# ADVISORY CIRCULAR

**CAA-AC- AGA304**

**December 2022**

**ASSESSMENT, MEASUREMENT AND REPORTING OF RUNWAY SURFACE CONDITIONS.**

## 1.0 PURPOSE

1.1. The purpose of this circular is to provide guidance to be used by aerodrome operators in relation to the assessment and reporting of runway surface conditions.

1.2. The Circular also provides information and guidance to Air Navigation Services and Meteorological Services for Air Navigation providers regarding the reception, processing and transmission or sharing of information to users.

1.3. The circular further provides actions required by various players including aerodrome operators, aircraft operators, Air Navigation Service Providers and Meteorological Agencies in compliance with the new provisions on runway surface conditions.

## 2.0 REFERENCES

2.1 Civil Aviation (Aerodromes) Regulations.
2.2 Civil Aviation (Air Traffic services) Regulations.
2.3 Civil Aviation (Aeronautical Information Services) Regulations.

### 2.1 ABBREVIATIONS

| | |
|---|---|
| AIC | Aeronautical information circular |
| AIP | Aeronautical Information Publication |
| AIREP | Air-Report |
| AIS | Aeronautical Information Services |
| ATM | Air Traffic Management |
| ATS | Air Traffic Service |
| ICAO | International Civil Aviation Organization |
| MET | Meteorological Services |

| | |
|---|---|
| NOTAM | Notice To Airmen |
| PANS | Procedures For Air Navigation Services |
| RCAM | Runway Condition Assessment Matrix |
| RCR | Runway Condition Report |
| RESA | Runway End Safety Area |
| RST | Runway Safety Team |
| RWYCC | Runway Condition Code |
| SARPS | Standards And Recommended Practices |
| SLA | Service Level Agreement |
| SMS | Safety Management System |
| SOP | Standard Operating Procedure |
| TWY | Taxiway |
| LDA | Landing distance available |
| ASDA | Accelerate-stop distance available |
| TODA | Take-off distance available |
| TORA | Take-off run available |

## 2.2 DEFINITIONS

***Air-report.*** A report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting.

***Air traffic service.*** A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

***Automatic terminal information service (ATIS).*** The automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof:
*Data link-automatic terminal information service (D-ATIS).* The provision of ATIS via data link.
*Voice-automatic terminal information* service *(Voice-ATIS).* The provision of ATIS by means of continuous and repetitive voice broadcasts.

***Braking action.*** A term used by pilots to characterize the deceleration associated with the wheel braking effort and directional controllability of the aircraft.

***Coefficient of friction.*** A dimensionless ratio of the friction force between two bodies to the normal force pressing these two bodies together.

***Contaminant.*** A deposit (such as snow, slush, ice, standing water, mud, dust, sand, oil and rubber) on an aerodrome pavement, the effect of which is detrimental to the friction characteristics of the pavement surface.

***Declared Distances***

- Landing distance available (LDA). The length of runway which is declared available and suitable for the ground run of an aeroplane landing.
- Take-off run available (TORA). The length of runway declared available and suitable for the ground run of an aeroplane taking off.
- Take-off distance available (TODA). The length of the take-off run available plus the length of the clearway, if provided.
- Accelerate-stop distance available (ASDA). The length of the take-off run available plus the length of the stop way, if provided.

***Friction.*** A resistive force along the line of relative motion between two surfaces in contact.

***Friction characteristics.*** The physical, functional and operational features or attributes of friction arising from a dynamic system.

***Hazard.*** A condition or an object with the potential to cause injuries to personnel, damage to equipment or structures, loss of material, or reduction of the ability to perform a prescribed function.

***Runway condition assessment matrix (RCAM).*** A matrix allowing the assessment of the runway condition code, using associated procedures, from a set of observed runway surface condition(s) and pilot report of braking action.

***Runway condition code (RWYCC).***1 A number describing the runway surface condition to be used in the runway condition report.

***Runway condition report (RCR).*** A comprehensive standardized report relating to runway surface conditions and its effect on the aeroplane landing and take-off performance.

***Runway Safety Team.*** A team comprising representatives from the [aerodrome operator], air traffic service provider, airlines or aircraft operators, pilot and air traffic controller's associations and any other group with a direct involvement in runway operations [at a specific aerodrome,] that advise the appropriate management on potential runway [safety] issues and recommend mitigation strategies.

***Runway surface condition(s).*** A description of the condition(s) of the runway surface used in the runway condition report which establishes the basis for the determination of the runway condition code for aeroplane performance purposes.

a) *Dry runway*. A runway is considered dry if its surface is free of visible moisture and not contaminated within the area intended to be used.
b) *Wet runway*. The runway surface is covered by any visible dampness or water up to and including 3 mm deep within the intended area of use.
c) *Slippery wet runway*. A wet runway where the surface friction characteristics of a significant portion of the runway have been determined to be degraded.
d) *Contaminated runway*. A runway is contaminated when a significant portion of the runway surface area (whether in isolated areas or not) within the length and width being used is covered by one or more of the substances listed in the runway surface condition descriptors.

*Note: - Procedures on determination of contaminant coverage on runway is available in the PANS Aerodromes (Doc 9981).*

e) *Runway surface condition descriptors*. Report of on the presence of standing water whose depth is greater than 3mm.

*Note: - Running water of depth greater than 3 mm is reported as standing water by convention.*

***Safety.*** The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.

***Safety management system (SMS).*** A systematic approach to managing safety, including the necessary organizational structures, accountability, responsibilities, policies and procedures.

***Significant change.*** A change in the magnitude of a hazard, which leads to a change in the safe operation of the aircraft.

***Skid resistant.*** A runway surface that is designed, constructed and maintained to have good water drainage, which minimizes the risk of hydroplaning when the runway is wet and provides aircraft braking performance shown to be better than that used in the airworthiness standards for a wet, smooth runway.

***SNOWTAM.*** A special series NOTAM given in a standard format providing a surface condition report notifying the presence or cessation of hazardous conditions due to snow, ice, slush, frost, standing water or water associated with snow, slush, ice or frost on the movement area.

***Surface friction characteristics.*** The physical, functional and operational features or attributes of friction that relate to the surface properties of the pavement and can be distinguished from each other.

## 3.0 BACKGROUND

Global Reporting Format (GRF) is a harmonized methodology developed by the International Civil Aviation Organization (ICAO) for runway condition assessment and reporting. The methodology requires the airport operator to assess and report the runway surface conditions whenever a contaminant is present on an operational runway. This format, based on the type, depth and coverage of the contaminant. The aerodrome operator uses Runway Condition Assessment matrix (RCAM) to derive a runway condition code (RWYCC) and a description of the runway surface, which are reported to the flight crew through Aeronautical Information Services and Air Traffic Control Units. The RWYCC reflects the expected braking capability as a function of the surface conditions. The flight crew uses the report to calculate aeroplane performance such as landing distance of an aeroplane under existing conditions from the information provided by the aeroplane manufacturer. When RWYCC is not provided, pilots reference the reported runway surface conditions to determine expected landing performance.

## 4.0 PROCEDURE FOR REPORTING RUNWAY SURFACE CONDITION

### 4.1.1 General

4.1.1.1 Assessing and reporting the condition of the movement area and related facilities is necessary in order to provide the flight crew with the information needed for safe operation of the aeroplane. The runway condition report (RCR) is used for reporting assessed information.

