Quality Assurance Demanded In Aviation Turbine Fuel Handling

by
Robert A. Feeler
Editorial Coordinator

[Editor's Note: *An article on proper turbine fuel handling published in the July/August 1993* Aviation Mechanics Bulletin *discussed the types and sources of potential contamination, and the various methods of detecting each contaminant. The following article describes receiving procedures, filtration systems, quality assurance checks and quality assurance records.*]

Most operators receive fuel for their tank farm/storage facility from tank trucks. Whenever a facility receives fuel, it is the operator's responsibility to conduct a physical inspection of the fuel and to review the paperwork provided by the delivery driver to ensure that the fuel is clean and free of any contamination. If there is any doubt about its suitability or purity, fuel should not be off-loaded until it has been inspected and any substandard conditions rectified. After the fuel is in the operator's storage tanks, the fuel is the operator's responsibility.

Before receiving fuel, it must be confirmed that the receiving tank has the capacity to accept the amount of fuel being delivered. A dipstick check or sight gauges will help to ensure that there is sufficient volume for the full amount, plus 10 percent. Usage records or estimates of quantity are not adequate to ensure that sufficient volume is available in the intended tank. With today's emphasis on environmental concerns, operators cannot afford the risk of an overflow spill.

The operator should also check the bill of lading or truck-loading ticket to verify the type and quantity of product ordered. A physical inspection through the top-loading openings will confirm that the various compartments are indeed full and that the product appears clear and bright and has a normal odor.

A sample should be taken from each compartment of the delivery truck. Many operators retain these samples for 30 days in sealed containers stored separately in a cool location to have a physical record of the fuel as it was received.

A one-gallon sample should be taken from each compartment in a clean white porcelain or stainless steel bucket. A portion of the sample(s) should be checked using a standard American Petroleum Institute (API) hydrometer and beaker to confirm the specific gravity of the product. The API gravity should conform to that indicated on the shipping papers within one degree. Differences greater than this should be cause for investigation.

Any visible water or contaminants are cause for suspending the off-loading. The compartment sumps or off-loading valves should be used to drain any water or contaminated fuel, and an additional sample should then be taken from the affected compartments.

The truck should be allowed to stand for at least 30 minutes to allow any remaining contaminants to settle. Any water or visible contaminants that have settled should be drained. A clean one-gallon sample is drawn for a second inspection to ensure that it is clear and bright and free from any visible contaminants.

If the second sample still does not meet quality standards, the truck should not be off-loaded, and the entire shipment should be rejected. Inspection records should be posted to preserve findings for future reference.

Sample Testing Required During Unloading

Assuming that the samples meet specifications, visual inspections are acceptable and all paperwork is in order, the off-loading may proceed. If possible, fuel should be off-loaded into a facility through the filtration system of the tank farm.

After the truck is off-loaded, a physical check of each compartment should be conducted to ensure that each tank compartment is empty. Observation can be made through the top-loading covers. Some over-the-road tankers have a sight glass in the unloading line for each compartment that can also be used to verify that the compartment is empty.

About 15 minutes after completing the receiving operation, it is advisable to take a one-gallon composite sample from the tank into which the fuel was received. The intervening time will allow the fuel to settle. This sample should be compared with the sample taken from the truck prior to off-loading. This simple observation will confirm that no contamination has occurred in the off-loading operation. The results of this comparison should also be recorded on the receiving inspection forms. If this composite sample is acceptable, the receiving tank sump should be drained (or pumped) to remove any water that may have settled from the fuel just received.

If any difference is noted between this composite sample and the sample(s) taken from the delivery truck, another one-gallon sample from the receiving tank should be taken for inspection and retesting. If this second sample is found unacceptable, there is reason to suspect that contamination has occurred and the fuel should not be released to any aircraft.

Pipeline or Barge Deliveries Pose Special Problems

Some high-volume facilities receive deliveries directly from a pipeline, or from a marine barge if the facilities are close to a navigable body of water. Inspection procedures from pipelines and barges are more complex and somewhat specific to each installation. Persons involved with deliveries from such sources should receive specific training from the supplier to ensure that clean, contaminant-free fuel is delivered into their storage facilities.

