Your Slip Is Showing

BY JOE VIZZONI

FOQA data can detect airports where runways are likely to be slippery and help pilots compensate.

Pilot statements such as "it was as slippery as grease" and "I thought I wouldn't be able to stop in time" would normally be associated with stopping on winter-contaminated runways. These are, rather, pilot responses upon landing in *rain* and on a *wet* runway. They form part of the pilot feedback in a test program related to aircraft braking action.

In fact, the test program revealed that some wet runways have equal or worse braking action than snow- or ice-covered runways.

The Program

The braking action test program came about in 2010 at legacy Continental Airlines, which has been merged with United Airlines, and

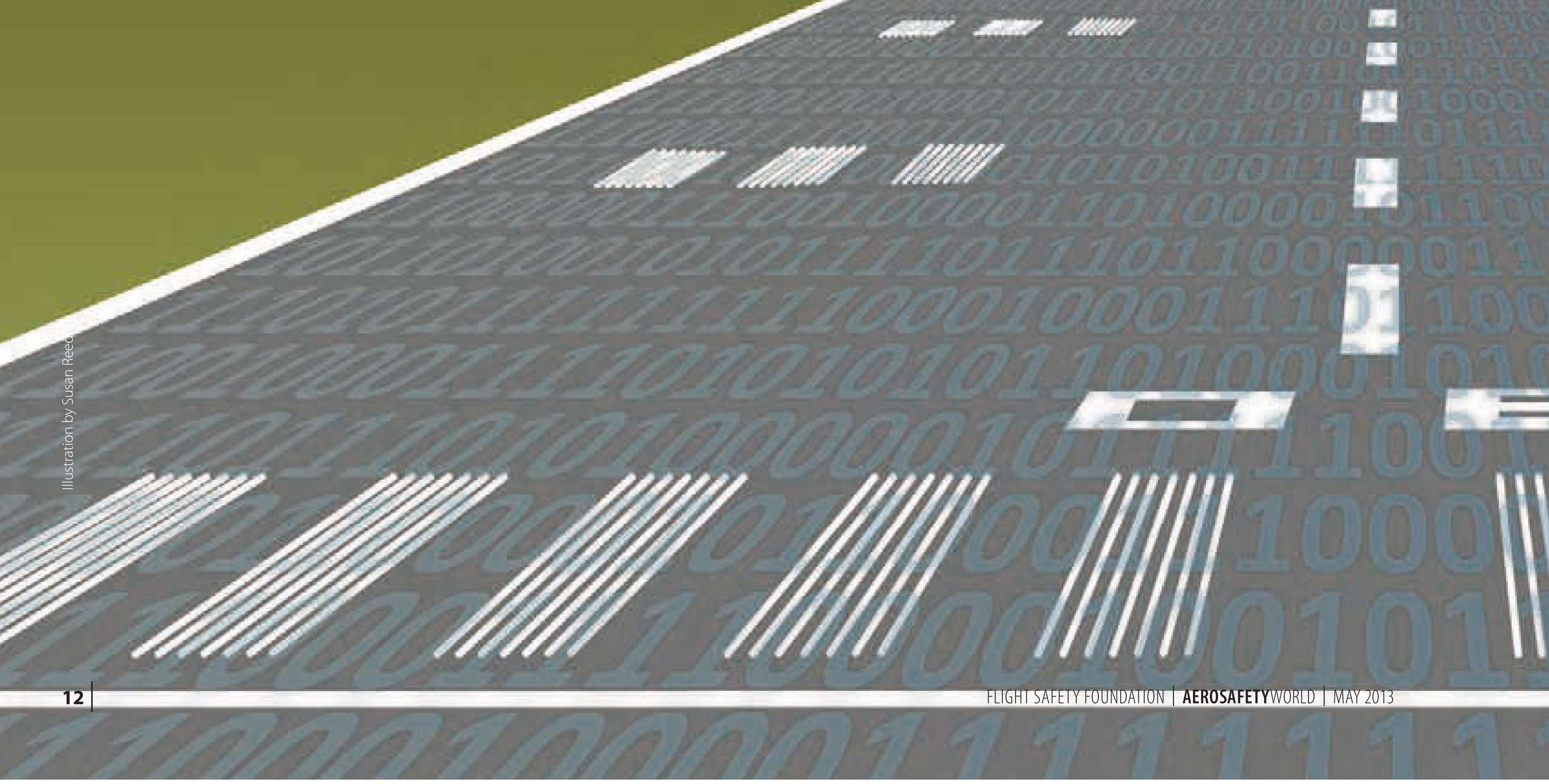


Illustration by Susan Reed

was based on using the aircraft itself and flight data to better assess braking action. In cooperation with Kongsberg Aeronautical, which possessed an algorithm developed for the purpose that it could easily be adapted and downloaded into the aircraft, the airline's flight operational quality assurance (FOQA) group saw this as an exciting safety project and subsequently initiated the test program. Due to the inherent sensitivity of FOQA data and its use, representatives of pilots as well as operational management were summoned to take part in decisions and approve the framework for the test program.

Sensitive Issues

When it came to sensitivity in the use of flight data, one factor proved essential and favorable. The algorithm and the subsequent program loaded onto the aircraft fleet did not require flight data downloading from the aircraft or any other distribution of flight data. The program was designed to obtain braking action information purely through onboard calculation processes. Only the resulting braking action information was transmitted by a downlink.

The braking action information generated by the system on the aircraft was not influenced by the pilot. The information did not reflect on the skill and airmanship of the pilot.

According to established practices, the FOQA group did not have direct contact or communication with pilots. All crew contact was through the Air Line Pilots Association, International (ALPA) as a gatekeeper.

With a clear understanding of the framework for the test program, the next step was to set up a system to assess, receive and evaluate feedback from pilots.

Management of Test Data and Pilot Feedback

