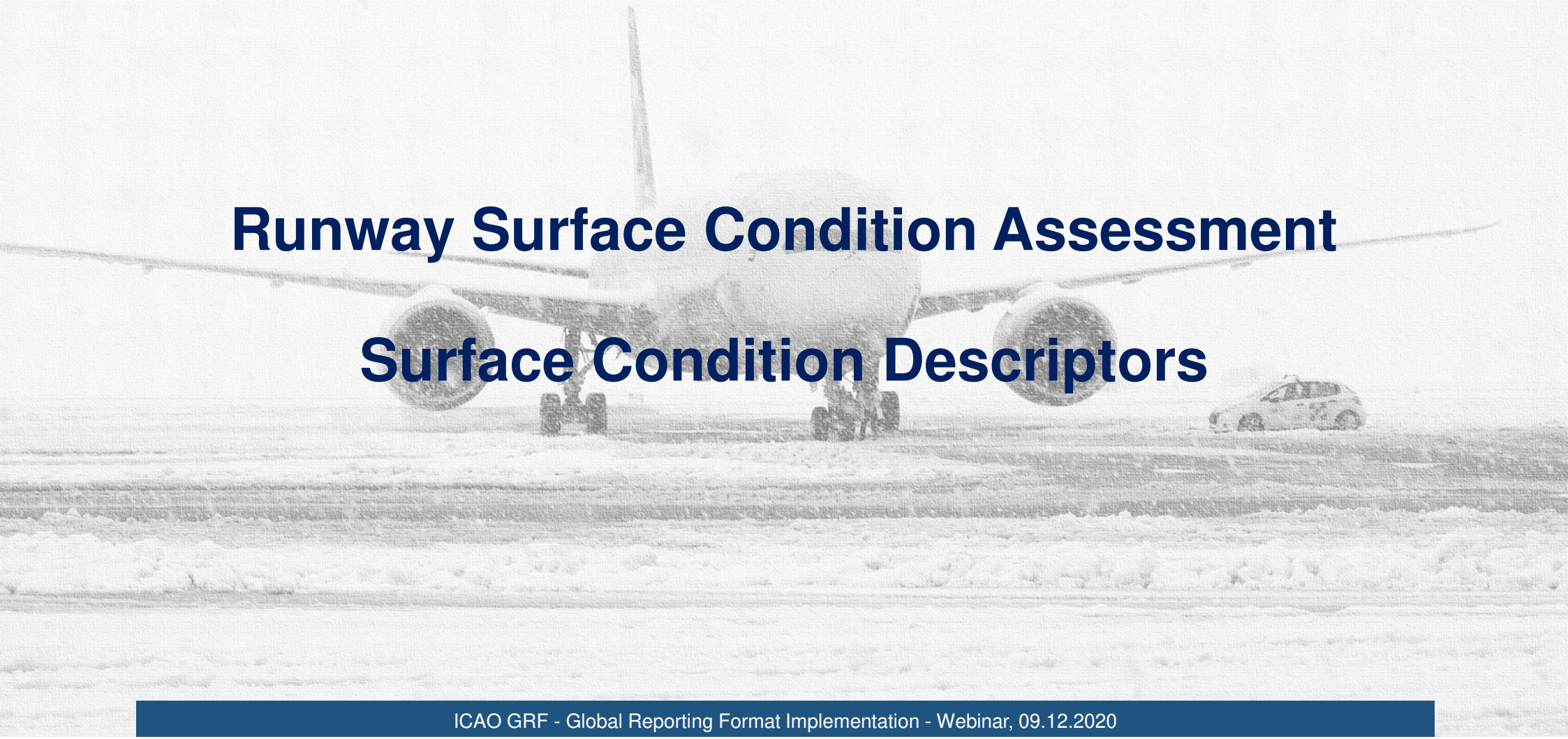
ICAO GRF - Global Reporting Format Implementation

Webinar, 09.12.2020

Runway Surface Condition Assessment

Giorgio A.M. Cascone



Runway Surface Condition Assessment

Surface Condition Descriptors

Runway Surface Condition Assessment

A runway surface condition assessment is required whenever water, snow, slush, ice, frost or de/anti-icing fluids[1] are present on the surface of a runway.

