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Safety and Security Regulation Department

Flight Operations and Flight Crew Licensing Inspectorate

FLIGHT OPERATIONS NOTICE

Number: OPS/2021/001

Runway Surface Condition Assessment and Reporting

Flight Operations Notices are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material. Flight Operations Notices should always be read in conjunction with the relevant regulations.

1. Purpose

This notice aims to provide an overarching conceptual understanding of the surface friction characteristics that contribute to controlling an aircraft via the critical tire-to-ground contact area. The intent is to provide broad and fundamental concepts and guidance to support maintenance of surface friction characteristics and the global reporting system and format for assessing and reporting runway surface conditions applicable as of 4th November 2021.

2. Applicability

This notice is applicable to aircraft (aeroplane) operators and flight crew members.

3. References

- ICAO Aeroplane Performance Manual
- ICAO Circular 355 Assessment, Measurement and Reporting of Runway Surface Conditions
- ICAO Doc 9157 Aerodrome Design Manual

4. Additional Information/Clarification/Queries

Any queries, requests for guidance/clarification or additional information subsequent to this publication should be addressed to General Manager Safety and Security Regulations by mail dalabrosse@scaa.sc or by contacting the SCAA Safety and Security Regulations Flight Operations and Flight Crew Licencing Inspectorate (telephone **4384271**)

5. Effective Date

06 September 2021.

6. Cancellation

This notice replaces Information Notice – New Runway Surface Condition Reporting System dated 22nd January 2020.

This Notice will remain in force until revoked or replaced by the Authority.

7. Runway Surface Condition Assessment and Reporting

7.1 General

7.1.1 Runway accidents and incidents are aviation's number one safety-related risk category. A primary factor contributing to this risk includes runway excursions during take-off or landing in adverse weather conditions; the runway surface may be contaminated by snow, ice, slush or water, with a potentially negative impact on an aircraft's braking, acceleration or controllability. ICAO therefore introduced a methodology to harmonize the assessment and reporting of runway surface conditions. This methodology will improve the flight crew's assessment of the take-off and landing performance of aeroplanes. The report is intended to cover conditions found in all climates and provides a means for aerodrome operators to rapidly and correctly assess the conditions, whether they be a wet runway, snow, slush, ice or frost, including rapidly changing conditions such as those experienced during winter or in tropical climates. The information can be provided to the flight crew via various channels, such as the revised SNOWTAM or air traffic control. This is a conceptual change for the airport as it no longer just reports a series of observations and measurements, but it also turns this information into an overall assessment of the effect that the surface condition has on the aeroplane performance.

7.1.2 The reporting process begins with the evaluation of a runway by human observation, normally performed by airport operations personnel. A description of the surface contaminant based on its type, depth and coverage for each third of the runway, is then used to obtain a runway condition code (RWYCC) specific to the conditions observed. The evaluation and associated RWYCC are used to complete a standard report called the runway condition report (RCR) which is then forwarded to air traffic control (ATC) and the aeronautical information service (AIS) for onward dissemination to pilots.

7.1.3 Pilots use the RCR provided to determine the expected performance of their aircraft by correlating the RWYCC or the reported runway condition description with performance data provided by the aircraft manufacturer. This helps pilots to correctly carry out their landing and take-off performance calculations for wet or contaminated runways.

Pilots should also report their own observations of runway conditions once a landing has been completed, thereby confirming the RWYCC or providing an alert to changing conditions. This relatively simple and globally applicable reporting methodology is an important means by which the risk of runway excursion can be mitigated and the safety of runway operations improved. This notice describes the reporting method in more detail and provides guidance for flight crew on how to interpret and use the information.

Note: The procedures for making special air-reports regarding runway braking action are contained in Flight Operations Notice – Air Reports (AIREP).

7.1.4 Further guidance on runway surface condition assessment and reporting that is specific to airport operations personnel is presented in the ICAO Doc 9981 PANS-Aerodromes and ICAO Circular 355 Assessment, Measurement and Reporting of Runway Surface Conditions.

7.2 The Runway Condition Report (RCR)

7.2.1 The RCR is the basis for all runway surface condition reporting. It is a comprehensive, standardized report relating to the runway surface condition and its effect on the landing and take-off performance of an aeroplane. In accordance with aerodrome regulations for design and operations, the runway condition should be reported with an RCR whenever a runway is contaminated by water, snow, slush, ice or frost, to the extent where its state has an impact on the performance of an aircraft operating on it. Whatever the means of communicating the report (SNOWTAM, automatic terminal information service (ATIS) [refer to note below], ATC), it should contain the elements that are comprehensively described in ICAO Doc PANS-Aerodromes, Part II, Chapter 1, 1.1.3. These elements, including details on how they are relevant to the operation of an aeroplane and its performance, are presented below.

Note: The minimum elements to be transmitted on ATIS are presented in Circular 355 section 4.68.

7.2.2 The information provided by an RCR is divided in two sections: the aeroplane performance calculation section, which contains information that is directly relevant in a performance computation; and the situational awareness section, which contains information that the flight crew should be aware of for a safe operation but does not have a direct impact on the performance assessment.

