

ICAO Global Reporting Format

Introducing Reporting of Runway Condition
Relevant for Aircraft Performance



Lars Kornstaedt / Rapporteur Annex 6/8 Subgroup, Friction Task Force
GRF Workshop, Frankfurt
10 December 2019

AIRBUS

ICAO Friction Task Force Jobcard

PART I		Safety	Sustainability	Implementation	Reference: AP001
Category	Assessment and reporting of runway surface conditions				
Title	Secretariat/WG-PDP				
Proposed by	Runway surface conditions have contributed to many safety events and investigations have revealed shortfalls in the accuracy and timeliness of assessment and reporting methods currently provided for in ICAO provisions and guidance material				
Problem Statement	While techniques for the measurement of runway friction provide useful information for runway surface friction maintenance purposes, they are not suitable in all weather conditions when the runway is contaminated and the information when used in reports could be misleading to pilots. Reports used by pilots need to be performance of the runway for both airport operations and use it effectively. Reports need to be incorporated into current guidance material where necessary.				
Specific Details (including impact statements)	Reports that are directly related to the existing conditions for reports. In addition, reports need to be updated to reflect "dry", "wet", "slippery when wet", and how to maintain runway surface conditions. Reports need to be updated to reflect runway conditions that aid friction and drainage. The reports also need to be reviewed and updated as necessary.				
PART II					
Rating	High				
Rationale for acceptance/rejection					
Action already in progress	Current work programme				
Interdependencies/References	AN-WP/8571.PD				
Required Action					Timescales (for deliverable)
1	Develop provisions for the reporting of runway surface conditions	AP/PASG	Proposed amendments to Annex 14 Volume 1 and other related Annexes	Q2/2014	
			Proposed amendments to PANS-Aerodromes and PANS-ATM	Q2/2015	
2	Develop guidance material for the assessment of runway surface conditions, including friction level and where contamination exists	AP/PASG	Proposed amendments to PANS-Aerodromes	Q2/2015	
			Proposed amendments to Doc 9137	Q1/2016	
3	Develop guidance material for the measurement and maintenance of runway friction	AP/PASG	Proposed amendments to PANS-Aerodromes	Q2/2015	
			Proposed amendments to Doc 9137	Q1/2016	

...need reports that are directly related to the performance of the aircraft.