Braking action data were processed, handled and communicated for feedback from pilots (Figure 1, p. 14). The following steps and phases further detail the procedure:

- The FOQA group checked daily incoming data from flights and looked for landings that qualified as being within the determined runway slipperiness threshold.
- Landings found to be within the runway slipperiness threshold were then tested against the weather conditions prevailing at the time of landing. By using METARs (the international standard code format for hourly surface weather observations) for the airport, the FOQA group could easily assess whether the landing information likely represented a slippery runway landing.
- To ensure the anonymity of the crew and avoid potential traceability, only a de-identified METAR eliminating the date was used to match the flight.
- In the next phase, the FOQA group approached the ALPA gatekeeper with the landing details. He contacted the crew to receive their feedback.
- The ALPA gatekeeper relayed the feedback and comments to the FOQA group.

The system comprising detection, verification and the final validation by the pilot worked well, and the pilot statements referred to earlier represent some of the feedback results.

'Friction-Limited' Braking Action

Setup of the on-board algorithm and program is, in broad terms, targeted to detect when aircraft encounter "friction-limited" braking situations. Detecting when an aircraft encounters friction-limited braking is a key constituent in determining maximum braking capability for an aircraft. The test program defined braking action as "dry," "good," "medium" (fair) or "poor" and assigned numerical equivalents of the airplane braking coefficient.

For practical purposes throughout the test program and in pilot contact, the feedback process was focused solely on landing situations in which braking action was classified as being less than "good." This was to avoid adding to pilots' workload for routine landings, when the test was designed to focus on difficult occasions.

A Pilot's Dilemma

Although it is common knowledge that wet runways may be slippery, the issue of slippery runways traditionally has been associated with winter operations and winter contaminants.

However, recently the wet runway issue has received increased attention, and for good reason. Early in this test, program data showed that airports where runways were neither grooved nor crowned for water drainage had increasingly higher risk of being slippery when wet. Various types of deposits on the runways compounded the problem.

