

Aircraft Performance

ICAO Document 10064

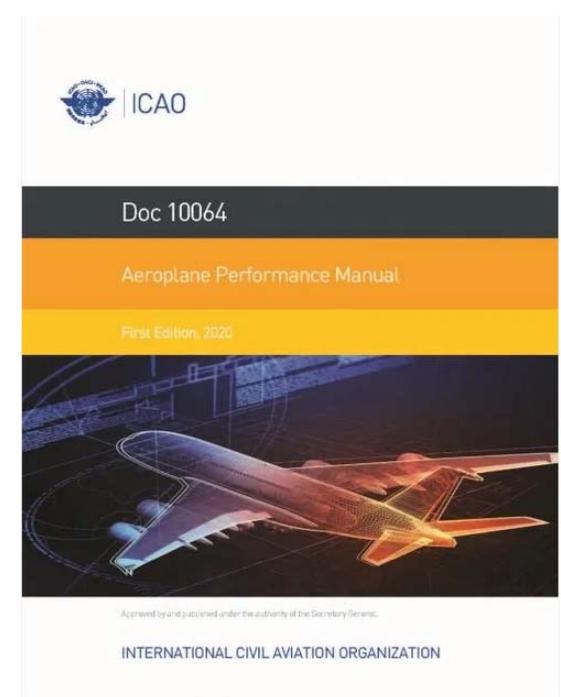
Presented to: **East/South Africa Region Workshop**
By: **Paul Giesman – FAA Policy and Innovation**
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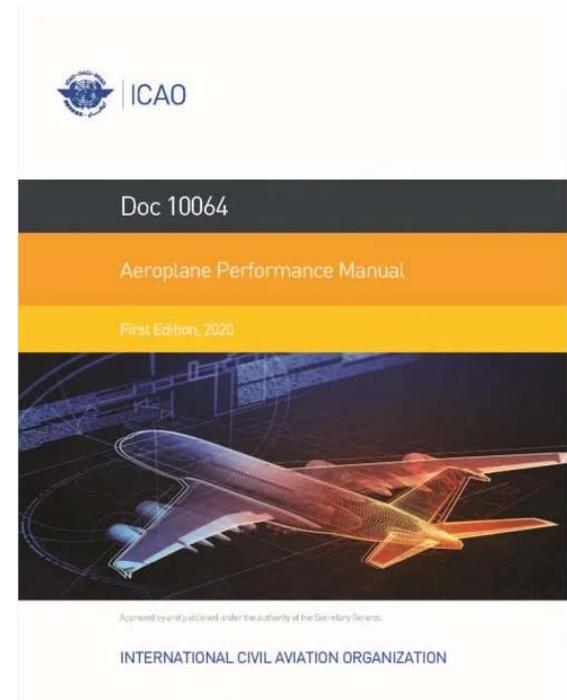
Aeroplane Performance Manual

- **ICAO Document 10064**
 - Created by Aeroplane Performance Subgroup of ICAO Friction Task Force
 - FTF recognized that the GRF reporting format would only be relevant if information important to aeroplane performance is considered
 - Same philosophy espoused by United States Takeoff and Landing Performance Assessment (TALPA) Aviation Rulemaking Committee in 2008/9