Effect of Runway Condition on Aircraft Performance



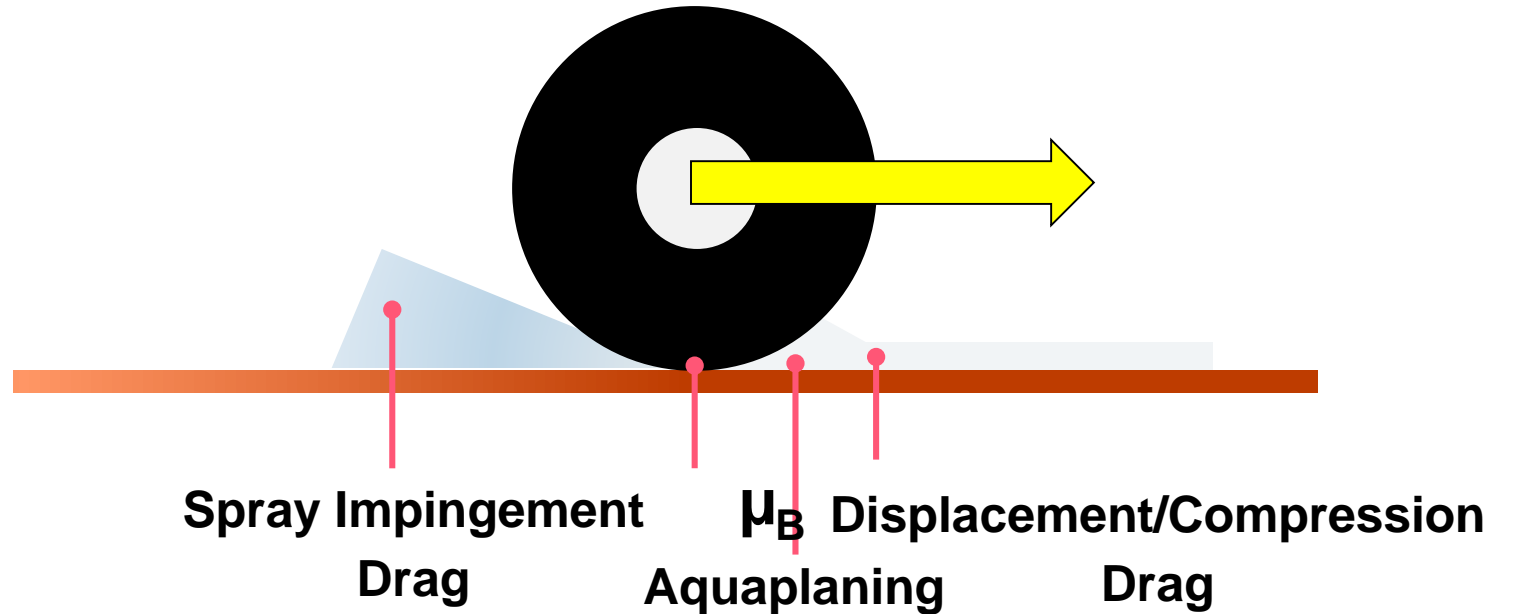
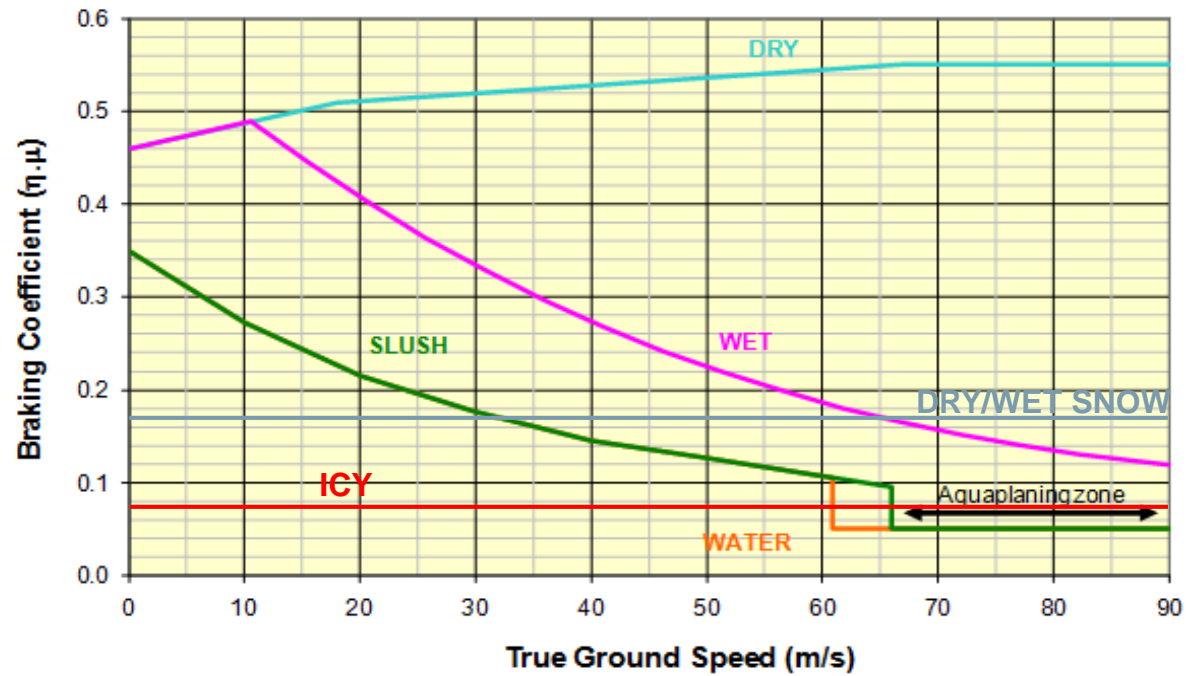
Effects on Performance

Braking Performance reduced

- Wheel to ground friction
- Aquaplaning

Acceleration reduced

- Contaminant drag



Performance Relevant Reporting

The Operational Need

- What is on the runway?
- Does it cover a significant portion?
- How deep is it?
- Are in-built qualities of the surface deficient?

The Assessment and Reporting Method

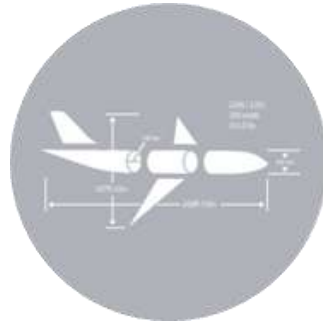
- The essential information
- Updated according relevant criteria
- When there is a significant change



End to End System



Aerodromes



Manufacturers



AIS/ATM



Operators

Common Language

Contaminant Types

Runway Condition Codes

Direct Input to Performance Assessment

Performance Relevance

Depth Thresholds & Temperatures

Significant Changes

ICAO Provisions



Standards and Recommended Practices

- **Annex 14, Volume 1:** fundamental provisions for assessing and reporting runway surface conditions
- **Annex 6, Parts I and II:** assessment by the pilot-in-command of the landing performance and report of pilot observations
- **Annex 8:** information provided by the aircraft manufacturers;
- **Annex 3:** removal of the runway state group for METAR/SPECI
- **Annex 15:** syntax and format used for dissemination