4.1.1.2 The RWYCC reflects the runway braking capability as a function of the surface conditions. With this information, the flight crew can derive, from the performance information provided by the aeroplane manufacturer, the necessary stopping distance of an aircraft on the approach under the prevailing conditions.

4.1.1.3 The Civil Aviation (Aerodrome) Regulation contains provisions related to the assessment & reporting of runway surface condition, associated objectives and operational practices

4.1.1.4 The operational practices are intended to provide the information needed to fulfil the syntax requirements for dissemination and promulgation specified in the Civil Aviation (Aeronautical Information Management) and (Air Traffic services) Regulations.

4.1.1.5 When the runway is wholly or partly contaminated by standing water the runway condition report should be disseminated through the AIS and ATS services. When the runway is wet, not associated with the presence of standing water, the assessed information should be disseminated using the runway condition report through the ATS only.

4.1.1.6 The operational practices describe procedures to meet the operationally needed information for the flight crew and dispatchers for the following sections:

a) Aeroplane take-off and landing performance calculations:
i). Dispatch — pre-planning before commencement of flight:
— take-off from a runway; and

— landing on a destination aerodrome or an alternate aerodrome;

ii). in flight — when assessing the continuation of flight; and

— before landing on a runway; and

b) Situational awareness of the surface conditions on the taxiways and aprons.

### 4.1.2 Objectives

4.1.2.1 The RWYCC shall be reported for each third of the runway assessed. The direction for listing the runway thirds should be in the direction as seen from the lower runway designation number

4.1.2.2 The assessment process shall include:

a) assessing and reporting the condition of the movement area;

b) providing the assessed information in the correct format; and

c) Reporting significant changes without delay.

4.1.2.3 The information shall be included in an information string (Table 1-8 refers) in the following order using only AIS- compatible characters:

a) Aeroplane performance calculation section:

i) aerodrome location indicator;

ii) date and time of assessment;

iii) lower runway designation number;

iv) RWYCC for each runway third;

v) per cent coverage contaminant for each runway third;

vi) depth of loose contaminant for each runway third;

vii) condition description for each runway third; and

viii) Width of runway to which the RWYCCs apply if less than published width.

b) situational awareness section:

i) reduced runway length;

ii) loose sand on the runway;

iii) chemical treatment on the runway;

iv) taxiway conditions;

v) apron conditions;

vi) State-approved, and published use of, measured friction coefficient; and

vii) Plain language remarks.

4.1.2.4 The syntax for dissemination is determined by the operational need of the flight crew and the capability of trained personnel to provide the information arising from an assessment as described in the RCR template attached as Table 1-7 in Appendix 1 of this advisory circular.

4.1.2.5 The syntax requirement in the RCR template shall be strictly adhered to when providing the assessed information.

### 4.1.3 Operational practices

4.1.3.1 Reporting, in compliance with the runway condition report, shall commence when a significant change in runway surface condition occurs due to water. When this situation occurs, the aerodrome will issue a runway condition report that states the runway is wet or dry as appropriate.

4.1.3.2 Reporting of the runway surface condition should continue to reflect significant changes until the runway is no longer contaminated.

4.1.3.3 A change in the runway surface condition used in the runway condition report is considered significant whenever there is:

a) any change in the RWYCC;

b) any change in contaminant type;

c) any change in reportable contaminant coverage according to Table 1-1;

d) any change in contaminant depth according to Table 1-2; and

e) any other information, for example a pilot report of runway braking action, which according to assessment techniques used, are known to be significant

**Runway Condition Report — Aeroplane performance calculation section**

4.1.3.4 The aeroplane performance calculation section is a string of grouped information separated by a space " " and ends with a return and two line feed "≪≡". This is to distinguish the aeroplane performance calculation section from the following situational awareness section or the following aeroplane performance calculation section of another runway.

The information to be included in this section consists of the following.

a) **Aerodrome location indicator:** a four-letter ICAO location indicator in accordance with Doc 7910, *Location Indicators.*
This information is mandatory.
Format: nnnn
Example: HKJK

**b)** **Date and time of assessment:** date and time (UTC) when the assessment was performed by the trained personnel**.**
This information is mandatory.
Format: MMDDhhmm
Example: 09111357

c) **Lower runway designation number:** a two- or three-character number identifying the runway for which the assessment is carried out and reported.
This information is mandatory.
Format: nn[L] *or* nn[C] *or* nn[R]
Example: 06L
*Note: the designator L, C or R denotes left, center and right respectively for parallel runway operations*.

d) **Runway condition code for each runway third:** a one-digit number identifying the RWYCC assessed for each runway third. The codes are reported in a three-character

group separated by a "/" for each third. The direction for listing the runway thirds shall be in the direction as seen from the lower designation number.

*This information is mandatory.*

When transmitting information on runway surface conditions by ATS to flight crews, the sections are, however, referred to as the first, second or third part of the runway. The first part always means the first third of the runway as seen in the direction of landing or take-off as illustrated in Figures 1-1 and 1-2 and relevant section in ICAO Doc 4444
Format: n/n/n
Example: 5/5/2

*Note 1.— A change in RWYCC from, say, 5/5/2 to 5/5/3 is considered significant. (See further examples below). Note 2.— A change in RWYCC requires a complete assessment taking into account all information available.*

**e) Percent coverage contaminant for each runway third**: a number identifying the percentage coverage. The percentages are to be reported in an up-to-nine-character group separated by a "/" for each runway third. The assessment is based upon an even distribution within the runway thirds using the guidance in Table 1-1.

This information is conditional. It is not reported for one runway third if it is dry or covered with less than 10 per cent.

Format: [n]nn/[n]nn/[n]nn
Example: 25/50/100
NR/50/100 if contaminant coverage is less than 10% in the first third
25/NR/100 if contaminant coverage is less than 10% in the middle third
25/50/NR if contaminant coverage is less than 10% in the last third.

With uneven distribution of the contaminants, additional information is to be given in the plain language remark part of the situational awareness section of the runway condition report. Where possible, a standardized text should be used.

*Note.— When no information is to be reported, insert "NR" at its relevant position in the message to indicate to the user that no information exists (/NR/).*

f) **Depth of loose contaminant: standing water for each runway third:** a two- or three-digit number representing the assessed depth (mm) of the contaminant for each runway third. The depth is reported in a six to nine character group separated by a "/" for each runway third as defined in Table 1-2. The assessment is based upon an even distribution within the runway thirds as assessed by trained personnel. If measurements are included as part of the assessment process, the reported values are still reported as assessed depths, as the trained personnel have placed their judgment upon the measured depths to be representative for the runway third.

Format: [n]nn/[n]nn/[n]nn

Examples: 04/06/12 *[STANDING WATER]*
This information is conditional. It is reported only for STANDING WATER.

***Example of reporting depth of contaminant whenever there is a significant change***

1) After the first assessment of runway condition, a **first runway condition report** is generated. The initial report is:

   3/3/3 100/100/100 02/02/02 STANDING WATER/ STANDING WATER/ STANDING WATER

   *Note. — The full information string is not used in this example.*

2) With continuing precipitation, a new runway condition report is required to be generated as subsequent assessment reveals a change in the runway condition code. A **second runway condition report** is therefore created as:

   2/2/2 100/100/100 05/05/05 STANDING WATER/ STANDING WATER/ STANDING WATER

3) With even more precipitation, further assessment reveals the depth of precipitation has increased from 3 mm to 5 mm along the entire length of the runway. However, a new runway condition report **is not** required because the runway condition code has not changed (change in depth is less than the significant change threshold of 3 mm).

