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Knowledge of Hazardous Chemicals in the Aviation Workplace Can Help Prevent Work-related Illness and Injury

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Knowledge of Hazardous Chemicals in the Aviation Workplace Can Help Prevent Work-related Illness and Injury

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FSF Editorial Staff

Aviation maintenance facilities use a number of substances containing chemicals that regulatory agencies have labeled as toxic. These include solvents, cleaning agents, hydraulic fluids, coolants and fuels.

Inappropriate exposure to or ingestion of toxic substances may lead to illness or injury, ranging from short-term effects such as headache, shortness of breath and dizziness, to paralysis, kidney failure, cardiovascular disease, blindness, respiratory ailments and even death.

Reactions to a particular chemical may vary, depending on the duration of exposure, dosage, personal factors (for example, those who are asthmatic, have heart trouble or smoke tobacco), type of exposure (by breathing or physical contact), whether exposure was to more than one chemical, and how quickly and effectively action is taken to counteract the toxin's effects.

Among the most widely encountered hazardous chemicals in aviation maintenance facilities are acetone, ammonia, asbestos, carbon monoxide, chlorofluorocarbon 113 (CFC-113), ethylene glycol, methylene chloride and methyl ethyl ketone (MEK).[1] Below is a brief description of each of these chemicals, along with general symptoms from exposure and first-aid action.

As a general rule, prompt professional medical attention should be obtained any time a person is inappropriately exposed to a hazardous

chemical. Workers should not wear contact lenses when working with hazardous chemicals; where appropriate, goggles, face masks and respirators should be worn to reduce the probability of exposure or inhalation.

Acetone is a clear, colorless, volatile liquid with a sweet odor. It is used as a solvent in many aviation applications. Individual products may refer to acetone as dimethyl ketone, methyl ketone, 2-propane or beta-ketopropane. Upon exposure, acetone enters the bloodstream and is circulated throughout the body. Limited exposure is generally not injurious because the liver is capable of turning small amounts of acetone into harmless byproducts. Larger concentrations are more serious. Breathing moderate to high levels of acetone for even a short time can cause nose, throat, lung and eye irritation; shortening of the female menstrual cycle; headaches; light-headedness; confusion; increased pulse rate; nausea; vomiting; unconsciousness; and coma. Physical contact with acetone does not cause skin cancer; no determination has been made if breathing acetone for long periods will lead to other forms of cancer.[2]

Medical tests (breath, blood or urine samples) to confirm exposure to acetone are available, but these tests must be performed within two days after exposure because acetone is naturally flushed from the body after that time.[2]

Acetone first aid:

- Eyes: If acetone comes in contact with the eyes, they should be irrigated immediately with large amounts of water, occasionally lifting the lower and upper lids to further remove the chemical.
- Skin: Skin contaminated with acetone should be washed immediately with soap and water. If clothing has become contaminated with acetone, the clothing should be removed and the skin underneath should be washed with soap and water.
- Inhalation: A person who has inhaled acetone vapor should be moved immediately into fresh air. If breathing has stopped, mouth-to-mouth resuscitation should be performed. The affected person should be kept warm and at rest, and medical attention obtained immediately.
- Ingestion: Immediate medical attention should be obtained.[3]

Ammonia is used in the aviation industry as a cleaning agent, particularly in fuel cells.[1] Its noxious fumes, which can be severe eye irritants, should provide a warning of exposure. When inhaled, ammonia irritates the mouth, nose, throat and lungs. Continued exposure by breathing can lead to headaches, loss of the sense of smell and vomiting. The most severe effect of ammonia inhalation is a buildup of

fluid in the lungs that can lead to suffocation and death.

A person exposed to high levels of ammonia should be kept under observation by medical personnel for at least three days, because the buildup of fluid in the lungs might cause a delayed reaction.

Skin contact with ammonia causes burns, the severity of which depends on the concentration of the ammonia solution, the moisture content of the skin and the length of time that passes before the area is flushed with water.

Ammonia reacts violently with, and should be stored away from, strong oxidizers, chlorine, bromine, acids, gold, silver, calcium, and hypochlorite bleaches.

Ammonia first aid:

- Eyes: If ammonia contacts the eyes, they should be irrigated immediately with water for 15 minutes, holding the eyelids open and away from the eyeballs. Speed and thoroughness are very important.
- Skin: Skin contaminated with ammonia should immediately be flushed with water. If ammonia penetrates the clothing, it should be removed and the skin underneath should be flushed with water. Ointment should not be applied to ammonia burns; burned areas should not be rubbed.
- Inhalation: A person who breathes large amounts of ammonia should be moved immediately into fresh air. If breathing has stopped, mouth-to-mouth resuscitation should be performed. Oxygen may be administered. The affected person should be kept warm and at rest.
- Ingestion: Vomiting should not induced. A glass of milk or water should be given to the affected person to drink.[3]

If symptoms of exposure to ammonia persist, immediate medical attention should be sought.

Asbestos, which primarily affects the lungs, may be found in aviation brake linings, electrical insulation and friction components.[1] It is classified as a carcinogen. Few or no symptoms are evident at the time of exposure. Asbestosis, a disease that manifests as scarring of the lungs and shortness of breath upon exertion, may not appear for seven to 30 years after exposure. The risk of lung cancer for tobacco smokers who have been exposed to asbestos is 92 times higher than for smokers who have not been exposed.[4]

In the United States, and in other countries, there are several requirements for the handing and storage of asbestos, including: (1) Advanced training must be provided for personnel who are to handle asbestos; (2) a regulated,

marked, enclosed, isolated area must be established for asbestos storage and handling; (3) the asbestos must be kept wet with special surfactant and water while handling; and (4) local exhaust ventilation with negative pressure air filtration and high-efficiency particulate filters must be used in areas of asbestos removal.[4]

Asbestos first aid:

Because there are virtually no symptoms evident at the time of exposure to asbestos, there are no first aid recommendations.