Procedures

- **PANS-Aerodromes:** reporting procedures and RCAM
- **PANS-ATM:** phraseology and communication of special air-reports concerning runway braking
- **PANS-AIM:** report syntax

Guidance material

- **Aeroplane Performance Manual (Doc 10064)**
- **Circular 355 Assessment, Measurement and Reporting of Runway Surface Conditions**

Aerodromes – Annex 14

- New set of **Definitions**, including
 - Runway Condition Assessment Matrix (RCAM)
 - Runway Condition Code (RWYCC)
 - Runway Surface Descriptors
- Mandate reporting whenever significant conditions or changes thereof occur
 - List of contaminant restricted to those with known performance effect
 - Wet must be reported but may not use Special NOTAM
 - Slippery When Wet must be reported but continues to use NOTAM instead of ad-hoc
 - Winter runway treatment is reported for situational awareness only
 - Friction measurement may not be sole criterion for RWYCC and should not be reported
- Runway inspector training becomes Standard
- Quantitative information on functional and operational friction is deleted or becomes guidance



Aerodromes - PANS

- Reporting of Runway Condition Codes (RWCCs)
- Reporting of conditions by runway thirds
- Identification of contaminated conditions based on
 - Coverage: 25% of a runway third
 - 3mm or more for fluid contaminants
- Definition of significant changes
 - Change of RWYCC
 - Significant change in depth specified for each contaminant
- Definition of Information string and its format
- Runway Condition Assessment Matrix (RCAM)
- Identification of Situational Awareness items (reduced LDA, drifting snow, snow banks, treatment)



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	<ul style="list-style-type: none"> • DRY 	---	---
5	<ul style="list-style-type: none"> • FROST • WET (The runway surface is covered by any visible dampness or water up to and including 3 mm depth) <p><i>Up to and including 3 mm depth:</i></p> <ul style="list-style-type: none"> • SLUSH • DRY SNOW • WET SNOW 	Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	GOOD

The Runway Condition Report

- Aircraft Performance Section (mandatory)
 - Airport Designator
 - Assessment Date and Time
 - Lower Runway Designator
 - RWYCC per third
 - Coverage per third
 - Depth of contamination per third
 - Contaminant type per third
 - Width for which assessment of RWYCC applies
- Situational Awareness Section (optional)
 - Reduced Runway length
 - Drifting Snow
 - Loose Sand
 - Chemical Treatment
 - Snowbanks on Runway
 - Snowbanks on Taxiway
 - Snowbanks adjacent to Runway
 - Taxiway Conditions
 - Apron Conditions
 - Measured Friction
 - Free-text Remarks

GG EADBZQZX EADNZQZX EADSZQZX
070645 EADDYNYX
SWEA0151 EADD 02170055
SNOWTAM 0151

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 2/3/1 75/100/100 06/12/12 SLUSH/WET SNOW/WET SNOW 30

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

Circular 355

- Guidance material primarily written for airport operators
- Historical and Technical Background
 - Runway Characteristics
 - Impact on Aircraft Performance
- Runway Condition Reporting Concept and Methodology
 - Adapted formats of the Runway Condition Assessment Matrix (RCAM)
 - Rationale for criteria and thresholds
 - Downgrading and Upgrading of RWYCCs
 - Flowcharts
- Information Dissemination
- Friction Measurement
- Operational Hazards