4) A final assessment of the precipitation reveals that the depth has increased to 7 mm. A new runway condition code is required because the change in depth from the last runway condition report (**second runway condition code**) i.e. from 3 mm to 7 mm is greater than the significant change threshold of 3 mm. A **third runway condition report** is thus created as below:

   2/2/2 100/100/100 07/07/07 STANDING WATER/ STANDING WATER/ STANDING WATER

For contaminants other than STANDING WATER, the depth is not reported. The position of this type of information in the information string is then identified by /NR/.
Example: /NR/
When the depth of the contaminants varies significantly within a runway third, additional information is to be given in the plain language remark part of the situational awareness section of the runway condition report.

*Note.— In this context a significant variation in depth in the lateral direction is more than twice the depth indicated in column 3 of Table 1-2. Further information is available in Circular 355 —* Assessment, Measurement and Reporting of Runway Surface Conditions.

g) **Condition description for each runway third:** to be reported in capital letters using terms specified in Regulation 46. The condition type is reported by any of the following condition type descriptions for each runway third and separated by an oblique stroke "/".

This information is mandatory.
DRY
STANDING WATER

h) **Width of runway to which the RWYCCs apply if less than published width** is the two-digit number representing the width of cleared runway in metres.

This information is optional.
Format: nn
Example: 30
If the cleared runway width is not symmetrical along the center line, additional information is to be given in the plain language remark part of the situational awareness section of the runway condition report.

***Runway condition report — Situational awareness section:***

4.1.3.5 All individual messages in the situational awareness section end with a full stop sign. This is to distinguish the message from subsequent message(s).

4.1.3.6 The information to be included in this section consists of the following:

**a) Reduced runway length**

This information is conditional when a NOTAM has been published with a new set of declared distances affecting the LDA.
Format: Standardized fixed text
RWY nn [L] or nn [C] or nn [R] LDA REDUCED TO [n]nnn
Example: RWY 22L LDA REDUCED TO 1450.

**b) Loose sand on the runway**
This information is optional.
Format: RWY nn[L] or nn[C] or nn[R] LOOSE SAND
Example: RWY 02R LOOSE SAND.

**c) Chemical treatment on the runway**
This information is mandatory.
Format: RWY nn[L] or nn[C] or nn[R] CHEMICALLY TREATED
Example: RWY 06 CHEMICALLY TREATED

**d) Taxiway conditions**
This information is optional.
Format: TWY [nn] n POOR
Example: TWY B POOR.

**e) Apron conditions**
This information is optional.
Format: APRON [nnnn] POOR
Example: APRON NORTH POOR.

**f) State-approved and published use of measured friction coefficient**
This information is optional.
Format: [State set format and associated procedures]
Example: [Function of State set format and associated procedures].

**g) Plain language remarks using only allowable characters in capital letters**
Where possible, standardized text should be developed. This information is optional.
Format: Combination of allowable characters where use of full stop « . » marks the end of the message.
Allowable characters:
A B C D E F G H I J K LM N O P Q R S T U V W X Y Z 0 1 2 3 4 5 6 7 8 9
/ [oblique stroke] "." [Period] " " [space]
***Complete information string***

4.1.3.7 An example of a complete information string prepared for dissemination is as follows:

[COM header and Abbreviated header] (Completed by AIS)
GG HKNAZQZX, HKNAZEZX HKMOZAZX HUENYNYX
070645 HKJKYNYX
SWHK0151 HKJK 02170055
SNOWTAM 0151
[Aeroplane performance calculation section]
HKJK 02170055 05L 5/5/5 100/100/100 NR/NR/NR WET/WET/WET HKJK
02170135 05R 5/4/3 100/50/75 NR/06/06 WET/WET/WET
[Situational awareness section]
RWY 05L LDA REDUCED TO 3500. TWY F POOR. APRON THREE POOR

**Assessing and assigning a runway condition code**

4.1.3.8 The assessed RWYCC to be reported for each third of the runway is determined by following the procedure described below

4.1.3.9 If 25 per cent or less area of a runway third is wet or covered by contaminant, a RWYCC 6 shall be reported.

4.1.3.10 If the distribution of the contaminant is not uniform, the location of the area that is wet or covered by the contaminant is described in the plain language remarks part of the situational awareness section of the runway condition report.

4.1.3.11 A description of the runway surface condition is provided using the contamination terms described in capital letters in Table 1-3 — assigning a runway condition code (RWYCC).

4.1.3.12 If multiple contaminants are present where the total coverage is more than 25 per cent but no single contaminant covers more than 25 per cent of any runway third, the RWYCC is based upon the judgment by trained personnel, considering what contaminant will most likely be encountered by the aeroplane and its likely effect on the aeroplane's performance.

4.1.3.13 The RWYCC is determined using Table 1-3.

4.1.3.14 The variables, in Table 1-3, that may affect the runway condition code are:

a) type of contaminant;
b) depth of contaminant; and
c) Outside air temperature. Where available the runway surface temperature should preferably be used.

4.1.3.15 An assigned RWYCC 5, 4, 3 or 2 shall not be upgraded

4.1.3.16 An assigned RWYCC 1 or 0 can be upgraded using the following procedures

a) if a properly operated and calibrated State-approved measuring device and all other observations support a higher RWYCC as judged by trained personnel;

b) the decision to upgrade RWYCC 1 or 0 cannot be based upon one assessment method alone. All available means of assessing runway slipperiness are to be used to support the decision;

c) when RWYCC 1 or 0 is upgraded, the runway surface is assessed frequently during the period the higher RWYCC is in effect to ensure that the runway surface condition does not deteriorate below the assigned code; and

d) variables that may be considered in the assessment that may affect the runway surface condition, include but are not limited to:

i). any precipitation conditions;
ii). changing temperatures;
iii). effects of wind;
iv). frequency of runway in use; and
v). type of aeroplane using the runway.

4.1.3.17 Upgrading of RWYCC 1 or 0 using the procedures in 4.1.3.15 shall not be permitted to go beyond a RWYCC 3.

4.1.3.18 If sand or other runway treatments are used to support upgrading, the runway surface is assessed frequently to ensure the continued effectiveness of the treatment.

4.1.3.19 The RWYCC determined from Table 1-3 should be appropriately downgraded considering all available means of assessing runway slipperiness, including the criteria given in Table 1-4.

4.1.3.20 Where available, the pilot reports of runway braking action should be taken into consideration as part of the ongoing monitoring process, using the following principle:

a) a pilot report of runway braking action is taken into consideration for downgrading purposes; and
b) a pilot report of runway braking action can be used for upgrading purposes only if it is used in combination with other information qualifying for upgrading.

The procedures for making special air-reports regarding runway braking action are contained in the relevant section in the Civil Aviation Air Traffic Management Regulations on Instructions for air-reporting by voice communication.

*Note 2. — Procedures for downgrading reported RWYCC can be found in 4.1.3.23 including the use of Table 1-5 Runway Condition Assessment Matrix (RCAM).*

4.1.3.21 Two consecutive pilot reports of runway braking action of POOR shall trigger an assessment if an RWYCC of 2 or better has been reported. When one pilot has reported a runway braking action of LESS THAN POOR, the information shall be disseminated, a new assessment shall be made and the suspension of operations on that runway shall be considered.

If considered appropriate, maintenance activities may be performed simultaneously or before a new assessment is made.

Procedures for the provision of information to arriving aircraft are contained in ICAO Doc 4444(PANS-ATM).

