

Winter Runway Estimated Braking Action Assessment Procedures

Contents

- 1 Introduction
- 2 Background
- 3 Scope
- 4 Assessment Methodology
- 5 The Matrix
- 6 Advisory Landing Distance
- 7 '3-Kelvin-Spread Rule
- 8 Definitions

Appendices

- A Table – Runway Surface Contamination Reporting
- B Task Data Sheet
- C The Matrix

Winter Runway Estimated Braking Action Assessment Procedures

1 Introduction

- 1.1 These procedures provide for licensed aerodromes intending to continue operations in winter weather where conditions on the runway are termed contaminated.
- 1.2 The main benefit of adoption to both aerodrome and aircraft operators is a methodology whereby greater clarity and accuracy will lead to improved safety through a reduction in the excursion risk and in weather diversions due to inestimable contamination on the runway.

2 Background

- 2.1 The CAA Winter Wash-Up meetings held following the severe weather experienced across the UK in 2010 prompted the formation of a Winter Information Group (WIG). This group, made up of industry stakeholders drawn from aircraft operators, Air Traffic Control (ATC), aerodromes and the Regulator, reviewed all current available information published by the CAA concerning winter operations, amended where necessary, and published new guidance in the form of NOTAL, ATSIN, FODCOM and updated AIP and AIC pages regarding the reporting of runway surface conditions. Appendix A shows the runway surface condition reporting table created to help ensure the fullest amount of detail is passed via ATC to aircraft intending to use the runway.
- 2.2 Feedback from aircraft operators on the WIG suggested that trials taking place in North America under the FAA's Takeoff and Landing Performance Assessment – Airworthiness Rulemaking Committee (TALPA ARC), could be adapted for use in the UK. The trials included a Runway Condition Assessment form used to generate a code equating to the estimated braking action that could be expected by aircraft operating on a contaminated runway.
- 2.3 A parallel UK trial was commissioned at four aerodromes for winter 2010-11 which provided limited information due to the largely mild winter. For winter 2011-12 the trial was expanded to include 17 aerodromes, geographically spread across the United Kingdom. Unfortunately, owing to the mild winter not enough results were recorded, and the resulting data set was small; however, there was evidence of correlation between the braking action estimate and the perceived braking action reported by aircrew. The WIG concluded that the proof of concept had been achieved, and the trial was re-commissioned to increase the data set and confirm the potential safety benefits.
- 2.4 The 2012-13 winter provided sufficient adverse weather to allow participating aerodromes to gather plenty of data. There were 30 days of airport disruption across the UK and more than a thousand landings were recorded. This showed a better than 60% correlation between the estimated braking action provided by the aerodrome and the after landing PIREP. This supports the TALPA-ARC work which had a near 80% correlation rate
- 2.5 As a consequence, the CAA is content to promulgate the assessment and reporting methods developed over the trial period to a greater number of licensed aerodromes. The following text should form the basis of the operation.

3 Scope

- 3.1 These procedures are for use by any licensed aerodrome intending to operate in periods of winter runway contamination by reference to the runway condition assessment tools described herein.
- 3.2 Those aerodromes which participated previously in the trials leading up to this change may continue by using methods developed over that period. Any aerodrome wishing to start using the assessment table must contact the CAA in the first instance via their nominated aerodrome operations inspector, for a detailed briefing.

4 Assessment Methodology

- 4.1 A task data sheet has been produced to help aerodrome operations staff carry out a runway inspection and obtain all the necessary data to pass on to ATC (see Appendix B).
- 4.2 An assessment table (The Matrix) is provided for use in contaminated runway conditions to help enable aerodrome operations staff assess conditions and derive an estimate of runway braking action.

Note: The words (GOOD, MEDIUM or POOR) are the same as those used in reports of braking action on compacted snow and ice detailed in the UK AIP AD1-2-4 para 5.4.1 but it must be emphasised that the meanings of these words are not directly related to any numerical values of friction.

