FLIGHT SAFETY FOUNDATION

ALAR

APPROACH-AND-LANDING ACCIDENT REDUCTION

TOOL KIT

FSF RSI BRIEFING NOTE

Runway Condition Reporting

Flight dispatchers and flight crewmembers should obtain accurate and timely information on runway conditions. Runway conditions are not static, they change with time as surface temperature changes and precipitation accumulates.

Measuring and reporting runway condition is the airport's responsibility; however, understanding the information and its possible problems is the operator's responsibility.

Dispatchers and flight crewmembers can make good decisions only by understanding the basis for and limitations of the information that has been reported to them.

Statistical Data

The Flight Safety Foundation Runway Safety Initiative (RSI) team found that runways contaminated by standing water, snow, slush or ice were involved in approximately 80 percent of the runway excursion accidents[1] that occurred in 1995 through March 2008.[2]

Runway Condition Reporting

Runway condition typically is provided in pilot reports of braking action, physical descriptions of runway conditions and/or friction measurements.

Physical Description of Runway Condition

The airport provides a physical description of runway surface condition using terms such as "wet," "flooded," "patches of ice," "5 mm of slush," "compact snow," "10 mm of dry snow" and "standing water." These surface condition reports provide an indication of braking action, but they can also be misleading if all the appropriate information is not known. For example, very cold, compact snow on the runway may have relatively good friction characteristics, but with a change of a few degrees in temperature, causing the snow to change to slush, and/or additional precipitation in the form of wet snow, runway friction will deteriorate.

When evaluating surface condition reports, it is important to know how much additional contamination has occurred since the report was issued. For example, a report might say that there is a trace of residual snow on a runway that had just been cleaned. However, snow may continue to fall, and the report quickly becomes out of date. With a snowfall rate between 20 and 40 mm (0.7 and 1.6 in) per hour, braking action can deteriorate from good to poor within 15 minutes.

Pilot Reports of Braking Action

Pilot braking action reports can be affected by the reporting crew's experience and the equipment they are operating. The terminology recommended by the International Civil Aviation Organization (ICAO) is "good," "good to medium," "medium," "medium to poor" and "poor." The terminology recommended by the U.S. Federal Aviation Administration (FAA) is "good," "fair," "poor" and "nil." Table 1 provides a conservative correlation of reported braking action with runway states.

Braking Action Terms

Term	Runway Condition
Good	Wet
Medium	Compact snow
Poor	Ice

Source: Flight Safety Foundation Runway Safety Initiative

Table 1

Pilot braking action reports generally are the most recent information available and therefore provide information about changing runway conditions. However, pilot reports are subjective. The pilot of a small airplane may perceive different braking conditions than the pilot of a large airplane. The braking action assessment also can be influenced by the airplane's weight, approach speed, amount of wheel braking applied and the location on the runway where the highest amount of wheel braking is used.

Friction Measurement

Runway friction is reported numerically (e.g., 30 or 0.30). The reports are derived from measurements by a variety of vehicles and by different methods. For example, some vehicles have decelerometers that measure the deceleration of the test vehicle during a maximum-effort stop. This deceleration is then converted to a friction reading.

Another method is to use a device, typically towed, that continuously measures the force on a braked wheel. Friction is then calculated from the forces on this wheel. Typically, these friction measurements are reported for each third of the runway.

Runway friction reports are objective and predictive. However, the different methods used to measure friction can provide different results.

Measurements by either the same vehicle/device — or the same type of vehicle/device — can vary between runs. Especially on "soft" surfaces (e.g., loose snow, slush, standing water), the vehicles/devices modify the surface over which they are run due to their contact with the deformable contaminate. The FAA states that ground friction vehicle reports are not considered reliable when the depth of the contaminant exceeds:

- 1 mm of water;
- 3 mm of slush or wet snow; or,
- 2.5 cm (1 in) of dry snow.

ICAO provides a similar warning.