Nevertheless, certain preventive and surveillance measures should be taken in the aviation workplace. Care should be used in handling components containing asbestos. Where materials containing asbestos are present, periodic sampling and analysis for airborne asbestos should be conducted to ensure that particulate levels remain within safe minimums.[1]

Carbon monoxide (CO) has been described as one of the most common industrial hazards[5] and is also a danger to those in aviation maintenance. The U.S. National Institute of Occupational Safety and Health (NIOSH) reports that several workers have died in or near refueling trucks as a result of CO poisoning.[6]

When inhaled, CO takes the place of oxygen in the bloodstream, reducing the supply of oxygen to the body's cells. CO is colorless, odorless and tasteless, properties that make it particularly difficult to detect.

One of the characteristic signs of CO poisoning is a cherry-red color of the skin and lips. Any of the following symptoms can signal moderate CO poisoning: headaches, tightness across the chest, nausea, drowsiness, inattention or fatigue. If exposure continues, a lack of coordination, weakness or confusion may develop. Breathing high concentrations of CO can lead to unconsciousness, even before other symptoms are evident, and can kill in minutes.[5]

Because CO remains in the blood for several days, a gradual increase in the level of CO in the body may occur. The health hazards of CO exposure are increased for individuals who smoke tobacco or have heart damage.[5]

To reduce workers' exposure to CO while operating equipment, NIOSH recommends the use of diesel-powered equipment. A diesel engine generates less CO than a gasoline engine, and the strong odor of diesel exhaust provides a more pronounced warning of possible CO presence.

Also important is the proper maintenance of all vehicles to prevent CO from entering the cab while the engine is running. These measures include:

- Fit tight rubber boots around pedals and levers in the vehicle cab;
- Put snug-fitting grommets in holes through the firewall;
- Close rust holes in the cab floor pans or elsewhere;
- Ensure that heater and fresh air intakes are remote from the exhaust discharge;
- Check regularly for leaks in exhaust system components;
- Tighten or replace components to stop leaks; and,
- Provide vehicle cabs with continuous CO monitors, including alarms to warn operators before concentrations of CO reach dangerous levels.[6]

Wiring a ventilation fan to operate whenever the engine is running will usually build positive pressure in a closed cab, minimizing in-seepage of CO. But NIOSH cautions that there are circumstances in which such an arrangement might draw CO into the vehicle.[6] Workers in enclosed areas should be alert to ventilation problems, and, if CO poisoning is suspected, they should vacate the area immediately.

Carbon monoxide first aid:

- In mild CO poisoning, half of the CO accumulated in the body will be eliminated in four hours or five hours of breathing CO-free air.
- A person who has inhaled large amounts of CO should be moved into fresh air at once. If breathing has stopped, mouth-to-mouth resuscitation should be performed. The affected person should be kept warm and at rest. In severe cases, the affected person should be given 100-percent oxygen to breathe.[1,3]

Chlorofluorocarbon 113 (CFC-113) is used primarily in aircraft maintenance for cleaning of metals and electronic assemblies. Smaller quantities are used in aerosol propellants, coatings, adhesives, thermal stressing (to locate faulty components in failed electronic circuit boards), as a diluting agent and as a lubricant carrier.[7] CFCs are commonly referred to by the trade names Freon 113®, Genetron 113®, Halocarbon 113®, or Refrigerant 113®, or generically as 1,1,2-trichloro-1,2,2 trifluoroethane fluorocarbons.[8]

CFCs are noncombustible, colorless, nearly odorless and have only slight irritant effects on the skin.[7] CFCs have a relatively low toxicity in low concentrations, which can create the misconception that CFCs are safe.

Symptoms of inhalation exposure to CFCs include dizziness, lightheadedness and unconsciousness.

Heavy concentrations can cause death by cardiac arrhythmia (irregular heartbeat) or asphyxiation in as little as one minute.[8]

Training of maintenance personnel should include the hazards of working with CFCs and should provide instruction on the use of supplied-air respirators (SARs) or a self-contained breathing apparatus (SCBA).[8] There is no known antidote to CFC exposure, nor are there any laboratory tests to confirm whether an individual has been exposed.[1]

Asthmatics are particularly cautioned against CFC exposure. Taking epinephrine, norepinephrine, dopamine, isoporteranol and medications containing catecholamines increases an asthmatic's risk of CFC poisoning.[8] Exposure to CFCs will also aggravate existing cardiovascular disease (involving the heart and blood vessels).

CFCs are being phased out throughout the world as commercially practicable alternatives have been developed. Preventative workplace measures should include the provision of adequate ventilation and exhaust systems and the avoidance of CFC use in closed spaces.[1]

CFC first aid:

- Eyes: If CFCs come in contact with the eyes, the eyes should be irrigated immediately with water for at least 15 minutes, occasionally lifting the lower and upper lids.
- Skin: Contaminated skin should be washed with soap and water.
- Inhalation: The health hazard from inhalation of CFCs is acute. A person who has breathed a large amount of CFCs should be moved into fresh air at once. If breathing has stopped, mouth-to-mouth resuscitation should be performed. Oxygen should be given. The affected person should be kept warm and at rest. Immediate medical attention should be obtained.
- Ingestion: Ingestion is not considered a route of entry for CFCs.[3]