4.1.3.22 Table 1-4 shows the correlation of pilot reports of runway braking action with RWYCCs.

4.1.3.23 Table 1-3 and Table 1-4 combined form the Runway Condition Assessment Matrix (RCAM) in Table 1-5. The RCAM is a tool to be used when assessing runway surface conditions. It is not a standalone document and shall be used in compliance with the associated procedures of which there are two main parts:

a) assessment criteria; and

b) downgrade assessment criteria.

## 5.0 ROLES OF VARIOUS AGENCIES

### 5.1. Aeronautical Information Services (AIS)

1. To disseminate information on runway surface conditions, and issue SNOWTAM when standing water depth value is 4 mm and above during periods when deposits water remain on aerodrome pavements.
2. Distribute runway surface condition information to all whom the information is of direct operational significance.
3. Appraise the situation at least once every 8 hours, preferably before the commencement of a major traffic movement.
4. Issue a new SNOWTAM whenever a new runway condition report (RCR) is received from the aerodrome operator.
5. Publish in the Aeronautical Information Publication (Part 3 — Aerodromes (AD), AD 2.12) a description of the runway surface friction characteristics (can be included in the remarks section).
6. Develop and publish procedures for the receipt and sharing of information on the runway surface conditions.

### 5.2. Air Traffic Services

1. Air Traffic Services (ATS) should convey the information received via the RCR and/or special air-reports (AIREP) to end users.
2. Coordinate with other aerodrome users as detailed in section 5.3 and 5.4 below.
3. Develop procedures to guide air traffic controllers on receipt and sharing of information on the runway surface conditions.

## 5.3. Coordination with air traffic control (ATC) and Aerodrome operator

The aerodrome operator should have a formal coordination with the ATS provider in order to be advised of any significant change to runway surface conditions;

a) The runway surface conditions information of operational significance shall be provided by the aerodrome operator to the ATS units, to enable the units to provide necessary information to arriving and departing aircraft. The information shall be kept up-to-date and changes in conditions reported without delay.
b) The aerodrome operator should gather data and process information of operational significance relating to runway conditions and send information to ATC as soon as possible.
c) ATC, in turn, is required to provide this information to the flight crew if different from data already in the ATIS so as to provide timely information to the flight crew, especially in rapidly changing conditions.
d) In addition to being timely, information disseminated through ATC may contain additional information associated with weather observed and forecasted by meteorological (MET) personnel, even before it is available on ATIS, as well as information gathered by other flight crews, such as braking action reports. This arrangement provides pilots with the best possible information available within the current system for sound decision-making.
e) Finally, where visibility conditions and aerodrome configuration permit, ATC can provide the flight crew, at very short notice, with their own immediate observations, such as a rapid change in rainfall intensity or the presence of snow, notwithstanding that this may be considered as unofficial information.

## 5.4. Coordination of information received from pilots and AIREPs

a) Pilot reports of runway braking action via AIREPs will typically provide aerodrome personnel and other pilots with an observation that can confirm the ground-based assessment or alert of degraded conditions experienced in terms of braking capability and/or lateral control during the landing roll.
b) The braking action observed depends on the type of aircraft, aircraft weight, runway portion used for braking and other factors. Pilots will use the terms GOOD, GOOD TO MEDIUM, MEDIUM, MEDIUM TO POOR, POOR and LESS THAN POOR. When receiving an AIREP, the recipient should consider that these terms rarely apply to the full length of the runway and are limited to the specific sections of the runway surface in which sufficient wheel braking is applied. Since AIREPs are subjective and contaminated runways may affect the performance of different aeroplane types in

different ways, the reported braking action may not be directly transferrable to another aeroplane.

c) If air traffic service (ATS) units receive an AIREP by voice communications concerning braking action that is found not to be as good as that reported, they will forward the AIREP without delay to the appropriate aerodrome operator. This is a prerequisite for using the AIREP for downgrading purposes when assessing the RWYCC. The distribution of AIREPs to aerodrome operators may be regulated by service level agreements (SLAs).;

## 5.5. Meteorological Services for International Air Navigation

a) Meteorological service provider will:
   i). maintain a continuous survey of meteorological conditions over the aerodromes;
   ii). exchange meteorological information with aerodrome operator and ATS units
   iii). advise on any significant meteorological conditions;
   iv). share adverse weather forecasts related to thunderstorms, strong surface winds and gusts, sandstorms including heavy rains and/ or precipitation in a timely manner

b) For hazardous meteorological situations related to the conditions mentioned above, MET office will coordinate with the aerodrome operator, AIS and ATS as applicable;

## 5.6. Aircraft Operators

a) Utilize the information of runway surface conditions in conjunction with the performance data provided by the aircraft manufacturers to determine if landing or takeoff operations can be conducted safely.
b) Provide runway breaking action special air reports (AIREP).
c) Undertake the review of the aircraft operating manual, flight manual and the operations manual as applicable in compliance with the provisions of chapter 5 of Annex 6 part 1
d) Review other operational documentation in line with the guidance contained in ICAO Doc 10064 (Aeroplane Performance Manual).

## 5.7. Aerodrome Operators

a) The aerodrome Operator shall assess the runway surface conditions, including contaminants, for each third of the runway length.
b) Assigns the correct RWYCC after the assessment of the existing contaminants through Runway Condition Assessment Matrix.
c) Generates through RWYCC and report the information in a timely manner to ATS/ATC through the Runway Condition Reports (RCRs)
d) Review the pilot reports of runway braking action passed via AIREPs and correlate with the ground-based assessment or alert of degraded conditions experienced in terms of braking capability and/or lateral control during the landing roll.
e) Develop and operationalize applicable procedures to facilitate the collection and processing the required data on runway surface conditions. This will involve the review of applicable documents and/or manuals;

f) Encourage the use of teams at each aerodrome to facilitate /operationalize the runway surface condition reporting framework.
g) Coordinate the training of personnel assessing and reporting runway surface conditions to ensure they are competent to perform their duties in order to manage and reduce uncertainty.
h) Identify and make available all the required equipment and tools for assessment of runway surface conditions.
i) Develop a runway maintenance program for monitoring runway contaminants and ensure removal where necessary to ensure runway friction characteristics do not drop below the minimum levels.

## 6.0 MODELLING OF WATER FLOW AND PREDICTION OF WATER DEPTH ON RUNWAYS

Runway design parameters, notably texture depth, are a main indicator of water depth as a function of rain intensity. Determination of rain intensity itself can be derived from weather radar data or forward-scatter meters. The two provide timely warning of potential rain and actual rain intensity information for each runway third.

Water depth depends on runway geometrical and surface characteristics (such as slopes, evenness, texture) and meteorological parameters (rain intensity).
Additionally, water depth on the runway determines what aircraft performance data should be used by the flight crew, e.g. regular wet performance or standing water performance.

Consequently, whenever water is present on a runway, a description of the surface conditions including an assessment of water depth and a runway surface condition is reported using the terms DRY, WET or STANDING WATER and associated with a RWYCC. Additionally, a Notice to Airmen (NOTAM) will be issued whenever a significant portion of a runway drops below the minimum friction level set or agreed by the State.

However, assessing depth and percentage coverage of water on the whole length and width of a runway is a huge issue due to the lack of tools and methods, and the rapidity of rain evolution and water flow.

Water depths are generally assessed through visual observations, or using simple tools such as dipsticks. These methods are inaccurate and time-consuming. They are not compatible with airport capacity requirements, with size of monitored surfaces, or even with rapid evolution of rainy events.

