# GRF – Operational Need

## Relevance to Aeroplane Performance

Paul Giesman – Friction Task Force - Annex 6/8 Subgroup

Nairobi 14-15 August 2019

**Pilots use the runway condition information to prepare their take-off and landing**

- **Type, Depth and Coverage are necessary to compute the take-off distance**
- **RWYCC is necessary to compute the landing distance**
- **Runway Thirds is important for situational awareness**

**The accuracy and timeliness of the runway condition information is a vital piece of the safety barriers**

# Documentation

**Example from AIRBUS FCTM**

**USE OF THE RCAM**

The flight crew gathers all available information (e.g. ATIS, METAR, SNOWTAM, TAF, ATC report such as PiRep, NOTAM, Airport Documentation) related to Runway Surface Conditions.

The flight crew makes a **primary** assessment based on Runway Condition information (i.e. runway state, contaminant type, depth, temperature). This results in a **primary** Braking Performance Level.

Then, the flight crew **downgrades** this primary Braking Performance Level, if:

- A Pilot Report of Braking Action (PiRep) is available and this PiRep corresponds to a lower Braking Performance Level
- A SNOWTAM is published, and the Estimated Surface Friction (ESF) corresponds to a lower Braking Performance Level For loose contaminants (Dry Snow, Wet Snow or Slush), the flight crew should not consider an ESF based on friction measurements.
- Complementary information is available and is related to a possible degradation of the Runway Condition or braking action.