Ethylene glycol is a colorless, slightly viscous liquid with a mild odor. It is used mainly as a coolant and aircraft deicing agent, but is also found in paints and hydraulic fluids. Ethylene glycol is not an inhalation hazard unless it is heated and vapors form; it is not toxic unless it is ingested.[1]

There are three stages of toxic exposure to ethylene glycol. Stage I occurs up to 12 hours after exposure; the individual may appear inebriated, drowsy, dizzy or unable to coordinate voluntary muscle movements. Stage II occurs 12 hours to 24 hours

after exposure and can lead to heart arrhythmia or congestive heart failure. In Stage III, which begins 24 hours after exposure, kidney failure is a possible outcome.[1]

Ethylene glycol first aid:

- Eyes: If ethylene glycol contacts the eyes, they should immediately be irrigated with large amounts of water, occasionally lifting the lower and upper lids.
- Skin: Skin contaminated with ethylene glycol should immediately be flushed with water. If ethylene glycol penetrates the clothing, it should be removed and the skin underneath flushed with water.
- Inhalation: A person who breathes large amounts of ethylene glycol vapors should be moved into fresh air at once. If breathing has stopped, mouth-to-mouth resuscitation should be performed. The affected person should be kept warm and at rest.
- Ingestion: Immediate medical attention should be obtained.[3]

Fuels. Jet fuel (kerosene) and aviation gasoline may not appear to pose major medical problems. Nevertheless, the cleaning of closed, unventilated fuel tanks can expose an individual (through inhalation) to concentrated levels of fumes. Reactions include slurred speech, blurred vision, headache, drowsiness and dizziness. In the most severe cases, long-term exposure to jet fuel or aviation gas vapors has caused deaths from suffocation.[1]

Fuels first aid:

- Eyes: If fuel contacts the eyes, they should immediately be irrigated with large amounts of water, occasionally lifting the lower and upper lids.
- Skin: Skin contaminated with fuel should immediately be flushed with water. If liquid fuel penetrates the clothing, it should be removed and the skin underneath flushed with water.
- Inhalation: A person who breathes large amounts of fuel fumes should be moved to fresh air at once. If breathing has stopped, mouth-to-mouth resuscitation should be performed. The affected person should be kept warm and at rest.
- Ingestion: Immediate medical attention should be obtained.[3]

Methylene chloride is used as a solvent in paint strippers and degreasing agents, as a propellant in aerosols and in metal cleaning and finishing.[1] A colorless liquid with a mild sweet odor, it is also known as dichloromethane.[9] Upon skin contact, methylene chloride causes intense burning and mild skin redness.

People differ in their ability to smell methylene chloride, so it is possible to be unknowingly exposed. Symptoms of low exposure are slightly impaired hearing and vision. At higher levels of exposure, methylene chloride acts like an anesthetic, reducing one's ability to remain steady or perform tasks that require precise hand movements. Other symptoms of severe exposure include dizziness, nausea, tingling and numbness in the fingers and toes. In most cases, these effects stop shortly after exposure ends. Methylene chloride is a carcinogen, and smokers are at increased risk to the effects of exposure to methylene chloride.[9]

Methylene chloride first aid:

- Eyes: If methylene chloride contacts the eyes, the eyes should immediately be irrigated with water for at least 15 minutes, occasionally lifting the lower and upper lids.
- Skin: Skin exposed to methylene chloride should promptly be washed with soap and water. If the methylene chloride penetrates the clothing, it should be removed and the skin underneath washed with soap and water.
- Inhalation: A person who has inhaled large amounts of methylene chloride should be moved into fresh air at once. If breathing has stopped, mouth-to-mouth resuscitation should be performed. The affected person should be kept warm and at rest.
- Ingestion: Immediate medical attention should be obtained.[3]

Methylethyl ketone (MEK) is used in aviation maintenance facilities as a solvent, primarily in paints and glues.[1] The EPA has labeled it the "single most widely used hazardous air pollutant in aerospace applications."[7] Nevertheless, it is not considered particularly toxic unless there is exposure to a very high concentration for an extended period. Also known as 2-butanone, MEK is a colorless, flammable liquid with a sharp, sweet odor that is similar to that of acetone.[10]

In the aviation industry, the most common exposure to MEK is by breathing its fumes, which cause mild irritation to the eyes, nose and throat. Skin contact can lead to drying, scaling and cracking. Mild exposure may also manifest in headache, dizziness, incoordination, nausea and vomiting. High levels of exposure to MEK, though not common, can cause depression of the central nervous system, coma and death.[1] MEK has not been classified as a human carcinogen.[10]

MEK first aid:

- Eyes: If MEK contacts the eyes, the eyes should immediately be irrigated with water for at least

15 minutes, occasionally lifting the lower and upper lids.

- Skin: Skin contaminated with MEK should be washed promptly with soap and water. If MEK penetrates the clothing, the clothing should be removed and the skin underneath washed with soap and water.

- Inhalation: A person who has inhaled a large amount of MEK should be moved into fresh air at once. If the person is unconscious, cardiopulmonary resuscitation (CPR) may be necessary. Oxygen may also be given.

- Ingestion: The affected person should be given two glasses of water to drink, with an emetic (an agent that induces vomiting), if possible. Liquids should not be given if the affected person is unconscious.[3]

Those who work in maintenance facilities servicing agricultural aircraft should also be aware of the hazards of pesticides and insecticides. General information on handling and storage of these chemicals is also provided by special interest groups such as the American Crop Protection Association.[11]

Many other hazardous chemicals are found in the aviation maintenance workplace. These include, but are not limited to, cadmium, chromium, cyanide, lead, mercury, phenol, phosphoric acid, trichloroethylene, tricresylphosphate (TCP), sulfuric acid, tetrachloroethylene, toluene, toluene diisocyanate and xylene.