In view of the above, there is need for water depth modelling to allow real-time information, a complete runway surface monitoring, and anticipation of runway surface condition in a timely manner to inform flight crews of the amount of water present on a runway.

This advisory circular serves as a guidance to the aerodrome operator’s personnel on the need to determine the water depth measurements and water flow modelling. The second part describes the developed approach.

Whereas the following methods are available for determination of runway water depth, the Aerodrome Operator is required to determine the best method for measurement of water depth and water flow model and notify the Authority accordingly.

The aerodrome operator shall adopt the best method to measure water depth and submit the details to the Authority for review and acceptance and implementation.


**Director Safety, Security and Economic Regulation**

## APPENDIX 1: LIST OF TABLES AND FIGURES

**Figure 1- 1. Reporting of Runway Condition Code from ATS to flight crew for runway thirds**

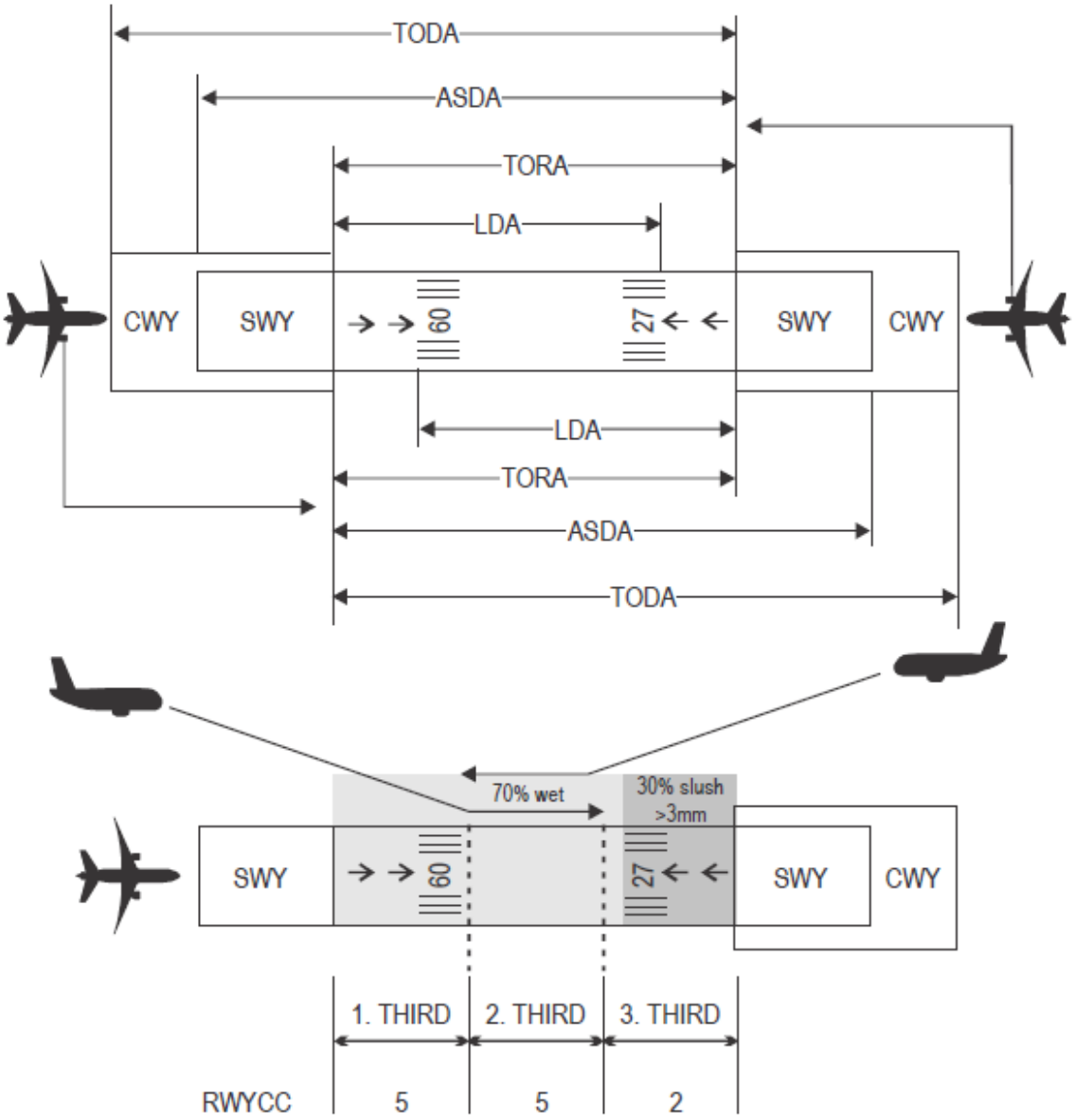



***Figure 1- 2. Reporting of Runway Condition code for runway thirds from ATS to flight crew on a runway with displaced threshold.***

**Table 1-1. Percentage of coverage for contaminants**

| ***Assessed per cent*** | *Reported per cent* |
|---|---|
| **10 – 25** | 25 |
| **26 – 50** | 50 |
| **51 – 75** | 75 |
| **76 – 100** | 100 |

**Table 1-2. Depth assessment for contaminants**

| ***Contaminant*** | *Valid values to be reported* | *Significant change* |
|---|---|---|
| ***STANDING WATER*** | *04, then assessed value* | *3 mm up to and including 15 mm* |
| ***SLUSH*** | *03, then assessed value* | *3 mm up to and including 15 mm* |
| ***WET SNOW*** | *03, then assessed value* | *5 mm* |
| ***DRY SNOW*** | *03, then assessed value* | *20 mm* |

*Note 1. — For STANDING WATER, 04 (4 mm) is the minimum depth value the depth is reported. (From 3 mm and below, the runway third is conside*

*Note 2. — For SLUSH, WET SNOW and DRY SNOW, 03 (3 mm) is the minimum depth value at and above which the depth is reported*

*Note 3. — Above 4 mm for STANDING WATER and 3 mm for SLUSH, WET SNOW and DRY SNOW an assessed value is reported and a significant change relates to observed change from this assessed value.*

**Table 1-3. Assigning a runway condition code (RWYCC)**

| *Runway condition description* | *Runway condition code (RWYCC)* |
|---|---|
| **DRY** | **6** |
| **FROST**<br>**WET** (the runway surface is covered by any visible dampness or water up to and including 3 mm deep)<br>**SLUSH** (up to and including 3 mm depth)<br>**DRY SNOW** (up to and including 3 mm depth)<br>**WET SNOW** (up to and including 3 mm depth) | **5** |
| **COMPACTED SNOW**<br>(Outside air temperature minus 15 degrees Celsius and below) | **4** |
| **WET** ("Slippery wet" runway)<br>**DRY SNOW** (more than 3 mm depth) **WET SNOW** (more than 3 mm depth) **DRY SNOW ON TOP OF COMPACTED SNOW** (any depth)<br>**WET SNOW ON TOP OF COMPACTED SNOW** (any depth)<br>**COMPACTED SNOW** (outside air temperature above minus 15 degrees Celsius) | **3** |
| **STANDING WATER** (more than 3 mm depth)<br>**SLUSH** (more than 3 mm depth) | **2** |
| **ICE** | **1** |
| **WET ICE**<br>**WATER ON TOP OF COMPACTED SNOW**<br>**DRY SNOW OR WET SNOW ON TOP OF ICE** | **0** |

**Table 1-4. Correlation of runway condition code and pilot reports of runway braking action**

| ***Pilot report of runway braking action*** | ***Description*** | ***Runway condition code (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 |