7.2.3 The aeroplane performance calculation section is a string of grouped information with clear identifiers to distinguish it from the situational awareness section, or from the aeroplane performance calculation section of another runway. The information included in the aeroplane performance calculation section consists of:

(a) *Aerodrome location indicator*. The four-letter ICAO location indicator, in accordance with *ICAO Doc 7910 Location Indicators*.

(b) *Date and time of the assessment*. Especially important whenever there is active precipitation, as the flight crew can assess the magnitude of its evolution since the report was generated. It should be understood that reports are snapshots at a given date and time and do not indicate a prediction of conditions at a later date and time.

(c) *Lower runway designation number*. The information is conveyed per third of the runway. The direction of reporting information relating to these thirds is always from the end with the lower designator number (except in a report by ATC, which will always be in the operational direction). The reference length for the runway is described in 2.3.2 and in line with this, not all of the runway length to which the report applies may be relevant to the particular operation (take-off or landing). In case of differences between the different thirds, the pilot should assess which parts of the reported conditions are relevant.

(d) *Runway condition code for each runway third*. This code classifies the available braking action in one of seven categories. This code is a direct input into a landing performance assessment at time of arrival but should also never be disregarded for take-off. As conditions are always reported in the direction of the lower runway designator in the RCR, pilots are expected to attribute the information from each runway third correctly for their intended operation.

(e) *Per cent coverage contaminant for each runway third*. Contamination is reported only when the coverage exceeds 10 per cent. Runway contamination affects aeroplane performance only when the coverage exceeds 25 per cent in at least one third. However, the flight crew should exercise judgement as to the location of the contamination in the perspective of the portion of the runway that the aircraft will be using for the intended operation. Runway inspectors are advised to focus on the area around the wheel tracks when assessing coverage.

(f) *Depth of loose contaminant; dry snow, wet snow, slush or standing water for each runway third*. This information is conditional. For contaminants other than standing water, slush, wet snow or dry snow, the depth is not reported. The position of this type of information in the information string is then identified by /NR/.

(g) *Condition description for each runway third*. Only one type of contamination is reported for each runway third (this includes layered contaminants) and the runway inspector should include the contaminant type most prevalent or most relevant to performance. In contentious cases, contamination judged to be secondary may additionally be reported in the free text section.

(h) *Width of runway to which the RWYCCs apply, if less than published width*. Whenever clearing cannot occur on the entire width of the runway, the aerodrome personnel may report only the contaminant remaining on the cleared centre portion of the runway. This item indicates the width of this section. RWYCCs apply only to this centre section.

7.2.4 Examples of the RCR aeroplane performance calculation section are given below:

EADD 02170055 09L 5/5/5 100/100/100 NR/NR/NR WET/WET/WET
EADD 02170135 09R 5/2/2 100/50/75 NR/06/06 WET/SLUSH/SLUSH
EADD 02170225 09C 2/3/3 75/100/100 06/12/12 SLUSH/WET SNOW/WET SNOW

7.2.5 The situational awareness section consists of the following items, with guidance on how the flight crew should consider situational awareness in briefings and actual flight operations in cold weather conditions:

(a) *Reduced runway length*. The flight crew should check that the correct landing distance available (LDA)/take-off distance available (TODA)/take-off run available (TORA)/accelerate-stop distance available (ASDA) is used in performance calculations, and verify the position of the runway threshold in use.

(b) *Drifting snow on the runway*. Be aware of the optical illusion of a “moving runway” in crosswind conditions.

(c) *Loose sand on the runway*. Be aware of sand ingestion to engines if using reverse thrust. Adjust performance calculations according to the intended use of reversers.

(d) *Chemical treatment on the runway*. Some operators may collect this information because of brake wear.

(e) *Snowbanks on the runway*. Be aware of snowbanks if cleared width is less than full runway width. There is a danger of losing directional control or snow ingestion into the engines.

(f) *Snowbanks on taxiway*. Avoid taxiing to keep clear of snow ingestion.

(g) *Snowbanks adjacent to the runway*. Avoid taxiing to keep clear of snow ingestion.

(h) *Taxiway conditions*. Adjust taxiing speed and techniques accordingly.

(i) *Apron conditions*. Adjust taxiing speed and techniques accordingly.

(j) *State approved and published use of measured friction coefficient.* Use only if approved by the operator.

(k) *Plain language remarks*. Note any other relevant information.

7.2.6 An example of the RCR situational awareness section is given below. All individual messages in the situational awareness section end with a full stop sign to distinguish the message from subsequent messages:

RWY 09L SNOWBANK R20 FM CL. RWY 09R ADJ SNOWBANKS. TWY B POOR. APRON NORTH POOR.