In the United States, the U.S. Occupational Safety and Health Administration (OSHA) requires manufacturers of toxic chemicals to issue a material safety data sheet (MSDS) for each chemical. The MSDS describes first aid, storage, handling, transportation, fire-fighting and spill and disposal procedures for that chemical.

OSHA's Hazard Communication Standard (HCS)[12] requires that manufacturers, importers or distributors of hazardous chemicals or products supply a copy of the appropriate MSDS to their customers. MSDSs are to be provided automatically, and it is the responsibility of the producers and importers of the material — not the persons who receive their products — to make the hazard determination. Further, the supplier is required to update the MSDS with the next shipment if new and significant information about the hazards of a particular chemical have come to light.

The HCS directs the employer to maintain copies of the MSDSs for each hazardous chemical or product. It also requires that MSDSs be readily accessible to employees in their

work areas. These MSDSs may be maintained on computer, microfiche or other alternatives to paper copies as long as there are no barriers to immediate employee access.

OSHA says that the HCS "covers chemicals in all physical forms — liquids, solids, gases, vapors, fumes and mists — whether they are 'contained' or not. The hazardous nature of the chemical and the potential for exposure are the factors which determine whether a chemical is covered [by the HCS]."[13] If it is not hazardous, or if there is no potential for exposure, the chemical is not covered by HCS.

In the United States, proper employee access to the current MSDS for each chemical in the workplace is a critical step in HCS compliance. The company should have a written program that:

- Designates a person responsible for obtaining and maintaining the MSDSs;
- Describes how employees can obtain access to the MSDSs when employees are in their work areas;
- Describes how the MSDSs are to be maintained (in notebooks or in a computer terminal);
- Outlines procedures to follow when MSDSs are not received at the time of the first shipment; and,
- Describes alternatives to MSDSs in the workplace.

The HCS says that employees "who may be 'exposed' to hazardous chemicals when working must be provided information and training prior to their initial assignments ... and whenever the hazard changes."[13] Exposure can be through any route of entry (inhalation, ingestion, skin contact, eye contact).

It is the responsibility of OSHA compliance officers to determine "if [the employees] have received training, if they know [whether] they are exposed to hazardous chemicals and if they know where to obtain substance-specific information on labels and MSDS," according to OSHA.[13]

The following checklist will help an organization determine whether it is in compliance with HCS directives. The organization should have:

- Obtained a copy of the rules from HCS;
- Read and understood the requirements;
- Assigned responsibility for tasks;
- Prepared an inventory of chemicals;
- Ensured that containers are labeled;
- Obtained the MSDS for each chemical;
- Made MSDSs available to workers;

- Conducted training of workers;
- Prepared a written program;
- Established procedures to maintain a current program; and,
- Established procedures to evaluate the program's effectiveness.♦

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11. Boillot, James. Telephone interview by Glenn Orthmann, Flight Safety Foundation, on April 11, 1997.
12. *Chemical Hazard Communication*. OSHA Publication No. 3084.
13. 29 U.S. Code of Federal Regulations 1910.1200, *Hazard Communication*. Appendix E, "Guidelines for Employer Compliance."

Additional Reading From FSF Publications

Feeler, R. A. "Correct Selection and Use of Respirators Is Vital in Contaminated-air Environments." *Aviation Mechanics Bulletin* Volume 42 (November–December 1994).

Feeler, R. A. "One Cure for Workplace Safety Complacency: Safety Checklists." *Aviation Mechanics Bulletin* Volume 43 (September–October 1995).

New Advisory Circulars List Certificated Agencies, Designated Airworthiness Representatives for Maintenance

A new U.S. Federal Aviation Administration (FAA) advisory circular (AC) provides information and guidance concerning designee application, authorized functions and certificates of authority for Designated Airworthiness Representatives (DARs) for Maintenance.

DARs are individuals, corporations, associations or partnerships who represent the FAA in issuing recurrent and standard airworthiness certificates for U.S.-registered aircraft, non-U.S.-manufactured aircraft imported into the U.S. from other countries, restricted-category aircraft and experimental aircraft.

AC 183-53, *Airworthiness Designee Function Codes and Consolidated Directory* … defines designee authorized functions and function codes, and provides a state-by-state listing of the names and addresses of persons currently designated.

The FAA has also announced the availability of AC 140-7I, *FAA Certificated Maintenance Agencies Directory*, which contains yearly updated listings of current FAA repair stations and manufacturer's maintenance facilities.

Ultrasound Workshop Can Lead to Level I Certification

UE Systems Inc. will present a five-day Ultrasonic Workshop Nov. 11–14 in Elmsford, New York, U.S. Qualified participants will receive Level I certification.

The workshop will focus on handheld, portable, ultrasonic detectors and inspection devices and their use both on the ground and in flight.

Some of the topics to be covered include: physical principles of sound; equipment construction, characteristics and signal presentations; testing techniques for leak detection, electrical and mechanical inspection; recording, documentation and interpretation of test results.

Registration is limited to 25 persons.

For information on cost and enrollment, contact Alan Bandes, UE Systems Inc., 14 Hayes Street, Elmsford, New York 10523 U.S. Telephone: (914) 592-1220, extension 614; Fax: (914) 347-2181.

Aircraft Maintenance Human Factors Seminar/Workshop Scheduled

Human factors error-reduction programs, such as crew resource management, are well established in the airline industry in connection with flight crews. As their benefits have become widely recognized, such programs have been increasingly applied to the technical operations area, including maintenance.