The care and maintenance of filtration systems is normally conducted by fuel suppliers or companies that specialize in this task. Nevertheless, the technicians responsible for oversight and management of the facility should have a basic understanding of the filtration system. The technician should be able to identify the function and operation of each component to confirm proper service and maintenance.

Potential contaminants are particulate matter, surfactants or free water. Filtration systems must be capable of removing all three of these potential contaminants with:

- A pre-filter (or micronic filter) to remove particulate contaminants;
- A clay treatment unit to remove surfactant contaminants; and,
- A filter/separator to remove free water and particulate contaminants.

The pre-filter unit removes particulate matter such as rust, dirt, pipe scale, sand or any metallic fragments that may be present in the fuel. These units typically use replaceable filter elements (cartridges) that must not pass more than one milligram (mg) of "test dirt" when subjected to 10 mg of such dirt per gallon of flow. This test dirt consists of particles that are smaller than 10 microns, 98 percent of which are five microns or smaller, and nearly 48 percent of which are smaller than 0.25 microns. Considering that this paper is about 75 microns in thickness, it is obvious that these filters are extremely effective if properly used and maintained.

The pre-filter will always be installed upstream of the more expensive clay treatment and filter separator units, to remove as much of the harmful particulate matter before it can reach the other units and thereby reduce their effectiveness. In a pre-filter, the fuel flows through the housing inlet chamber and through an equalizer tube that distributes the fuel to each of the multiple filter cartridges within the housing. As the fuel passes through the micronic elements, the particulate matter is trapped and only clean fuel should flow out of the housing.

Any free water in the fuel should settle into the sump of the pre-filter vessel. It is necessary to drain these sumps every day, with the system under pressure and flowing, to eliminate free water from the system. Daily draining of the pre-filter sump also protects the clay filter unit, which tends to become saturated with free water.

Proper operation of the pre-filter/micronic filter is observed by monitoring the differential pressure upstream and downstream of the filter. This may consist of two indicators, a single indicator with a selector valve, or a differential pressure. Differential pressure readings should be recorded on a daily log to properly monitor the system's operation. A properly operating unit must have some differential pressure; a zero indication may signal a ruptured filter. A drop in the differential pressure of more than two pounds per square inch (PSI) from that normally recorded is cause for investigation and/or element replacement.

At the other extreme, a differential pressure exceeding 15 PSI is an indication that the filter elements are becoming clogged and the elements may have to be replaced.

Most operators replace the elements on a calendar basis, regardless of the differential pressure readings. This interval may be as little as one year or as much as three years, depending on the flow or system usage.

The clay filter (or clay treatment unit) has only one purpose — to remove surfactants from turbine fuel. Clay filter/treatment units are not present in all filtration systems. If installed, they will always be downstream of the pre-filter and upstream of the final filter/separator unit.

This unit consists of cartridges filled with a special material (fibrous clay granules) that has hundreds of porous surfaces that trap and hold any surfactants that may be in the fuel. Like the pre-filter, an equalizer tube distributes the fuel within the housing to flow evenly through all of the elements.

The filter sump of this unit should also be drained daily to remove any free water which has settled from the fuel. This lessens the possibility that the cartridges will become saturated with water, which disarms the unit and can lead to the growth of microorganisms within the accumulated water.

Clay filter units are also provided with differential pressure indications and should be monitored and recorded daily. If fuel usage is sporadic, readings should be recorded at least weekly. This record provides a means of monitoring the cartridge deterioration as well as ensuring that the cartridges have not ruptured. A sudden darkening or an unusual color of a Millipore sample filter membrane may also indicate a ruptured clay treatment cartridge.

Clay treatment cartridges should be replaced according to each company's calendar schedule, or sooner if a microseparometer test indicates that the fuel is not being entirely cleansed of surfactants. A microseparometer is an electronic device that tests fuel samples to determine purity. If a microseparometer reading is less than 85 or if a test of the fuel upstream compared to a sample collected downstream is nearly equal, the clay filter cartridges should be replaced.