'Runway Surface Condition' is *'a (standardized) description of runway surface conditions, used for reporting purposes by means of the Runway Condition Report (RCR).'*

Runway Condition Assessment is the basis for the determination of the Rwy Condition Code (RWYCC), used by pilots for aircraft performance calculation purposes.

ref. new ADR.OPS.B.037; 1: ref. new ADR.OPS.A.060 (a)/(e);

Runway condition assessment is conducted by checking

- exent of contamination (% coverage)
- type of contaminant (‘condition descriptor’)
- depth of contaminant *(loose contaminants only)*
- outside air temperature (OAT) or surface temp.

- Based on the information above the aerodrome operator is able to assign a Runway Condition Code (RWYCC) and issue a Runway Condition Report (RCR). [1]

N.B.: A new inspection is required whenever the surface condition may have changed.

1: ref. new ADR.OPS.B.037

In terms of 'Surface Conditions', a runway may be: [1]

Dry - when the surface is free of visible moisture and not contaminated within the area intended to be used.

Wet - when the surface is covered by any visible dampness or water up to and incl. 3 mm within the area intended to be used.

Slippery wet - a wet rwy whose surface friction characteristics for a significant portion have been determined to be degraded.

Contaminated - if a significant portion[2] of the rwy within the length/width being used is covered by one or more of the substances listed under the sfc condition descriptors.

1) Definitions added in Annex I to Reg. 139/2014; 2) Draft EASA GM1 ADR.OPS.B.037(a)

Runway Surface Condition Descriptors [1]

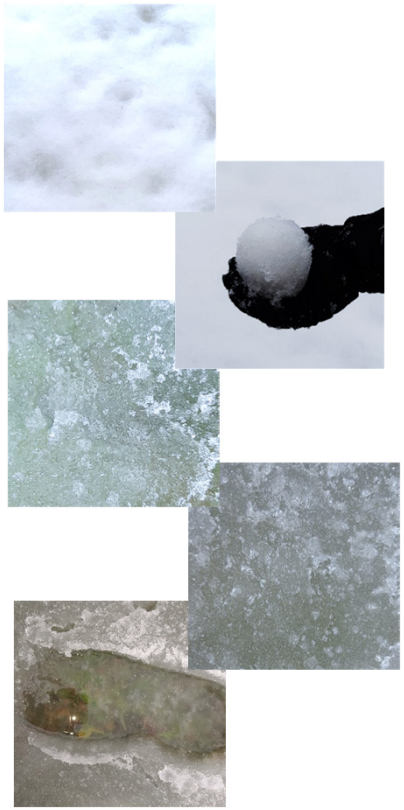
Standard terms to describe water-based contaminants covering a rwy.

Standing water - water of depth greater than 3 mm.

Dry snow - snow from which a snowball cannot readily be made.

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

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



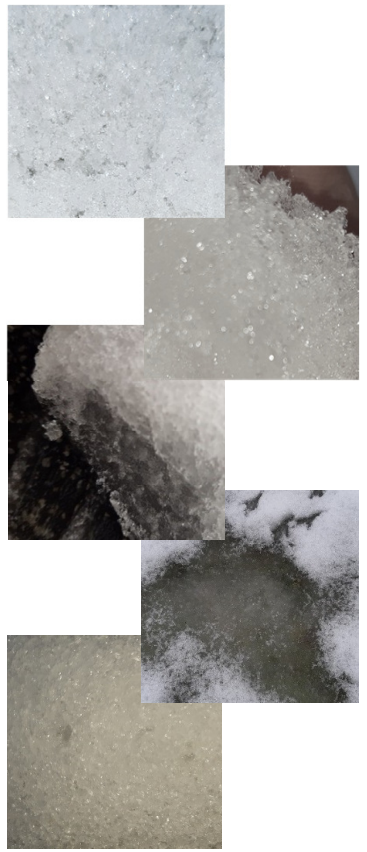
1) Definitions added in Annex I to Reg. 139/2014

Compacted snow - snow that has been compacted into a solid mass such that aeroplane tyres, at operating pressures and loadings, will run on the surface without significant further compaction or rutting.

Frost - ice crystals formed from airborne moisture on a surface whose temperature is at or below freezing; it differs from ice in that frost crystals grow independently and have a more granular texture.

Ice - water that has frozen or compacted snow that has transitioned into ice in cold and dry conditions.

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



(Definitions added in Annex I to Reg. 139/2014)

Specially Prepared Winter Runway

'SPWR' refers to runways with a dry frozen surface of compacted snow and/or ice which has been treated with sand or grit or mechanically treated to improve friction.