## Table 1-5A. Runway Condition Assessment Matrix (RCAM)

| RUNWAY CONDITION ASSESSMENT MATRIX (RCAM) | | | |
|---|---|---|---|
| **Assessment criteria** | | **Downgrade assessment criteria** | |
| **Runway condition code** | **Runway surface description** | **Aeroplane deceleration or directional control observation** | **Pilot report of runway braking action** |
| **6** | • DRY | --- | --- |
| **5** | • FROST<br>•WET (The runway surface is covered by any visible dampness or water up to and including 3 mm depth)<br><br>***Up to and including 3 mm depth:***<br>• SLUSH<br>• DRY SNOW<br>• WET SNOW | Braking deceleration is normal for the wheel braking effort applied AND directional control is normal. | GOOD |
| **4** | ***-15ºC and lower outside air temperature*:**<br>• COMPACTED SNOW | Braking deceleration OR directional control is between Good and Medium. | GOOD TO MEDIUM |
| **3** | • WET ("slippery wet" runway)<br>• DRY SNOW or WET SNOW (any depth) ON TOP OF COMPACTED SNOW<br>***More than 3 mm depth:***<br>• DRY SNOW<br>• WET SNOW<br>***Higher than -15ºC outside air temperature*[1]:**<br>• COMPACTED SNOW | Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced. | MEDIUM |
| **2** | ***More than 3 mm depth of water or slush:***<br>• STANDING WATER<br>• SLUSH | Braking deceleration OR directional control is between Medium and Poor. | MEDIUM TO POOR |
| **1** | • ICE [2] | Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced. | POOR |
| **0** | • WET ICE [2]<br>• WATER ON TOP OF COMPACTED SNOW [2]<br>• DRY SNOW or WET SNOW ON TOP OF ICE [2] | Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain. | LESS THAN POOR |

**Table 1-5B. Runway Condition Assessment Matrix (RCAM)**

| RUNWAY CONDITION ASSESSMENT MATRIX (RCAM) – WATER CONTAMINANTS | | | |
|---|---|---|---|
| **Assessment Criteria** | | **Downgrade assessment criteria** | |
| **Runway condition code** | **Runway surface description** | **Aeroplane deceleration or directional control observation** | **Pilot report of runway braking action** |
| **6** | • DRY | --- | --- |
| **5** | •WET (The runway surface is covered by any visible dampness or water up to and including 3 mm depth) | Braking deceleration is normal for the wheel braking effort applied AND directional control is normal. | GOOD |
| **4** | | Braking deceleration OR directional control is between Good and Medium. | GOOD TO MEDIUM |
| **3** | • WET ("slippery wet" runway) | Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced. | MEDIUM |
| **2** | ***More than 3 mm depth of water:*** • STANDING WATER | Braking deceleration OR directional control is between Medium and Poor. | MEDIUM TO POOR |
| **1** | | Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced. | POOR |
| **0** | | Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain. | LESS THAN POOR |

**Table 1-6. Methods of Assessing Runway Surface Condition**

| | | ***CIVIL AVIATION (AERODROME DESIGN AND OPERATION) REGULATIONS*** | ***REMARK*** |
|---|---|---|---|
| DESIGN AND CONSTRUCTION | Slope | Regulation 69 (1) Longitudinal slopes<br><br>Regulation 69 (7) Transverse slopes | |
| | Texture | Regulation 71(5) - The average surface texture depth of a new surface should be not less than 1.0 mm. | |
| | Minimum friction level set by the State | Regulation 71- A paved runway shall be so constructed or resurfaced as to provide surface friction characteristics at or above the minimum friction level set by the State. | The State set criteria for surface friction characteristics and output from State set or agreed assessment methods form the reference from which trend monitoring are performed and evaluated. |
| | Polishing | Regulation 71- A paved runway shall be so constructed or resurfaced as to provide surface friction characteristics at or above the minimum friction level set by the State. | Polished Stone Value. (PSV-value) is a measure of skidding resistance on a small sample of stone surface, having being subjected to a standard period of polishing. |

| | | | Rubber build-up | Geometry change | Polishing |
|---|---|---|---|---|---|
| ASSESSMENT METHODS FOR MONITIORING TREND OF CHANGE TO SURFACE FRICTION CHARACTERISTICS | Visual – macro texture | Visual assessment will only give a very crude assessment of the macro texture. Extensive rubber build-up can be identified. | X | | |
| | Visual – micro texture | Visual assessment will give a very crude assessment of the micro texture and to what degree the micro texture has been filled and covered by rubber. | X | | |
| | Visual – runway geometry (ponding) | Visual assessment during a rain storm and subsequent drying process of the runway will reveal how the runway drains and if there have been any changes to runway geometry causing ponding. Depth of any pond can be measured by | | X | |

| | | | | |
|---|---|---|---|---|
| | a ruler or any other appropriate depth measurement method/tool. | | | |
| By touch − macro texture | Assessment by touch can differentiate between degree of loss of texture but not quantifying it. | X | | |
| By touch − micro texture | Assessment by touch can identify if micro texture has been filled in/covered by rubber build-up. | X | | |
| Grease smear method (MTD) | Measure a volume – Mean Texture Depth (MTD) primarily by using the grease smear method, is the measurement method used for research purposes related to aeroplane performance. | X | | |
| Sand (glass) patch method (MTD) | Measure a volume – Mean Texture Depth (MTD). The sand (glass) patch method is not identical to the grease smear method. There is at present no internationally accepted relationship between the two methods. | X | | |
| Laser – stationary (MPD)<br>Laser – moving (MPD) | Measure a profile – Mean Profile Depth (MPD). There is no established relationship between MTD and MPD. The relationship must be established for the laser devices used and the preferred volumetric measurement method used. | X | | |
| | | Rubber build-up | Geometry change | Polishing |
| Friction measurement – controlled applied water depth | A friction measurement is a system output, which includes all the surface friction characteristics and characteristics of the measuring device itself. All other variables than those related to the surface friction characteristics must be controlled in order to relate the measured values to the surface friction characteristics.<br><br>The system output is a dimensionless number, which is related to the surface friction characteristics and as such is also a measure of macro texture. (The system generated number needs to be paired with other information (assessment methods) to identify which surface friction characteristics significantly influence the system output.) | X | | X |

| | | | | | |
|---|---|---|---|---|---|
| | | It is recognized that there is currently no consensus within the aviation industry on how to control the uncertainty related to repeatability, reproducibility and time stability. It is paramount to keep this uncertainty as low as possible; consequently, ICAO has tightened the Standards associated with use of friction measurement devices, including training of personnel who operate the friction measuring devices. | | | |
| | Friction measurement – natural wet conditions | Friction measurements performed under natural wet conditions during a rainstorm might reveal if portions of a runway are susceptible to ponding and/or to fall below State set criteria. | X | X | X |
| | Modelling of water flow and prediction of water depth | Emerging technologies based on the use of a model of the runway surface describing its geometrical surface (mapped) and paired with sensor information of water depth allow real-time information and thus a complete runway surface monitoring, and anticipation of water depths. | | X | |