© AIRBUS S.A.S. 2016 - photo by S. RAMADIER

# Documentation

**Example from AIRBUS FCTM**

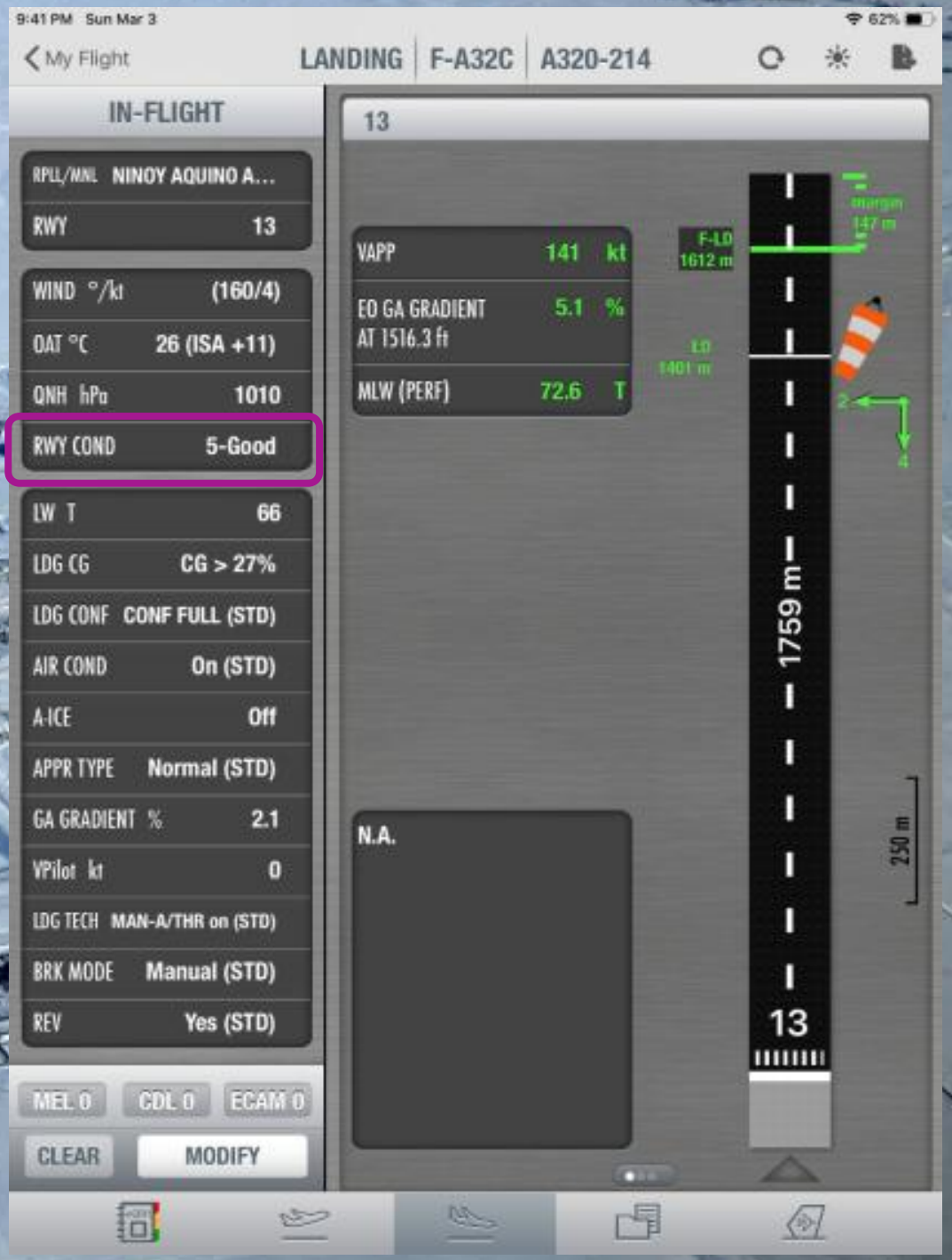
**RISK OF DEGRADED RUNWAY CONDITIONS**

If there is a risk of degraded runway conditions, in addition to the usual assessment with the Braking Performance Level "5 - Good", it is a safe practice to perform a second assessment with "2 - Medium to poor". If the result of the second assessment shows that the runway is too short, it enables the flight crew to anticipate, in the event of degraded runway conditions (e.g. strong rain), an appropriate decision to continue or to discontinue the approach if they become aware of such conditions late in approach. e.g. following a PiRep transmission that contains "Medium to Poor", or following the visual assessment of the runway.

Generally speaking, if there is a possibility that meteorological conditions will change, or under active precipitation, the flight crew should consider performing a backup in-flight landing performance assessment associated with the worst likely Braking Performance Level.

# Descent Preparation

```
        ACARS REPORT
F04 B-MED   LDIST    LTP
6 DRY        1890    853
5*GOOD       1890    853
4 G/M        1981    853
3 MED        2103    853
2 M/P        2529    518
1 POOR       ----    ----
```