7.3 Runway Condition Code (RWYCC)

7.3.1 The RWYCC is a single-digit number describing the deceleration and lateral control capability for the runway surface condition. They are assigned to each runway third whenever the coverage of any water-based contaminant on that runway third exceeds 25 per cent. It is the total assessment of the slipperiness of the surface, as judged by the trained and competent aerodrome personnel and based on given procedures and all information available, and enables flight crew to determine the effect of the runway surface condition on aeroplane deceleration performance and control. There are seven surface condition levels associated with RWYCC numbers zero to six and they represent conditions that range from too slippery to operate on (zero), to completely dry conditions (six). Each RWYCC (except zero) is matched with a corresponding aeroplane deceleration performance level. Airport operations staff assign the RWYCC based on the conditions observed in their physical evaluations of runway conditions, which are then included in the RCR as discussed in the previous section. Measured coefficients of friction should no longer be communicated to pilots but restricted to use by the airport staff in consolidating the runway surface condition assessment made from observed surface contamination characteristics like type, depth and temperature. As a general rule, the runway contaminant type and depth permit determination of a RWYCC, but a RWYCC can never give contaminant type and depth.

7.3.2 The reference runway length will typically be the full length of asphalt or concrete available for take-off or landing. However, it should be noted that when a stopway exists at the airport, it is excluded from the scope of the runway surface for which RWYCC are assigned. This is shown in Figure 2-1, which illustrates the runway thirds and RWYCCs for runways with and without, a displaced threshold. It is important for the flight crew to be aware that the stopways will see less traffic than the rest of the runway surface and may therefore be subject to more accumulation of contamination. If the condition of the stopway is significantly different from the rest of the runway, this should be reported in the free text comments of the RCR.

7.3.3 As new information becomes available, there may be a need to revise the RWYCC assigned. The RWYCC may be downgraded or upgraded in accordance with the procedures contained in ICAO Doc 9981 PANS-Aerodromes. New information may be acquired by aerodrome personnel from additional observations of the runway surface. Reports from pilots following aeroplane operations on the runway, known as an air-report (AIREP) and that reflect the impact of the surface condition on the braking action of the aeroplane, also allow the aerodrome personnel to revise the RWYCC assigned. More information on AIREPs is provided in paragraph 7.4 below.

7.3.4 The airport staff use any updated information to downgrade or upgrade a RWYCC in accordance with the procedures associated with the runway condition assessment matrix (RCAM). The RCAM provides a combination of available information (runway surface conditions, including runway state and contaminant; pilot report of runway braking action) in order to assess the RWYCC. The RCAM is a tool to be used when assessing runway surface conditions. It is not a standalone document and is used in compliance with the associated assessment procedures. The RWYCC and runway braking action are mapped against each other, enabling aerodrome personnel to factor in all available information and update the assigned RWYCC if necessary. Such a decision cannot be taken by a flight crew on the approach, as it must be supported by all other observations.

7.3.5 Upgrading a primary RWYCC 5, 4, 3 or 2 determined from the observed contaminant type is not allowed. The flight crew may thus trust the reported RWYCC if it is equal or lower than the corresponding contaminant stated as plain language. A RWYCC 1 or 0 can, in exceptional cases, be upgraded to a maximum of 3 even when the contaminant that has caused this primary classification has not been removed. It may have been treated with sand or gravel, or simply provide exceptional friction due to its inherent characteristics, as assessed by trained aerodrome personnel.

7.3.6 Some circumstances are prone to rapid changes in the runway surface conditions and, therefore, how conditions affect aeroplane braking action and lateral control. In such cases, the flight crew may ask for a recent report, if the last available report may not correctly reflect the prevailing conditions at the time of landing. Examples of such conditions are active precipitation and when the runway is contaminated with compacted snow or ice with an outside air temperature (OAT) above -3°C or a difference between OAT and dew point of 3°C or less. If a recent report is not available, the flight crew should consider an appropriate lower RWYCC in their assessment of the worst likely degradation of the conditions.