A 'brand-new definition', introduced by EASA, to deal with operations on specially treated snow- or ice-covered rwys

Procedures for operations on SPWR require prior approval by the Competent Authority !

n.b.: SPWR may be associated with an initial RWYCC '4' !

(ref.: new ADR.OPS.B.036)

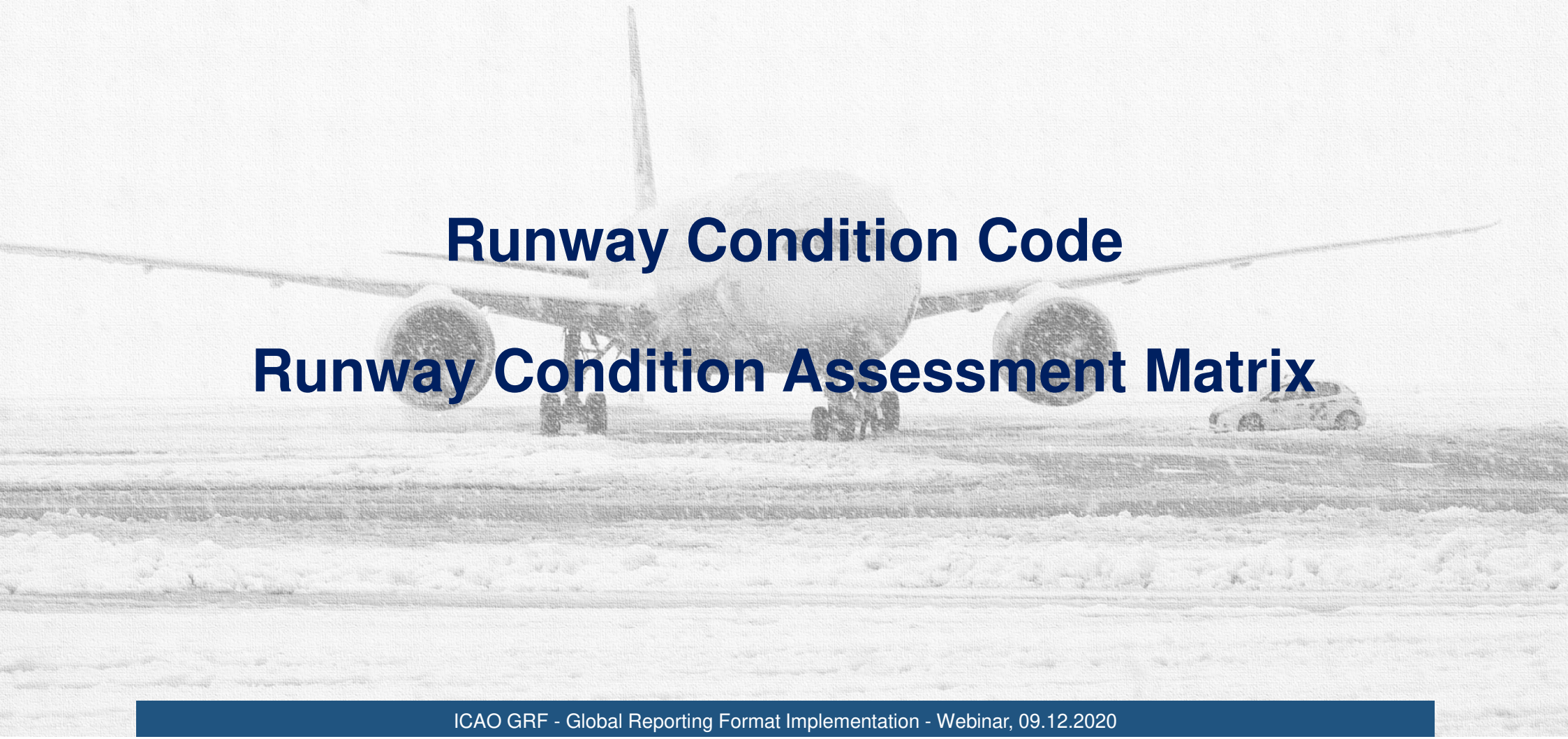
In order to obtain the CA's approval for SPWR, the Aerodrome Operator shall

- establish procedures including:
  - type of equipment, quality/quantity of material and method of application;
  - monitoring of meteorological parameters affecting the method;
  - assessment of the achieved results;
- obtain acft data from at least one aircraft operator to demonstrate - by comparison, with a 95% statistical level of confidence - consistency of the braking action indicated by the aircraft data with the reported RWYCC (min. 30 landings required).
- analyze braking action data recorded during landing to demonstrate the capability to fulfill a given RWYCC;
- establish a maintenance programme covering the equipment in use.