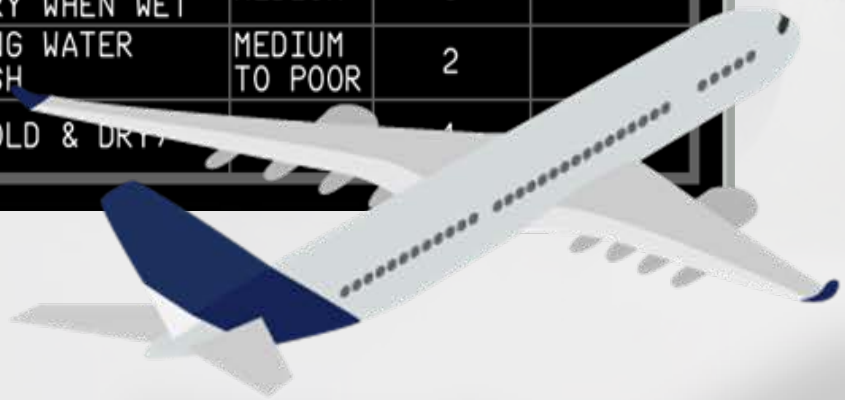


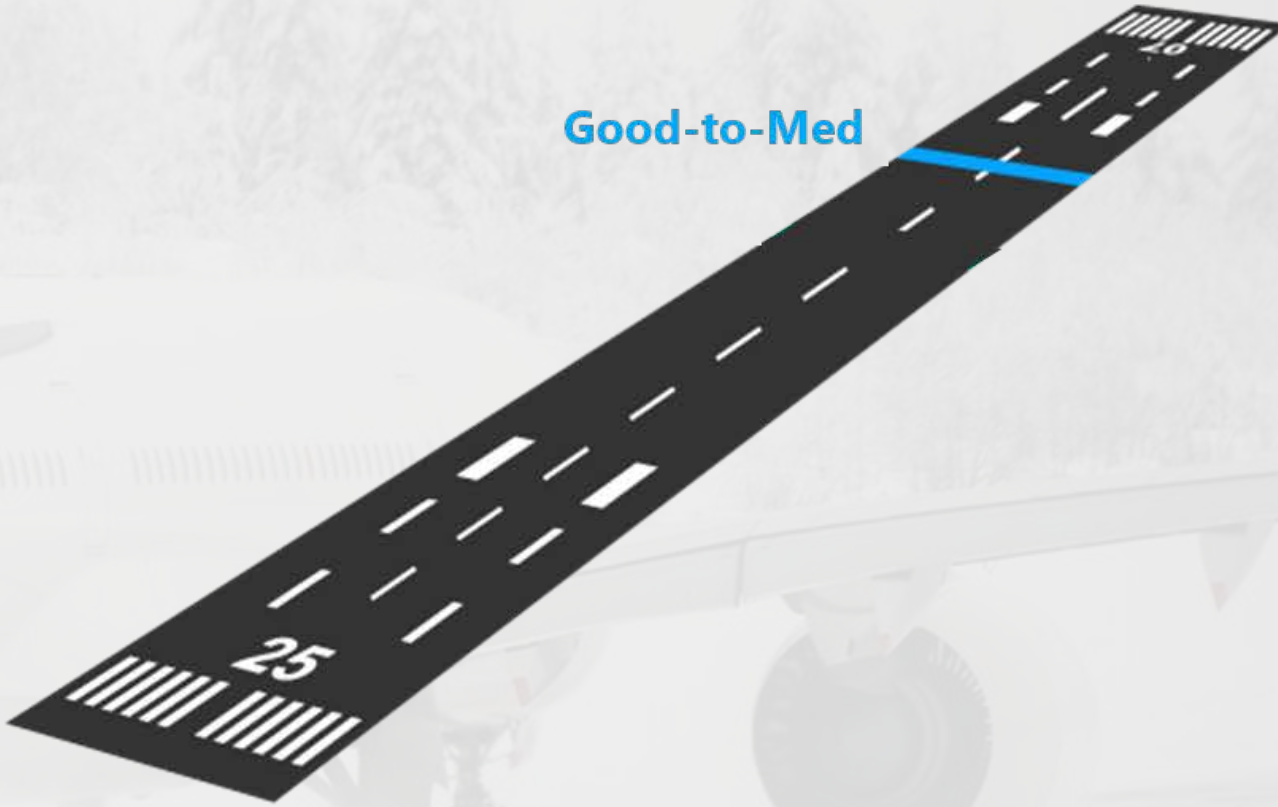
# Descent Preparation

RWY CONDITION / BRAKING ACTION

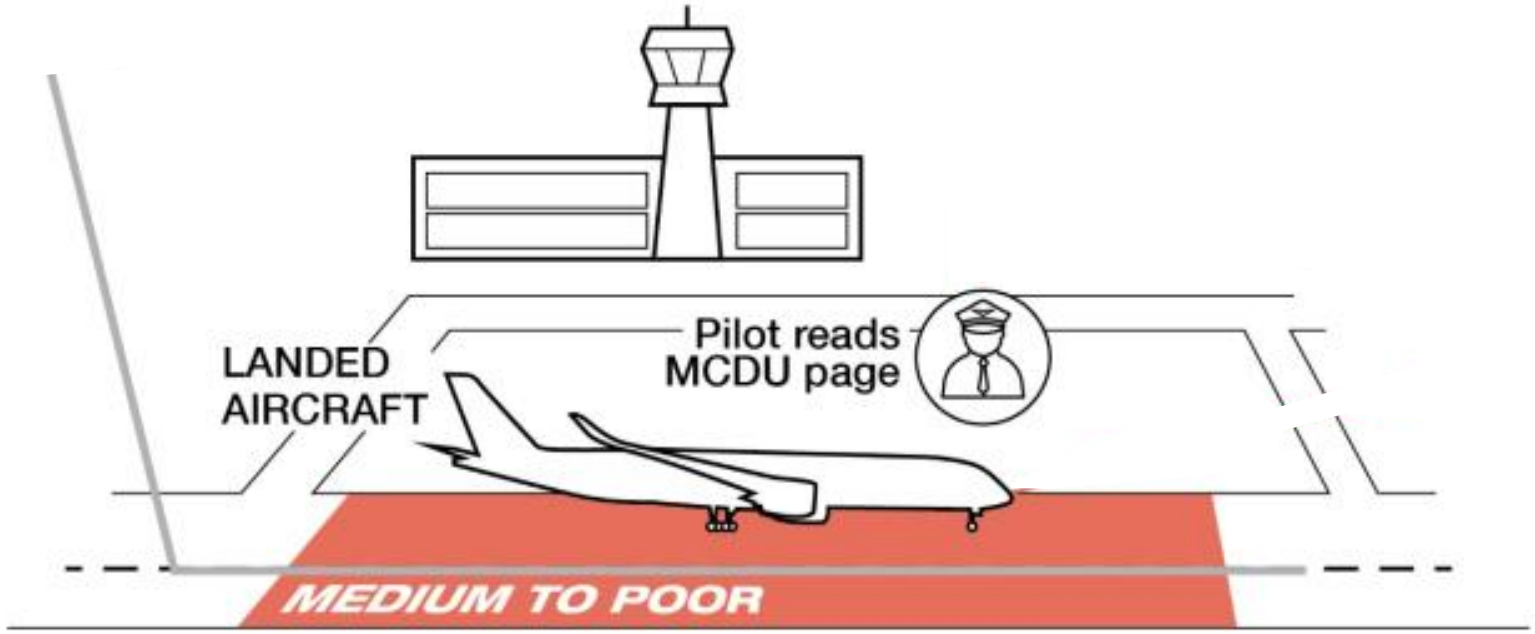
LFBO 14L QNH 998 OAT -5°C
VAPP 164 KT CONF FULL WIND 285°/ 35KT

| RWY CONDITION | BRAKING ACTION | LDG PERF CODE |
|---|---|---|
| DRY | DRY | 6 |
| WET | GOOD | 5 |
| COMPACTED SNOW & OAT AT OR BLW -15°C | GOOD TO MEDIUM | 4 |
| SLIPPERY WHEN WET | MEDIUM | 3 |
| STANDING WATER OR SLUSH | MEDIUM TO POOR | 2 |
| ICE (COLD & DRY) | | |





# Feedback



# RCAM Elements

RWYCC

Depth

OAT

Contaminants

Coverage

"Other" Observations

AIREPs

~~Measured Friction~~

| 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 less than 3 mm deep)<br>***Less than 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 | ***-15°C 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>***3 mm and more depth:***<br>• DRY SNOW | Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is | MEDIUM |

# Reportable Contaminants

COMPACTED SNOW
DRY SNOW
DRY SNOW ON TOP OF COMPACTED SNOW
DRY SNOW ON TOP OF ICE
FROST
ICE
SLUSH
STANDING WATER
WATER ON TOP OF COMPACTED SNOW
WET
WET ICE

Layered associated with top contaminant or Less Than Poor

WET SNOW
WET SNOW ON TOP OF COMPACTED SNOW
WET SNOW ON TOP OF ICE
CHEMICALLY TREATED
LOOSE SAND

Situational Awareness

MUD
DUST
SAND
VOLCANIC ASH
OIL
RUBBER

Not in the RCAM

- RCAM covers only conditions with deterministic performance effect
- Other conditions (sanding/chemicals) addressed by down-/upgrade mechanism
  - Driven by Mu / Other observations / AIREPs

