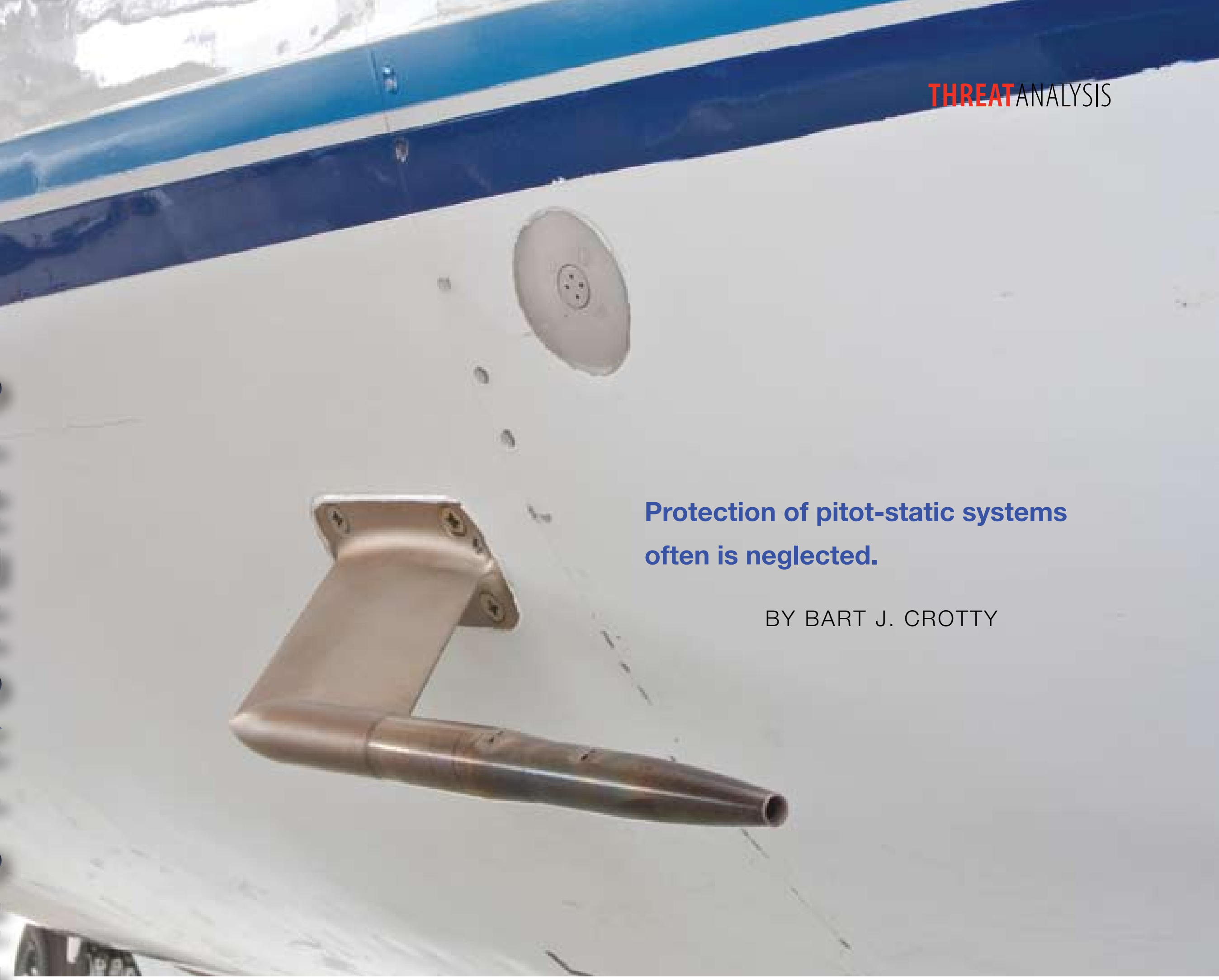

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FROZEN FLIGHT INSTRUMENTS

Protection of pitot-static systems often is neglected.

BY BART J. CROTTY

An alarming number of aircraft operators do not have — or do not ensure compliance with — written policies on the use and care of protective covers for aircraft pitot probes and static ports, on-site safety audits over the past three years have discovered.

