniques aimed at increasing productivity."

Topics to be discussed in the seminar/workshop include:

- Management skills and practices;
- Reliability program overview;
- Financial management;
- Engineering and quality assurance;
- Maintenance information systems;
- Material and logistics management;
- Maintenance planning and control; and,
- Maintenance control center.

For more information, contact: Transportation Systems Consulting Corp., 35111 U.S. 19 North, Suite 101, Palm Harbor, FL 34684 U.S. Telephone: (813) 785-0583; Fax: (813) 789-1143.

Simulator Maintenance Course Inaugurated

A new course in flight simulator maintenance has been inaugurated by Embry-Riddle Aeronautical University in Daytona Beach, Florida, U.S.

Students in the course service Frasca 141 and Frasca 142 simulators, which are used in learning to fly single- and twin-engine aircraft. Plans call for maintenance training on a Beech 1900D simulator and a Boeing 737-300 simulator.

Many simulator manufacturers will train an airline's personnel to operate the simulators, but not how to repair them, an Embry-Riddle spokesman said. Nevertheless, simulators need to be adjusted periodically to maintain their accuracy.

From the present single class, the training is expected to be expanded to the creation of a degree program.

For more information, contact: Embry-Riddle Aeronautical University, 600 S. Clyde Morris Boulevard, Daytona Beach, Florida 32114-3900 U.S. Telephone: (904) 226-6618 or (904) 226-6651; Fax: (904) 226-6158.

Heli-Expo 1998 Features Maintenance Courses

Professional education courses in Helicopter Maintenance Management, Human Performance in Helicopter Maintenance, and Regulatory Compliance: Airworthiness and Maintenance Issues will be offered in conjunction with Heli-Expo 1998, held at Anaheim, California, U.S., Feb. 9–21, 1998. The exposition and courses are sponsored by Helicopter Association International.

According to the course announcement, Helicopter Maintenance Management (Feb. 11–14) is "designed to give new or prospective managers of helicopter operations the management skills needed to become more efficient in the area of costs and to help increase profitability ... ." The course includes:

- Principles of management and management information systems;
- Maintenance malfunction information reporting (MMIR) basics;
- Inventory management;
- Productivity improvement and error reduction;
- Financial management;
- Accounting overview; and,
- Regulatory overview.

Human Performance in Helicopter Maintenance (Feb. 13–14) is described as "a workshop put together by maintenance personnel for maintenance personnel. The training goal of this two-day workshop is to examine the human role in the chain of events that cause[s] an aviation occurrence and develop ways to prevent or lessen the seriousness of the occurrence." Participants will examine:

- Actual case studies;
- What determines a person's characteristics and behavior;

- Human factor errors; and,
- Stress, fatigue and how to deal with them.

Regulatory Compliance: Airworthiness and Maintenance Issues (Feb. 14) was developed "in recognition ... that most aviation regulatory law is practiced on a daily basis by nonlawyers, such as quality assurance or other technical personnel." Participants will examine:

- U.S. Federal Aviation Regulations (FARs) and U.S. Federal Aviation Administration (FAA) guidance material relating to FARs Parts 21, 43, 91, 119, 135 and 145;
- FAA organization;
- Major FAA inspections;
- How to work with the local FAA office; and,
- FAA enforcement issues and criminal laws applicable to the aviation industry.

For more information, contact: Helicopter Association International, 1635 Prince Street, Alexandria, VA 22314 U.S. Telephone: (703) 683-4646; Fax: (703) 683-4745.

Old Product Finds New Use

Abrasive cords and tapes are normally used to deburr or smooth out crevices and fillets. There is also a way to use the cords to smooth the edges of drilled holes.

Abrasive cord and drill

A short length of abrasive cord is doubled over, twisted and inserted into a drill. The loose ends of the cord are inserted into the drilled hole. When the drill is actuated, the cords spin and the complete circumference of a drilled hole is effectively deburred.

There are two safety concerns when using this procedure. Safety glasses or other eye protection should be worn to guard against flying metal chips. And adjacent materials or areas should be protected from debris that can be thrown by the spinning cords.

Maintenance-related Scholarships Available For Women in Aviation

More than US$200,000 in scholarships will be awarded at the International

Women in Aviation Conference in Denver, Colorado, U.S., in March 1998. Scholarships will be awarded in the maintenance category, as well as other categories.