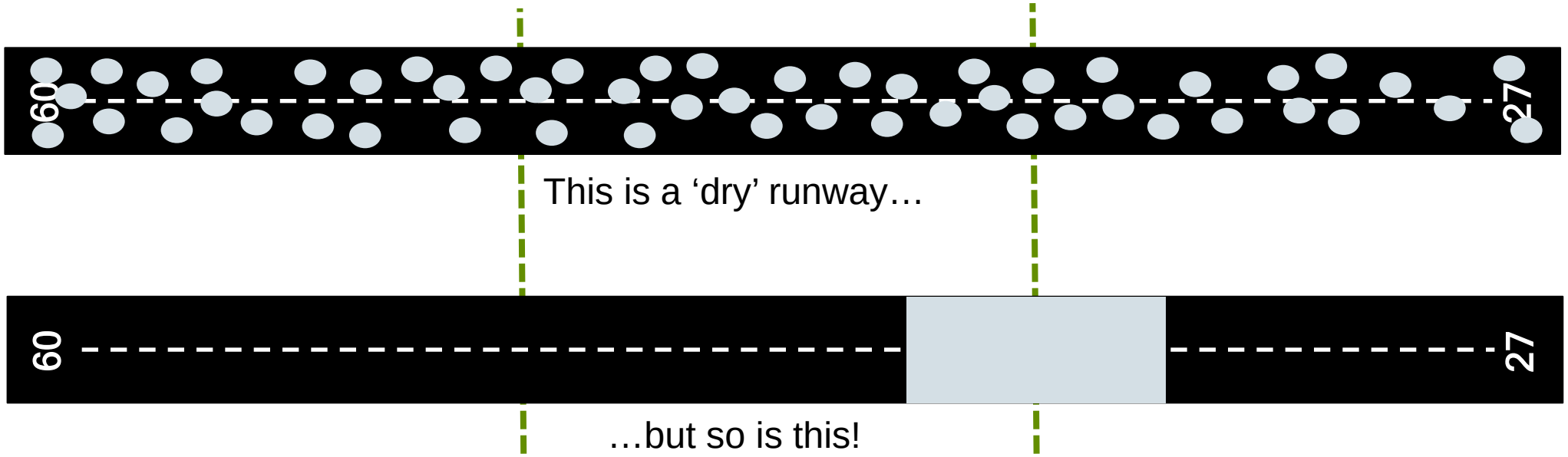
# Depth

- Any fluid contaminant below 3mm = WET
  - Well constructed and maintained pavement allows tire to drain fluid from footprint and maintain contact with runway – NO dynamic AQUAPLANING
- Any fluid contaminant above 3mm = CONTAMINATED
  - AQUAPLANING occurs above aquaplaning speed

- Dry Snow and Wet Snow are not fluids
  - Same 3mm depth threshold
  - Below 3mm loose contaminant is compressed into macrotexture allowing contact of tire and runway surface
  - Caution - Some evidence shows that conditions may become slippery even below 3mm

# Coverage

- Coverage reported for each third
- Coverage reported as 25% above 10% observed coverage
- Contaminated in terms of performance above 25% coverage

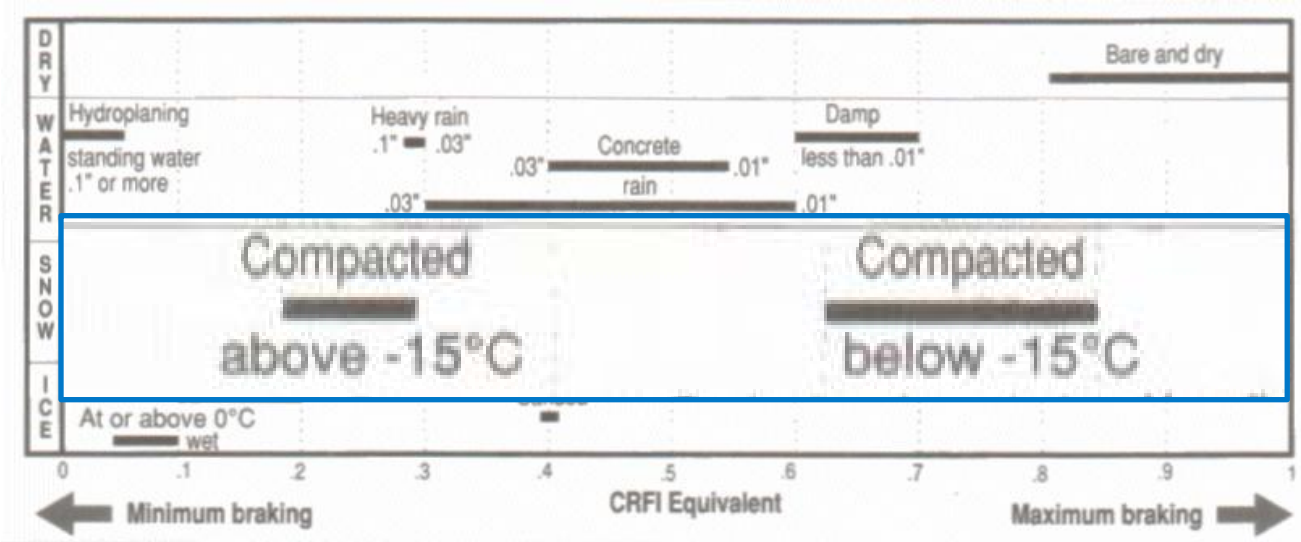



- It has been demonstrated that, if performance calculated for dry condition, regulatory/recommended margins cover concentration of contaminant in worst location

# Temperature

| Contaminant | Better Braking Action | Worse Braking Action |
|---|---|---|
| Compacted Snow | Below -15°C | Above -15°C |

- -15°C based on original JWRFMP data
- Probably very conservative




- Braking Action is more closely correlated with surface temperature than with OAT

# Measured Friction

- ICAO provides no friction scale due to poor correlation with aircraft braking action
- CFME used is based on a method approved by the State