An Aircraft Maintenance Human Factors Seminar/Workshop, organized by Transportation Systems Consulting Corp., will be held Oct. 14–17 at the Radisson Hotel, Clearwater Beach, Florida, U.S.

Topics to be presented at the seminar include, among others:

- The importance of effective communications;
- The influence of organizational changes;
- The safety impacts of maintenance errors;
- Managing maintenance error;
- Analysis methods;
- Investigation teams;
- Building a human factors program for aircraft maintenance; and,
- Key elements of training programs.

There will also be workshops on the following topics, among others:

- Human factors training plan;
- Dealing with human error;
- Maintenance human error case studies;
- Human performance investigation techniques; and,
- Sharing lessons learned.

For registration or 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.

SAE Publishes New Aerospace Standards

The Society of Automotive Engineers (SAE) Inc. has published six new standards for the aerospace industry. They are:

- AS4873: Gland Design, Elastomeric O-ring Seals, Static Radial and Face 800 psi Maximum Service;
- ARP4898: Stands, Shipping and Storage, Aircraft Engines, Reusable;

- ARP5007: Development Process — Aerospace Fly-by-wire Actuation System;
- AIR5052: Crack Initiation and Growth Considerations for Landing Gear Steel with Emphasis on AerMet 100;
- ARP5107: Guidelines for Time-limited-dispatch (TLD) Analysis for Electronic Engine Control Systems; and,
- AS5255: Exfoliaton Testing of Aluminum.

For further information, contact: Society of Automotive Engineers Inc., Dept. 2786, 400 Commonwealth Drive, Warrendale, PA 15096-0001 U.S. Telephone: (412) 776-4970; Fax: (412) 776-0790.♦

MAINTENANCE ALERTS

Failure of Windshield Electrical Terminal Blocks Investigated

An incident involving smoke in a Boeing widebody cockpit in late 1992 raised the possibility that the screw securing the power lead to the terminal block in the windshield may have loosened and led to an electrical short circuit. Boeing issued an operator action notice on the subject in September 1993, suggesting that all operators of possibly affected Boeing 767 and Boeing 747 models check the torque on this screw and increase it if necessary. The increased-torque requirement was also made part of the appropriate maintenance manuals.

In a more recent incident, smoke entered the cockpit of a B-767-200 during cruise at 11,285 meters (37,000 feet). The crew put on their oxygen masks, declared an emergency and landed without further incident at Sydney, Nova Scotia, Canada.

In that incident, the technician who removed the failed windshield terminal block (J5) from the B-767 indicated that the screw securing the power lead was properly torqued. As a result, maintenance focus has shifted away from the screw torque to the terminal block as the likely cause of the smoke.

A test facility determined that the terminal block was destroyed internally by heat. The windshield and terminal block were sent to the manufacturer for testing to determine the exact cause of the failure. Recently released findings indicated that arcing caused the melting of the inner glass ply on the terminal block,

but that because of the extensive damage the origin of the arcing could not be isolated. It is suspected that severance of copper braid conductors started the arcing.

NTSB Recommends Required Inspection of Beech 1900 Flap-Attachment Bearings And Aft Roller Bearings

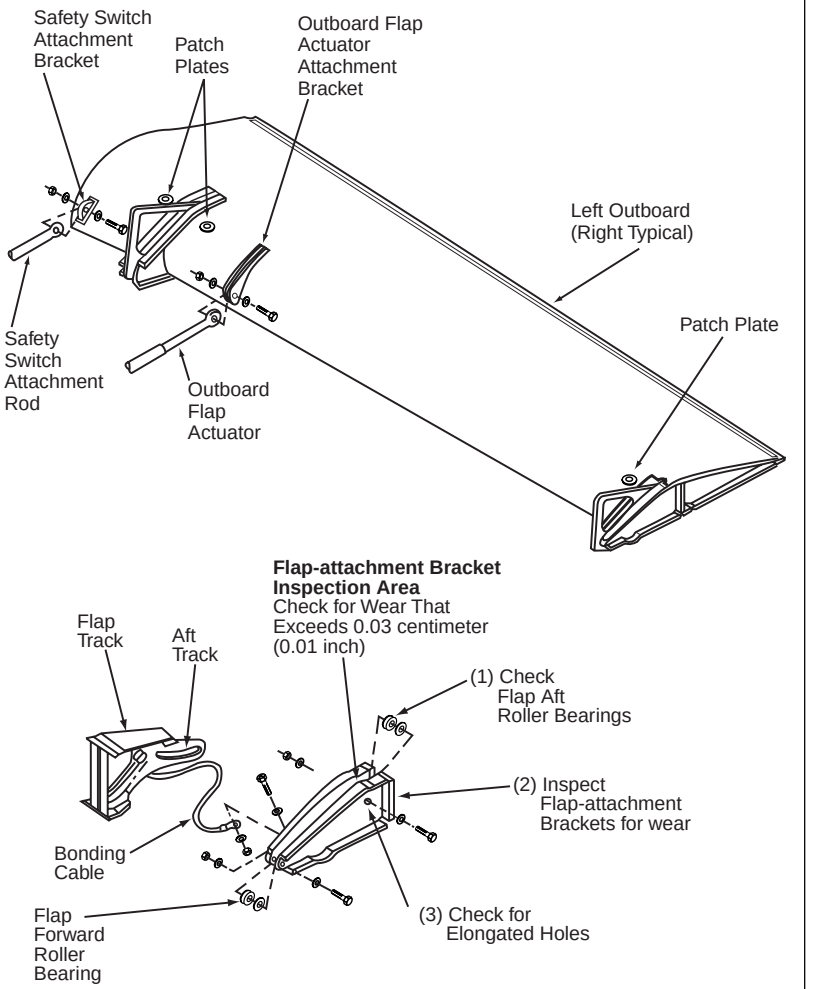
The Beech 1900C twin-turboprop regional commuter aircraft was on final approach to Los Angeles International Airport in visual meteorological conditions (VMC) with a crew of two and 17 passengers. The aircraft was descending normally with 20 degrees of flaps selected. At 90 meters (300 feet) above ground level (AGL), the first officer, who was the pilot flying, increased the flap setting to 35 degrees. The aircraft suddenly made an uncommanded left roll of about 35 degrees. The pilot was required to apply full right aileron and strong control-wheel force to level the wings. The landing then continued normally, and no one was injured.