Contamination of pitot-static systems by foreign object debris (FOD) is a safety hazard to critical flight instruments in aircraft ranging from Piper Cubs to Airbus A380s. A basic safety practice that pilots and maintenance technicians are taught early in their primary training is to protect aircraft flight instruments from blockage or the intrusion of any foreign material. The easiest way is to secure protective covers over the pitot probe(s) and static ports, which allow necessary impact air pressure and ambient pressure, respectively, to enter the pitot-static system. A few manufacturers provide hard plastic plugs that can be inserted into the probes to protect the system. Many large aircraft have flush covers that can be placed over the static ports on the front of the fuselage to prevent insects or airborne debris from entering the system. Brightly colored streamers usually are attached to the covers/plugs to remind personnel to remove them before flight.

Henri Pitot in the mid-1700s established the scientific principles of measuring fluid flow pressure that later were applied to aircraft, to provide pilots with airspeed indications. Both dynamic air pressure and static pressure are used to derive the measurement so critical to flight control. Over time, other flight instruments were connected to the basic indicated airspeed system, and pitot-heating systems were incorporated to prevent the formation of ice that could block or reduce the airflow to various flight instruments.[1]

Many aircraft accidents and incidents have involved pitot-static systems that were affected adversely by ice or FOD that accumulated either during flight or while the aircraft was parked or stored on the ground, or by tape that had been affixed for washing or painting and subsequently forgotten (see "Enterprising Insects").

Zero Tolerance

Modern pitot-static and air data systems are designed with features intended to trap small amounts of moisture, dirt and other substances.[2] However, there is no actual standard for flight instrument tolerance to any water or FOD — in other words, there is *zero tolerance*.[3]

And, although periodic tests of static pressure systems, altimeters and altitude-reporting systems are required, there is no requirement for testing airspeed indicators.[4]

Some aircraft in commercial use have only one pilot station and only one altimeter and airspeed indicator. On large or transport category aircraft, the pitot-static system is part of the air data system. Modern transport category aircraft typically have two sources of pitot and static pressure, and dual flight instruments, which should reduce the impact on flight safety if one of the pitot-static systems should become contaminated or blocked. But experience shows that primary and alternate static systems can — and do — become completely clogged.

The pitot cover on this Learjet has a strap to secure the angle-of-attack vane; the circular static port, however, is not protected.

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Most operators have maintenance programs that call for the overhaul of certain flight instruments — but usually after the instruments have accumulated 10,000 hours or more of service since new or since their last overhaul. Some operators maintain flight instruments under an "on-condition" or "reliability" program, which generally means that the instruments continue in service until they fail or until excessive failure or replacement rates are documented. A complete aircraft system test and calibration check usually is not a scheduled maintenance task.

Policies on the use of protective covers on aircraft pitot-static system probes and ports should be developed, recognizing the fact that the airspeed indicator and rate-of-climb instruments — and the air plumbing to these instruments — are not inspected or tested on a scheduled basis.

Gaps in Protection

Recent safety audits of 25 charter operators and airlines worldwide have revealed the following problems in protecting pitot-static and air data systems:

- No written policies;
- Vague written or verbal policies;
- Different applications of verbal policies among pilots, mechanics and ground personnel;
- No standard location in aircraft for storing pitot probe and static port covers;
- Storage locations that are not convenient to user access;
- Pitot cover linings that are torn or frayed, burned or charred (from installation on hot probes), or contain dirt or loose plastic;
- No requirements or standards for periodic examination of pitot cover linings; and,
- Soiled, inconspicuous or missing warning streamers.

During more than half of the safety audits, multiple discrepancies were found. None of the audits found all the elements of a satisfactory policy for protecting pitot-static and air data systems.

Opinions among aircraft operators differ about the policies and practices that should be followed, based on their experience, location, operating and environmental conditions, fleet makeup, and other factors. Manufacturers' recommendations are not always practical, and civil aviation authorities usually provide only advice and guidance, not specific requirements. The only universal agreement likely is that protection is required during long-term storage and during sand, snow/ice or dust storms.