When operating in accordance with the 'SPWR concept', the aerodrome operator shall establish / implement a programme to monitor the effectiveness of the method, incl.:

- comparison of reported runway conditions with braking action reports from aircraft;
- review of the performance of winter operations after the winter season to identify:
  - additional training requirements
  - need for update of the procedures
  - additional or different equipment and materials.
- establishing, recording (monthly) and reviewing (annually) performance indicators to monitor the effectiveness of its procedures*

Ref. Draft EASA AMC1 ADR.OPS.B.036(c); * see EASA GM1 ADR.OPS.B.036(c) for examples.



Runway Condition Code

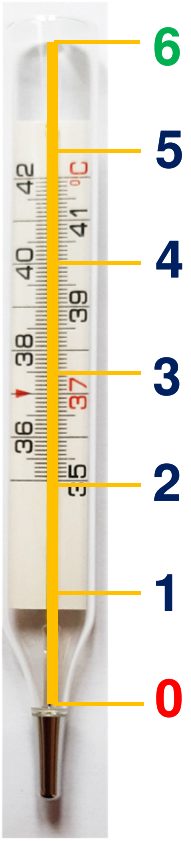
Runway Condition Assessment Matrix

Runway Condition Code (RWYCC)

RWYCC is a number (0-6) used in Runway Condition Report (RCR), describing the effect of rwy surface condition on aircraft performance (aircraft braking capability as a function of surface condition).

It allows the flight crew to conduct the performance calculation and determine the landing distance needed under given conditions (based on data provided by manufacturers).

The procedures for determining the RWYCC are described in the PANS-Aerodromes Doc 9981 (RCAM).



RCAM - Runway Condition Assessment Matrix

The RCAM is a dedicated tool that supports the classification of rwy surface conditions (RWYCC) by their effect on acft braking performance, using

- a set of reasonably conservative criteria* based on the best industry knowledge & flight testing, and
- associated procedures (ref. ICAO Doc 9981).

* e.g.: observed surface conditions and pilot report of braking action

Draft EASA GM1 ADR.OPS.B.037(a)

Assessment Criteria	
RWYCC	**Runway surface description**
6	• DRY
5	• FROST • WET (the runway surface is covered by any visible dampness or water up to and including 3mm) Up to and including 3 mm depth: • SLUSH • DRY SNOW • WET SNOW
4	• SPECIALLY PREPARED WINTER RUNWAYS -15°C and lower outside temperature: • COMPACTED SNOW
3	• SLIPPERY WET • DRY SNOW or W COMPACTED SNO More than 3 mm dep • DRY SNOW • WET SNOW Higher than -15°C out • COMPACTED SNO
2	More than 3 mm: • STANDING WATE • SLUSH
1	• ICE
0	• WET ICE • WATER ON TOP • DRY SNOW or W

Downgrade Assessment Criteria	
Aeroplane deceleration or directional control observation	**Special air-report of runway braking action**
-	-
Braking deceleration is normal for the wheel braking effort AND directional control is normal	GOOD
Braking deceleration OR directional control observation is between good and medium	GOOD TO MEDIUM
Braking deceleraton is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced	MEDIUM
Braking deceleration OR directional control is between medium and poor	MEDIUM TO POOR
Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced	POOR
Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain	LESS THAN POOR

- The RCAM allows an initial assessment based on visual observation of contaminants on the runway surface (type, depth and coverage) + outside air temperature.

- However when other observations, experience, knowledge indicate the RWYCC does not match the prevailing conditions, a downgrade or upgrade should be made.

- 'Downgrading' and 'Upgrading' are an integral part of the assessment process and essential to developing relevant reports.