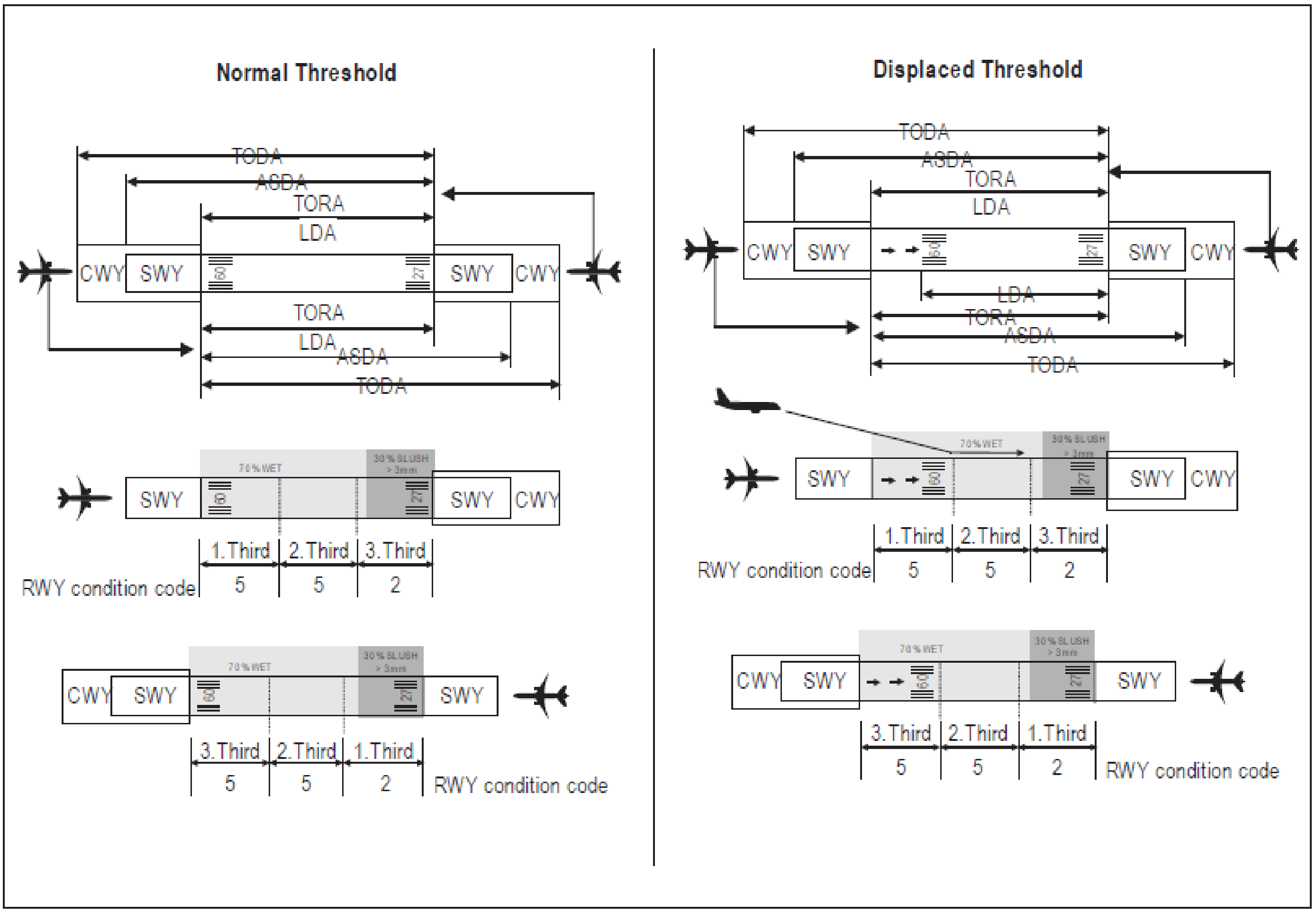

Figure 1 Reporting of runway condition code from ATS to flight crew for runway thirds (ICAO Doc 9981 PANS-Aerodromes, Part II)

7.3.7 Information about sanding and chemical treatment information is shown in the situational awareness section of the RCR. The aerodrome operator decides how to use these treatments as they best understand their effectiveness. Inadequately applied sand or sand displaced by aeroplane traffic may not be efficient and the initial effect of chemicals may be a degradation of the achievable friction. As the reported RWYCC already considers their effect on performance, no automatic extra credit can be attributed to sanding or chemical treatment when calculating the landing distance. Loose sand in RCR is for flight crew situational awareness and is intended to mitigate the risk of foreign object debris (FOD) to the engines.

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7.4 Pilot Report after Landing

7.4.1 The role of the pilot in the runway surface condition reporting process does not end once the aeroplane safely exits the runway. While the aerodrome operator is responsible for generating the RWYCC for a runway, pilots are responsible for providing accurate braking action reports. Flight Operations Directive – Flight Operations paragraph 7.4.2.1 mandates that the flight crew make AIREPs whenever they observe worse runway braking action than previously reported. It is up to the pilot to assess the manner in which an aircraft responds to the application of wheel brakes. These reports provide feedback to the aerodrome operator regarding the accuracy of the assigned RWYCCs relative to the runway surface conditions actually experienced. Table 1 below shows the correlation of pilot reports of runway braking action with RWYCCs (this table forms part of the overall RCAM).

Table 1 Correlation of runway condition code and pilot reports of runway braking action

Pilot report of runway braking action	*Description*	*RWYCC*
N/A		6
GOOD	Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	5
GOOD TO MEDIUM	Braking deceleration OR directional control is between good and medium.	4
MEDIUM	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	3
MEDIUM TO POOR	Braking deceleration OR directional control is between medium and poor.	2
POOR	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced.	1
LESS THAN POOR	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain.	0

Note: Operations in conditions where LESS THAN POOR braking action prevails are prohibited.