As with the pre-filter unit, the differential pressure should be monitored and recorded. The same replacement requirements apply.

The filter/separator removes free water from fuel and then filters that water, along with any particulate matter which may still be in the fuel. In some low-volume installations, this may be the only filter device installed. Filter/separators use two different elements to remove free water and particulate matter. These elements are a coalescer cartridge and a separator cartridge.

Fuel flows into the filter/separator via the housing inlet chamber, passing through the coalescer cartridge. These cartridges cause any excess free water to collect on the cartridge surface, becoming larger droplets that then fall to the bottom or sump of the filter housing. These cartridges also filter out any particulate matter which may still be in the fuel.

The fuel then passes through the separator cartridge, which is made of a water-repellent material. These separator cartridges remove any remaining water droplets from the fuel and cause them to settle into the filter sump so that they will not be carried into the fuel system.

The sump of each filter/separator unit should be drained under pressure if fuel flows every day. A normal operating unit should have no more than one-half cup of water in the sump on a daily basis. Any water drained from the filter/separator sump should be clear and bright. Any evidence of debris or a brownish tint to the water is indicative of system contamination. The use of the system's fuel should be suspended until the contaminant is removed and the fuel is checked for purity.

If the unit is operating properly, the coalescer cartridges may remain in service for a calendar year, at the end of which the cartridges should be removed and checked by performing a single-element test. This test uses a special device that tests the cartridge's ability to coalesce and separate the water from the fuel. This device injects a precise amount of water into a quantity of fuel and tests a single element's ability to separate that quantity. If the cartridge passes, it may remain in service for another six months, when the test should be repeated. Most operators choose to replace the cartridges at a conservative one-year interval. If tested at 12- and 18-month intervals and found satisfactory, they may remain in use up to a suggested maximum life of two years.

Coalescer cartridges should be inspected, cleaned and tested whenever a Millipore test conducted downstream of the unit shows an unusually high depth of color. They should also be replaced if the Aqua-Glo test reading indicates in excess of 10 parts per million (PPM) of entrained water in the fuel, downstream of the filter/separator. The filter/separator coalescer cartridges should be inspected, cleaned and tested whenever particulates, surfactants or microorganisms are noted in the water drained from the filter case sump.

As with the other units, differential pressure readings across the filter/separator are also an important indicator of the unit's condition. The same requirements for replacement apply.

Filter/separator units are normally provided with a water-defense feature that shuts down the unit if unacceptable levels of water are present. The operation of the water-defense system should be checked once each year to ensure that it remains effective.

Protective Devices Are Crucial to Ensuring Purity

Two different safety devices should be installed to protect each filter unit: a pressure relief valve and an air eliminator. These devices are usually installed on the top of the filter vessels and are constructed of stainless steel material. The pressure relief valve merely prevents the filter vessel from rupture or a seal blowout from overpressure. The air eliminator relieves any air buildup that develops in the system.

Sometimes the filter system is unable to remove all of the contaminants in the fuel during a single pass through the system. Most storage facilities have piping and plumbing that enables the fuel to be recirculated through the system. This recirculation redirects the flow of the fuel, causing it to pass through the filters continuously without leaving the storage system.

If contamination is detected or suspected, recirculation can usually bring the fuel up to specification. In systems that are not used on a regular basis, fuel should be recirculated for a reasonable period at least once a week to ensure that the fuel remains free of any contamination.

Some operators inject an additive into the fuel to enhance static discharge capabilities and to reduce exposure to static discharges as fuel is pumped and filtered. A test unit called a "staticon" can be used to measure and record the electrical conductivity of the fuel to ensure that sufficient additive has been injected.

If static dissipator additives are in use, a conductivity check using a hand-held conductivity meter should be made, comparing the reading taken with the staticon chart. Readings should be comparable within 30 units of each other and appropriately recorded.

The station should be checked daily to ensure that the recorder is operating properly and that the paper supply is adequate. These units are usually designed to shut down the system automatically if conductivity goes beyond the established limits.

