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Safety in Numbers

The 2009 C-FOQA aggregate data show improvements in most metrics.

The rate of unstable approach events declined 36 percent in 2009 from the previous year among aviation departments participating in Flight Safety Foundation's corporate flight operational quality assurance (C-FOQA) program, according to a statistical summary report prepared by Austin Digital, which aggregates and analyzes the data.[1]

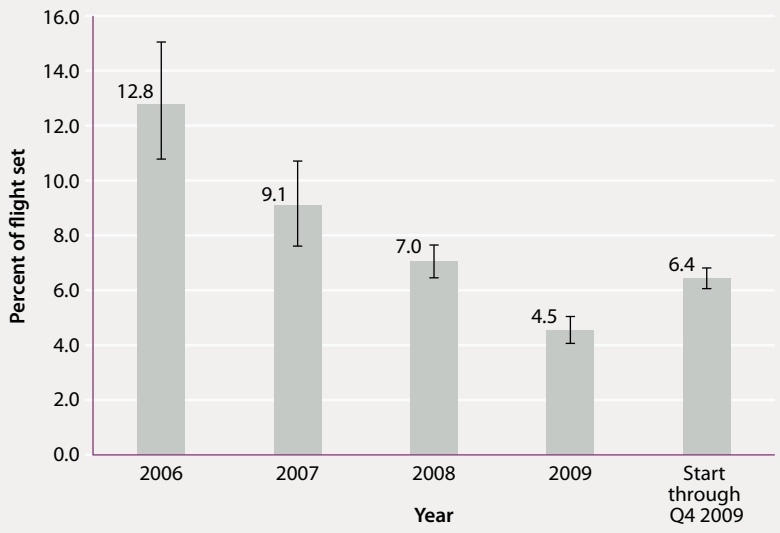
The 4.5 percent rate of unstable approach events in 2009 was the lowest since data collection and analysis began in 2006 (Figure 1), when the rate was more than 2.5 times higher, at 12.8 percent. The mean rate for the four years was half that for 2006. In addition, as the C-FOQA program has grown to include more organizations and more flights, the data have become more statistically significant — as shown by the decreasing size of the error bars.[2]

The FSF Corporate Aviation Committee and the National Business Aviation Association Safety Committee developed the C-FOQA program to enable corporate flight departments to use a safety monitoring system similar to those used by many airlines. The system collects flight data, recorded and downloaded from a quick access recorder, which are then analyzed for exceedances of selected parameters from predetermined values. The results are available confidentially to each participating operator for its own fleet, and publicly in de-identified and aggregated form.

As of 2009's fourth quarter, 27 aircraft of 11 types contributed to the aggregated data set.[3] The number of flights per quarter hovered around 200 through the third quarter of 2007, then began a rapid rise as participation in the program increased. Quarterly flight numbers peaked at more than 1,480 in 2009's second quarter, and decreased to 1,230 in the fourth quarter.

Unsafe practices or occurrences are defined as exceedances of standard event limits developed by the Foundation. The exceedances are ranked, in ascending severity, as caution events or warning events. Events are further subdivided by genre. Aircraft limitation events, related to equipment and configuration, represent conditions that place undue stress on the aircraft. Events potentially necessitating aircraft maintenance are another category. Yet another is flight operations events.

C-FOQA Unstable Approach Event Rates, 2006–2009



C-FOQA = corporate flight operational quality assurance; Q = quarter

Note: Error bars represent a 90 percent confidence interval.

Source: Flight Safety Foundation C-FOQA program and Austin Digital

Figure 1

Few aircraft limitation events in 2009 triggered either cautions or warnings. An exception was "flap airspeed limit exceedance," with 47 caution events and one warning event. The largest number of warning events was three, for "flap/slat altitude limit exceedance."

Among aircraft maintenance events, "reverse thrust while slow" triggered 23 cautions, and "hard landing" triggered four. There were four warning events for "roll attitude disagreement." No other category of aircraft maintenance events resulted in more than one warning event.