7.4.2 Air traffic control (ATC) relays the pilot reports of runway braking action to the aerodrome operator who in turn uses them in conjunction with the RCAM to determine if the RWYCC should be downgraded until the runway surface condition is improved. These reports thus play an important part in the cycle of runway surface condition assessment and reporting. Since both the ATC and the aerodrome operator rely on accurate runway braking action reports, pilots should become familiar with this terminology and use it when providing controllers with runway braking action reports. If the differences between two consecutive levels of the categories between “GOOD” (RWYCC 5) and “LESS THAN POOR” (RWYCC 0) are too subtle for the pilot to detect, the pilot may report on a coarser scale of “GOOD”, “MEDIUM” and “POOR”.

7.4.3 During periods of increased traffic flow, runway inspection and maintenance may be less frequent and should be sequenced with aeroplane arrivals. Aerodrome operators may depend on runway braking action reports to confirm that the runway surface condition is not deteriorating below the assigned RWYCC. Whenever requested by ATC, or if the assessed runway braking action is less than previously reported, pilots should provide a braking action report. This is especially important where the experienced braking action differs from the braking action associated with any RWYC currently in effect. When the braking occurrence and the report match up, the pilot and the aerodrome operator gain additional confidence in the reported runway codes. AIREPs play an important role in preventing runway excursions as reports of runway braking action below the assigned RWYCC may influence a subsequent pilot's decision to continue with a landing. A report from a preceding aeroplane is all the more reliable when it emanates from another aircraft with landing performance capabilities similar to his/her own. The pilot should, however, be conscious that even similar aeroplanes may be operated at a very different mass and approach speeds. Aircraft control or safety should not be jeopardized

7.4.4 There can be difficulties in making reports of braking action for the pilot since these reports are intended to characterize only one of the aeroplane deceleration elements: the availability of wheel braking. When operating on long dry or wet runways, pilots apply low autobrakes or partial pedal braking. For most landings, only idle reverse thrust is used. Landing on slippery or contaminated runways requires a different technique and results in the energy dissipation by the aerodynamic means, use of reverse thrust, and applied wheel braking in different proportions than during a "normal" landing. Aerodynamic drag and reverse thrust are most effective at high speed and initially can, by themselves, generate a deceleration rate that can be close to that experienced in non-performance limited landings. The lack of wheel-to-ground friction during the high speed portion of the landing may thus not be immediately apparent to the pilot, although reduced lateral control due to reduced cornering forces may be an indicator of reduced wheel-to-ground friction. As the aeroplane decelerates, drag and reverse thrust become less effective and thrust reversers may be stowed between 70 and 60 kts, in line with manufacturer recommendations for normal landings (they can typically remain deployed to full stop if necessary, but when it is not required to ensure a safe stop, manufacturers recommend stowage to avoid re-ingestion). During the lower speed portion of the landing, the deceleration is, to a large extent, created by the wheel brakes. It is consequently in this phase that the reduced braking action is most noticeable to the pilot. The pilot should, however, attempt to characterize the entire length of runway used during the stop in an AIREP.

7.4.5 Furthermore, flight crew must understand that a report will only be relevant when the braking demand has exceeded the braking action available, i.e. the anti-skid system, if installed, has regulated brake pressure below that commanded by the pilot or the autobrake system, to avoid skidding and maintain a close-to-optimum slip ratio. The braking is then called "friction limited". Braking occurs when the tire is slowed relative to the runway by applying pressure on the brakes. The maximum braking force occurs when the tire speed is between 7 and 15 per cent slower than the ground speed of the aeroplane, referred to as the slip ratio. On slippery runways, the tire may have a tendency to stop due to lack of friction. Most modern airplanes are equipped with anti-skid systems that prevent such skidding from occuring and optimize the slip ratio for maximum braking. Friction-limited braking thus occurs when the pilot, or the anti-skid system when available, must adjust brake pressure to avoid skidding. There is usually no indication in the cockpit to inform the pilot that the anti-skid system is cycling. Skidding may not occur on all wheels simultaneously.

7.4.6 When using manual braking, the pilot can, to some extent, judge the available braking action by the amount of pedal deflection, above which, no increase in deceleration occurs. Brake pressure control may not be linear with pedal deflection. When using autobrakes, the system targets an overall airplane deceleration rate. At low target values, the system may release the brake pressure to a large extent when the target can be achieved with aerodynamic and reverse thrust only. In autobrake mode, the pilot can only detect lack of braking action when the target deceleration is not achieved; i.e. the braking demand is above the existing capability and the braking is friction limited. Cockpit deceleration indications may not be accurate enough to indicate whether the requested deceleration is achieved or not. In such cases, the commander needs to use their best judgement on whether to report braking action.

7.4.7 A condition where a valid braking action report can be observed rarely occurs over the full length or width of a runway. Therefore, when possible, the flight crew should communicate the sections of runway in which wheel braking was applied and/or directional control difficulties were encountered, e.g. “Braking Action Medium on last third of runway 08” or “Braking Action Poor on high-speed exit Bravo Runway 20.”

7.5 Training Requirements

75.1 Both airline operators and flight crew should be appropriately trained on runway surface condition assessment and reporting, and on the impact on the aeroplane performance data. While the methodology establishes a clear link between the observation, reporting and accounting for runway surface conditions in performance, it also creates new paths for errors that should be highlighted during the proactive training of crew. As the assessment of the runway condition, friction measurement, and estimation of braking action are not an exact science, it is important that training emphasizes that the methodology provides a toolset permitting an approximate assessment of the aeroplane performance rather than establishing exact aeroplane behaviour in terms of numbers.