A flight examination showed that, although the inboard flaps and outboard flaps were fully and equally extended on both sides of the airplane, the inboard end of the left outboard flap had disengaged from its flap track (Figure 1, page 16). The inboard aft flap roller-bearing assembly on the left outboard flap, including the bolt and washer (Figure 1, "flap aft roller bearings"), had pulled through the skin of the flap-track hinge bracket (Figure 1, "flap-attachment brackets"), allowing the inboard end of the flap to disengage from the flap track.

A circular wear pattern matching the diameter of the bearing outer-roller flange was found on the skin of the hinge bracket. As a result, the detached inboard trailing edge of the flap was twisted about 7.6 centimeters (three inches) above its normally installed position in the flap track. The failed flap-track hinge bracket and bearing assembly (Figure 1) are contained within the interior of the flap structure.

In its investigation, the U.S. National Transportation Safety Board (NTSB) determined that the flap outer-bearing roller had shifted axially (for reasons unknown), and that the shift had resulted in erosion and failure of the flap-track hinge bracket and bearing assembly. Contributing factors to the incident were the difficulty of inspecting the interior of the flap structure without disassembly and the lack of inspection criteria for the flap-track hinge bracket and bearing assembly in the Raytheon Aircraft Co. (of which Beech is a subsidiary) maintenance manual for the aircraft.

Outboard Flap-attachment Mechanism
Beech 1900



Source: Raytheon Aircraft Co./Rendered by Karen Ehrlich

Figure 1

In April 1996, about a year after the foregoing incident, Raytheon revised the Beech Model 1900/1900C and 1900D maintenance manuals to include new criteria for inspecting wing flaps. The wing flaps were included as a new item in the airplane's major maintenance schedule, shown under "flight controls." The revised manual required that the flaps be removed every 10,000 (aircraft) cycles or every five years, whichever occurs first, and that the flap roller brackets, rollers, bearings and attachment hardware be checked for wear. (An aircraft cycle comprises engine start-up, increase to normal flight power, one landing gear retraction and extension, and complete shutdown.)

Inspection of these same components without removing the flaps was made a part of the aircraft's next 200-hour inspection, and Raytheon recommended that the components be reinspected (without removing the flaps) every 1,200 hours thereafter.

A second incident, which occurred in June 1996, involved a Beech 1900D on a landing approach to Cavern City Air Terminal, Carlsbad, New Mexico, U.S. Extension of the flaps to 35 degrees triggered a sharp uncommanded roll at low altitude. The pilot flying righted the airplane, but there was very little aileron control during the remainder of the landing approach because the control wheel could be rotated only about 2.5 centimeters (one inch) left or right.

An examination of the left wing showed that the left outboard flap was tilted up on the inboard side and tilted down on the outboard side, and that the edges of the aileron and flap metal were ripped.

A third incident involved a Beech 1900D approaching Seattle-Tacoma (Washington, U.S.) International Airport in January 1997 with two crew members and five passengers. When the wing flaps were lowered from 17 degrees to 35 degrees, the aircraft began an abrupt roll to the right at an altitude of about 150 meters (500 feet). The pilot countered the roll with left control-column input; he said that, when he did so, he felt as if something in the controls had jammed and then had suddenly "popped" free. The airplane landed safely.

Examination showed that the inboard aft end of the outboard flap had detached, causing seizure of the inboard flap-track aft roller bearing and tearing of the flap-bracket assembly. The seized bearing outer roller had shifted on the roller element bearing and allowed the outer roller flange to wear against, and eventually pull through, the skin of the flap-track hinge bracket. The three other flap-track roller bearings were also examined; they showed

erosion and the presence of dirt and debris. The outboard edge of the outboard flap, adjacent to the aileron, was gouged.

None of these three Beech 1900 airplanes involved in incidents had had a detailed inspection of flap hardware as outlined in the April 1996 revisions to the Raytheon maintenance manual.

The roller bearings on the inboard wing flaps are sealed; the roller bearings on the outboard wing flaps — the flaps that failed in each of the foregoing incidents — are not sealed. According to the NTSB, sealed bearings for installation in the outboard wing flaps will be made available in the near future.

A review of Raytheon's database showed 20 reports of worn flap aft roller bearings and damaged flap brackets in Beech 1900 series aircraft.

On May 19, 1997, Raytheon issued *Safety Communique No. 137* (SC) to alert owners and operators of Beech 1900 series aircraft to the flap problem. It said, in part:

"Detachment of the outboard flap from [the flap aft roller bearing] could result in a flap asymmetric condition and the outboard end of the flap coming in contact with the aileron and inhibiting the travel of the aileron."

The detachment of this flap aft roller bearing from the outboard wing flap resulted from the repositioning of the outer flange element of the roller bearing, which allowed the outer flange element to come into contact with the attachment and eventually wear through the bracket. When the bracket failed, the outboard flap detached from the aft roller bearing.