A decelerometer should not be used in loose snow or slush, as it can provide misleading friction values. Other friction measuring devices also can give misleading friction values under certain combinations of contaminants and air/pavement temperature.

Friction measurements are taken at specific times, and runway condition may change between reports. More precipitation may fall, the temperature may change, or other traffic may cause changes in the runway condition. These changes may increase or decrease runway friction.

Manufacturers currently do not supply performance information based on friction measurements due to concerns about the accuracy of relating the measured friction to an airplane's performance capability.

How Reports Are Disseminated

Runway condition reports may be included in routine notices to airmen (NOTAMs), snow-related NOTAMs (SNOWTAMs), aviation routine weather reports (METARs), automatic terminal information system (ATIS) broadcasts or via ATC communication with the flight crew. For a short flight, the flight crew may have NOTAMs and/or SNOWTAMs available prior to departure that will enable them to perform a preliminary evaluation of the airplane's capability based on conditions reasonably expected at the time of arrival. The flight crew must recognize that conditions may change during the flight and that updated reports will be required as they near the airport.

Best Practices

During the preliminary evaluation, the flight crew should consider whether it is probable or possible that the conditions will change by the time of arrival and whether the conditions will change for the better or worse. A second evaluation should be performed to help with operational decisions such as:

- How long can a hold be maintained until a diversion decision must be made?
- Should extra fuel be loaded in order to hold while the runway is being improved?
- Are there any minimum equipment list (MEL) items that would affect the airplane's performance?
- Should landing weight (and therefore takeoff weight) be restricted to ensure the airplane's performance capability?
- Should the flight be delayed?
- Should an alternate airport be specified that has a higher likelihood of adequate runway conditions?
- What is the possibility that the expected wind conditions will exceed the recommended crosswind limit for the runway conditions?

On a long flight, the flight crew should perform another evaluation two to four hours before arrival. If it is determined that the conditions likely will change for the worse, the evaluation should include the following considerations:

- How long can a hold be maintained until a diversion decision must be made?
- Are there any MEL items that would affect the airplane's performance?
- What is the possibility that the expected wind conditions will exceed the recommended crosswind limit for the runway conditions?

As the flight nears the airport, the flight crew should perform a landing distance assessment based on the data provided by the airline. This assessment should take into account:

- Known and anticipated conditions at the airport;
- Runway condition;
- Pilot braking action reports;

- Weather conditions;
- Runway to be used;
- Runway length and slope (if available);
- Planned landing configuration and approach speed;
- Planned use of autobrakes or manual braking;
- Thrust reverser status;
- Expected speed at the threshold (per manufacturer's recommendation) and the possibility of hydroplaning;
- Expected visibility of runway markings; and,
- Runway lighting configuration.

As part of the landing distance assessment, the flight crew should develop a strategy that results in a land/no-land decision if additional information is received late in the approach.

Human Factors

The flight crew's training and experience will directly affect how they evaluate the information they receive on runway conditions. Flight crews who fly in specific areas — such as Alaska, northern Europe or Russia — may have more confidence in and place more importance on specific information based on local knowledge.

During international operations, the flight crew may have less confidence in runway-condition information because the terminology, measuring equipment and methods of reporting vary. In addition, the flight crew may have limited training or experience in the area.

Company Prevention Strategies

To help flight crews cope with contaminated runways, the airline or aircraft operator should provide the following:

- Winter operation/slippery runway standard operating procedures (SOPs);
- Interpretation of the manufacturer's data;
- Analysis of specific runway conditions;
- No-fault diversion policy; and,
- Training programs that include winter-operations elements such as evaluation of runway condition information.

Summary

Flight crews need timely, accurate information on runway conditions so that they can make informed decisions about the suitability of the runway for landing.

There are three primary methods of reporting runway conditions:

- Runway descriptions, which are the responsibility of the airport;
- Friction measurements, which also are the responsibility of the airport; and,
- Pilot braking action reports transmitted from flight crews to ATC and then to other pilots.