Flight Operations Events

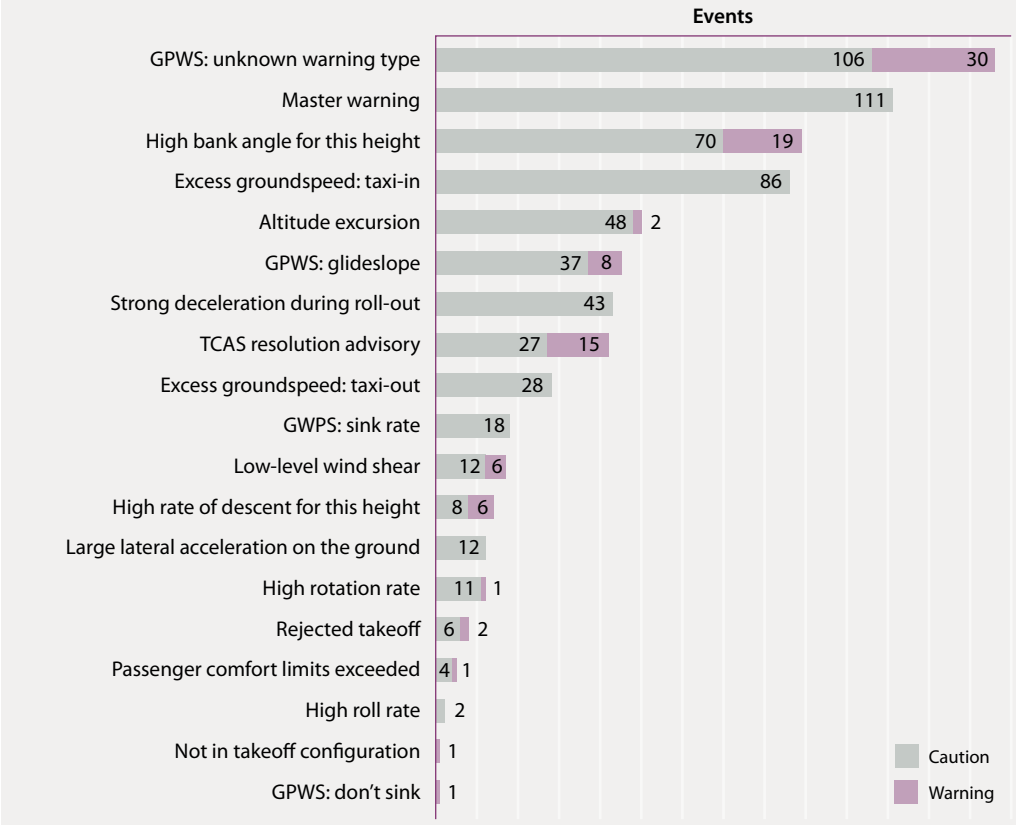
"GPWS [ground proximity warning system]: unknown warning type" accounted for the largest number of both caution events and warning events in 2009 — 106 and 30, respectively (Figure 2). "Master warning" had the next-highest number of caution events, but no warning events. "Excess groundspeed: taxi in" followed in number of caution events, but also had no warning events.

"High bank angle for this height" had the second-highest number of warning events, 19. "TCAS [traffic-alert and collision avoidance system] resolution advisory" accounted for 15 warning events. Other categories in which warning events were recorded included "altitude excursion," "GPWS: glideslope," "low-level wind shear," "high rate of descent for this height," "high rotation rate," "rejected takeoff," "passenger comfort limits exceeded," "not in takeoff configuration" and "GPWS: don't sink."

"GPWS: unknown warning type," with the greatest number of events in 2009, had been fifth in 2008. The 2009 total events in the category, including both caution and warning events, was 136, an 84 percent increase over the comparable number in the previous year, 74.

There were fewer examples of "master warning" caution events in 2009, 111 compared with 158 in 2008, a 30 percent improvement. "Excess groundspeed: taxi in," the category with the second-largest number of instances in 2008, decreased by 37 percent in 2009.