Whatever the individual operator's experience or operational situation may be, once the hazards of contaminated pitot-static or air data systems are evaluated or re-evaluated, and a policy and standards are adopted or revised, no more than one page of the company manual would be required to establish the protection requirements and provide the first step in eliminating or substantially reducing the problems listed above. ●

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Notes

1. In most aircraft, flight crewmembers must manually activate pitot or air data sensor heating systems. For more than 30 years, the U.S. National Transportation Safety Board has urged the Federal Aviation Administration to require automatic activation of the heating systems (*ASW*, 11/07, p. 10, "Automatic Heat").
2. U.S. Federal Aviation Regulations (FARs) Part 25, *Airworthiness Standards: Transport Category Airplanes*. Part 25.1323, "Airspeed Indicating System." Part 25.1325, "Static Pressure System." Similar design features are required by Part 23 for non-transport-category airplanes and by Parts 27 and 29 for rotorcraft.
3. Telephone interviews with Edward Haering, engineer and air data specialist, U.S. National Aeronautics and Space Administration Dryden Flight Research Center; and Roy Gentry, vice president, Kollsman Commercial Aviation Systems.
4. FARs Part 91, *General Operating and Flight Rules*. Part 91.411, "Altimeter System and Altitude Reporting Equipment Tests and Inspections."

Enterprising Insects

A recent report by the Australian Transport Safety Bureau (ATSB) shows how quickly an unprotected pitot-static system can become contaminated.[1] The incident involved an Airbus A330 that was at the gate at Brisbane Airport's international terminal about 55 minutes before pushback for a flight to Singapore.

While rolling for takeoff, the pilot-in-command (PIC) and the copilot, the pilot flying, noticed that the PIC's airspeed indication was 70 kt while the copilot's airspeed indication was 110 kt. The PIC assumed control and rejected the takeoff. The report said that the PIC's decision to reject the takeoff was "reasonable" and "consistent with the operator's SOPs [standard operating procedures]."

While vacating the runway, the crew noticed that the wheel brake temperatures were increasing. Although the brake-cooling fans were activated, brake temperature continued to increase until the fusible plugs in six of the eight wheels on the main landing gear melted, causing the tires to deflate while the aircraft was being taxied on the ramp. The crew stopped the aircraft and shut down the engines, and the passengers were disembarked with portable stairs.

"A postflight engineering inspection of the aircraft found what appeared to be wasp-related debris in the PIC's pitot probe," the report said.

Noting that there was a "wasp problem" at the international gates, the report said that the March 19, 2006, incident was the fifth involving a "pitot system fault during takeoff" at Brisbane so far that year. All the incidents involved A330s, but none involved the same aircraft. Three takeoffs were rejected; two were continued, and the flight crews "actioned an instrument-switching, non-normal procedure and cleared the fault" on their way to Singapore, the report said.

However, one of the aircraft subsequently was involved in a rejected takeoff at Singapore when the crew observed an "IAS" (indicated airspeed) caution message on their electronic centralized aircraft monitor. "An engineering inspection at Singapore found no foreign matter in the aircraft's pitot system, and the aircraft was returned to service," the report said. "During the subsequent takeoff, the crew again rejected the takeoff as a result of a further airspeed discrepancy. The fault was suspected by the operator's maintenance staff to be the result of a prior pitot probe contamination migrating to the aircraft's air data module."

After the third incident at Brisbane on Feb. 5, the operator's maintenance manager at the airport had instructed line maintenance personnel to "fit pitot probe covers as soon as possible and remove them as close as possible to departure." A survey of the line engineers revealed different interpretations of the instruction. "Some engineers stated that pitot probe covers should be fitted if the aircraft's turn-around time exceeded three hours, whereas other engineers commented that fitment was dependent on the level of wasp activity present that day," the report said. Pitot probe covers had not been installed on the aircraft involved in the March 19 incident.

The report noted that the operator initiated a pest-eradication program that has been successful in controlling wasp activity at Brisbane.

— Mark Lacagnina

Note

1. ATSB report no. 200601453, "Rejected Takeoff, Brisbane Airport, Qld, 19 March 2006, VH-QPB, Airbus A330-303."