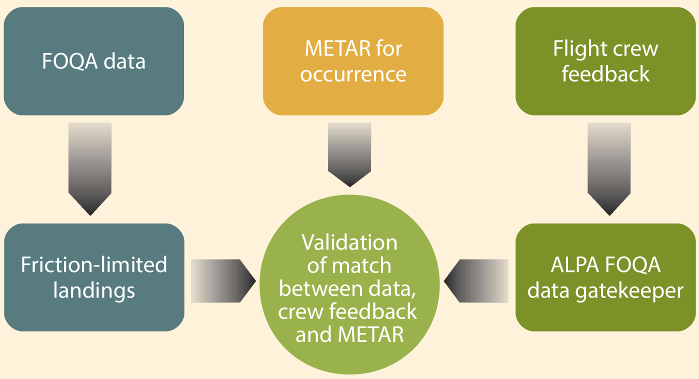
Ideally, airport management should ascertain proper runway design and maintenance programs to ensure proper friction. In reality, this is not always the case, and the test program revealed substantial variations. A pilot's job is to make the right decisions and land the aircraft safely given the prevailing conditions. Therefore knowledge of, and access to, crucial information is of utmost importance for the pilot.

Test Program Findings

One unexpected outcome of the test program was the finding that a few airports recurrently presented slippery conditions. The METAR analysis confirmed conditions to be rain and/or wet runways. Pilot feedback also supported the finding that conditions were slippery. Some of the pilot statements quoted earlier originate from these airports, primarily located in Central America, where the runways are typically neither grooved nor crowned. A history of overrun accidents further added to a perception of these airports being at higher risk.

To conduct further in-depth analysis, the FOQA group plotted, using a global positioning system tool, the number of slippery landings on maps of the runways to enhance situational awareness of the problem. The photograph (p. 15) shows an example of one of the airports where aircraft encounter friction-limited situations. For practical purposes, the illustration only shows encounters at groundspeeds less than 70 kt. This also is the phase of the stopping run when engine reverse thrust and aerodynamic drag have less impact on the deceleration and leave most of the stopping to the wheel brakes. The photograph shows consistency and further supports the findings.

FOQA for Wet and Slippery Runways Test Program



ALPA = Air Line Pilots Association, International; FOQA = flight operational quality assurance; METAR = international standard code format for hourly surface weather observations

Source: Joe Vizzoni

Figure 1


Satellite photo of Guatemala Airport. Magenta areas indicate positions where the on-board program recurrently indicated friction-limited braking. These positions were defined by the global positioning system, enabling comparison of multiple flights.

Google Maps

FOQA Alert

In response to a slippery landing that needed pilot feedback, the ALPA gatekeeper asked the crew for recommendations in addition to their feedback.

A frequent issue was the emphasis on idle reversers. Although never compromising safety, the company recommended, to an extent, idle reverser usage for fuel savings years ago when fuel prices were on the rise. It seemed that too many pilots relied on brakes when reverser usage was more appropriate, especially at the beginning of the landing roll.[1] What surfaced with this test program was potential increased risk with such a policy at certain airports when conditions involved rain and/or wet runways.

Finding that a significant number of pilots addressed the problem and approached it from virtually the same viewpoint, it became apparent that issue had to be pursued. In one of the company's monthly safety meetings, it was decided to bring up the issue. The safety meeting normally involves participants from ALPA, fleet managers, the safety group, etc. At the meeting, the ALPA gatekeeper presented the case supported by the pilot recommendations, the data and in-depth analysis from the FOQA group. This became then an action item.

In considering the action item, the options were to issue a pilot bulletin or insert a 10-7/FOQA alert — a notification that describes a problem and recommends a response — into the pilots' approach plate for an airport. Due to the seriousness of the issue, the pilot bulletin was considered less appropriate because it would likely be forgotten within six months. The 10-7, on the other hand, represented information in a more permanent form and was used for some of the airports revealed to be at higher risk in the test program.