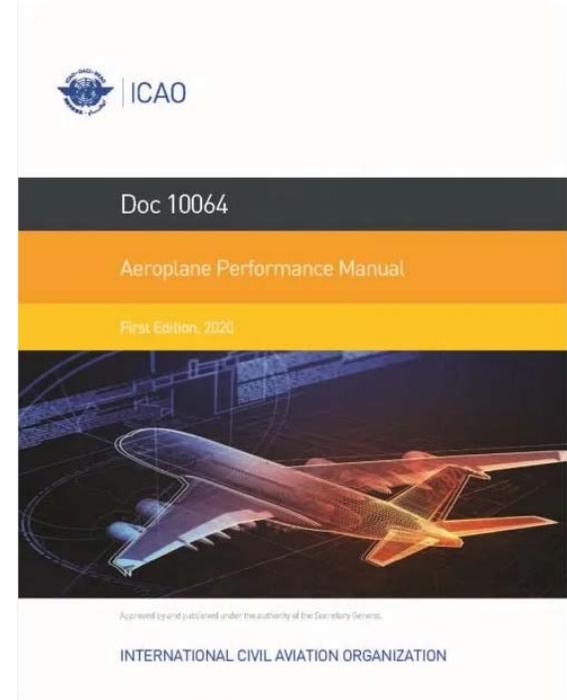
Aeroplane Performance Manual

- **ICAO Document 10064**
 - ICAO FTF recognized that safe operation of aeroplanes requires performance information from 3 sources:
 - Airworthiness, Annex 8 requirement
 - Operations, Annex 6 requirement
 - Additional supplementary data provided by manufacturers
 - It further recognized that aerodrome operations and standards play a significant role in safe operation of aeroplanes in particular in challenging weather conditions



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- **ICAO Document 10064**
 - The ICAO APM contextualizes the interaction of the Airworthiness performance requirements (Annex 8), Operations performance requirements (Annex 6), Advisory data performance information and airport reporting information (Annex 14 & 15 plus ATC) that result in safe operation of aeroplanes



Aeroplane Performance Manual

- **Content organized with 5 chapters**
 - **Chapter 2 – Runway Surface Condition Assessment and Reporting – will discuss**
 - Information to support safe aircraft operations during takeoff and landing
 - Runway Condition Report (RCR) – type and depth – takeoff performance
 - Runway Condition Code (RWYCC) – number 0-6 – used for time-of-arrival landing performance
 - Pilot Report after landing – real time qualitative update of pilot impression of braking action available
 - Training Requirements
 - **Chapter 3 – Take-off Performance**
 - Limitations –
 - Obstacle clearance
 - Operations on contaminated runways **will discuss more**

Aeroplane Performance Manual

- **Content organized with 5 chapters**
 - **Chapter 4 – En-route Performance**
 - **Chapter 5 – Landing Performance – will discuss**
 - Performance check at time of takeoff
 - Performance check at time of landing
 - Contaminated runway braking performance
 - Not part of ICAO GRF/APM but FAA guidance on Heavy Rain
 - **Chapter 6 - Missed Approach**

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Chapter 2 – Runway Surface Condition Assessment and Reporting

- **General Description of ICAO GRF as it pertains to flight operations and aircraft performance**
 - Airports are to assess runway surface – not just report it.



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

- Includes ability to upgrade (winter ops) or downgrade



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Effect of Runway Condition on Aircraft Performance



Performance Relevant Reporting

The Operational Need

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

The Assessment and Reporting Method

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



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Chapter 2 – Runway Surface Condition Assessment and Reporting

Global Reporting Format - GRF

```
EADD 02170055 09L 5/5/5 100/100/100 NR/NR/NR WET/WET/WET
EADD 02170135 09R 5/2/3 100/50/100 NR/04/NR WET/STANDING WATER/WET
EADD 02170225 09C 2/3/3 75/100/100 06/12/12 SLUSH/WET SNOW/WET SNOW
```

Runway Condition Code
Landing oriented

Depth of contaminant

```
EADD 02170135 09R 5/2/3 100/50/100 NR/04/NR WET/STANDING WATER/WET
```

**Percent Coverage of most
performance relevant
contaminant**

Surface Description



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Chapter 2 – Runway Surface Condition Assessment and Reporting

Global Reporting Format - GRF

Middle Third – RCR 2, 50% covered, 4 mm, Standing Water

EADD 02170135 09R 5/**2**/3 100/**50**/100 NR/**04**/NR WET/**STANDING WATER**/WET

Final Third – RCR 3, 100% covered, Not Reported, WET

EADD 02170135 09R 5/2/**3** 100/50/**100** NR/04/**NR** WET/STANDING WATER/**WET**

Final Third – Downgraded to slippery wet due to:

- Failed friction test?
- Failed texture test?
- Reduced wheel braking reported?