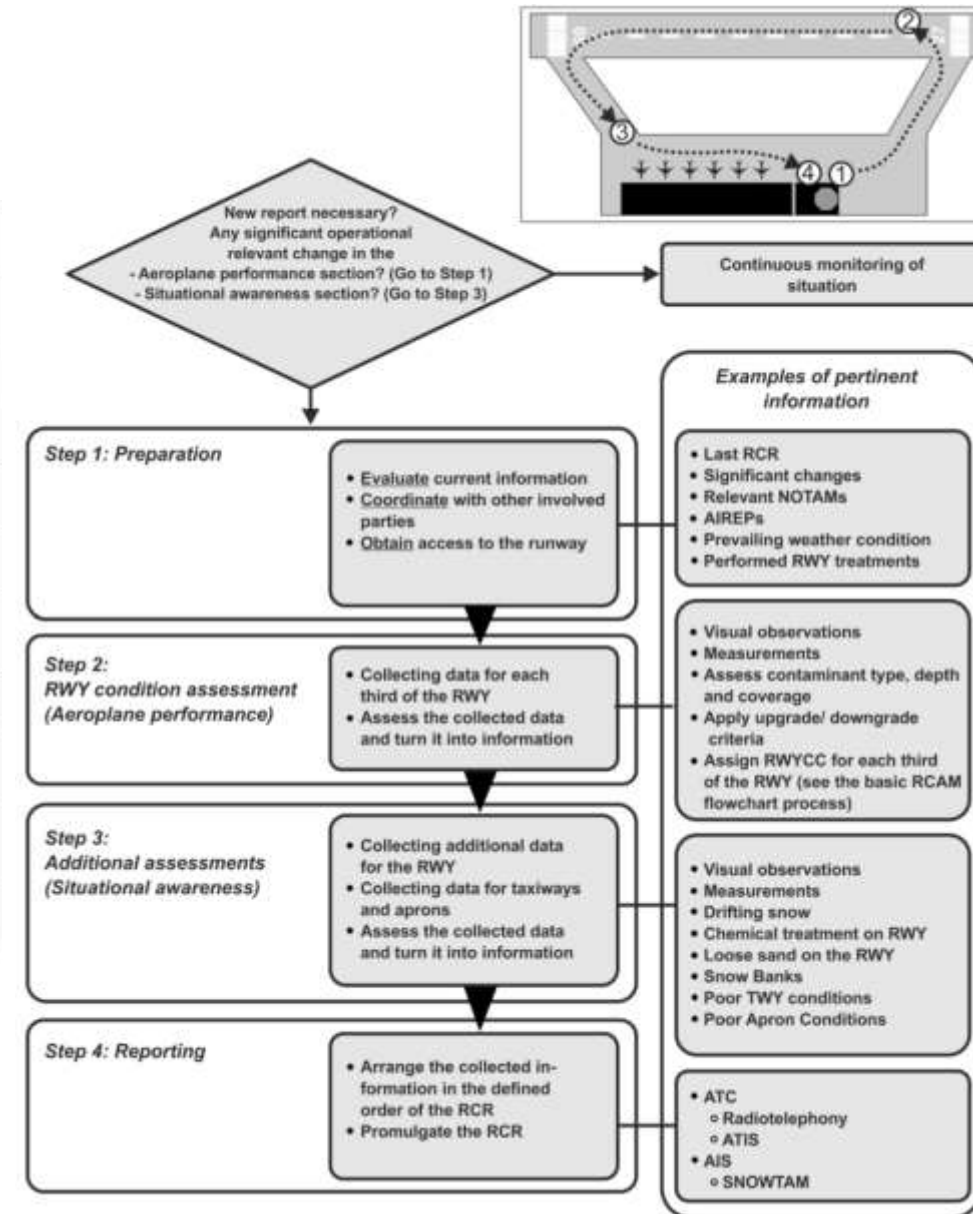


The Assessment Process

RUNWAY CONDITION REPORT (RCR)	
Aeroplane performance calculation section	
Information	Source
Aerodrome location indicator	ICAO Doc 7910, <i>Location Indicators</i>
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
Depth of loose contaminant for each runway third	Visual observation assessed confirmed by measurement
Condition description (contaminant type) for each runway third	Visual observation for each
Width of runway to which the RWYCCs apply if less than published width	Visual observations while from local procedures/snow



Assessment... NOT Measurement
Visual Inspection is the primary tool



Meteorology – Annex 3

- Removal of METAR/SPECI runway state group (MOTNE)



Phraseology – Annex 11 & PANS ATM



- Doc 4444
 - Integration of Pilot Reports of Braking Action into existing mechanism of AIREPs
 - Creation of Phraseology for Tower reports of runway condition using Information String and plain language



AIS/ATM – Annex 15

- Replace SNOWTAM with new special NOTAM
- Clear format and syntax
- Report validity period 8hrs



SNOWTAM FORMAT

Source: *Procedures for Air Navigation Services — Aeronautical Information Management (PANS-AIM, Doc 10066)*
(see Chapter 5, 5.2.5.1.5)

(applicable 5 November 2020)

(COM heading)	(PRIORITY INDICATOR)	(ADDRESSES)				←←										
	(DATE AND TIME OF FILING)	(ORIGINATOR'S INDICATOR)				←←										
(Abbreviated heading)	(SWAA* SERIAL NUMBER)		(LOCATION INDICATOR)	DATE/TIME OF ASSESSMENT	(OPTIONAL GROUP)											
	S	W	*	*												←←(
SNOWTAM →	(Serial number)											←←				
Aeroplane performance calculation section																
(AERODROME LOCATION INDICATOR)												M	A)	←←		
(DATE/TIME OF ASSESSMENT <i>(Time of completion of assessment in UTC)</i>)												M	B)	→		
(LOWER RUNWAY DESIGNATION NUMBER)												M	C)	→		
(RUNWAY CONDITION CODE ON EACH RUNWAY THIRD) (From Runway Condition Assessment Matrix (RCAM) 0, 1, 2, 3, 4, 5 or 6)												M	D)	/ /	→	
(PER CENT COVERAGE CONTAMINANT FOR EACH RUNWAY THIRD)												C	E)	/ /	→	
(DEPTH (mm) OF LOOSE CONTAMINANT FOR EACH THIRD OF RUNWAY)												C	F)	/ /	→	
(CONDITION DESCRIPTION OVER TOTAL RUNWAY LENGTH <i>(Observed on each runway third, starting from threshold having the lower runway designation number)</i>)												M	G)	/ /		