Regular Inspections Are Needed to Ensure Quality and Safety

To ensure that aviation turbine fuel remains clean and free of any contaminants, inspections should be conducted on a regular basis. Certain checks and inspections should be performed daily, others weekly, and yet other, more comprehensive checks on a monthly basis. Each of these checks should be documented on a routine inspection/check form. Sample forms are included at the end of this article.

A general inspection of the fuel facilities and equipment should be conducted every day. A daily inspection check form will ensure that nothing is overlooked and provide a format for documenting accomplishment of the required checks.

A check of the general condition of tanks, plumbing, pumps and valves for leaks is a basic safety measure. Any substandard conditions should be corrected immediately. Serviceability of floating suction fuel pickup inlets should be confirmed daily if possible, but at least once per week. If a floating suction is found to be sunk, fuel usage should be suspended or special procedures adopted until the condition is corrected.

If fuel is being drawn when the floating suction is inoperative, the tank sump should be drained or pumped just prior to each withdrawal of fuel. Each vehicle loaded at the facility should be inspected via the top openings; sump-drained samples should also be taken 30 minutes after receiving the fuel.

Filter/separator sumps should be drained immediately following each off-loading when the floating suction is inoperative. In addition, it is suggested that a Millipore test and an Aqua-Glo water test be conducted on each load of fuel withdrawn from a tank with the unusable floating suction.

Each storage tank should be checked for free water in its sump on a daily basis, using the water draw-off for above-ground tanks or a special pump (sometimes called a "thief" pump) drawing from the lowest point of each underground tank. The sample drawn from the sump should be captured in a clean container and inspected. The approximate amount of water drained off, the presence of any contaminants, and the general appearance of the fuel should be recorded.

Above-ground tanks, especially those having a floating top, are susceptible to taking in water after a heavy rain. Rainwater can leak through faulty seams or seep past the seals. An extensive drop in temperature caused by the cooling effects of rain can cause dissolved water to settle from the fuel, resulting in a large amount of water precipitating to the sump.

In draining each filter case sump, the sample should be captured and subjected to the bucket examination. The filter sumps should be drained and checked in the reverse direction of the fuel flow, starting with the filter/separator and working back to the pre-filter case.

If a facility is providing fuel to other operators, draw a one-gallon sample from the truck-loading manifold for each delivery of fuel to another operator. Retaining this sample for 30 days provides a record in case the user later questions the quality of fuel that was provided.

It is also good practice to take a Millipore sample with each delivery to another operator. In addition to the daily inspection, weekly checks should be conducted.

Millipore, microseparometer, and Aqua-Glo tests (before and after filtration) should be taken each week. These tests help confirm the proper operation of each component of the filtration system. Results of each test should be recorded and one-half of each Millipore membrane retained with the records. Any adverse results are cause for investigation and corrective action.

The operation and freedom of movement of each valve on all fuel farm and truck facilities should be physically checked. All fire protection units should be checked for proper pressure, seals, inspection date and general condition. Make sure that all signs and labels are legible and in place.

Two-hour Delay Is Necessary After Fuel Delivery

Those responsible for a storage facility from which ramp-servicing units are filled or from which aircraft are directly serviced via a hydrant system need to ensure that the system is not used for two hours after receiving a delivery. In preparing to take fuel from the facility, the storage tank sump should be drained of any free water. As noted above, many operators draw and retain a one-gallon sample from each load delivered to a truck or other vendor in order to have proof of the quality of the fuel dispensed. A Millipore test can also provide a positive record of the quality of the fuel dispensed. Millipore comparative readings of A-2, B-2, G-2 or better and particulate levels of B or better are considered acceptable by most industry standards. The Millipore test involves matching samples according to an alphabetical/numerical ranking chart to determine fuel quality. Fuel samples that do not meet these standards will require recirculation and filtration until subsequent sample checks are found to be acceptable.

All servicing vehicles should be bottom-loaded if at all possible. This method minimizes the exposure to contamination and greatly reduces the exposure to static buildup.

There is no way to prove that preventive maintenance measures and quality assurance checks have been accomplished without proper records. Each company may have its own requirements for records; however, with many operators taking fuel from a single supplier, the possibilities for confusion and duplication are greatly magnified. The Air Transport Association of America (ATA), an airline industry group, has developed a standard specification and format for all operators and vendors to use.

