OPINION |

How risky is maintenance?

FAA reviewed 10 years of data and tried to quantify the risk

BY MIKE BUSCH

I'VE BEEN KNOWN TO PREACH about the virtues of maintenance minimalism—aka, "if it ain't broke, don't fix it"—and the risk of maintenance-induced failures. But just how risky is maintenance? How often do maintenance-induced failures occur? How serious are the consequences when they do?

When asked these questions, I usually lick my finger, hold it up in the breeze, and say that roughly three-quarters of GA accidents are pilot-caused and one-quarter are machine-caused. Licking again, I say that of the machine-caused ones, roughly half are mechanic-caused (i.e., maintenance-induced failures). That would put the fraction of GA accidents caused by maintenance-induced failures at around one-eighth, give or take a few spitballs.

While cleaning out my office recently, I ran into an old FAA study that might shed a little more light on this subject—and help quantify the risk of maintenance more accurately than my aforementioned spitballing. Published in December 2002, the FAA study titled *General Aviation Maintenance-Related Accidents: A Review of Ten Years of NTSB Data* analyzed NTSB accident investigation reports involving GA accidents between 1988 and 1997 that had at least one maintenance-related issue listed as the probable cause or a contributing factor.

The NTSB reported on 20,884 general aviation accidents during that 10-year period; 1,474 (7.1 percent) of those reported at least one maintenance-related error as a primary cause or factor in the accident, and 18 percent of these accidents were fatal. They were responsible for 504 fatalities, an average of more than 50 fatalities per year. Some 86 percent of the accidents involved airplanes; 12 percent involved helicopters; and the remaining 2 percent involved gliders, balloons, gyroplanes, blimps, and ultralights.

What kind of maintenance caused or contributed to these accidents? Well, the NTSB categorizes maintenance activities using the following strange taxonomy: adjustment, airworthiness directives, alignment, annual inspection, design change, installation, lubrication, maintenance, maintenance inspection, major alteration, major overhaul, major repair, modification, overhaul, rebuild, replacement, service bulletins/letters, servicing.

This coding system seems a bit inscrutable. The maintenance category seems overbroad and ambiguous—what's included in that? What's the difference between design change and major alteration? Why is servicing included, since that term is normally used for nonmaintenance activities such as fueling and adding oil?

Significantly, the NTSB cited Installation as the most frequent of these maintenance categories, accounting for 20 percent of the 1,474 maintenance-related accidents. Another 22 percent involved the two inspection categories, Maintenance Inspection (14 percent) and Annual Inspection (8 percent). The ambiguous catch-all Maintenance category came in at 15 percent. All the other categories came in at 5 percent or less.

Installation problems were not only the most frequently cited maintenance issue, they also resulted in the most severe consequences. Accidents involving installation errors accounted for 100 fatalities and 210 injuries, with 59 percent of the installation-related accidents resulting in injuries,

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fatalities, or both. Because installation errors were so deadly, the FAA analysts drilled down further. They found that the majority of installation errors involved the powerplant (56 percent), followed by flight controls (13 percent), landing gear (10 percent), rotorcraft rotors (10 percent), and electrical (5 percent).

The type of errors included incorrect attachment (29 percent), incorrect connection (22 percent), omission (22 percent), wrong part installed (17 percent), and reversed installation (10 percent). Almost all (91 percent) of the installation errors were made by certificated A&P mechanics, with only 9 percent by uncertified personnel. The vast majority (86 percent) resulted in emergency landings—two-thirds of which involved injuries, fatalities, or both—with only 14 percent ending up returning to the departure airport or continuing to the destination.

While more than half the installation-error accidents involved the powerplant, installation errors involving flight controls or the electrical system were the most likely to result in injury or death. The highest percentage of injury/fatality accidents by system were electrical system (73 percent), flight controls (69 percent), powerplant (62 percent), and rotor system (52 percent).

The FAA study ended with a discussion section in which the analysts pointed out that the percentage of GA accidents they attributed to maintenance (7.1 percent) is far lower than other well-respected studies that have found the rate to be close to 20 percent. The study authors attributed this discrepancy to the NTSB's methodology of codifying accident causes and contributing factors in a way that the analysts believed often failed to assign a maintenance-related code to accidents that were actually maintenance-related. "As a result, there are probably many more maintenance-related accident reports in the NTSB Database that were not included in this study because they were not designated with a maintenance code," the study concluded.

The authors pointed out that while helicopters comprise only 3 percent of the GA fleet, they were involved in 12.4

percent of the maintenance-related accidents. This reflects the maintenance-intensive nature of rotorcraft. However, the study suggests that the kinds of maintenance errors being made on helicopters are not very different from the kinds of errors that afflict airplanes.

The single most frequent kind of maintenance-related accident cause is installation errors involving the powerplant. I've written quite a lot about my aversion to doing cylinder work on piston engines unless it's absolutely unavoidable, because there are so many ways that installation of a cylinder can be screwed up even by experienced A&Ps. I've often expressed the opinion that most A&Ps do not have the appropriate level of fear when it comes to installing cylinders.

The authors of the FAA study seem to agree with me that mechanics need better guidance on risk management. "It seems reasonable to develop guidance to aid maintainers on the inherent risks of maintaining various general aviation aircraft," the study concludes. "These guidelines could be empirically developed, informed by accident and incident event data. Thus, a comprehensive database of maintenance error data becomes crucial."

That's a lot easier said than done, however. Our current GA maintenance culture seems spring-loaded to conceal its errors rather than fess up to them. "Nearly every mechanical failure is investigated and archived so that the failure rate of a specific type of component can be analyzed and precisely tracked," the report says. "However, the same investigative and analytical resources are not applied to cases of human error in the maintenance shop."

What would it take to accomplish this? "A major obstacle to 100-percent error reporting in maintenance is the punitive work environment so pervasive industrywide," the report says. "Many aviation maintenance technicians (AMTs) may hesitate to report their own errors for fear of reprisal from management or government. Therefore, any maintenance-error reporting system will likely require some level of immunity to disciplinary action to be successful."

While the Aviation Safety Reporting System (ASRS) theoretically offers mechanics immunity from FAA sanction for unintentional errors, it doesn't protect them from employer sanctions. It appears that ASRS is rarely used by mechanics: The ASRS database reveals 172,000 reports by flight crewmembers and 24,000 by air traffic controllers, but only 6,000 by maintenance technicians. **AOPA**

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