Assessment Criteria		Downgrade Assessment Criteria	
RWYCC	Runway surface description	Aeroplane deceleration or directional control observation	Special air-report of runway braking action
6	• DRY	-	-
5	• FROST • WET (the runway surface is covered by any visible dampness or water up to and including 3mm) Up to and including 3 mm depth: • SLUSH • DRY SNOW • WET SNOW	Braking deceleration is normal for the wheel braking effort AND directional control is normal	GOOD
4	• SPECIALLY PREPARED WINTER RUNWAYS -15°C and lower outside temperature: • COMPACTED SNOW	Braking deceleration OR directional control observation is between good and medium	GOOD TO MEDIUM
3	• SLIPPERY WET • DRY SNOW or WET SNOW (any depth) ON TOP OF COMPACTED SNOW More than 3 mm depth: • DRY SNOW • WET SNOW Higher than -15°C outside temperature: • 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: • STANDING WATER • SLUSH	Braking deceleration OR directional control is between medium and poor	MEDIUM TO POOR
1	• ICE	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced	POOR
0	• WET ICE • WATER ON TOP OF COMAPCTED SNOW • DRY SNOW or WET SNOW ON TOP OF ICE	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain	LESS THAN POOR

decision making !

Draft EASA GM2 ADR.OPS.B.037(b)

GRF - 2.2 Runway Condition Code, Runway Condition Assessment Matrix

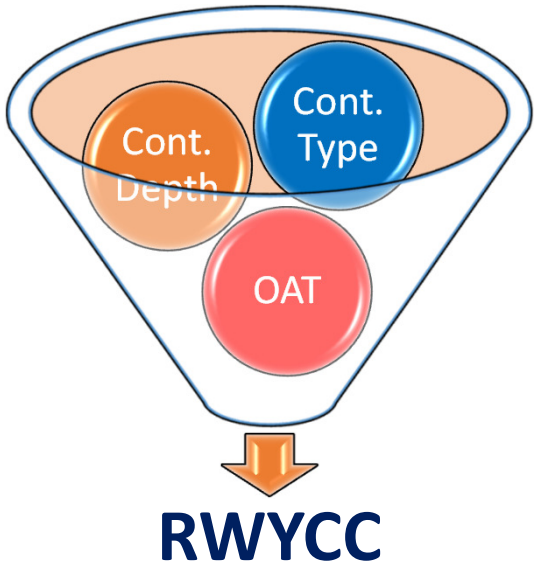
ASSESSMENT CRITERIA		DOWNGRADE ASSESSMENT CRITERIA	
RWYCC	**Runway surface description**	**Aeroplane deceleration or directional control observation**	**Special air-report of runway braking action**
6	• **DRY**	-	-
5	• **FROST** • **WET** (the runway surface is covered by any visible dampness or water up to and including 3mm) **Up to and including 3 mm depth:** • **SLUSH** • **DRY SNOW** • **WET SNOW**	Braking deceleration is normal for the wheel braking effort AND directional control is normal	GOOD
4	• **SPECIALLY PREPARED WINTER RUNWAYS** **-15°C and lower outside temperature:** • **COMPACTED SNOW**	Braking deceleration OR directional control observation is between good and medium	GOOD TO MEDIUM
3	• **SLIPPERY WET** • **DRY SNOW or WET SNOW (any depth) ON TOP OF COMPACTED SNOW** **More than 3 mm depth:** • **DRY SNOW** • **WET SNOW** **Higher than -15°C outside temperature:** • **COMPACTED SNOW**	Braking deceleraton is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced	MEDIUM
2	**More than 3 mm:** • **STANDING WATER** • **SLUSH**	Braking deceleration OR directional control is between medium and poor	MEDIUM TO POOR
1	• **ICE**	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced	POOR
0	• **WET ICE** • **WATER ON TOP OF COMAPCTED SNOW** • **DRY SNOW or WET SNOW ON TOP OF ICE**	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain	LESS THAN POOR

Simplified RCAM (for aerodromes never experiencing snow & ice conditions)

Assessment Criteria		Downgrade Assessment Criteria	
RWYCC	**Runway surface description**	**Aeroplane deceleration or directional control observation**	**Special air-report of runway braking action**
6	**DRY**	-	-
5	**WET** (the runway surface is covered by any visible dampness or water up to and including 3mm)	Braking deceleration is normal for the wheel braking effort AND directional control is normal	GOOD
4		Braking deceleration OR directional control observation is between good and medium	GOOD TO MEDIUM
3	**SLIPPERY WET**	Braking deceleraton is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced	MEDIUM
2	**More than 3 mm:** **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

How to use the RCAM … 'a quick reference guide' in 4 steps !

1. Assess runway conditions in terms of
   - Coverage of contaminant
   - Type of contaminant
   - Depth of contaminant (loose contaminants only)
   - OAT
2. Determine the (initial/provisional RWYCC)
3. Check Special Air-Reports (if any) + additional criteria
4. Consider Downgrade / Upgrade accordinigly



For the purpose of RWYCC assignment:

- If all thirds have <10% contaminant coverage no report (RCR) is generated.