Airworthiness – Annex 8



- Option for takeoff performance on contaminated runway
- Mandate split of landing performance information into
 - At Time of Takeoff data (dispatch)
 - At Time of Landing data (in-flight)
- New At Time of Landing Distances shall reflect real operating practices
- Both types of landing distances may be provided for contaminated runways

Operations - Annex 6



- For large and small airplanes
- Mandate AIREP when conditions worse than reported
- Mandate in-flight check with appropriate margin before starting approach

Aeroplane Performance Manual

- Introduction to Operations on Contaminated Runways
- 4 Flight-Phase oriented Chapters
 - Take-off
 - En-Route
 - Landing
 - Missed Approach

• Clear Focus on GRF

- Other information considered as non-controversial
- Based on existing national guidance and practices
- Still under Review by Ops Section



Chapter on Operations On Contaminated Runways

- Description of the RCR for Operators and Pilots
- Introduction to the Assessment Process applied by the Aerodrome
- Description and use of the RCAM and RWYCC
- Considerations for making AIREPs of Braking Action
- Training Syllabus

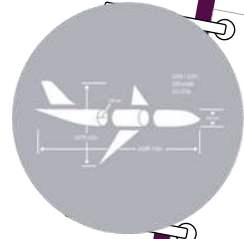


Chapter on Landing

- Derivation of Landing Performance Data for Time of Arrival
- Publication of Data and Limitations
- Fallback Generic Factors in case no Data is provided by the Manufacturer
- Regulatory background
- Considerations for Performance Assessment in Approach Preparation
- Considerations for Flight Crew
- Pilot Procedures for Landing on Length-Limited Runways

Guidance for Manufacturers

- Publish Operational Landing Distances
 - “Minimum” Compliance with principles
 - Cover all 6 friction levels
 - Introduce Accountability for
 - Temperature effect
 - Runway slope effect
 - Approach speed increment effect



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MANUALS

IN FLIGHT PERFORMANCE

LANDING DISTANCE - DRY

Part 1/4

The Reference Distance (REF DIST) considers: Sea Level (SL), ISA, no wind, no slope, no engine reverse
 Thrust, manual braking, VAPPROL without APPR CORR.

COND FULL

Conditions as Landing Distance (m)

Braking Mode	REF DIST (m) for 150% 150% 150%	WEIGHT		SFD	ALT	WIND	TEMP	SLOPE	REV
		Per 100% BELOW 150%	Per 100% ABOVE 150%						
Maximum MANUAL	1 750	-30	+140	+70	Per 100% above SL	Per Sea TW	Per 10°C ABOVE ISA	Per 1% Down Slope	Per Thrust Reverse Operative
AUTOPRACE USE	1 800	-30	+140	+70	Per 100% above SL	Per Sea TW	Per 10°C ABOVE ISA	Per 1% Down Slope	Per Thrust Reverse Operative
AUTOPRACE LOW	2 250	-30	+140	+70	Per 100% above SL	Per Sea TW	Per 10°C ABOVE ISA	Per 1% Down Slope	Per Thrust Reverse Operative
Overweight Ldg ops	+100 m								
Autoland	+200 m								

COND 3

Conditions as Landing Distance (m)

Braking Mode	REF DIST (m) for 150% 150% 150%	WEIGHT		SFD	ALT	WIND	TEMP	SLOPE	REV
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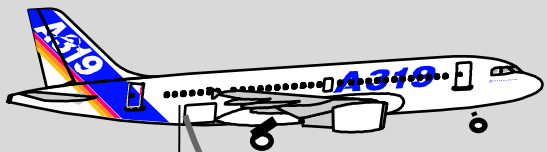
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OEB OPS DATA