C-FOQA Flight Operations Events, 2009, by Type

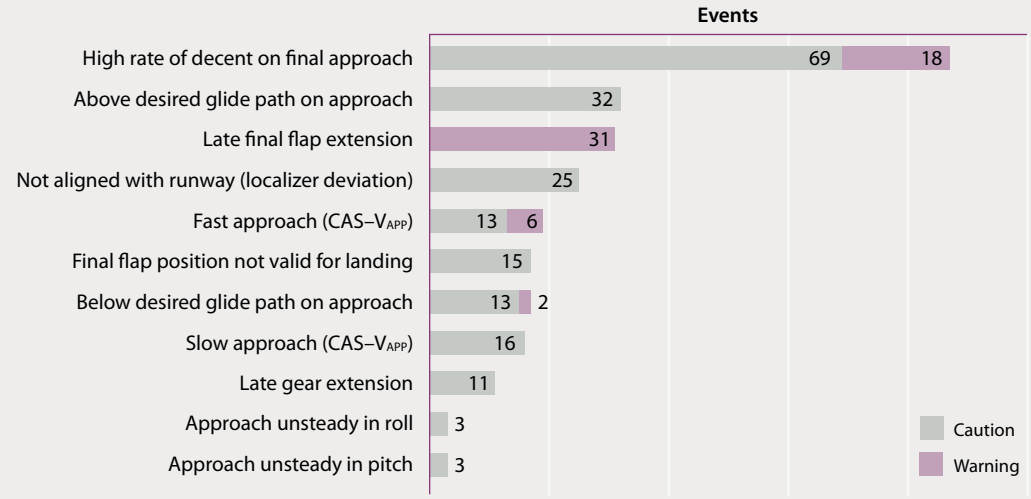


C-FOQA = corporate flight operational quality assurance; GPWS = ground proximity warning system; TCAS = traffic-alert and collision avoidance system

Source: Flight Safety Foundation C-FOQA program and Austin Digital

Figure 2

C-FOQA Unstable Approach Events, 2009, by Causal Factor

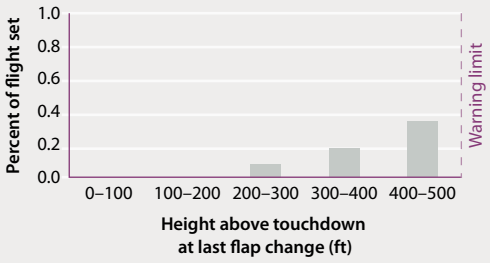


C-FOQA = corporate flight operational quality assurance; CAS = calibrated airspeed; V_{APP} = approach speed

Source: Flight Safety Foundation C-FOQA program and Austin Digital

Figure 3

C-FOQA Late Flap Extension Distribution, 2009



C-FOQA = corporate flight operational quality assurance

Note: Only an expanded view around the event limit is shown.

Source: Flight Safety Foundation C-FOQA program and Austin Digital

Figure 4

Overall, quarterly flight operations event rates have decreased since the second quarter of 2008, from occurring in 20.7 percent of flights to 12.8 percent in the last two quarters of 2009, a 38 percent drop. From the start of the C-FOQA program through the end of 2008, the mean rate was 15.8 percent.

Approach Events

The report is particularly concerned with event rates related to approach stability and landing performance — potential contributors to approach and landing accidents. In considering unstable approaches, exceedances up to 10 percent beyond the standard event limits are defined as caution events; above 10 percent, as warning events.

"High rate of descent on final approach" was the most common type of unstable approach event in 2009, resulting in 69 caution events — more than twice the next highest category — and 18 warning events (Figure 3). But the largest number of warning events, 31, involved "late final flap extension." Because it considered late flaps to be critical, the Foundation defined it as a warning event. The criterion was final flap selection below 500 ft height above the runway touchdown zone elevation (HAT).

In "high rate of descent on final approach" events, the 2009 numbers were worse than 2008's. The 69 caution events and 18 warning events added 38 percent and 13 percent, respectively.

But 2009's 31 warning events for "late final flap extension" were a 35 percent reduction from the 48 in the previous year, and localizer deviations — where the aircraft was not aligned with the runway — dropped from 46 to 25, or 46 percent.

Other improvements were evident in 2009 as well. In the "above desired glide path on approach" category, the 32 caution events recorded were a decrease of 32 percent from 47 in 2008. The year-over-year improvement in "final flap position not valid for landing" was 45 percent, and in "late gear extension," 52 percent.

In 2008, there had been 17 caution events and six warning events for "fast approach." The corresponding numbers for 2009 were 13 — 24 percent fewer — and six. Most "high rate of descent" events occurred at lower altitudes, less than 300 ft HAT. Fewer than 1 percent of flights were flagged as warning event limit exceedances in the "late flap extensions" category, and most occurred in the 400–500 ft HAT range (Figure 4). Three exceedances were

recorded as low as 200–300 ft HAT, however.

For "fast approach" events, the caution event limit triggered when the aircraft exceeded a reference value[4] by more than 20 kt from 500 ft HAT to 50 ft above ground level (AGL), and the warning limit triggered if the reference value was exceeded by more than 25 kt. The percentage of flights recording exceedances was about 0.5, and about 0.1 percent exceeded the warning limit by more than 32 kt. "Slow approaches," at 500 ft HAT to 50 ft AGL, exceeded the corresponding caution limit reference value by more than 12 kt in about 0.5 percent of flights.