7.5.2 The overall time for initial training on the global reporting format should be no less than 1.5 hours and include classroom elements with an instructor in addition to self-study or in line with current training methods utilising virtual classrooms/e-learning. Having the appropriate attitude and mind-set should also be part of the objectives met in addition to the knowledge and skills required.

7.5.3 A training syllabus should include the following, as a minimum (a more complete list of training items is presented in Appendix 1 below):

(a) The history of runway surface condition reporting:

(1) accident history; and

(2) reasoning and description of the reporting method.

(b) The purpose of new runway surface condition reporting.

(c) Matrix fundamentals:

(1) RCAM layout:

(i) differences between those published for aerodromes and flight crew;

(ii) format in use;

(iii) the use of runway friction measurements;

(iv) the use of temperature;

(v) the concept of “performance buckets” and ICAO runway surface condition codes;

(2) runway contaminant definitions;

(3) depth measurements;

(4) runway coverage: errors in the reporting percentage coverage and how reporting in thirds can produce highly deceptive information to the flight crews;

(5) use of the term “slippery wet”: conditions must be effectively observed and reported; and

(6) downgrading or upgrading criteria.

(d) Flight crew related actions:

(1) the difference between a calculation and an assessment;

(2) effects of aircrew task loading on receiving condition reporting; and

(3) pilot braking AIREPs: pilots must understand the physics the reports represent as well as the techniques necessary to produce an accurate observation.

(e) Types of runway contamination and its effects:

(1) general types of contaminant;

(i) solid;

(ii) loose; and

(iii) deformable.

(f) Aircraft performance:

(1) effects of contamination during take-off;

(2) effects of contamination during landing;

(3) airport items used for landing;

(i) visual cues; and

(ii) Category III cues;

(4) the components of a pilot braking report;

(i) how to give an accurate report; and

(ii) when reports are not valid;

(g) Operational observations with friction devices: the friction measuring devices must be properly calibrated and operated and should meet the standard and correlation criteria set by the State.

(h) Critical areas of the runway;

(i) Safety considerations;

(1) types of errors possible;

(2) mindfulness principals necessary for high reliability; and

(3) safety reporting.

(j) Documentation and records.

7.5.4 The introduction of the runway surface condition assessment and reporting format has highlighted some specific areas that should be addressed as part of a training plan, including:

- *Techniques used as a best practice for one organization may not be applicable for others*. Example:
  Airports that operate frequently in winter conditions may develop observational techniques that rely on extensive experience and apprenticeship. Other airports may find it hard to match that same level of expertise. Using vehicle braking observations, for example, may not be a best practice if the airport is not exposed to winter conditions long enough to maintain this type of corporate knowledge.

- *Misunderstanding terminology*. Technical discussions on runway observations and aircraft vehicle performance can have similar sounding terms and even numbers: "MU" being a primary example. Anyone using an RCAM should understand what the terms are, and how they are related.

- *Timeliness of communication*. Beyond 180 NM, flight crews may obtain information from airports in order to make runway surface condition assessments. Between 180 and 40 NM, any change in condition reporting must be communicated to the flight crew. Within 40 NM, any change in runway surface condition must be pro-actively communicated to the aircraft. Any change in condition that occurs too quickly for the flight crew to take notice of can invalidate their assessment and lead to unexpected risk.

- *Conflicting reports between pilots and aerodromes*. There may be a range of aeroplane performance indicators for a given runway. In some cases, the AIREP of braking action may be more accurate than the condition report. These reports can be more or less conservative than the original report by the aerodrome. If an operator wishes to base their risk management process on an AIREP that is less conservative than a runway condition report, the process must be carefully designed to demonstrate and maintain an equivalent level of quality assurance regarding risk exposure.

- *Operational bias*. Much of the observational criteria for an RCAM depends on judgment that can be subject to social, political and economic pressures. The differences between 3 mm and 5 mm of contaminant or between wet snow and slush can have a large effect on operations. It is a human factors norm that people tend to bias perceptions in favour of what they expect to hear and see, and disregard information that does not fit into a pre-planned expectation. This lack of mindfulness can contribute greatly to errors in the perception, assessment and reporting of runway surface conditions from flight crews and airports.

7.6 General Considerations for Aeroplane Performance on Contaminated Runways

7.6.1 As previously discussed, the RCR reflects the runway braking capability as a function of the surface conditions. With this information, the flight crew can derive the necessary stopping distance of an aircraft under the prevailing conditions from the performance information provided by the aeroplane manufacturer. Aeroplane deceleration results from a combination of factors. First, there are the aerodynamic drag forces generated by the airframe and, in particular, the ground spoilers. Second, reverse thrust may be used if available. Finally, deceleration occurs from wheel-to- ground friction, which is of course influenced by the runway surface, as well as by manual or automated braking of the aeroplane. Performance computations assume a homogenous distribution of the contaminant along the entire length and width of the runway. Coverage reported as 25 per cent may be significantly less and is provided only for situational awareness. Performance calculations may then assume a dry or wet runway as appropriate, but any coverage in excess of 25 per cent should be considered as though the entire runway is covered. In other words a runway will be considered contaminated if one of the thirds has contaminant coverage in excess of 25 per cent.