The SC called for expedited inspection of the flaps on all Beech 1900 and model C-12J (military version of the Beech 1900) airplanes with more than 2,500 flap cycles (a flap cycle comprises one downward movement and one upward movement of the flaps), in keeping with the following schedule:

- Aircraft with more than 10,000 flap cycles: inspect within 30 days;
- Aircraft with 5,001 flap cycles to 10,000 flap cycles: inspect within 60 days; and,
- Aircraft with 2,500 flap cycles to 5,000 flap cycles: inspect within 90 days.

The SC included detailed instructions for the required inspections. They included (1) inspecting the aft roller bearings and their outer-flange elements for wear and damage, (2) inspecting the surfaces of the flap-attachment brackets that contact

the aft roller bearing for indications of wear from the aft roller-bearing outer-flange element and (3) inspecting the aft roller-bearing attachment holes in the flap-attachment brackets for elongation (see lower half of Figure 1, page 16).

The SC said that revisions to maintenance manuals were being issued to change flap-inspection intervals. The revisions required the removal and inspection of all flap-attachment roller brackets, roller bearings and attaching hardware every 2,500 flap cycles or five years, whichever occurs first.

In a letter including a recommendation (A-97-37) to the U.S. Federal Aviation Administration (FAA), the NTSB said that, to prevent any further flap malfunction and possible in-flight loss of control, compliance with the SC should be mandatory.

The NTSB therefore recommended that the FAA issue an airworthiness directive (AD) requiring an expedited initial inspection of the outboard flap-attachment brackets and aft roller bearings as outlined in the SC; and further inspection thereafter every 2,500 flap cycles or five years, whichever occurs first.♦

NEW PRODUCTS

Instrument Provides Clean Air for Pneumatic Power Tools

The typical compressed air source in an aircraft hangar or shop is subject to contamination by water, dirt, oil and oil aerosols. The Eliminizer® by Reading Technologies Inc., a new air dryer/coalescer, removes contaminants from compressed air prior to use.

The Eliminizer employs four modes of filtration in one assembly. In the first two modes, spinning air drives contaminants to a collection point. The third mode uses filters: one of stainless steel mesh, another of cotton, polyester and stainless steel that trap contaminants down to one micron (one millionth of an inch) in size. Finally, the air enters the coalescer, which removes oil aerosols down to 0.01 micron with an efficiency near 100 percent.

According to the manufacturer, clean compressed air extends the life of equipment using compressed air, reduces work interruptions caused by air contaminants and prevents possible contamination of paint or other products being manufactured or repaired.

The Eliminizer does not use electricity, refrigerants, motors, fans, timers

or switches, making it reliable and relatively inexpensive to acquire and maintain. It is available in port sizes from 0.6 centimeter to five centimeters (0.25 inch to two inches).

The Eliminizer® by Reading Technologies

For more information, contact Reading Technologies Inc., Airport Industries Building 2, RR9, Box 9391, Reading, PA 19605-9650 U.S. Telephone: (800) 521-9200 (United States and Canada); (610) 372-9200; Fax: (610) 372-1984.

Cleaning Solution Is Water Based

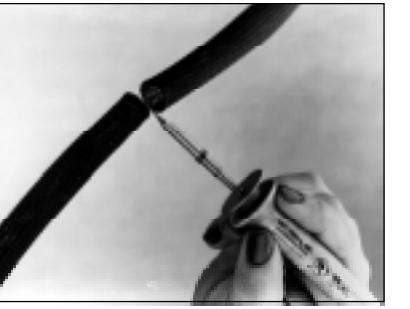
AquaWorks™ is a new water-based cleaning solution for industrial use. Based on inorganic chemistry, it is said by the manufacturer to be mildly alkaline, nonhazardous, nontoxic and nonflammable, with no volatile organic compounds or ozone-depleting chemicals.

AquaWorks is product of Church & Dwight Co. Inc., best known for its Arm & Hammer® Baking Soda, and Safety-Kleen Corp. For more information, contact: Church & Dwight Co. Inc., 469 North Harrison Street, Princeton, NJ 08543-5297. Telephone: (609) 683-5900.

Hot Knife Cuts and Seals

Fabrics that unravel or fray if cut by scissors or a razor blade can be cut cleanly and sealed with the new WB-1 Hot Knife from Hot Tools. The tool also reduces exposure to repetitive-motion injury associated with use of scissors.

According to the manufacturer, the replaceable blade reaches 455 degrees



WB-1 Hot Knife from Hot Tools

C (850 degrees F) in less than one minute; as it cuts, it melts woven expandable plastic sleeving, synthetic ropes and related products, creating a beaded edge that will not unravel.

The knife is 17 centimeters (6.75 inches) long and weighs less than 28 grams (one ounce). It can be used hand-held or mounted. For more information, contact: Hot Tools, a division of M.M. Newman Corp., 24 Tioga Way, P. O. Box 615, Marblehead, MA 01945 U.S. Telephone: (617) 639-1000; Fax: (617) 631-8887.

Multichannel Ultrasonic Inspection Instrument Uses Standard Software And Hardware

The new USPC 2100 from Krautkramer Branson is a multichannel, computer-based ultrasonic instrument for in-line flaw detection and thickness measurement. Typical applications include the in-line evaluation of plate, bar and tubing components.

The manufacturer says that the USPC 2100 uses plug-and-play peripheral component interconnect (PCI) boards, a simple Windows 95™ graphical interface and easy menu configurations to set up and run the inspection.