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NO MARGIN

ACTUAL LDG DIST



V_{REF}

V_{TD}

Demo/Regul

STOP

- DRY
- WET
- WATER
- SLUSH
- SNOW
- ICE



ISA



15% MARGIN

IN-FLIGHT LDG DIST



V_{APP}

V_{TD}

Operational

%

STOP

- DRY
- GOOD
- GOOD TO MEDIUM
- MEDIUM
- MEDIUM TO POOR
- POOR



OAT



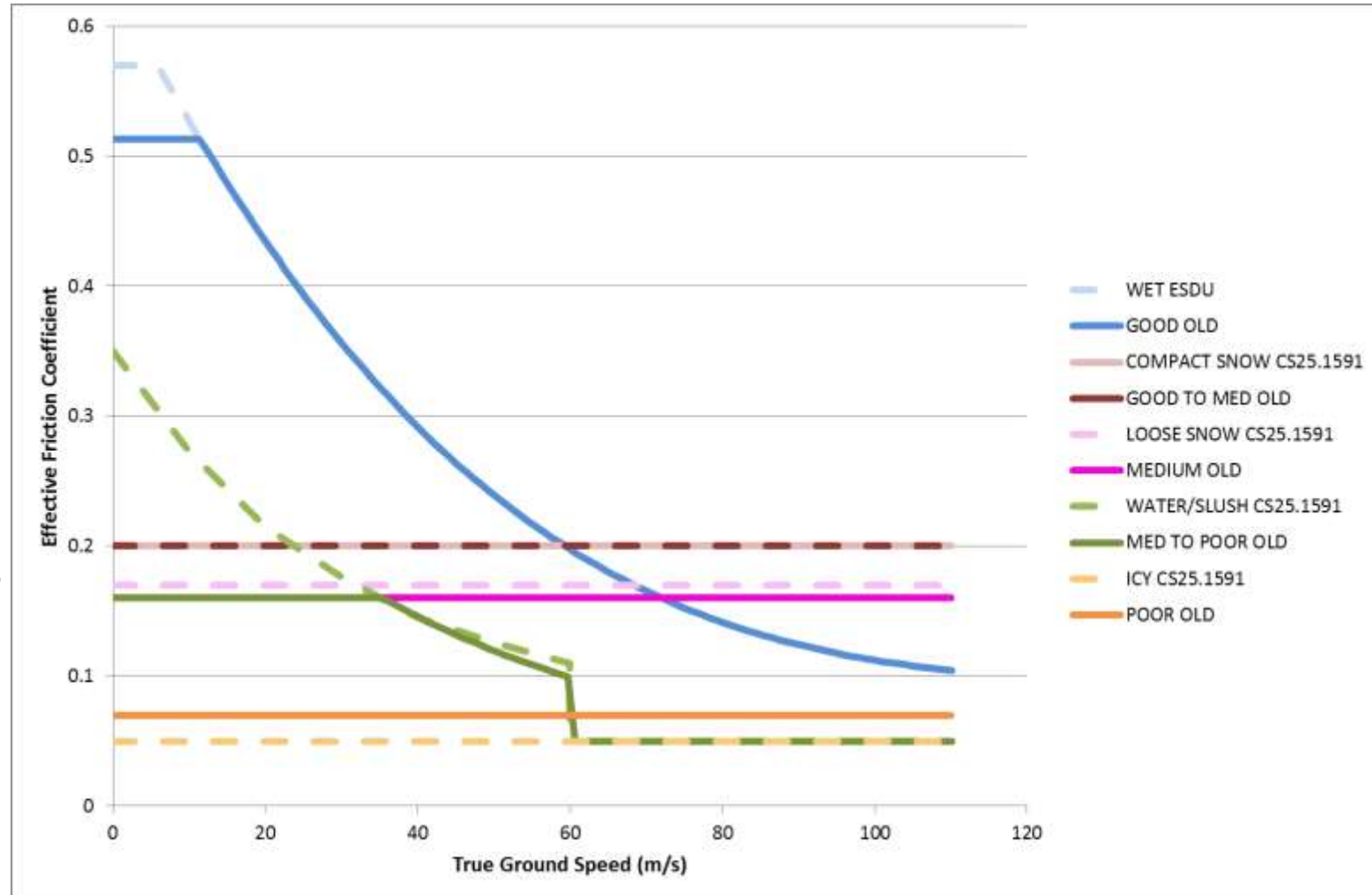
ICAO Doc 10064 Aeroplane Performance Manual

- Provides the **effective wheel to ground coefficient** for each **RWYCC**
- Not specific to an individual aeroplane
- Adaptable to the anti-skid system type
- Ensures harmonized **Landing Distances at Time for Arrival** between all types