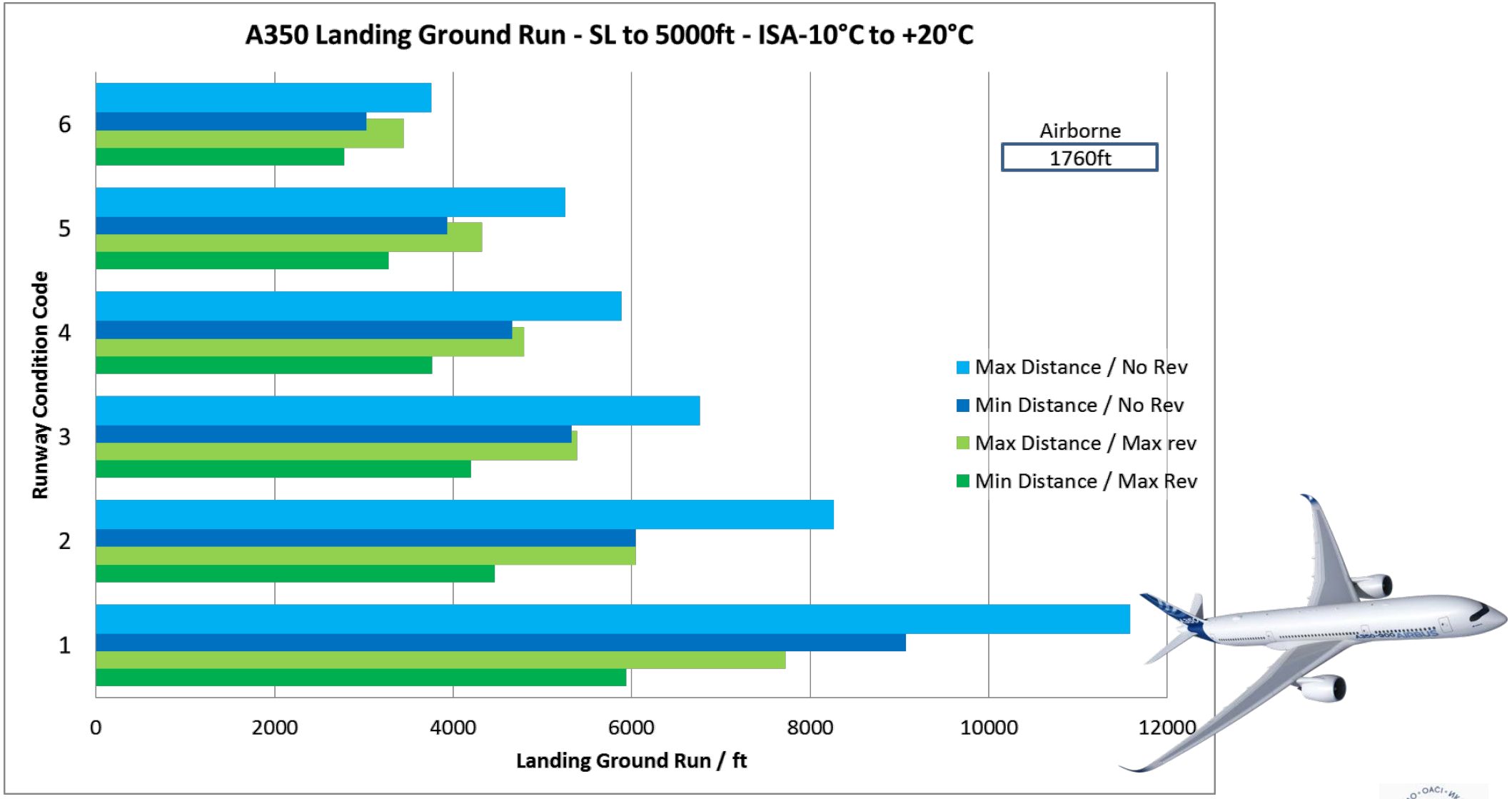
| *Measured coefficient* | *Estimated braking action* | *Code* |
|---|---|---|
| 0.40 and above | Good | 5 |
| 0.39 to 0.36 | Medium to good | 4 |
| 0.35 to 0.30 | Medium | 3 |
| 0.29 to 0.26 | Medium to poor | 2 |
| 0.25 and below | Poor | 1 |