Maintenance-related scholarships include the Aircraft Technical Publishers Maintenance Technician of the Year Award, FlightSafety International Maintenance Scholarship (Citation V Maintenance Initial) and the SimuFlite Training International Maintenance Scholarship (Citation III Maintenance Initial Training).

Scholarship applications must be received by Dec. 12, 1997.

For more information, contact: Women in Aviation, 3647 S.R. 503 South, West Alexandria, OH 45381 U.S. Telephone: (937) 839-4647; Fax: (937) 839-4645.♦

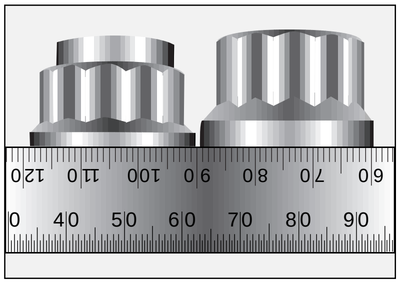
MAINTENANCE ALERTS

Broken Nut Brings Training Flight To a Halt

The Boeing 707, in service with the Australian Defence Force (ADF), was beginning a series of practice full-stop landings using engine thrust reversers. On the first landing, the reversers worked properly; on the second landing, the indicator lights on the no. 1 engine thrust reverser did not show that the reverser doors had retracted.

The aircraft was returned to the flight line, where an inspection revealed that the no. 1 engine was hanging about 10 centimeters (3.94 inches) too low.

After an examination, the flight engineer discovered that the nut was missing on the rear engine-mount cone bolt. The engine was still supported by the forward engine mount, but the aft end of the engine was resting on the nacelle, on the floor of which were found the two broken halves of the missing nut. A nearly complete part number was legible on the nut parts. It read, “NAS 1804-[?]2.” The parts of the broken nut were sent to a laboratory for analysis.



Wrong nut (left) and correct nut (right) for Boeing 707 engine mount

Aircraft records show that the affected engine had been fitted in the incident aircraft for five years and showed no previous history of nut or bolt failure. The maintenance provider and the Boeing Commercial Airplane Group had no record of such nut failure in the type of B-707 involved in this incident.

Nevertheless, between 1959 and 1963, some operators of B-707-100 and B-707-300 airplanes were alerted by a Boeing Service Bulletin (SB) to the possibility of cadmium embrittlement of engine-mount nuts. The SB gave operators the discretion to replace the cadmium-plated nut with a silver-plated nut.

The SB did not apply in the instance, because the incident airplane had Pratt & Whitney JT3D turbojet engines, and the NAS 1804-12 nut has not been approved for application to the JT3D. Boeing cites only one approved nut — part number 65-10600-49 — for the JT3D engine.

The nut failure triggered an inspection of the operator's fleet of B-707s, where the nonconforming nut was found on 50 percent of all fitted engines. Remedial action was deferred until the results of the laboratory test of the failed nut were available.

In the lab, the two pieces of the nonconforming nut were subjected to visual, scanning electron microscope, and energy dispersive X-ray examinations. The ADF report on the incident said, "Several crack sites, apart from the primary fractures which split the nut, were typical of embrittlement effects. In this case, the cadmium plating had undergone transformation under the influence of excessive heat and interacted with the steel nut to reduce the original properties of the parent material.

"[The testing laboratory] was unable to determine the timing factor for failure other than to say that it could happen fairly quickly when [the nut] was subjected to temperatures above 230 degrees C [446 degrees F]. Cadmium-plated components are not designed for use above this temperature. The nature of the failure was clearly defined by metallurgical evidence."

How the nonconforming nut found its way into the supply department and onto the operator's airplanes remains unclear.

As a result of this incident, the operator has replaced all nonconforming engine mount nuts on fitted JT3D engines. All stocks of part NAS 1804-12, which could contain additional nonconforming nuts, have been quarantined.

In addition, the current NSN has been categorized as obsolete, and a new manufacturer's part number has been assigned. The number for the correct nut is 5130-01-163-5535.

[NSN is a stock number assigned to a part by the ADF. It can represent several different manufacturers' part numbers, depending on how many different manufacturers supply the part to the ADF.]