Landing Events

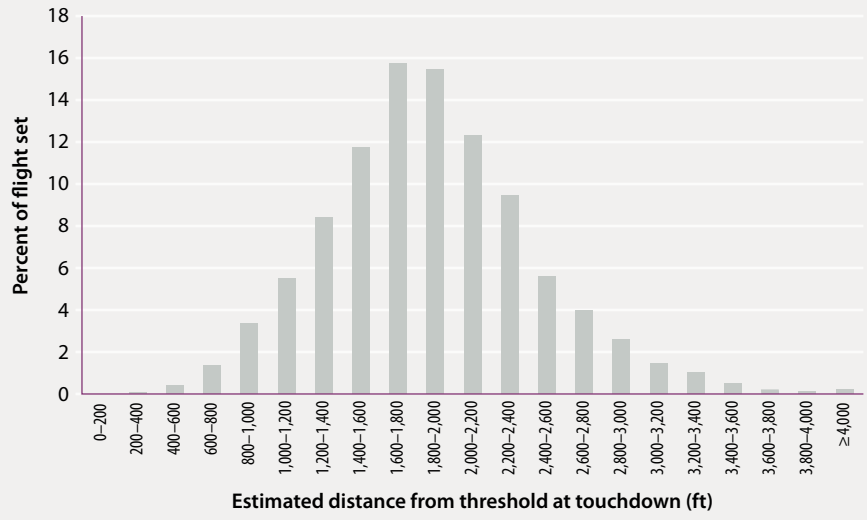
The report includes a scatter plot of groundspeed versus airspeed at touchdown that indicates that tailwind landings greater than 10 kt were a relatively small fraction of tail wind landings.

The aircraft distances from the threshold at touchdown resembled a standard "bell curve" distribution, with about 2 percent within zero to 800 ft (244 m) and about 4 percent beyond 3,000 ft (914 m; Figure 5). About 4 percent of flights had less than 3,750 fit (1,143 m) of runway distance remaining at touchdown (Figure 6). When the aircraft had slowed to 80 kt, about 6 percent of flights had less than 2,500 ft (762 m) remaining.

Notes

1. The report is available on the FSF Web site at <flightsafety.org/current-safety-initiatives/corporate-flight-operational-quality-assurance-c-foqa>.
2. The error bars represent that there is a 90 percent probability that the rate for the C-FOQA operators would fall within the range shown if there were an infinite number of their flights available for analysis.
3. Aircraft that contributed to the data set included the Bombardier Challenger 300, 605, Global Express and Global Express XRS; Dassault Falcon 900EX and 7X; Embraer ERJ-135; and Gulfstream 450, 550, IV and V.
4. The reference value for "fast approach" was set at one standard deviation from the average for the approach for the type. A standard deviation is the square root of deviation from the mean, which shows how much the range varies from the average.

C-FOQA Distribution of Distance From Threshold at Touchdown, 2009



C-FOQA = corporate flight operational quality assurance

Source: Flight Safety Foundation C-FOQA program and Austin Digital

Figure 5

C-FOQA Distribution of Runway Distance Remaining at Touchdown, 2009

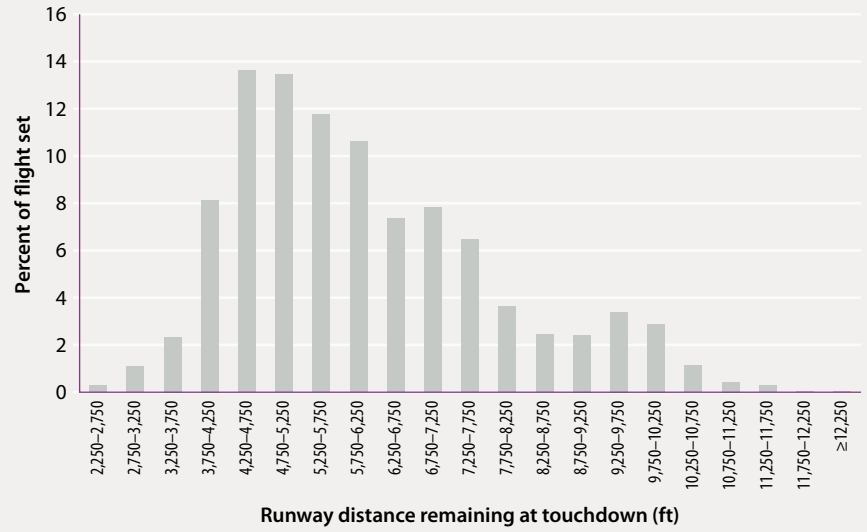


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Figure 6