- Used basically for downgrade
- Upgrade only with significant margins

Differences with Aircraft

Tire Size
Tire Load
Tire Press
Speed
Slip Ratio
Drag

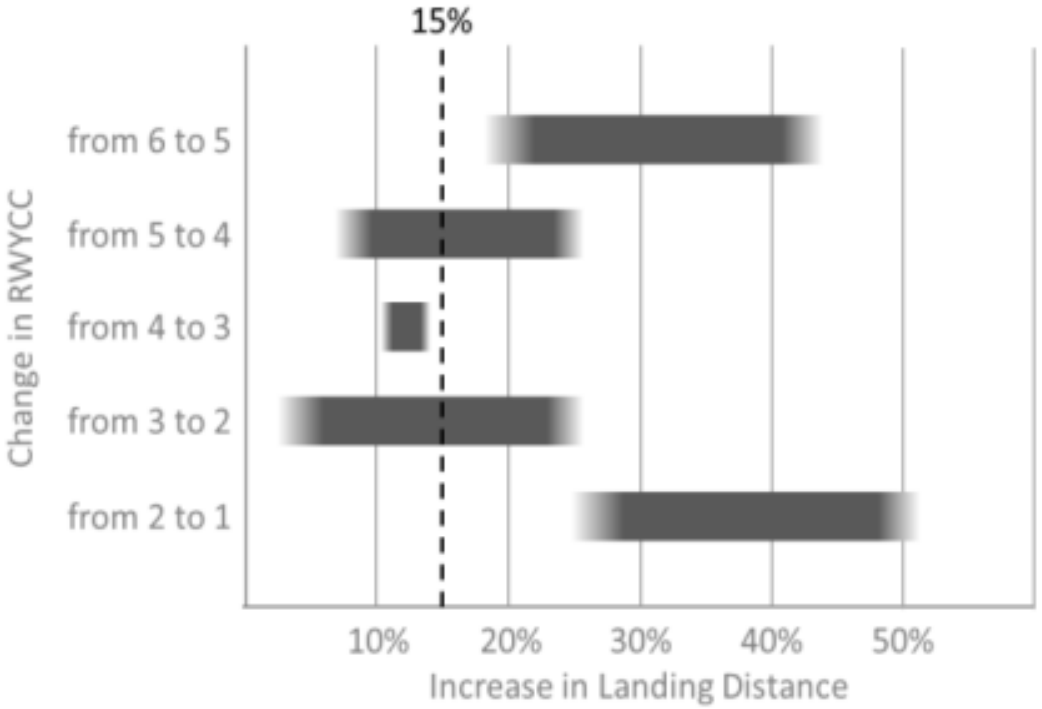
# Cir355 – Overall Landing Ground Run



# Doc10064, APM – Robustness to Misreported RWYCC

- Pilots are encouraged to apply 15% distance margin to distance assessment at time of arrival
- Computation not systematically robust to optimistic classification by 1 RWYCC

- Particular attention required for transition
  - Dry to Wet (6 to 5)
  - Wet to Standing water (5 to 2)
  - To Poor or Less Than Poor (1 or 0)



# Takeoff Performance

- Example of A350 Takeoff from Montreal Pierre-Elliott Trudeau 06R Intersection A4
  - Elevation 101ft
  - Runway Length 2700m (ASDA 2400m)
  - Temperature 25°C
  - Takeoff Weight 230t

| A350941 - EASA | Trent XWB-84 Engine | MONTREAL - P.E TRUDEAU YUL - CYUL | 06R A4 | 37.0.0 20-Mar-19 AJ941B02 V32 |
|---|---|---|---|---|
| Wind 0 KT<br>QNH 1013.25 HPA<br>Air cond. On<br>Anti-icing Off<br>Crosswind UP TO 25KT<br>All reversers inoperative<br>Dry check | | Elevation 101 FT TORA 2399 M<br>Isa temp 15 C TODA 2699 M<br>Rwyslope 0.21% ASDA 2399 M<br>Line up dist. TOD/ASD: 0 M / 0 M | 2 obstacles | CONF 2<br>TOGA |
| | | STD. At 1700 turn LEFT to YUL HP. D116.3 YUL HP: Inbound 150 , LEFT turn. | | |

| OAT C | DRY | | | WET | | |
|---|---|---|---|---|---|---|
| 15 | 249.7 | 143/44/52 | 3/4 | 205.0 | 133/36/45 | 3/3 |
| 20 | 248.4 | 142/44/51 | 3/4 | 191.5 | 134/36/46 | 3/3 |
| 25 | 247.1 | 141/43/51 | 3/4 | 178.2 | 134/36/46 | 3/3 |
| 30 | 245.6 | 140/43/51 | 3/4 | 164.9 | 134/36/46 | 3/3 |