Samples of some of the more commonly used forms are illustrated here. Operators can obtain the complete document, including all of the sample forms, by requesting ATA Spec. #103 from the Air Transport Association, 1709 New York Avenue, N.W., Washington, DC 20006 U.S.

Persons interested in the computer-based training program entitled "Aviation Turbine Fuel Handling," upon which much of this article has been based, should contact Gulf Publishing Co., P.O. Box 2608, Houston, TX 77252-2606 U.S. Telephone (713) 529-4301. ♦

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One Small Problem Causes Many Complaints

A persistent problem is often caused by the smallest component. This series of switch-related complaints was experienced by an operator of Boeing 737 aircraft; however, similar switches are used in many installations and this type of situation could have occurred on other types of aircraft.

The problem was identified after a series of complaints about the brake disarm lights illuminating after touchdown, often accompanied by an unwanted disconnecting of the autobrake system.

During a period of nearly four months, flight crew reports resulted in maintenance actions including:

- Replacement of two relays;
- Replacement of the anti-skin control unit;
- Replacement of brake pedal hydraulic pressure switches;
- Replacement of the parking brake shutoff valve;
- Replacement of the speedbrake arming switch;
- Checking of the speedbrake arming switch;
- Checking of the throttle switches;
- Checking of the anti-skid transducers; and,
- Extensive checking of wiring by various methods.

When none of these actions brought a solution, the operator decided to remove the aircraft from service and check the system piece by piece until the troublemaking component was located. During a night-long session in which every possible configuration or situation was simulated, it was finally found that a simple microswitch was stuck.

This particular switch and bracket assembly had apparently been replaced during a major check some months before. It was discovered that this switch and bracket combination can be installed in such a way that the switch closes properly, *but then never returns to the open position.*

It was determined that this situation was possible because of some play in the mounting holes of the combination, which allowed the parts to be installed with some torque on the switch body. When removed from the mounting bracket, the switch operated freely. But when the assembly was in place, force on the switch body restricted the minute movement of the internal parts.

Adapted from *KLM Technical Information Program*, July 1993.

First Switch Power Off!

A major international airline recently issued a technical bulletin to all maintenance and ramp service personnel after suffering a number of damaged ground power control units (GPCU). An extensive investigation disclosed that the damage occurred to the external power interlock circuit. The damage was suspected to be the result of inadvertently applying 115 volts AC [alternating current] to pins on the GPCU, which are intended for only 28 volts DC [direct current].

Analysis disclosed two potential sources of this high voltage in the GCPU.

A short could exist in the power cable whereby 115 VAC could contact the external power interlock leads and introduce the high voltage to the 28 VDC circuit. Such shorting is most likely caused by vehicles driving over the power cord when it is extended across the ramp. The obvious fix for this problem is to prevent vehicular traffic from passing over the power cord.

Disconnecting the power cord plug from the aircraft when power is applied to the aircraft can result in 115 VAC power being momentarily applied to the interlock circuit. *Before the external power plug is removed from the aircraft receptacle, aircraft power must always be switched off!*

Adapted from *KLM Technical Information Program*, July 1993. ♦

This information is intended to provide an awareness of safety problems so that they may be prevented in the future. Maintenance alerts are based upon preliminary information from government agencies, aviation organizations, the press and other sources. The information may not be entirely accurate.

NTSB Cites Weaknesses In FAA's Service Difficulty Reporting (SDR) System

Mechanical malfunctions, structural defects and service difficulties are encountered every day in the operation of airplanes all over the world. To minimize the safety hazards associated with these occurrences, the various regulatory agencies, manufacturers and associations promoting safety in aviation collect data and attempt to detect trends or specific hazards which can then be corrected. One of the preeminent programs of this nature has been the U.S. Federal Aviation Administration's (FAA) Service Difficulty Reporting (SDR) program.