RWYCC	Runway Surface Condition Description	Pilot-Reported Braking Action	Wheel Braking Coefficient
6	DRY	—	90 per cent of certified value used to comply with Annex 8 Part IIB 2.2.7 e) ¹ .
5	FROST WET (The runway surface is covered by any visible dampness or water up to and including 3mm deep.) SLUSH (up to and including 3mm depth) DRY SNOW (up to and including 3mm depth) WET SNOW (up to and including 3mm depth)	Good	Per method defined in Note 2 below.
4	COMPACTED SNOW (Outside air temperature minus 15 degrees Celsius or below)	Good to Medium	0.20 ³
3	WET (Slippery Wet) (any depth) DRY SNOW (more than 3mm depth) WET SNOW (more than 3mm depth) DRY SNOW ON TOP OF COMPACTED SNOW (Any depth) WET SNOW ON TOP OF COMPACTED SNOW (Any depth) COMPACTED SNOW (Outside air temperature above minus 15 degrees Celsius)	Medium	0.16 ³
2	STANDING WATER (more than 3mm depth) SLUSH (more than 3mm depth)	Medium to Poor	(1) For speeds below 85 per cent of the aquaplaning speed ³ : 50 per cent of the wheel braking coefficient determined for RWYCC=5, but no greater than 0.16; and (2) For speeds at 85 per cent of the aquaplaning speed ⁴ and above: 0.05 ³ .
1	ICE	—	0.07 ³

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- Not specific to an individual aeroplane
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- Ensures harmonized **Landing Distances at Time for Arrival** between all types
- Based on **existing** EASA guidance on contaminated runway friction from **historic** flight tests



Runway Condition Code – Direct Input to Landing Distance Computation

Runway condition code	AIR CANADA 4216A318A320A327 IN FLIGHT PERFORMANCE PER-B 1/2 22 MAR 17	AIR CANADA 4216A318A320A327 IN FLIGHT PERFORMANCE PER-B 2/2 22 MAR 17																																																																										
6	<p>6 - DRY</p> <p>reverse thrust, manual landing⁽¹⁾, VAPP-VLS without APPR COR.</p> <p>5 - DRY</p> <table border="1"> <thead> <tr> <th>Corrections on Landing Distance (ft)</th> <th>WGT⁽²⁾</th> <th>SPD</th> <th>ALT</th> <th>WIND</th> <th>TEMP</th> <th>SLOPE</th> <th>REV</th> <th>QVW</th> </tr> </thead> </table>		Corrections on Landing Distance (ft)	WGT ⁽²⁾	SPD	ALT	WIND	TEMP	SLOPE	REV	QVW																																																																	
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RWY COND

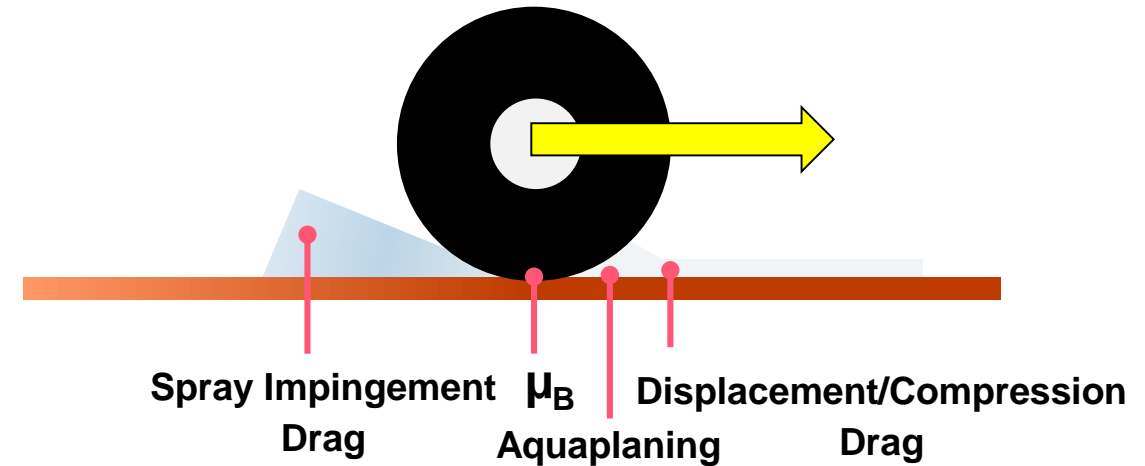
Cancel

Select runway condition from list

- 6-Dry
- 5-Good
- 4-Good to medium
- 3-Medium
- 2-Medium to poor
- 1-Poor

Chapter on the Situation for Takeoff

- RWYCC provides information on friction only
- At takeoff fluid contaminants generate drag
 - Displacement
 - Compression
 - Impingement
- Takeoff can be limited by
 - Distance needed to accelerate to lift-off speed
 - Distance needed to accelerate to decision speed V_1 and come to full stop on available runway
- Contaminant drag must be accounted for in takeoff computations



Takeoff computation must be done for prevailing contaminant!