Maximum Takeoff Weight:

Dry 247.1t Wet 178.2t

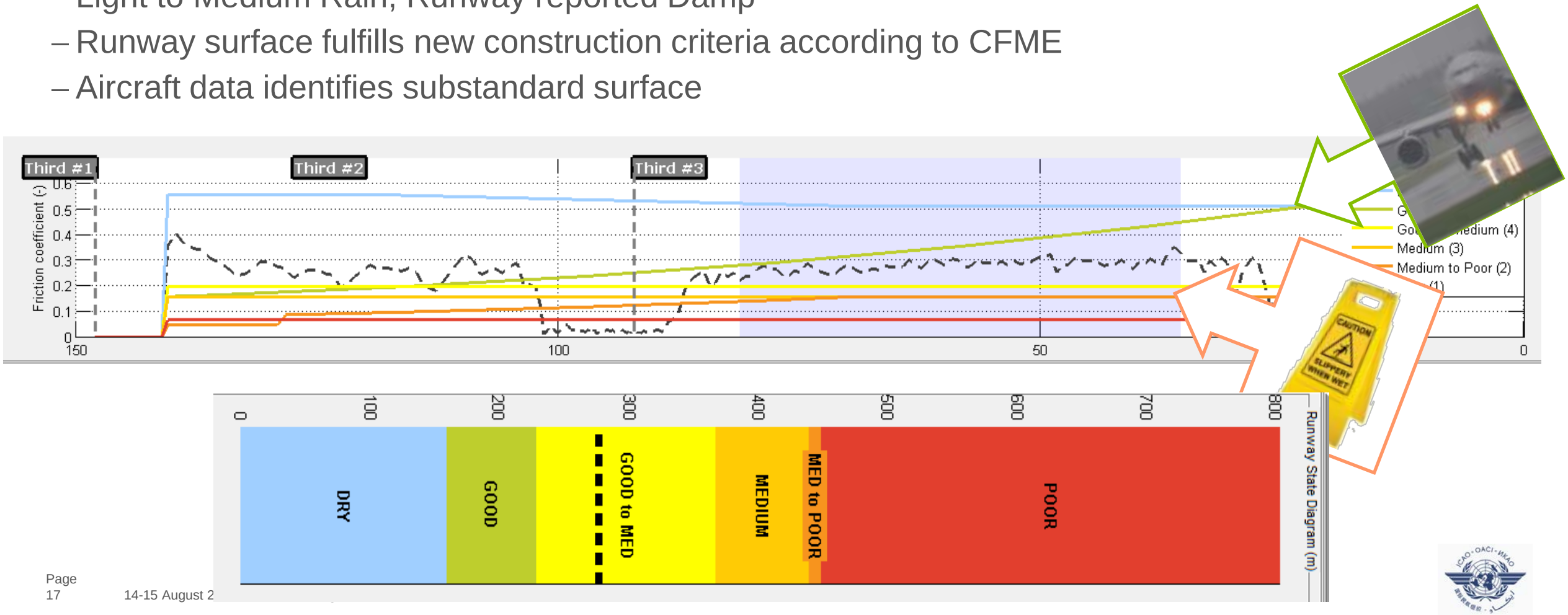
**What if dry is assumed when it is wet?**

Accelerate-Stop Distance (V1 dry):

Dry 1975m Wet 2575m

# Transition Damp to Wet to Slippery Wet

- Why is “Damp” now “Wet”? An example…
  - Airbus A320 & A350 Flight Tests on runway at commercial airport in France
  - Light to Medium Rain, Runway reported Damp
  - Runway surface fulfills new construction criteria according to CFME
  - Aircraft data identifies substandard surface



# Takeaways

## Performance Relevant Condition Reporting

Runway Condition Codes directly linked to Landing Performance available to Pilots

**Thresholds**

Representative of effect on aeroplane performance (depth, coverage,…)

**Difference between Dry and Wet matters even on long runways**

**Wet includes Damp**

**Aircraft data is final arbiter on real runway condition**

# Thank you!

**Rapporteur of FTF Annex 6/8 sub-group**
Lars Kornstaedt
Airbus Flight Operations Support
Aircraft-Performance
lars.kornstaedt@airbus.com
+33 561 933 675

**What we observe is not nature herself,**

**but nature exposed to our method of questioning.**

*Werner Heisenberg, theoretical physicist*