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- 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" runway) 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	Poor	0.07 ³

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Chapter 2 – Runway Surface Condition Assessment and Reporting

Global Reporting Format – GRF and Situational Awareness

- 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

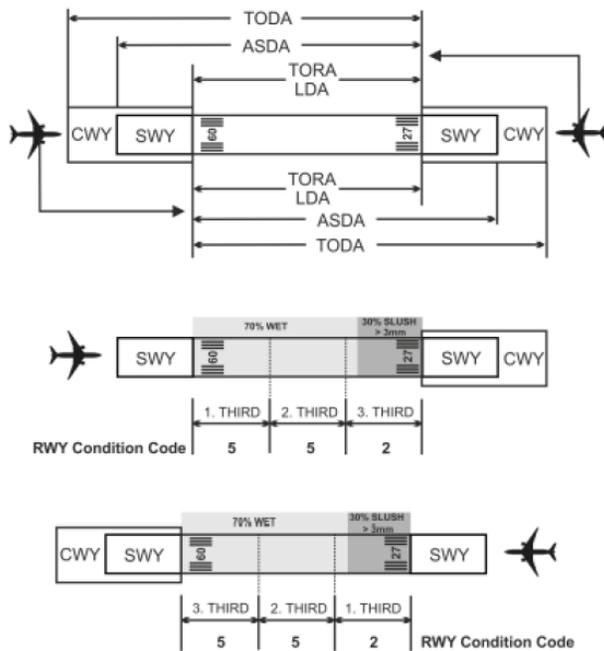
RWY 09R LDA REDUCED TO 2000. RWY 09R LAST THIRD SLIPPERY WET

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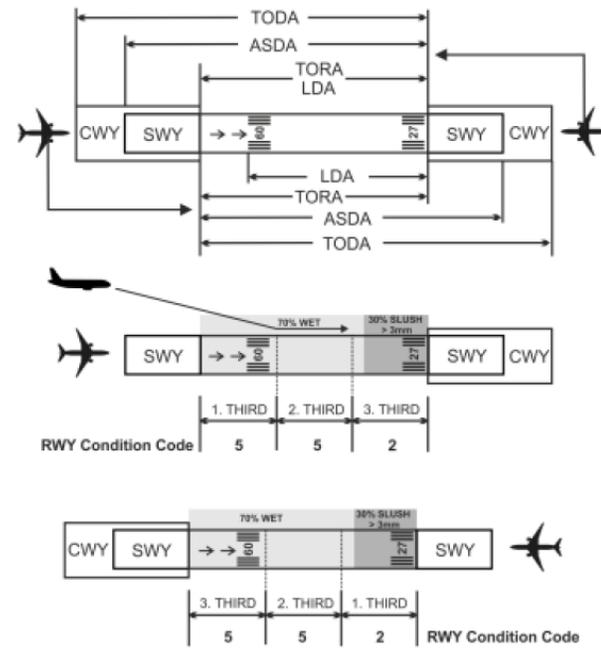
Chapter 2 – Runway Surface Condition Assessment and Reporting

Example of surface considered in Report

Normal Threshold



Displaced Threshold



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Chapter 3– Take-off Performance

- Aeroplane manufacturers publish take-off performance information (for example, runway limitations, climb capability and flight path) in the flight manual that complies with the regulation of the State of Design.
 - Certification standards are harmonized among States to a great extent for dry and wet runway;
 - Therefore no guidance provided in APM
- Guidance is provided for performance limitations during the initial climb and ensuring obstacle clearance throughout the departure sector.
- Performance information for contaminated runways has not been required by all States and may have been developed to a variety of standards.



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Chapter 3– Take-off Performance

- Guidance provided is based on EASA and FAA advisory material
- While not identical they are common when it comes to:
 - On contaminated runway covered by APM
 - FAA recommends manufacturers supply data; EASA requires manufacturers provided data
 - For Takeoff and Landing Time-of-Arrival (Landing) FAA AC and EASA AMC material very similar and currently being harmonized as to Airworthiness standards
 - For Landing there are differences that persist for Dispatch landing performance to contaminated runways between EASA and FAA