- If contaminant coverage for a third is < 10%, a RWYCC 6 is assigned and no contaminant is reported for that third.

- If contaminant coverage for a third is ≥ 10% but ≤ 25%, a RWYCC 6 is assigned and contaminant is reported at 25% for that third.

In case of multiple contaminants (total coverage >25% of any rwy third) but no single one covering > 25% of any rwy third, the RWYCC is assigned considering the contaminant most likely to be met and most likely affecting aircraft performance.

(Ref. Draft EASA AMC1 ADR.OPS.B.037(b), GM1 ADR.OPS.B.037(b)

Downgrade procedure - The RWYCC should be downgraded taking into account all available means of assessing runway slipperiness, including special air-reports[1] and:[2]

- Prevailing weather conditions
  - stable sub-freezing temperature
  - dynamic conditions
  - active precipitation
- Observations
  - vehicle behaviour
  - ‘shoe scraping’
- Measurements
  - friction measurements
- Experience (local knowledge)

1: Draft EASA AMC1 ADR.OPS.B.037(b); 2: Draft EASA GM2 ADR.OPS.B.037(b)

In respect of pilot's braking action reports (Special Air-Reports), specific obligations have been established

- for pilots to notify ASAP the AIS, by means of a special air-report, whenever the braking action met during landing is not as good as reported by the aerodrome; (Reg. 1387/2019 CAT.OP.MPA.311)
- for ATS to inform without delay the ADR operator when receiving a special air-report (braking action report) not matching the reported RWYCC. (Reg. 469/2020 ATS.OR.530)

Special Air-reports Terms to be used	
GOOD	5
GOOD TO MEDIUM	4
MEDIUM	3
MEDIUM TO POOR	2
POOR	1
LESS THAN POOR	0

Draft EASA GM1 ADR.OPS.B.037(c), Draft AMC1 SERA.14001)

Special Air-reports provide aerodrome with observations that can confirm the ground-based assessment or alert to degraded conditions but it should be borne in mind that

- … the braking action observed is dependent on the type of aircraft, aircraft weight, runway portion used for braking and other factors;
- … it rarely applies to the full length of the runway and is limited to the specific sections of the runway surface in which sufficient wheel braking was applied.
- … pilot reports are subjective and contamination may affect the performance of different aircraft types in different ways.

Draft EASA GM1 ADR.OPS.B.037(c)

Use of Special Air-Reports - 'Golden Rules'

- If a RWYCC ≥ 2 has been issued and two consecutive 'POOR' special air-reports are received, the aerodrome operator should re-assess the runway condition.

- If a 'LESS THAN POOR' braking action report has been received, the aerodrome operator should re-assess rwy condition and consider suspension of operations.

- A special air-report of runway braking action may be used for upgrading purposes only if used in combination with other information supporting upgrading.

Draft EASA AMC1 ADR.OPS.B.037(c)