The new instrument has eight channels of parallel firing, cross-channel firing, a 16-cycle sequencer, real-time gating, user-configurable application screens and comprehensive outputs. It supports all generations of recorders, alarms and programmable logic controllers, and is compatible with off-the-shelf hardware and software such as special keyboards, remote monitors and word processing software.

USPC 2100 from Krautkramer Branson

The USPC 2100's individual channels can be configured for either flaw detection or thickness measurement. It is said to allow for fast replacement into existing lines, integration into new systems and expansion as testing requirements change.

For more information, contact: Krautkramer Branson, 50 Industrial Park Road, Lewistown, PA 17044 U.S. Telephone: (717) 242-0327; Fax: (717) 242-2606.

Hand Protection Sprays On, Protects Against Irritants

Aircraft technicians are exposed to many skin-irritating or -damaging solvents and chemicals in the normal course of their work. Wearing protective gloves is necessary in the case of exposure to harsh or toxic chemicals, but a new product that resembles "spray-on gloves" can reduce minor irritation and skin-drying effects of exposure to petroleum products, paint solvents, glues, grease, dirt, coolants, chlorine, and detergents.

According to the manufacturer, the liquid in Gloves in a Bottle penetrates the outer skin layer, and one application lasts four hours or more. Gloves in a Bottle is said to protect against stains and odors, to protect hands that are often immersed in water and to prevent moisture loss. When used with gloves, the product is said to protect against skin reaction to latex and latex powder irritants in neoprene and other repeat-use gloves.

Gloves in a Bottle

The product is described as safe, nontoxic, nonallergenic and fragrance-free, leaving no sticky or greasy feeling. A 227-gram (eight-ounce) bottle delivers about 150 applications.

For more information, contact: Gloves in a Bottle, P.O. Box 1430, Glendale, CA 91209 U.S. Telephone: (800) 600-1881 (United States and Canada); (818) 247-2170; Fax: (818) 247-2253.

"MiniButton" Can Be Used as Electronic Logbook

The MiniButton™ by MacSema Inc. serves as a small stand-alone database, offering access to many pages of information that can be reviewed and updated.

When associated with a particular piece of equipment, the MiniButton becomes an electronic logbook that can be used to record the equipment's history, maintenance performance,

parts lists, changes in configuration or calibration, time-limited components, or any other information that can be entered into the nonvolatile memory.

The MiniButton™ by MacSema Inc.

Electronic data are added, deleted or read with a hand-held, portable terminal, and each transaction is date and time stamped. Data can be locked against changing or removal. A variation using permanent data storage is said to be useful in helping to guard against counterfeit parts.

The MiniButton uses electrically erasable, programmable, read-only memory technology and does not require batteries. It is 10.7 millimeters (0.4 inch) diameter and three millimeters (0.1 inch) high, weighs 0.8 gram (0.027 ounce) and is available in two sizes with read/write contact memory up to 8K bytes. The manufacturer says that a 32K version will be available in 1998.

For further information, contact MacSema, 358 NE Marshall Avenue, Bend, OR 97701-4346 U.S. Telephone: (541) 389-1122; Fax: 541-389-1888.

Wireless Computer Terminal Goes Where Technician Goes

A new hand-held, portable computer terminal brings the power of a networked personal computer (PC) to locally mobile aircraft workers, allowing them access to computing capabilities without being restricted to a fixed location.

According to the manufacturer, Motorola Inc., the SitePad™ runs standard Windows® applications, including Microsoft Word® and Excel®, on a Windows NT server.

The SitePad can be operated by screen touch or mouse. Its performance, except for motion video, is said to be equivalent to most desktop PCs. Only screen updates (no files) are transmitted wirelessly, ensuring information security. Security can be further enhanced by the use of passwords.

The manufacturer says that no new software is needed to use the SitePad, and that its low-power, spread-spectrum radio technology does not require U.S. Federal Communications Commission (FCC) licensing.

For more information, contact Motorola Worldwide Data Solutions Division, 1301 E. Algonquin Street, Schaumburg, IL 60196 U.S. Telephone: (800) 247-2346 (United States and Canada); (847) 576-6931.

Tamper-evident Labels Leave an Impression

Supermark Labels from Seton Identification Products are backed with an etching compound that leaves a stencil behind if they are tampered with, so the owner of the asset is still identified. Supermark Labels can be custom printed in four colors, are available with bar coding and sequential numbering and can accommodate up to two lines of stenciling.

According to the manufacturer, the marking compounds will work on glass, aluminum or plastic, leaving a frosty mark on glass and a shiny mark on aluminum.

For more information, contact: Seton Identification Products, Dept. ZSR, P.O. Box 819, Branford, CT 06405-0819 U.S. Telephone: (800) 243-6624 (United States and Canada); Fax: (800) 345-7819.

Cabinet Offers Protection for On-site Computers

A specially designed new nonmetal cabinet from Stanley Storage Systems protects computers that reside in work areas, including hangar floors.

The computer screen can be viewed through a window at the top of the cabinet. The central processing unit (CPU) is kept in a hideaway stowage compartment, below which are a fold-away keyboard drawer, an optional mousepad work-surface extension and a rollout printer shelf. A ventilating fan brings filtered air into the housing.

The cabinet is 76 centimeters (30 inches) wide, 71 centimeters (28 inches) deep, and 165 centimeters (65 inches) high and has six wheels for mobility. It is designed, its manufacturer says, to provide an effective safe haven for computers in the harsh factory environment.

For more information, contact Stanley Storage Systems, 11 Grammes Road, Allentown, PA 18105 U.S. Telephone: (610) 797-6600; Fax: (610) 776-3895.♦

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