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

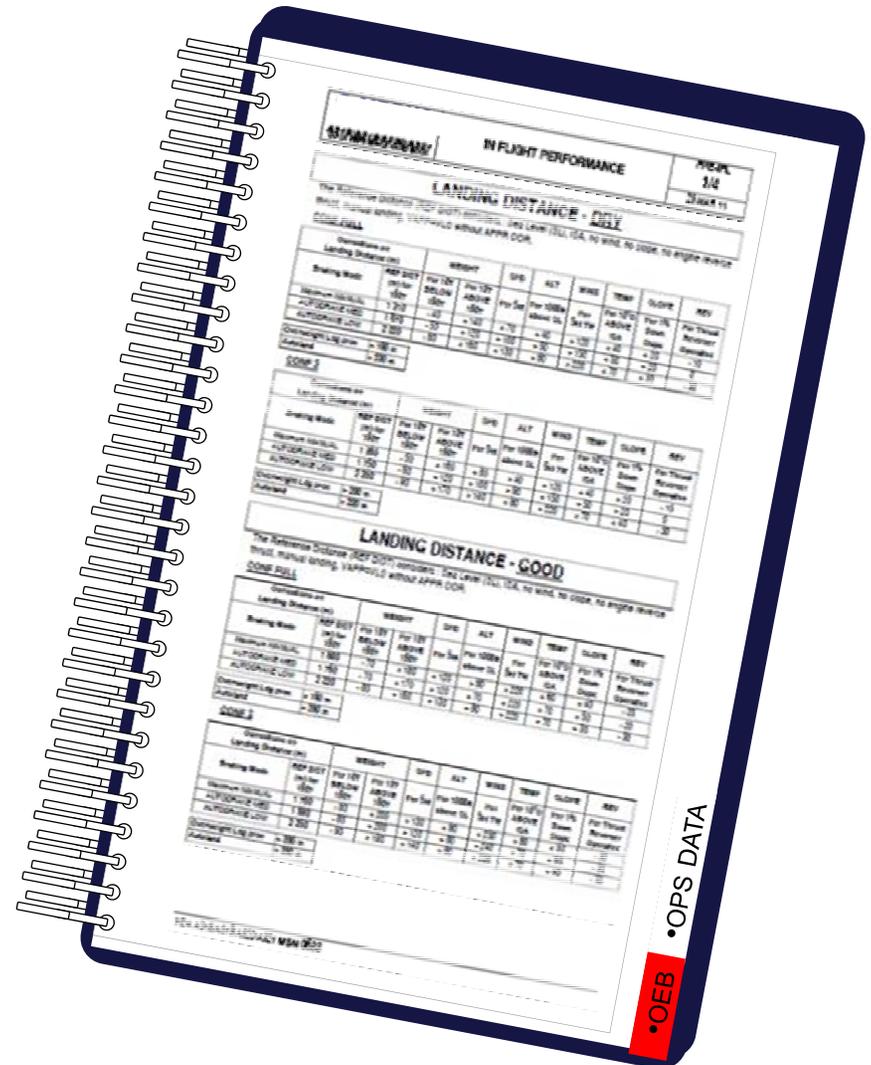
Runway condition assessment matrix (RCAM)				
Runway condition code	Assessment criteria		Downgrade assessment criteria	
	Runway surface description	Aeroplane deceleration or directional control observation	Pilot report of runway braking action	
6	<ul style="list-style-type: none"> • DRY 	---	---	
5	<ul style="list-style-type: none"> • FROST • WET (The runway surface is covered by any visible dampness or water less than 3 mm deep) <p>Less than 3 mm depth:</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	
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 (dry 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	
1	<ul style="list-style-type: none"> • ICE² 	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced.	POOR	
0	<ul style="list-style-type: none"> • WET ICE² • WATER ON TOP OF COMPACTED SNOW² • DRY SNOW or WET SNOW ON TOP OF ICE² 	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain.	LESS THAN POOR	