GRF - 2.2 Runway Condition Code, Runway Condition Assessment Matrix

How to use the RCAM …

1st Rwy Third
Wet Snow
6 mm (100%)
OAT 1°C
Special Air Rep:
medium to poor

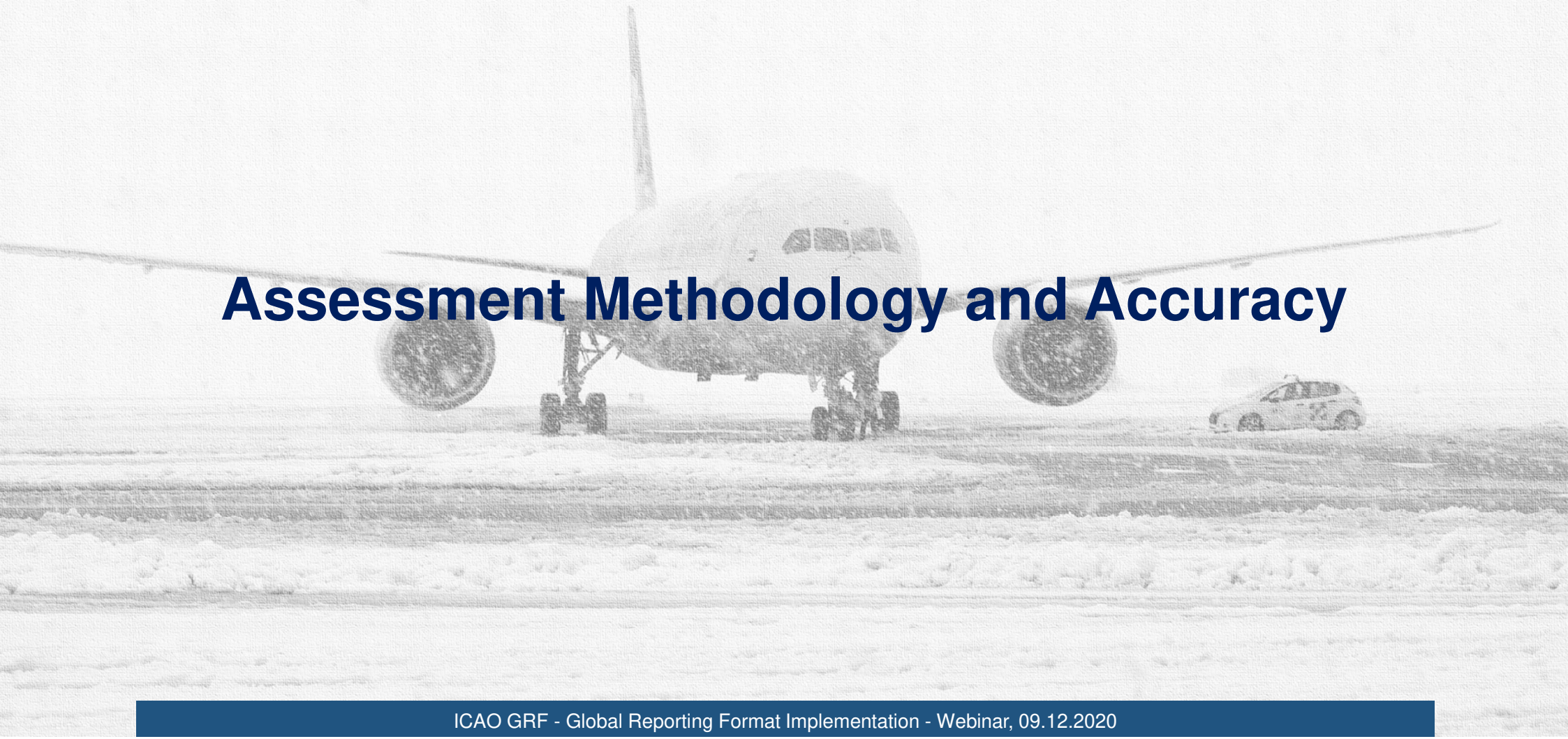
RWYCC: 2

Assessment Criteria		Downgrade Assessment Criteria	
RWYCC	**Runway surface description**	**Aeroplane deceleration or directional control observation**	**Special air-report of runway braking action**
6	• **DRY**	-	-
5	• **FROST** • **WET** (the runway surface is covered by any visible dampness or water up to and including 3mm) **Up to and including 3 mm depth:** • **SLUSH** • **DRY SNOW** • **WET SNOW**	Braking deceleration is normal for the wheel braking effort AND directional control is normal	GOOD
4	• **SPECIALLY PREPARED WINTER RUNWAYS** **-15°C and lower outside temperature:** • **COMPACTED SNOW**	Braking deceleration OR directional control observation is between good and medium	GOOD TO MEDIUM
3	• **SLIPPERY WET** • **DRY SNOW or WET SNOW (any depth) ON TOP OF COMPACTED SNOW** **More than 3 mm depth:** • **DRY SNOW** • **WET SNOW** **Higher than -15°C outside temperature:** • **COMPACTED SNOW**	Braking deceleraton is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced	MEDIUM
2	**More than 3 mm:** • **STANDING WATER** • **SLUSH**	Braking deceleration OR directional control is between medium and poor	MEDIUM TO POOR
1	• **ICE**	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced	POOR
0	• **WET ICE** • **WATER ON TOP OF COMAPCTED SNOW** • **DRY SNOW or WET SNOW ON TOP OF ICE**	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain	LESS THAN POOR

Upgrade procedure

- Upgrade procedure is applicable to RWYCC 0 or 1 only (not for RWYCC 2, 3, 4, 5)
- A RWYCC 1 or 0 may be upgraded up to 3 when that all available means are used to assess rwy slipperiness, incl. properly operated/calibrated measuring devices.
- When RWYCC is upgraded, the rwy should be assessed frequently (while the higher code is in effect) to ensure the conditions do not fall below the given code.
- If sand or other treatments are used to support upgrade, runway condition should be assessed frequently to ensure the continued effectiveness of the treatment.