The incident report said, "There is an assumption that manufacturers, stockists, cataloguers and provisioners have not deviated from the NSN and its associated part [number] and that the appropriate item is supplied against the correct NSN. Sufficient details in the field should be available to ensure that incorrect items are not inadvertently supplied for correctly demanded NSNs. ...

"Maintainers need to be reminded that they should question and not blindly accept what is handed to them to fit. Until we have perfect systems we are to a large extent dependent on the skills and inquisitiveness of our people. So, be alert and do not hesitate to ask a question when the validity of a spare does not seem right."

Aircraft Skin Damage Appears to Result from Trim Knife

In one recent incident involving a Royal Australian Air Force twin-turbofan transport aircraft, deep scoring was discovered on the outside fuselage skin where the cap fits over the cockpit. The scoring was almost certainly the result of using a sharp knife to trim off excess sealant that was used to seal the cap.

Maintenance personnel have to be especially careful when using sharp tools around pressurized airplanes. The slightest damage to an airplane's pressure hull can form a line of weakness that will over time be exploited by repeated cycles of microscopic expansion and retraction, and could lead to failure of the pressure hull at high altitudes.

Checks on other aircraft in the fleet showed similar damage. The training mission of the squadron was degraded by the severe altitude restrictions placed on airplanes until the scoring was repaired.

F-28 Landing Gear Separates from Aircraft on Rollout

After a normal landing, the left main landing gear of the Fokker F-28-1000 began to shimmy. When the brakes were applied in an attempt to control the shimmy, both of the left main wheels and the left brake assembly separated from the aircraft. The aircraft sustained substantial damage to the oleo (hydraulic) lower sliding member, wheels, tires, brakes and left inboard and outboard flaps.

The manufacturer's database showed that 29 accidents of this type had been reported for the F-28.

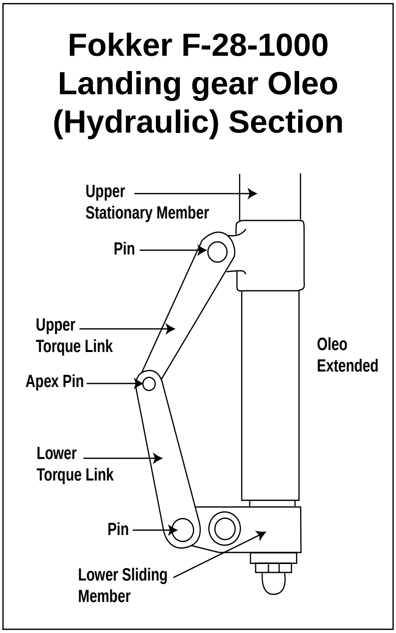


Figure 1

Investigation revealed that the upper torque link (Figure 1) on the landing gear had failed within the first 61 meters (200 feet) of landing roll and that the left main wheels separated from the airplane about 458 meters (1,500 feet) beyond touchdown.

Both landing-gear oleos were examined. All dimensions were determined to be within service limits except for the fit of the torque-link pins to the main oleo lug bushings, which showed clearances that were too large. According to the manufacturer's overhaul manual, the torque link pin is meant to be pressed into the bushing without any clearance — an interference fit. The interference fit is necessary to minimize free play and prevent landing gear shimmy.

Torque-pin clearance on the accident aircraft's main bushings were from 0.0030 centimeter to 0.0086 centimeter (0.0012 inch to 0.0034 inch); on the sliding member bushings the clearances were from 0.0053 centimeter to 0.0391 centimeter (0.0021 inch to 0.0154 inch).

Excessive nitrogen pressure in the oleo exacerbated the problem. This excess pressure prevented the oleo from compressing immediately at touchdown, which would have reduced the tendency for the landing gear to shimmy.

It was later reported that a former operator of the aircraft had used an overhaul procedure not authorized by the manufacturer for about two years, in which the bushings were actually reamed to create an intentionally loose fit for the torque link pins.