Chapter on Landing

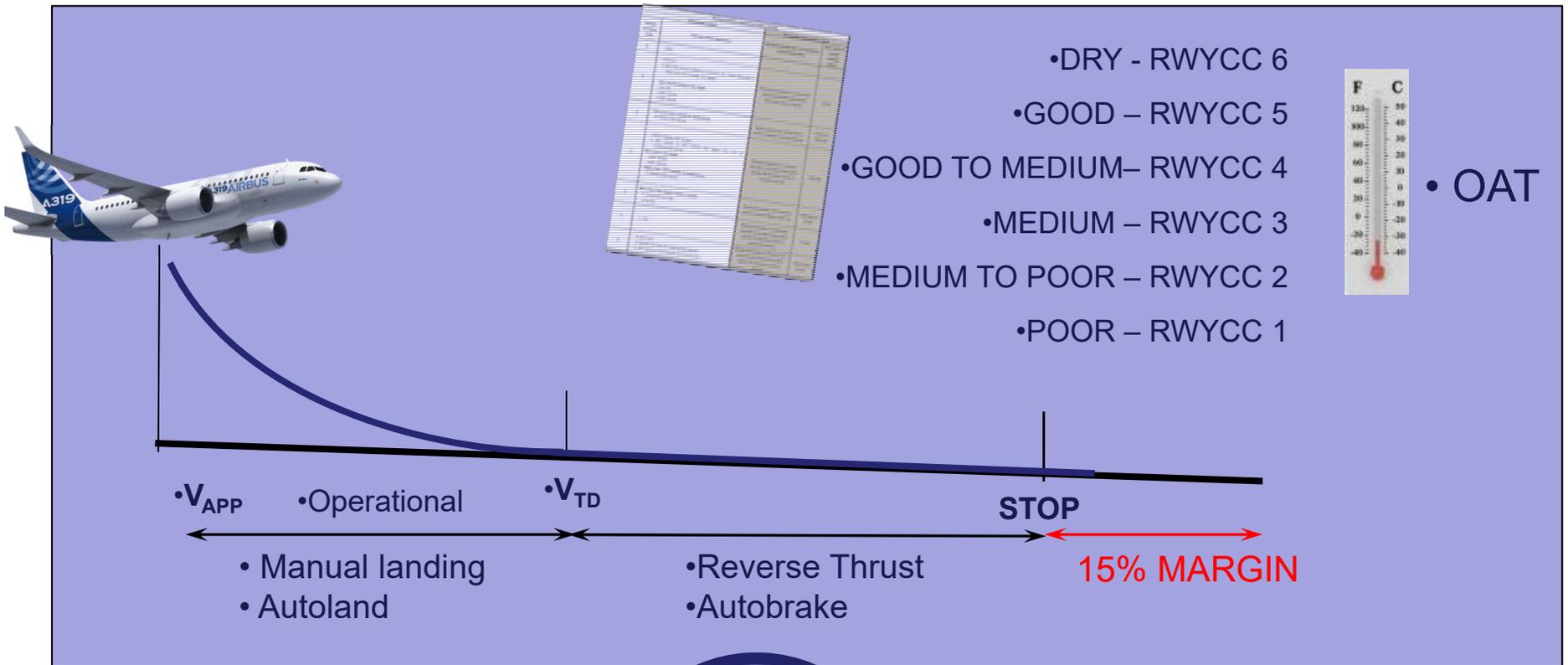
- Derivation of Landing Performance Data for Time of Arrival
- Publication of Data and Limitations
- Fallback Generic Factors in case no Data is provided by the Manufacturer
- Regulatory background
- Considerations for Performance Assessment in Approach Preparation
- Considerations for Flight Crew
- 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
 - Same assumptions used by all manufacturers



• Performance at Time of Landing



What is the contaminate on the runway?

Snow > 3mm <?

Compact Snow?

Ice?

Slush?



What is expected wheel braking?

Good?

Medium?

Poor?

Nil?



Runway Condition Report

- **Flight Crew totally dependent on information and assessment provided by airport inspection**
 - Runway surface description – type, depth
 - RwyCC 0 to 6
 - AIREP (Pilot Report of experienced wheel braking)
 - Other information?
 - Active precip
 - Wind
 - Temperature



ICAO Doc 10064 APM Manufacturer supplied data

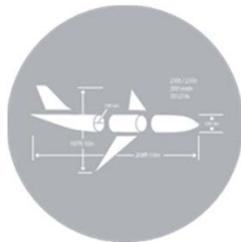
- **Airport assessment of expected wheel braking**
 - Based on Matrix
 - Downgrade - if appropriate
- **Runway Surface Description**
- **Pilot Reported Braking Action - AIREP**

RWYCC	Runway Surface Condition Description	Pilot-Reported Braking Action
6	DRY	—
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
4	COMPACTED SNOW (Outside air temperature minus 15 degrees Celsius or below)	Good to Medium
3	WET ("Slippery Wet" runway) 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
2	STANDING WATER (more than 3mm depth) SLUSH (more than 3mm depth)	Medium to Poor
1	ICE	Poor

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