7.6.2 The difficulties for a pilot to make an accurate report as illustrated here have led to research and development activities that use aircraft data recorded during the ground run to identify the available braking action objectively. Such technologies are now becoming available to assist the pilot in this task.

7.6.3 The RCR restricts the list of layered contaminants that can be reported. The most frequent cases are included, but some scenarios cannot be reported with specific terminology. In those cases, the aerodrome operator will strive to report the performance-relevant condition. When necessary, free text may be used to describe the actual condition of the runway. In most cases, layered contaminants lead to less than poor braking action and do not permit operation unless appropriately mitigated by the airport in order to upgrade the reported RWYCC. An exception to this is dry snow on top of compacted snow or wet snow on top of compacted snow, which is classified as medium braking action. The reported depth of this contaminant refers only to the top layer of loose snow and may be used in selecting the appropriate contaminant for performance computations, when the manufacturer has chosen to provide landing performance as a function of contamination rather than RWYCC. Even when this is not the case, the flight crew should ensure that the reported depth does not exceed the maximum depth of loose snow.

7.6.4 Aeroplane performance tables and computation tools assume a homogenous contaminant type and depth along the entire runway length and width. However, there may be significant differences reported between the runway thirds. The flight crew may use the most penalizing contaminant for performance computation, which may be excessively conservative. For this reason, the operator may have policies about disregarding a part of the runway. In such cases, the operator should give explicit guidance for crosswind analysis. For example, the flight crew could use only the two last thirds for landing distance calculations; or if the runway end was much more slippery than the first two thirds and it is possible to bring the aeroplane to a full stop in the less slippery part (two first thirds), the flight crew could be given a possibility to omit the last third. Computations accounting for different conditions in each runway third are not available from manufacturers, as regulation specifies that the contaminant should be assumed to be evenly distributed for establishing performance. Additionally, this capability may not be desirable as the computed landing distance with this method has been shown to be very sensitive to aeroplane speed evolution versus location on the runway; it may not be representative of what will be achieved during the actual stop.

7.6.5 Any change to the normal runway length available for take-off and landing is always communicated by NOTAM. The RCR may mirror the NOTAM if there is a change to the landing distance available, as a reminder for inbound flight crew. Departing flight crews should have fresh NOTAMs and calculate take-off performance accordingly. If, for any reason, part of the runway length has not been cleared in due time, the runway is considered to be usable by its full length and the un-cleared contaminant should be reflected in the RWYCC in the RCR. Policies mentioned in paragraph 7.6.7 may be applied, and the flight crew may also consider postponing the landing. The cleared runway width may also be limited for various reasons in adverse weather. This situation is often ad hoc and NOTAM communications may be too slow to reach flight crews in time. Therefore, a partially cleared width may be reported by RCR. Operators should have explicit policies for partial cleared runways, i.e. a defined minimum cleared width for each aeroplane type and possible reductions in the maximum permitted crosswind. The aerodrome should update the report whenever a significant change, relevant to aircraft performance, occurs to the runway condition, but this may be difficult in an active weather event. Note also that the maximum validity period of a SNOWTAM is 8 hours.

7.6.6 For either grooved or porous friction course (PFC) runways, and non-grooved or non-PFC runways, experience has shown that wheel braking is degraded when the runway is very wet. The root cause of the wet runway stopping performance shortfall is not fully understood; however, runway characteristics that appear to be contributors include texture (polished or rubber contaminated surfaces), drainage, puddling in wheel tracks and active precipitation. An analysis of this data indicates that 30 to 40 per cent of additional stopping distance may be required in certain cases where the runway is very wet, but not flooded. Wheel braking may be degraded when the runway is very wet, even when the runway has not been reported as “slippery wet”. If active moderate or heavy precipitation exists, the operator should consider additional conservatism in their assessment of performance at time of landing that is over and above that already calculated for wet conditions.

7.6.7 Possible methods of applying additional conservatism when operating on a runway that is degraded when very wet include assuming a braking action of medium (RWYCC 3) when computing performance at time of landing or increasing the factor applied to such an assessment established with landing performance data for RWYCC 5 (good braking action). A pilot should consider reduced crosswind limits and ensure the prompt application of braking means after touch-down, including the use of maximum reverse thrust until a safe stop is assured.

7.6.8 Operators should be aware of the runway maintenance program and wet runway friction capability at the airports in which they operate. Mitigation should be considered at airports where aircraft operators have a reason to suspect that the runway is not maintained in a condition such as to provide surface friction characteristics at or above the minimum friction level specified by applicable state aerodrome regulations while very wet during active precipitation.