Immediately after this accident, the operator (1) rechecked the nitrogen pressure in all F-28 landing gear oleos; (2) ordered a midlife inspection of all landing-gear torque links that had not been overhauled; and (3) incorporated the midlife landing-gear inspection into the initial inspection of all new additions to the F-28 fleet.♦

New Borescope Sees More

Hawkeye™ Precision Borescopes from Gradient Lens Corp. now have adjustable focus, so that the field of view can be adjusted for variations in the user's eyesight and eyeglass prescriptions. The adjustable-focus feature can also be added to current fixed-focus models.

Gradient has also added a new, larger borescope to its line. Called HARDY, its increased number of optic fibers is said to provide brighter illumination than previous models, making it well suited for use in tubes, pipes, engine cylinders and other spaces where it is difficult to get sufficient light.

It is also possible to make a videotape of what the borescope sees. According to the manufacturer, the new Hawkeye video system can display, digitize, record and print images from the borescope. The system includes a color video camera, a video adapter that relays the image, a high-intensity halogen light and a fiber-optic cable.

Hawkeye™ Precision Borescope

For more information, contact: Gradient Lens Corp., 207 Tremont Street, Rochester, NY 14608 U.S. Telephone: (800) 536-0790 (United States and Canada); (716) 235-2620; Fax: (716) 235-6645.

Vertical Storage Takes 90 Percent Less Space

Where relatively high ceilings are available and many different storage drawers do not have to be accessed at the same time, Stanley Storage Systems' new automated, vertical-lift powerdrawer™ system can be used to shrink the storage "footprint" to a fraction of that needed for conventional shelving.

According to the manufacturer, a single 12-meter (40-foot)-tall powerdrawer can store the same amount of material as 100 sections of 2.1 meter (seven-foot)-tall conventional shelving.

Powerdrawer systems are available for ceiling heights from 3.7 meters to 12 meters (12 feet to 40 feet). The system delivers modular drawers to a single access point, where items may be removed or the entire drawer transferred onto a cart.

The manufacturer says that the powerdrawer system is designed around Vidmar standard, extra-wide and double-wide drawer sizes, and that each drawer holds up to 227 kilograms (500 pounds). The system may be connected to company personal computer or mainframe computer systems, and free-standing operation is also possible through the use of an alphanumeric keyboard and display.

For more information, contact: Stanley Storage Systems, 11 Grammes Road, Allentown, PA 18105 U.S. Telephone: (800) 523-9462 (United States and Canada); (610) 797-6600; Fax: (610) 776-3895.

Heat-shrinkable PVC Tubing Guards Against Corrosion

Tools and other products or equipment can be protected against destructive environments with shrink-on polyvinyl chloride (PVC) tubing, now available in large sizes and ultraviolet (UV) stable, from INSULTAB Inc.

Insul-Grip HS-105 Heat Shrinkable Tubing is available in sizes from 0.1 centimeter to 10.2 centimeters (0.05 inch to four inches) outside diameter (O.D.) and in custom colors to match surrounding material. According to the manufacturer, it is easy to apply and is unaffected by most chemicals, chlorinated cleaners, gasoline, oils and salt water. The tubing has a 2:1 shrink ratio; it starts to shrink at 65 degrees C (149 degrees F) and recovers fully at 116 degrees C (241 degrees F).

Insul-Grip HS-105
Heat Shrinkable Tubing

Insul-Grip is priced according to the size, quantity and color ordered and can be supplied spooled, in boxes or cut to length.

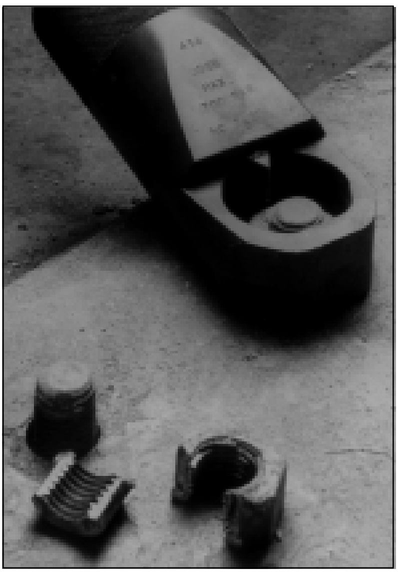
For more information, contact: INSULTAB Inc., 50 Evergreen Road, Woburn, MA 01801 U.S. Telephone: (800) 468-4822 (United States and Canada); (617) 935-0800; Fax: (617) 935-0879.