Takeoff

Computation with Contaminant Type and Depth

Runway state

Dry

Dry

Wet

Slippery wet

Compacted snow

Dry snow 10 mm (2/5")

Dry snow 50 mm (2")

Dry snow 100 mm (4")

Wet snow 5 mm (1/5")

Wet snow 15 mm (3/5")

Wet snow 20 mm (4/5")

Slush 6 mm (1/4")

Slush 15 mm (3/5")

Standing water 6 mm (1/4")

Standing water 15 mm (3/5")

Ice cold & dry

Takeoff

Computation with Contaminant Type and Depth

- Typical manufacturer data certified to CS25 pre-Amdt 2 does not cover many contaminants in the RCAM
- Missing:
 - Frost
 - Dry Snow
 - Wet Snow
 - Compacted Snow at OAT above -15°C
 - Slippery When Wet
 - Ice Cold & Dry
- APM offers advice on how to compute for missing contaminants conservatively

Runway condition assessment matrix (RCAM)				
Runway condition code	Assessment criteria		Downgrade assessment criteria	
	Runway surface description		Aeroplane deceleration or directional control observation	Pilot report of runway braking action
6	• DRY		---	---
5	• FROST • WET (The runway surface is covered by any visible dampness or water less than 3 mm deep) Less than 3 mm depth: • SLUSH • DRY SNOW • WET SNOW		Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	GOOD
4	-15°C and Lower outside air temperature: • COMPACTED SNOW		Braking deceleration OR directional control is between Good and Medium.	GOOD TO MEDIUM
3	• WET ("Slippery wet" runway) • DRY SNOW or WET SNOW (Any depth) ON TOP OF COMPACTED SNOW 3 mm and more depth: • DRY SNOW • WET SNOW Higher than -15°C outside air temperature: • COMPACTED SNOW		Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	MEDIUM
2	3 mm and more depth of water or slush: • STANDING WATER • 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 • WATER ON TOP OF COMPACTED SNOW ² • 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

Takeoff

Computation with Downgraded RWYCC

METAR



PAMC 13^{09:53} Z AUTO 000°00^{KT} 10SM CLR M09/M12
A2972 RMK AO2 SLP073 T10891117 TSNO=

SNOWTAM

MCG 1803121907 05 2/2/2 100/100/100 NR/NR/NR
COMPACTED SNOW/COMPACTED
SNOW/COMPACTED SNOW

APM recommends “to delay take-off. However, [...], it may be sufficient to determine performance in nominal conditions and to adopt appropriate operational procedures such as considering reduced crosswind limits, using the full length of available runway and avoiding rolling take-off.”

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	<ul style="list-style-type: none"> • DRY 	---	---
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4	<p>-15°C and Lower outside air temperature:</p> <ul style="list-style-type: none"> • COMPACTED SNOW 	Braking deceleration OR directional control is between Good and Medium.	GOOD TO MEDIUM
3	<ul style="list-style-type: none"> • WET ("Slippery wet" runway) • DRY SNOW or WET SNOW (Any depth) ON TOP OF COMPACTED SNOW <p>3 mm and more depth:</p> <ul style="list-style-type: none"> • DRY SNOW • WET SNOW <p>Higher than -15°C outside air temperature:</p> <ul style="list-style-type: none"> • COMPACTED SNOW 	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	MEDIUM
2	<p>3 mm and more depth of water or slush:</p> <ul style="list-style-type: none"> • STANDING WATER • SLUSH 	Braking deceleration OR directional control is between Medium and Poor	MEDIUM TO POOR
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A) ENNK  **SNOWTAM**
 B) 11 JAN 2013 04:43
 C) 01 F) 379/379/379 G) XX/XX/XX H) 3/4/4
 N) C/CLSD ALL REMAINING TWYS/379
 R) APRON B/CLSD ALL REMAINING APRONS/379
 T) CONTAMINATION/100/100/100/PERCENT. SAND APPLIED.
 UUEE 050230Z 17004MPS 0900 R25R/P1500U +SHSN VV004
 M01/M01 Q1017 **75590230 25590230**
METAR M 

Landing Performance Level
 Direct input into Assessment
 At Time of Arrival

Runway Number	Runway Length	Runway Width	Runway Condition		Runway Status
			Visual	Friction	
09L	3000	60	3	2	POOR
09R	3000	60	3	2	POOR
18	3000	60	3	2	POOR
27	3000	60	3	2	POOR



ENCN 09111400 09L **3/3/2** 25/50/50 05/05/02 DRY SNOW/WET
 SNOW/WET SNOW 30.
 DRIFTING SNOW. RWY 09L CHEMICALLY TREATED. TWY B
 POOR



Thank you