The SDR program has been in operation for many years, and the U.S. National Transportation Safety Board (NTSB) uses this database in researching the history of aircraft failures, malfunctions and defects. The NTSB recently reported, however, that attempts to use the SDR database in conjunction with current investigations have revealed that the current program is incomplete and of limited value in identifying accurate service defect histories. The basic cause of this inaccuracy was determined to be that many reportable items are not submitted to the FAA.

With the exception of the requirements under air carrier, commercial operator and repair station regulations, the SDR reporting criteria are voluntary. Even with the mandatory reporting requirements under the certificating rules, there are wide variations in what each operator reports.

The NTSB cited two specific examples of the problems in the SDR system, as follows:

In investigating an accident involving the failure of a Cessna 208 landing gear shimmy dampener and cracking of the engine/nose gear mounting structure, the NTSB queried the SDR database and found that only two reports of engine-mount cracking and no prior reports of shimmy-dampener failure were on file. Data supplied by the manufacturer, however, showed 17 reports of engine-mount cracking and 250 reports of shimmy dampener failure.

The NTSB's investigation of a major airline accident in 1992 involving a Lockheed L-1011 aircraft also demonstrated the inadequacy of the SDR system. In this accident, the stall warning system had malfunctioned, resulting in an attempted abort on takeoff that resulted in a crash. The FAA SDR database revealed only two reports of stall warning system failures on L-1011 airplanes. Fourteen additional L-1011 stall warning failures were identified by the airframe manufacturer, and 10 more incidents were recorded in the operator's files. None of these 24 incidents was found in the FAA's SDR database.

The NTSB is not alone in its concern about the adequacy of the SDR program. The International Airworthiness Communications Working Group (IACWG), founded in 1989, is intended to improve the reporting and analysis of safety-related operational data from air carriers. In addition, at the request of the Aviation Subcommittee of the U.S. Senate Committee on Commerce, Science and Transportation, the U.S. General Accounting Office (GAO) evaluated the effectiveness of the SDR program involving large, scheduled airliners. A 1991 GAO report and information from the IACWG detailed many shortcomings of the SDR system, including:

- The SDR system only contains a small percentage of the actual occurrences;
- Vagueness in reporting requirements and airlines' concerns about public access to SDR data contribute to low SDR reporting;
- Doubt about the system's capabilities and effectiveness has discouraged SDR reporters, users and analysts;
- The service and safety data maintained by manufacturers are more useful, comprehensive and timely than the FAA's SDR data;
- FAA analysis of SDR occurs rarely or not at all; and,
- FAA staff limitations and management inattention contribute to SDR program ineffectiveness.

The IACWG is working with the airlines and the FAA to clarify the SDR reporting criteria and to develop the capability for electronic reporting submitted directly to the database. In responding to the GAO recommendations, the FAA has stated that it will continue to manage the SDR program. The NTSB has indicated some dissatisfaction with the progress of the FAA improvements and NTSB summarized its recommendations below:

- "Review the reporting items and establish standardized reporting formats for malfunction or defect reports and service difficulty reports that include the capability for electronic submission. Encourage all operations under 14 CFR Parts 21, 43, 91, 121, 125, 127, 135, and 145 to use electronic reporting methods for submission of service difficulty information." (A-93-61)

- "Encourage all persons or organizations that operate under 14 CFR Parts 43 and 91 to submit malfunction or defect reports and provide appropriate guidance to improve the quality and content of the general aviation service difficulty database." (A-93-62)

- "Ensure that prompt analysis of service difficulty reports and dissemination of alerting information is being accomplished in accordance with FAA policies and procedures." (A-93-63)

- "Encourage foreign regulatory agencies to provide service difficulty data from resident operators and manufacturers to the FAA for incorporation into the FAA service difficulty database." (A-93-64)

Shortcut Results in Two Injuries

Two technicians were recently injured, one seriously, during removal of a landing gear assembly from a wide-body aircraft.

A major international airline was removing a time-expired gear assembly during a major check. Because there was a lot of other work in progress, the crew decided not to jack the aircraft high enough for the gear to clear the floor, but only partway to keep the aircraft more accessible to other workers. The plan was to partially deflate the strut, lock it in position with a stabilizer tool and roll it away on the wheels after disconnecting the trunnion fittings. *This was not in accordance with the stated procedures in the manual.*

When the trunnion was disconnected, the partially inflated strut did what it was supposed to do — it extended.