- 4.3 Should one or more thirds of the runway not be affected by contamination, the standard phraseology for runway state should be used, e.g. Dry, Damp, Wet or Wet with de-icer fluid.
- 4.4 In the case of a PIREP being communicated from an aircraft during periods of runway contamination, a hierarchy of validity is to be employed. Any PIREP that reports the runway as worse than the current Estimated Braking Action will prompt a downgrading to that state and require a reassessment of the runway condition. Any PIREP suggesting better than reported conditions will not upgrade the Estimated Braking Action but will trigger a reassessment of the runway state.
- 4.5 SNOWTAMs should be issued and updated, for significant changes, in accordance with AIC Yellow 86/2009. Notwithstanding the AIC, if sleet or snow is falling, or clearing is in progress, reports are usually provided every 30 minutes, but must be provided hourly.
- 4.6 Runway State Groups appended to the METAR should be issued in accordance with CAP 782 Regulation of Aeronautical Meteorological Services. When different states are reported for the three portions of the runway the one that equates to the worst condition will be reported.
- 4.7 Any aircraft operator using a participating aerodrome's runways during such conditions may participate. ATC will pass Estimated Braking Action information to any aircraft using RTF when aerodrome operations personnel make a report available. After each movement ATC may request a verbal report from landed aircraft on the braking action perceived by the flight crew.

This will comprise the following: "(Callsign), *were the estimated braking actions as reported?*".

- 4.8 Aircrew responses should be recorded and fed back to the aerodrome operations staff to help them refine their assessment procedures.

5 The Matrix

- 5.1 The matrix is contained at Appendix C. Aerodrome licence holders should also be aware of the two caution notices at sections 6 and 7 below, when using the matrix:

6 Advisory Landing Distance Data

- 6.1 As a consequence of the FAA trials mentioned above, advisory landing distance data has been made available by some aircraft manufacturers for use by aircraft operators' flight crew for the assessment of normal landing performance.
- 6.2 The additional performance data is based on normal operational landing techniques and runway surface conditions, enabling flight crew to derive a Representative Landing Distance Required (LDR). An additional 15% margin will normally be applied to the derived distance at the aircraft commander's discretion.
- 6.3 This has the potential to have an impact on the revised runway surface conditions assessment, which UK aerodromes trialled using a matrix derived from the TALPA-ARC matrix, to report an estimated braking action based on the surface conditions. CAA advice is that aerodromes need to be cognisant of this change and suggests aerodrome operators be aware that an optimistic report of the runway state by one category (e.g. from 'medium' to 'good to medium') could eliminate most of the safety margin and in some conditions could significantly exceed it and thus be of concern in the landing distance limited case.
- 6.4 Additionally, aerodrome operators should use this knowledge to inform their runway closure decision-making.

7 '3-Kelvin-Spread Rule'

- 7.1 The Norwegian Accident Investigation Board has published a report entitled 'Winter Operations, Friction Measurements and Conditions for Friction Predictions'. The report is based on findings from 30 incidents that have occurred on contaminated runways over the ten years in Norway. The report highlights a number of safety indicators from its findings, one of these is the '3-Kelvin-Spread Rule'.
- 7.2 The rule states that at air temperatures of +3°C and below, with a dew point spread of 3°C or less, the runway surface condition may be more slippery than anticipated on snow and ice. The narrow dew point spread indicates that the air mass is relatively close to saturation which is often associated with actual precipitation, intermittent precipitation, nearby precipitation or fog. How these atmospheric conditions affect braking action is not considered by the rule; however, many of the incidents highlighted in the Norwegian report which relate to insufficient grip were linked to precipitation or deposition of water, either liquid or frozen.

- 7.3 The validity of the rule may depend on its correlation with precipitation but it may also, at least in part, depend on the exchange of water at the air-ice interface. The rule was observed in 21 out of the 30 incidents related to braking action on ice and snow investigated by Norway. Due to the other variables involved such as surface temperature, solar heating and ground cooling or heating, a small temperature spread does not always mean that the braking action will be poor. The rule should be used by aerodrome operators as an indicator of slippery conditions but not as an absolute. When these conditions exist it may be appropriate for aircraft operators to factor the landing distance above and beyond those previously calculated.

8 Notes and Definitions

Note - the surface condition may be passed as Good when wet with de-icing fluid, as there should be no difference in braking action to that when the runway is wet with water.

Dry runway - a runway can be considered dry when no more than 25% of the runway surface area within the reported length and the width being used is covered by visible moisture or dampness.

Wet runway - a runway is considered wet when more than 25% of the runway surface area within the reported length and the width being used is covered by any visible dampness or any water up to 3 mm deep.