New Splitters Permit Safe Splitting of Rusted or Corroded Nuts

A new hydraulic tool from Enerpac uses air pressure of 10,000 pounds per square inch (psi) to split rusted or corroded nuts cleanly and, according to the manufacturer, without damaging the stud or bolt to which the nut was frozen.

Hydraulic pressure is created by a two-speed hand pump that has an internal pressure relief valve for overload protection.

Three sizes of nut splitters are available, with cutting capacities ranging from 1.9 centimeters to four centimeters (0.75 inch to 1.56 inches). The chisels used in the splitter can be resharpened. With carrying case, the nut splitters weigh from 8.6 kilograms to 11 kilograms (19 pounds to 25 pounds).



Enerpac hydraulic nut splitter

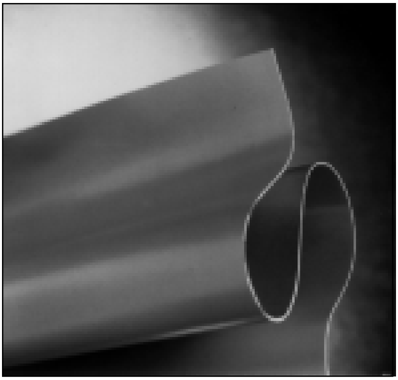
For more information, contact: Enerpac, P.O. Box 325, Milwaukee, WI 53201-0325 U.S. Telephone: (414) 781-6600; Fax: (414) 781-1049

New Flame-retardant Fabric Provides Flame, Smoke Protection

Developed especially for use as a vapor/smoke barrier between the cockpit and the hold of cargo planes, CHR® 4132 from Furon Co. can also be used in other applications where smoke protection or firewalls are necessary.

CHR 4132 is a plain-weave fiberglass fabric coated on both sides with flame-retardant silicone rubber. The finished fabric is 0.8 centimeter (0.032 inch) thick and is available in light blue or gray in continuous length 91 centimeters (36 inches) wide.

According to the manufacturer, the fabric remains pliant across a temperature range of -73 degrees C to 227 degrees C (-100 degrees F to +440 degrees F), is self-extinguishing and meets the flammability requirements of U.S. Federal Aviation Regulations (FARs) Part 25.853(a).



CHR® 4132 fiberglass fabric

For more information, contact: Furon Co., 407 East Street, New Haven, CT 06511-5015 U.S. Telephone: (800) 525-2523 (United States and Canada); (203) 777-3631; Fax: (203) 787-1725.

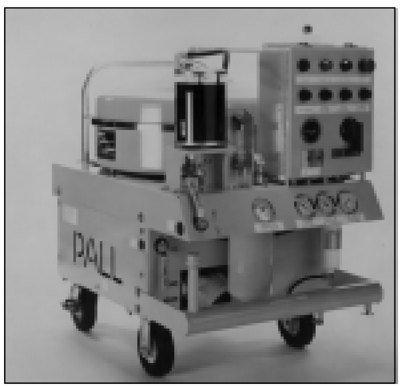
Portable Fluid Purifier Cuts Waste-disposal Requirements

Pall Aerospace Co. has marketed the Portable Fluid Purifier, which recycles hydraulic oil, lubrication oil, coolants and synthetic and organic ester base liquids by removing water, gases, solvents and particulates without altering the fluid's physical or chemical properties. Advantages for the user are said to include extended fluid life, fewer operational delays, increased system reliability and reduced need to store and transport contaminated fluids for disposal.

The unit operates through spinning-disk and vacuum dehydration technologies. Because the Portable Fluid Purifier uses no desiccants, high vacuum or added heat, the manufacturer says that the working properties of the fluid being purified are not degraded.

The unit's automatic, unattended operation includes safety features such as automatic shutdown and a filter-change indicator. It connects to any system using inlet and outlet hoses and requires no other connection other than a U.S.-standard 110-volt electrical supply. An optional water sensor is available for monitoring water contamination levels.

For more information, contact: Pall Aerospace Co., 5775 Rio Vista Drive, Clearwater, FL 33760-3114 U.S. Telephone: (800) 933-3111 (United States and Canada); (813) 539-8448.♦



Pall Portable Fluid Purifier

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