Runway descriptions and friction measurements are made at specific times and may not reflect changing conditions.

Pilot braking action reports reflect the changing conditions at an airport; however, these reports are subjective.

In changing conditions, flight crews should determine ahead of time the worst runway condition they will accept, so that they can make an informed decision if runway condition information becomes available very late in the flight.

Flight crews should not ignore parts of a condition report and rely on a single runway condition description; the most precise is not necessarily the most accurate.

The FSF RSI Briefing Note *Pilot Braking Action Reports* provides information to supplement this discussion.

Notes

1. The Flight Safety Foundation Runway Safety Initiative (RSI) team analyzed 548 runway-excursion accidents that occurred in 1995 through March 2008 involving civil airplanes weighing more than 12,500 pounds/5,700 kilograms.
2. The FSF RSI team defines a *runway excursion accident* as "a mishap characterized by an aircraft departing the usable surface of a runway during takeoff or landing." The team said, "An excursion can occur either by overrunning the end of the runway or by veering off its side. A runway excursion during takeoff assumes that the aircraft started its takeoff roll on the runway surface and later departed that surface with its wheels still on the ground. Runway excursions during landing are generally predicated on an aircraft having initially touched down on the runway surface, followed by a departure from that surface with its wheels still on the ground. Events where aircraft depart the runway while airborne are not considered runway excursions."

Related Reading From FSF Publications

Mook, Reinhard. "Treacherous Thawing — Slush may induce poor/nil aircraft braking action, contrary to runway friction readings." *AeroSafety World* Volume 3 (October 2008): 14-19.

Lacagnina, Mark. "Missed Assessment — Tired pilots neglected to perform a required review before landing." *AeroSafety World* Volume 3 (October 2008): 20-24.

Werfelman, Linda. "Blindsided — The pilots of an Airbus A340 did not anticipate the 'severe deterioration' of weather as they approached the runway threshold at Toronto." *AeroSafety World* Volume 3 (February 2008): 40-45.

Mook, Reinhard. "Insidious Ice — Basic physics makes slippery-runway issues crystal clear." *AeroSafety World* Volume 2 (October 2007): 24-28.

Johnsen, Oddvard. "Improving Braking Action Reports — Using performance data from landing aircraft would eliminate current inaccuracies." *AeroSafety World* Volume 2 (August 2007): 36-40.

Rosenkrans, Wayne. "Knowing the Distance — The FAA plans to require commercial and fractional turbojet flight crews to confirm landing distance capability on arrival in specific situations." *AeroSafety World* Volume 2 (February 2007): 22-25.

Regulatory Resources

International Civil Aviation Organization (ICAO). *International Standards and Recommended Practices, Annex 14 to the Convention on International Civil Aviation: Aerodromes*.

ICAO. *International Standards and Recommended Practices, Annex 15 to the Convention on International Civil Aviation: Aeronautical Information Services*.

ICAO. Doc 9137, *Airport Services Manual*. Part 2, *Pavement Surface Conditions*.

U.S. Federal Aviation Administration (FAA). Advisory Circular (AC) 150-5200.30C, *Airport Winter Safety and Operations*.

FAA. AC 91-79, *Runway Overrun Prevention*.

Notice

The Flight Safety Foundation (FSF) Runway Safety Initiative (RSI) team produced this briefing note to help prevent runway excursion accidents. This is one of two RSI briefing notes included in the FSF *Approach-and-Landing Accident Reduction (ALAR) Tool Kit*, which comprises a variety of other safety products that have been developed to help prevent approach-and-landing accidents.

The briefing notes have been prepared primarily for operators and pilots of turbine-powered airplanes with underwing-mounted engines, but they can be adapted for those who operate airplanes with fuselage-mounted turbine engines, turboprop power plants or piston engines.

This information is not intended to supersede operators' or manufacturers' policies, practices or requirements, and is not intended to supersede government regulations.

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