The 10-7/FOQA Alert Era

The braking action test program continues at an increasing scale and according to its original intent. A little more than two years after the 10-7 implementation, there has been a substantial reduction in pilot statements such as "slipperier than grease" for those airports that were subject to the 10-7.

To further look into the impact of the 10-7 and use of idle reversers, the FOQA group has run an analysis. Where METAR data indicated rain and/or wet runway conditions in landings, their reverser usage was analyzed before and after the 10-7 implementation and showed significant changes. Thrust reverser usage has been more selective. Deployment of reversers upon landing is normal procedure, but in line with policy, the use of reverse thrust by increasing the engine revolution speed has varied. Prior to the 10-7 era, it was normal to see engine speed about 40 percent, which is virtually "idle," even when conditions were rainy or wet. After introduction of the 10-7, the standard engine speed used in rainy or wet conditions was about 80 percent, which is maximum use of reverser thrust.

This action item demonstrates encouraging results. First, it serves as a useful tool for pilots operating in airports that are less than ideal in design and maintenance. Second, in a cost-conscious environment, it also shows that

Selections From a 10-7 Issued for a Runway

- The runway is not grooved and standing water is likely to be present when raining.
- Braking action is likely to be fair–poor when the runway is wet.
- Select and use the maximum autobrake setting.
- Make every attempt to touch down at the 1,000-ft point.
- Use maximum reverse thrust.

—JV

rather than issuing generalized notifications and procedures, proper use of technology and cooperation by pilots can enable a clinical approach and more detailed procedures, better balancing safety with economic considerations.

Safety Culture and Environment

Continental Airlines had a long history of using flight/FOQA data to proactively enhance safety and efficiency, which has continued after the merger with United. Although the braking action test program and the initial 10-7 FOQA alert may seem ordinary, the process epitomized what is needed to build a platform of understanding, trust and cooperation to create the right culture and environment for working with sensitive information such as FOQA data.

For all parties in this test project, the focus has always been on safety. Nevertheless, it has been important to safeguard the corporate safety culture and environment by having proper systems, routines and procedures. When this test program surfaced, the operational management took a keen interest, provided the "green light," and then supported the test program. This was important and provided the proper framework for the project's more active participants.

ALPA and the FOQA groups have had a long relationship and developed good rapport through many years of cooperation. The intriguing part was to have a third party working within the traditional format of the FOQA group and ALPA. It has been a success.

The Future

Although there has been an increasing focus on rain and wet runways, the braking action test program was not specifically set up to find runways prone to higher risk in rain. It was part of a general move to better and more accurately assess the braking capability of aircraft, in particular during challenging winter conditions.

The on-board system developed is now downloaded onto all United's Boeing 737NGs, representing a significant network. Today, this aircraft network furnishes braking action information daily, albeit not yet for operational purposes but only for FOQA group analysis.

United's pilots will continue to serve a pivotal role in the system verification by providing valuable feedback. A print function has been programmed on the flight deck and activated for response, thereby simplifying participation by pilots. The test program will continue to be focused on runway conditions where braking action is assessed to be less than good by the numerical scale of airplane braking coefficient.

In terms of the future viability of the system, the algorithm and program have proved stable and reliable. Currently the system is undergoing a validation in cooperation with the U.S. Federal Aviation Administration. Access to and availability of FOQA data provide new opportunities to improve safety and efficiency of airline operations. By the same token, it is important that the necessary framework be in place to pursue desired results, such as those that have been evident in this project.

Joe Vizzoni has been a part of this test program and all the processes described from its start. He is a first officer with United Airlines on the Boeing 757 and 767 and also has experience as an aerospace engineer, of which nine of 14 years were with Boeing.

Note

1. Thrust reversers are most efficient at higher speed, so to reduce the kinetic energy of a landing aircraft, it is best to apply them at once, thus carrying forward less energy toward the end of the runway.