Contaminated runway - a runway is considered to be contaminated when more than 25% of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by the following:

- (i) surface water more than 3 mm deep, or by slush, or loose snow, equivalent to more than 3 mm of water;
- (ii) snow which has been compressed into a solid mass which resists further compression and will hold together or break into lumps if picked up (compacted snow); or
- (iii) ice, including wet ice.

Dry snow - snow that can be blown if loose, or that will not stick together to form a snowball using gloved hands.

Wet snow - snow that contains enough water content to be able to make a well-compacted, solid snowball, but water will not squeeze out.

Slush - snow that is so water saturated that water will drain from it when a handful is picked up. Slush will splatter if stepped on forcefully.

Compacted snow - snow that has been compressed into a solid mass such that the airplane tyres, at operating pressures and loadings, will run on the surface without significant further compaction or rutting of the surface. Compacted snow may include a mixture of snow and embedded ice; if it is more ice than compacted snow, then it should be reported as either ice or wet ice, as applicable. A layer of compacted snow over ice should be reported as compacted snow.

Water - water in a liquid state.

Frost - frost consists of ice crystals formed from airborne moisture that condenses on a surface whose temperature is below freezing. Frost differs from ice in that the frost crystals grow independently and therefore have a more granular texture. Heavy frost that has noticeable depth may have friction qualities similar to ice and downgrading the runway condition code accordingly should be considered. If driving a vehicle over the frost does not result in tire tracks down to bare pavement, the frost should be considered to have sufficient depth to consider a downgrade of the runway condition code.

Rime - deposit of ice generally formed by the freezing of super cooled fog or cloud droplets on objects whose surface temperature is below or slightly above 0 Deg C.

Ice - frozen water.

Wet ice - ice with a layer of water on top of it or ice that is melting.

Appendix A

Runway Surface Contamination Reporting Table

	Touchdown Zone			Mid Point		Stop End		
Runway	% Cover	Type	Depth	Type	Depth	Type	Depth	
09R								
27L								

Appendix B

Runway State Assessment Task Sheet

- 1.1 For those adopting estimated braking action reports, the objective of this sample task sheet is to set out those actions aerodrome operations personnel may find necessary to carry out during an inspection of a potentially contaminated runway during winter, and pass data gathered during such an assessment to Air Traffic Control.
- 1.2 Equipment likely to be required:
 - a) Suitable transport permitted to enter a runway;
 - b) Appropriately trained and competent personnel;
 - c) Means of recording data;
 - d) Means of measuring or assessing depth of contaminant;
 - e) Means of measuring either surface or air temperature;
 - f) Means of passing data.
- 1.3 Regardless of air traffic movements, the assessment should cover the promulgated runway length.
- 1.4 Account should be taken of the cleared width of the runway in the case of contamination.
- 1.5 The assessed area should be divided up into equal thirds and reported as Touch Down, Mid Point and Stop End.
- 1.6 The Runway Assessment Matrix provided for the trial (see Appendix C) should be referred to in order to assign an estimated braking action to the conditions observed.
- 1.7 The parameters for the assessment are:
- 1.8 General:
 - Date and time of observation;
 - Operations mode (CAT I, LVPs or RWY closed);
 - Air temperature (surface temperature may be collected but will be used for comparison purposes only);
 - Dew point;
 - If present, restrictions to cleared width;
 - If present, restrictions to cleared length; and
 - If present, height of any snow banks.
- 1.9 For each runway third:
 - Type of contaminant;
 - Percentage of cover (greater than 25%);
 - Mean depth of contaminant per runway third.
- 1.10 Assessments should be repeated whenever conditions change and in any case 15 minutes before the first movement following any closure.

Appendix C - The Matrix

Depth	Water	Slush	Snow (Wet)	Snow (Dry)	Compacted Snow (any depth)	Ice/Rime	Frost
↑ >19mm	Flooded	STOP	STOP	STOP	Warmer than -15C Medium -15C and Colder Good to Medium	Poor	N/A
19mm >13mm	Flooded	STOP	STOP	STOP			
13mm >3mm	Medium To Poor	Medium to Poor	Medium	Medium			
3mm 0mm	Good	Good	Good	Good			Good
	See over for cautionary note ref 3 Kelvin Rule						
Dry	The runway is not affected by Water, Slush, Snow, Ice or Frost						