Draft EASA AMC1 ADR.OPS.B.037(b)



Assessment Methodology and Accuracy

Means used to determine the RWYCC

Visual inspection is the core method to assess the runway condition and assign the RWYCC by using the RCAM; however ...

- the RCAM has to be used along with the associated procedures (ICAO Doc 9981);
- continuous monitoring of the development of the situation and the prevailing weather conditions (significant changes) is essential to ensure safe operations;
- it is important for aerodrome personnel to accurately monitor and report conditions when operating ‘close to the boundaries’; training of personnel is a key element.

Ref. Draft EASA GM1 ADR.OPS.B.037(a)

Other aspects to be considered:

- outside air temperature,
- surface temperature,
- dew point,
- wind speed / direction,
- effect of surface treatment,
- behaviour of inspection vehicle,
- special-air-reports,
- output from friction measuring devices,
- weather forecast, etc.

Ref. Draft EASA GM1 ADR.OPS.B.037(a)

Impact of runway coverage

Remember …

- A runway is considered contaminated whenever the extent of the contaminant coverage is > 25% of the surface of at least one third.

- Whenever coverage is assessed to be < 25% in each third, the assumption made by flight crew will be as a 'dry runway'.*

* In case of contamination just below the threshold but concentrated in the most unfavourable location, the assumption of dry rwy still provides positive stop margin.

Ref. Draft EASA GM1 ADR.OPS.B.037(a)

Impact of contaminant type

Different contaminants affect the contact area between tyres and surface differently…

- A water film of any depth leads to partial or total separation (viscous / dynamic aquaplaning) of the tyre from the surface.
- Other fluid contaminants (e.g. wet snow, slush) have a similar effect.
- Hard contaminants (e.g. ice or compacted snow) prevent contact between tyre and runway completely at any speed, providing a new surface for tyres to roll on.

Draft EASA GM1 ADR.OPS.B.037(a)

Impact of contamination depth

- The threshold accepted by the industry for the effect of fluid contaminants on aicraft performance is 3 mm; within 3 mm, any type of fluid contaminant can be removed from the tyre/rwy contact zone (by drainage or compression into the macrotexture).

- Contamination up to 3 mm is expected to provide similar stopping performance as a wet runway.

- Above 3 mm, the impact on friction forces is more significant and depending on fluid density and depth, additional drag effects start to apply; these effects affect also aircraft ability to accelerate for take-off.

Ref. Draft EASA GM1 ADR.OPS.B.037(a)

- The physical effects impairing friction begin to act from very small film thickness; therefore damp conditions are considered to provide no better braking action than a wet runway.

- Friction in wet conditions (or thin fluid contaminants layers) is very dependent upon the inherent qualities of the runway surface and may be less than expected on poorly drained, polished or rubber contaminated surfaces.

Ref. Draft EASA GM1 ADR.OPS.B.037(a)

Contaminant depth has to be assessed for 'loose contaminants' only, i.e.

- Water
- Dry Snow
- Wet Snow
- Slush

Not reported for contaminants other than those listed above !

For the purpose of reporting

- 'water' depth ≤ 3 mm (wet runway) is not reported (NR)
- minimum depth of 'standing water' to be reported is 4 mm (04)
- 'slush', 'wet snow', 'dry snow' depth ≤ 3 mm is reported as 3 mm (03)

Ref. Draft EASA GM1 ADR.OPS.A.065(b);(c)

Significant changes - a new runway condition assessment (and a new Rwy Condition Report) is required whenever the surface condition may have changed significantly.

'Significant changes' include any change:

- in the RWYCC
- in the contaminant type
- in the reportable contaminant coverage (tab. 1)
- in the contaminant depth to be reported (tab. 2)
- other information, e.g. Special Air-Rep, known to be significant.

Table 1

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

Table 2

Contaminant	Valid values to be reported	Significant change
STANDING WATER	04, then assessed value	3 mm
SLUSH	03, then assessed value	3 mm
WET SNOW	03, then assessed value	5 mm
DRY SNOW	03, then assessed value	20 mm

Draft EASA AMC1 ADR.OPS.A.065(b);(c)

Thanks for your attention

Info: grf@enac.gov.it