The stabilizer tool broke under a load it was never intended to bear, and the gear rotated forward with great force, injuring the two technicians.

The manual procedure called for the strut to be fully deflated, an oleo lock fitting installed, the aircraft jacked to permit removal of the trunnion attachment, and the aircraft to then be "jacked up off the gear," allowing it to be rolled away on a service dolly.

The strut was not fully deflated, and as it was partially extended, the oleo lock fitting was too short to be used, so it was not installed. A stabilizer fitting intended to hold the truck perpendicular to the strut was installed; however, it was never intended to restrain the oleo extension forces, and it failed when exposed to this stress.

Shortcuts can result in catastrophe.♦

NEW PRODUCTS

Environmentally Friendly Drip Pans Reduce Slip and Fall Exposure

Although modern turbine engines are much cleaner than the reciprocating engines, there will always be a fluid drip or two from a vent or drain line plus the normal spillage during maintenance activities. Environmental agencies are pleased if such leakage can be captured before it reaches the drain systems of hangars and shops.

The Kell-strom Tool Co. has developed a lightweight and convenient drip pan designed for use with engine stands or under installed engines of aircraft. The pans are made of lightweight PVC plastic and are said to be unbreakable in normal use. The manufacturer claims that these pans are oil resistant, easy to clean and affordably priced and can be placed under each engine or area exposed to leakage to catch any drips and prevent slippery floors.

For more information, contact Kellstrom Tool Co. Inc., 214 Church Street, Wethersfield, CT 06109 U.S. Telephone (203) 521-8492.

Filtered Vacuum System Designed to Protect Against Hazardous Dust

As composite repairs become more common in the aircraft industry, concern has grown for worker protection from potentially hazardous dusts created while repairs are sanded. With manufacturers and regulating agencies now more aware of the dangers associated with composite fabrication and repair, new federal guidelines have been developed to provide worker protection.

The use of respirators and face masks is common practice; however, the residue of composite work may be retained in the circulating air long after the work is completed and workers have removed their protective gear. Nilfisk of America has developed a line of high-efficiency particulate air (HEPA)-filtered vacuum cleaning systems that it claims are capable of removing particulates as small as .3 microns in size.

Photograph not available.

The Nilfisk system includes a complete line of integral hand tools, such as an oscillating saw, saber saw, drill shield, circular saw and an assortment of sanders and grinders. Each of the tools can be attached to the filtered vacuum cleaner system, allowing capture and elimination of the dust created by the process. The manufacturer claims that the units meet or exceed U.S. Occupational Safety and Health Administration (OSHA) safety standards for the control of hazardous dust.

For more information, contact Nilfisk of America, 300 Technology Drive, Malvern, PA 19355 U.S. Telephone (215) 957-0300.

Flame-retardant Wire Jacketing Applicable For Aviation Use

Zippertubing Co. has developed a flame-retardant protective sleeving for protecting wiring, cable and plumbing runs exposed to high temperatures. The manufacturer states that "Type PFR" zippertubing meets U.S. Federal Aviation Regulations (FAR) standards for flame retardancy, is unaffected by most oils and chemicals and remains flexible in a temperature range from minus 67 degrees F (minus 98 degrees C) to plus 225 degrees F (plus 93 degrees C). The material is Underwriters Laboratories (UL) listed and conforms to MIL-C-13777G and MIL-C-27072.

Installation of the jacket is said to be fast and easy. With the "Zip-On" Closure Trac, the material is simply cut to length, wrapped around the bundle to be protected and zipped shut. The Trac can be reopened for inspection and reclosed or may be sealed with Zippertubing's exclusive polyurethane tape. According to the manufacturer, the jacketing is of polyurethane material which provides extraordinary abrasion resistance.

For more information, contact: Zippertubing Company, P.O. Box 61129, Los Angeles, CA 90061 U.S. Telephone (213) 321-3901. ♦