Table 1-7 RUNWAY CONDITION REPORT (RCR)

| **RUNWAY CONDITION REPORT (RCR)** | |
|---|---|
| **Aeroplane performance calculation section** | |
| **Information** | **Source** |
| Aerodrome location indicator | ICAO Doc 7910, *Location Indicators* |
| Date and time of assessment | UTC time |
| Lower runway designation number | Actual runway (RWY) |
| RWYCC for each runway third | Assessment based upon RCAM and associated procedures |
| Per cent coverage contaminant for each runway third | Visual observation for each runway third |
| Depth of loose contaminant for each runway third | Visual observation assessed for each runway third, confirmed by measurements when appropriate |
| Condition description (contaminant type) for each runway third | Visual observation for each runway third |
| Width of runway to which the RWYCCs apply if less than published width | Visual observations while at the RWY and information from local procedures/snow plan |

| Situational awareness section | |
|---|---|
| Reduced runway length | NOTAM |
| Drifting snow on the runway | Visual observation while at RWY |
| Loose sand on the runway | Visual observation while at RWY |
| Chemical treatment on the runway | Known treatment application. Visual observation of residual chemicals on the runway |
| Snowbanks on the runway | Visual observations while at the RWY |
| Snowbanks on taxiway | Visual observations while at the taxiway (TWY) |
| Snowbanks adjacent to the runway penetrating level/profile set in the aerodrome snow plan | Visual observations while at the RWY confirmed by measurements when appropriate |
| Taxiway conditions | Visual observation, AIREP, reported by other aerodrome personnel, etc |
| Apron conditions | Visual observation, AIREP, reported by other aerodrome personnel, etc |
| State approved and published use of measured friction coefficient | Dependent upon the State set or agreed standard |
| Plain language remarks using only allowable characters in capital letters | Any additional operational significant information to be reported |

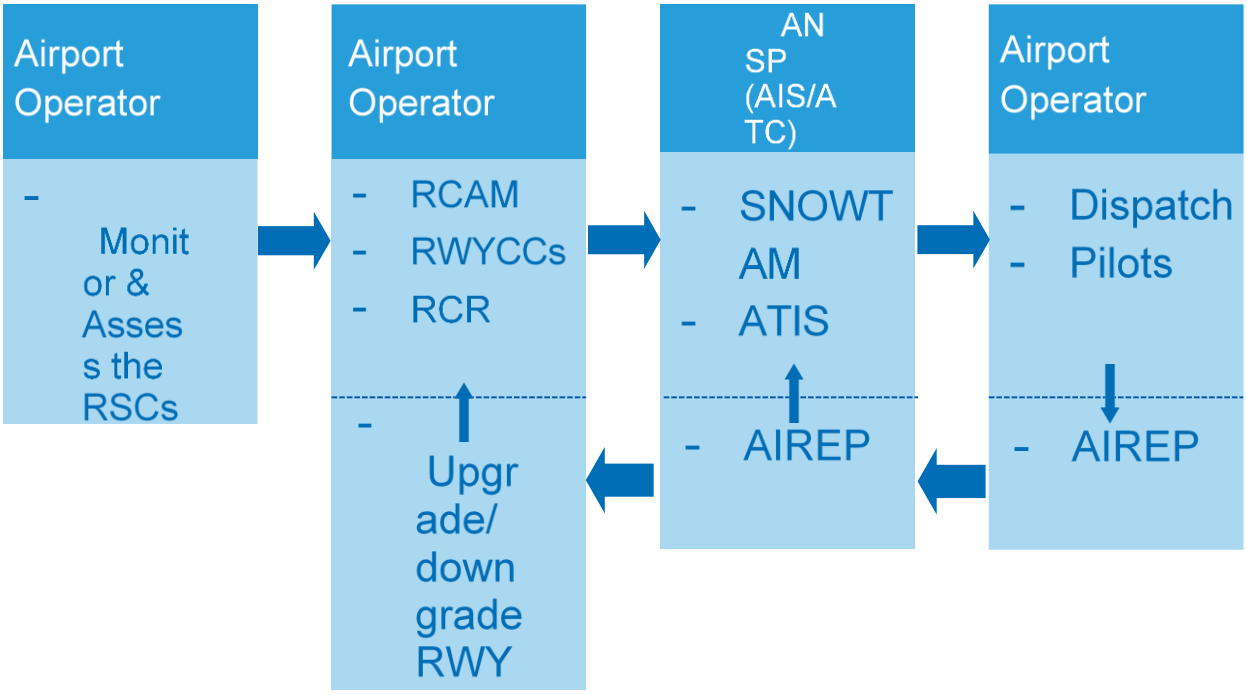



Figure 1-3 **GRF flowchart**

*Table 1-8: SNOWTAM FORMAT*

| | | | |
|---|---|---|---|
| (PRIORITY | (ADDRESSES) | | <≡ |
| | | | <≡ |
| | | | GROUP) |
| | | | <≡( |
| | | | |
| | | | <≡ |
| | | | → |
| | | | → |
| | | | → |
| | | | → |
| | | | → |
| | | | → |
| (WIDTH OF RUNWAY TO WHICH THE RUNWAY CONDITION CODES APPLY, IF LESS THAN PUBLISHED WIDTH) | O | H) | <≡≡ |
| **Situational awareness section** | | | |
| (REDUCED RUNWAY LENGTH, IF LESS THAN PUBLISHED LENGTH *(m)*) | O | I) | → |
| (DRIFTING SNOW ON THE RUNWAY) | O | J) | → |
| (LOOSE SAND ON THE RUNWAY) | O | K) | → |
| (CHEMICAL TREATMENT ON THE RUNWAY) | O | L) | → |
| (SNOWBANKS ON THE RUNWAY)<br>*(If present, distance from runway centre line (m) followed by "L", "R" or "LR" as applicable)* | O | M) | → |
| (SNOWBANKS ON A TAXIWAY) | O | N) | → |
| (SNOWBANKS ADJACENT TO THE RUNWAY) | O | O) | → |
| (TAXIWAY CONDITIONS) | O | P) | → |
| (APRON CONDITIONS) | O | R) | → |
| (MEASURED FRICTION COEFFICIENT) | O | S) | → |
| (PLAIN-LANGUAGE REMARKS) | O | T) | ) |

NOTES:
1. *Enter ICAO nationality letters as given in ICAO Doc 7910, Part 2 or otherwise applicable aerodrome identifier.
2. Information on other runways, repeat from B to H.
3. Information in the situational awareness section repeated for each runway, taxiway and apron. Repeat as applicable when reported.
4. Words in brackets ( ) not to be transmitted.
5. For letters A) to T) refer to the *Instructions for the completion of the SNOWTAM Format,* paragraph 1, item b).