7.6.9 Whenever an operator uses a performance credit for specific operations on grooved or PFC runways, the performance data has usually been prepared appropriately by the manufacturer and was approved by the Authority. Its use may be subject to operational conditions and procedures. It is the responsibility of the operator to ensure that the runway has been constructed and maintained in accordance with the applicable guidance, such as those laid out in ICAO Doc 9157 Aerodrome Design Manual. The extent of the performance credit given to the data should not be assumed to be valid systematically on all runways that, in appearance, have grooved or PFC surfaces.

Appendix 1 Example of a List of Subjects for Training Flight Crew Members on Contaminated Runway Operations

This appendix provides an example of a syllabus for training flight crew members using the global reporting format. The examples are provided to support ICAO Doc 9981 PANS-Aerodromes, Part II, Chapter 1, applicable as of 4th November 2021. The syllabus provides guidance on the training that will be required for the successful roll-out of the global reporting format.

1 Training and actual operations should be based on the fact that the assessment of the runway condition, friction measurement and estimation of braking action are not an exact science. Pilots should understand that the actual safety margins get smaller when conditions get worse and, at the same time, the assessment of the runway condition becomes more difficult in deteriorating weather. Therefore, the RCAM, RWYCCs and braking action are adaptive tools in decision-making rather than operating norms or rules. For example, a calculated 1 m margin in landing distance does not necessarily mean that the landing will be safe; the pilot must use his or her best judgement, taking different variables into account and cross-checking between sources when making decisions.

2 It is also good airmanship to determine how small changes in runway and/or weather conditions affect operations, for instance, how the downgrading of the RWYCC by one level or a predetermined wind change affect operations. It is good CRM to make some predetermined decisions regarding deteriorating conditions. These "canned decisions" improve situational awareness, help in late-stage decision-making and improve workload management.

Note: Items marked with an asterisk (*) are directly linked to runway surface condition reporting.

1. General	
Contamination	• Definition* • Contaminants that cause increased drag and therefore affect acceleration, and contaminants that cause reduced braking action and affect deceleration • Slippery when wet: status*
Contaminated runway	• Runway surface condition descriptors* • Operational observations with friction devices* • Operator's policy on the use of: o reduced take-off thrust; o runway thirds in take-off and landing performance calculations; and o low visibility operations and autoland. • Stopway • Grooved runway
RWYCCs*	• RCAM* o Differences between those published for aerodromes and flight crew* o Format in use* o The use of runway friction measurements* o The use of temperature* o The concept of performance categories and ICAO runway surface condition codes* o Interpretation of "slippery wet" o Downgrade/upgrade criteria* o Difference between a calculation and an assessment* • Braking action* o Reporting of LESS THAN POOR → no operations • Use of aircraft wind limit diagram with contamination
RCR (reference: Doc 10064)	• Availability* • Validity* • Performance and situational awareness* • Decoding* • Situational awareness (reference: Doc 10064)*

Aeroplane control in take-off and landing (reference: Doc 10064)	• Lateral control o Windcock effect o Effect of reversers o Cornering forces o Crosswind limitations ▪ Operations if cleared runway width is less than published width
	• Longitudinal control • V_1 correction in correlation with minimum control speed on ground o Aquaplaning o Anti-skid o Autobrake
Take-off distance	• Acceleration and deceleration • Take-off performance limitations • Take-off distance models • Factors involved • Reason for using the type and depth of contaminant instead of RWYCC* • Safety margins
Landing distance	• Model for distance at time of landing • Factors involved • Safety margins o Minimum equipment list (MEL) does not include any additional margins (e.g. 15%)
ICAO's exceptions in runway reporting	• States that do not comply with ICAO*
2. Flight planning	
Dispatch/in-flight conditions	
MEL/configuration deviation list (CDL) items affecting take-off and landing performance	
Operator's policy on variable wind and gusts	
Landing performance at destination and alternates	• Selection of alternates if airport is not available due to runway conditions o En-route o Destination alternates • Number • Runway condition
3. Take-off	
• Runway selection • Take-off from a wet or contaminated runway	
4. In-flight operations	
Landing distance	• Distance at time of landing calculations o Considerations for flight crew (reference: Doc 10064)* o Operator's policy • Factors involved • Runway selection for landing • Safety margins
Use of aircraft systems	• Brakes/autobrakes • Difference between friction-limited braking and different modes of autobrakes • Reversers • Aeroplane as a friction-measuring and/or reporting system
5. Landing techniques	
Pilot procedures and flying techniques when landing on length-limited runway (reference: Doc 10064)	
Use of the Engineered Materials Arresting System (EMAS) in case of overrun	
6. Safety considerations	
• Possible types of errors* • Mindfulness principles necessary for high reliability*	
7. Documentation and records*	
8. AIREPs (reference: Doc 10064)	
• Assessment of braking action* • Terminology* • Possible automated AIREPs* (aeroplane as a friction-measuring and reporting system) • Air safety reports if flight safety has been compromised	