SIGNATURE OF ORIGINATOR *(not for transmission)*

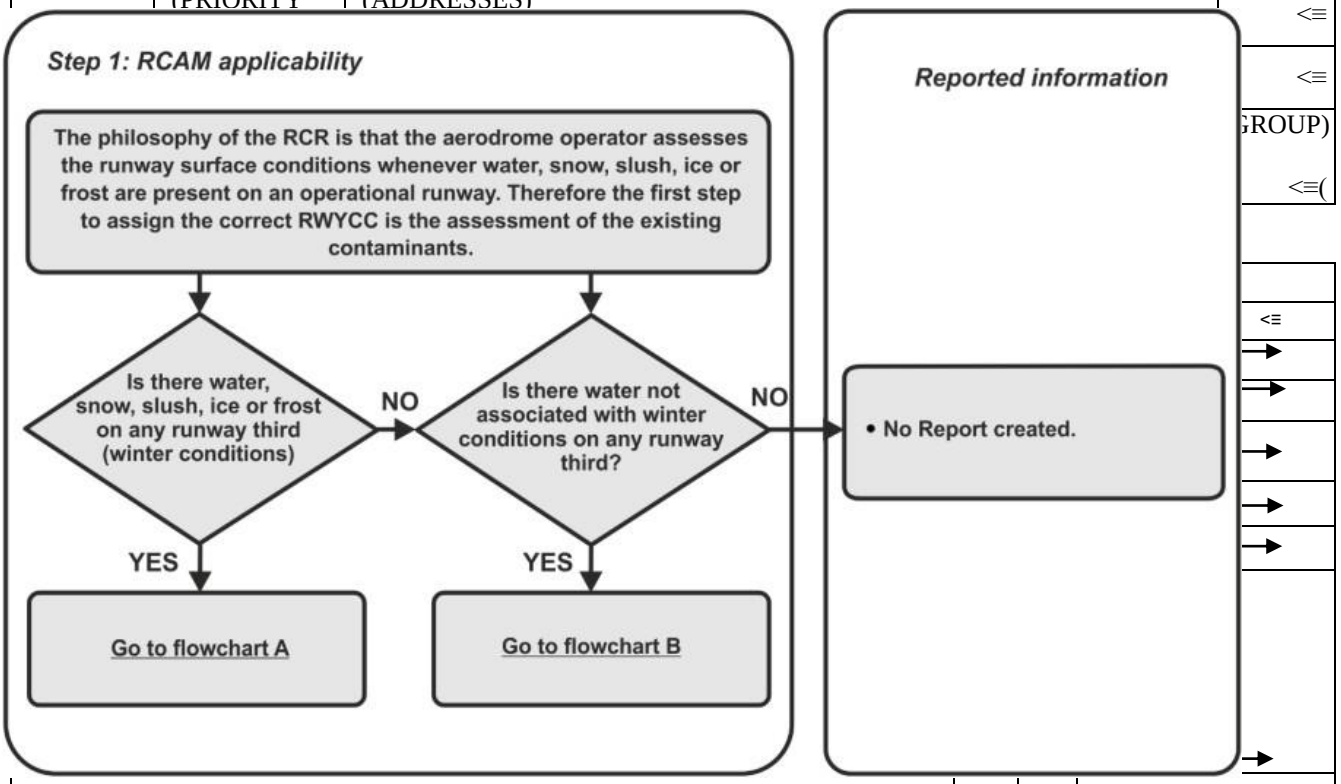
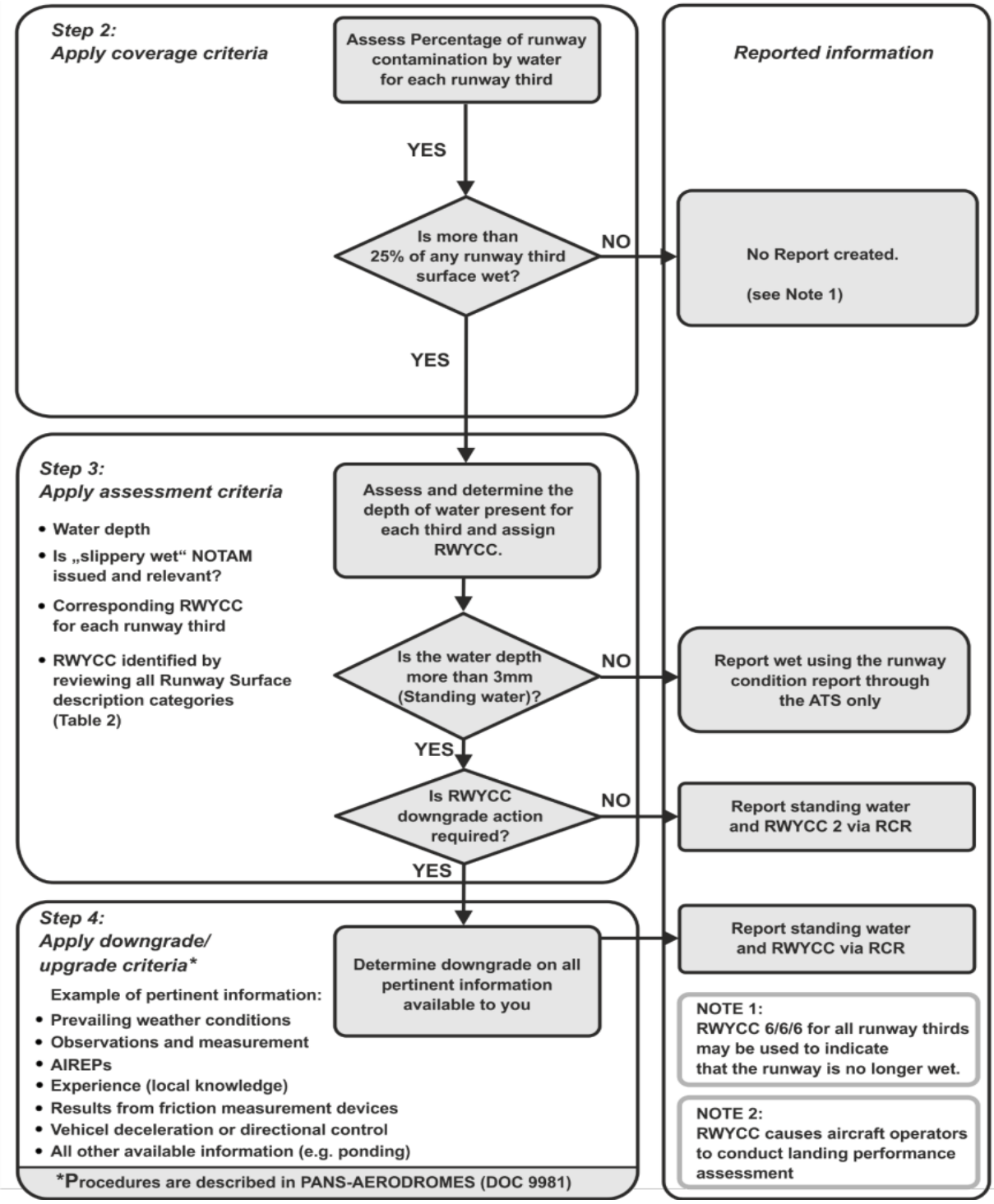



Figure 1-4. Basic RCAM Flow Chart Process


Step 2:
Apply coverage criteria
Assess Percentage of runway contamination by water for each runway third
YES
Is more than 25% of any runway third surface wet?
NO
YES
Reported information
No Report created.
(see Note 1)
Step 3:
Apply assessment criteria
• Water depth
• Is „slippery wet“ NOTAM issued and relevant?
• Corresponding RWYCC for each runway third
• RWYCC identified by reviewing all Runway Surface description categories (Table 2)
Assess and determine the depth of water present for each third and assign RWYCC.
Is the water depth more than 3mm (Standing water)?
NO
YES
Report wet using the runway condition report through the ATS only
Is RWYCC downgrade action required?
NO
YES
Report standing water and RWYCC 2 via RCR
Step 4:
Apply downgrade/ upgrade criteria*
Example of pertinent information:
• Prevailing weather conditions
• Observations and measurement
• AIREPs
• Experience (local knowledge)
• Results from friction measurement devices
• Vehicel deceleration or directional control
• All other available information (e.g. ponding)
Determine downgrade on all pertinent information available to you
Report standing water and RWYCC via RCR
NOTE 1:
RWYCC 6/6/6 for all runway thirds may be used to indicate that the runway is no longer wet.
NOTE 2:
RWYCC causes aircraft operators to conduct landing performance assessment
*Procedures are described in PANS-AERODROMES (DOC 9981)