

Runway Contamination Drag Measurement

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Friction lack and contamination drag

Friction lack

- Loose stability with cross winds
- Increase braking distance after landing



Contamination drag

- Hazardous head resistance on the landing gear.
- Increase take-off distance



Background

➡ Need for both information

➤ Friction level

➤ Contamination drag



Friction tester IMAG

IMAG Instrument **M**easuring **A**ctual **G**rip

Used by ADP for

- Functional Friction Measurement
- Operational Friction Measurement



Periodical Functional Measures

Annex 14

3.1.23 Recommendation.— *Measurements of the friction characteristics of a new or resurfaced runway should be made with a continuous friction measuring device using self-wetting features in order to assure that the design objectives with respect to its friction characteristics have been achieved.*

Periodical Functional Friction Measures

Use of IMAG

Each quarter /all runways and taxiways
at CDG, Orly & Le Bourget



Surface friction restoration



Runway Surface Friction Restoration



rubber deposit



rubber removal

Operational Friction Measurement

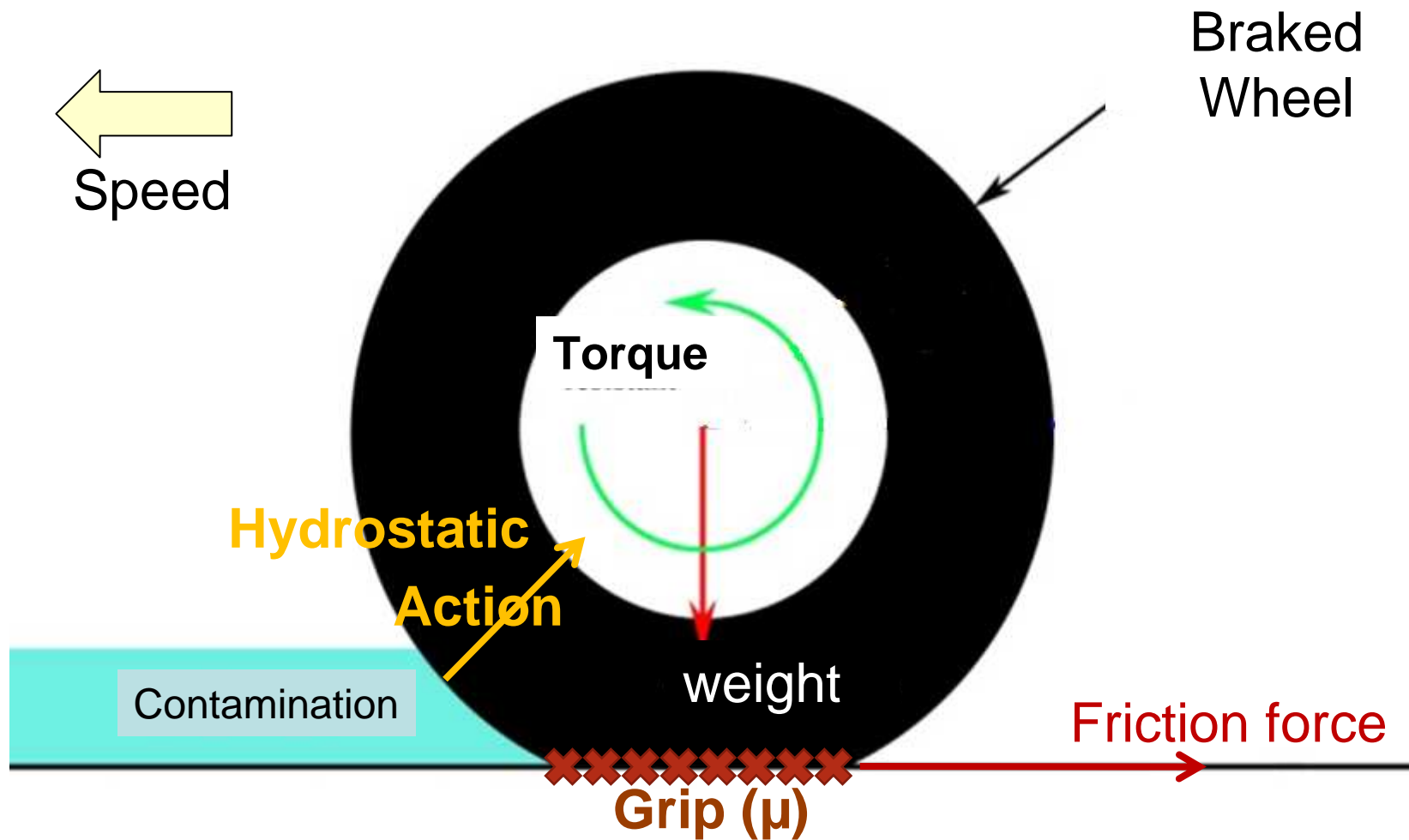
Braking action information >> pilots

« The friction coefficient should be measured if a runway is covered wholly or partly by snow or ice... »

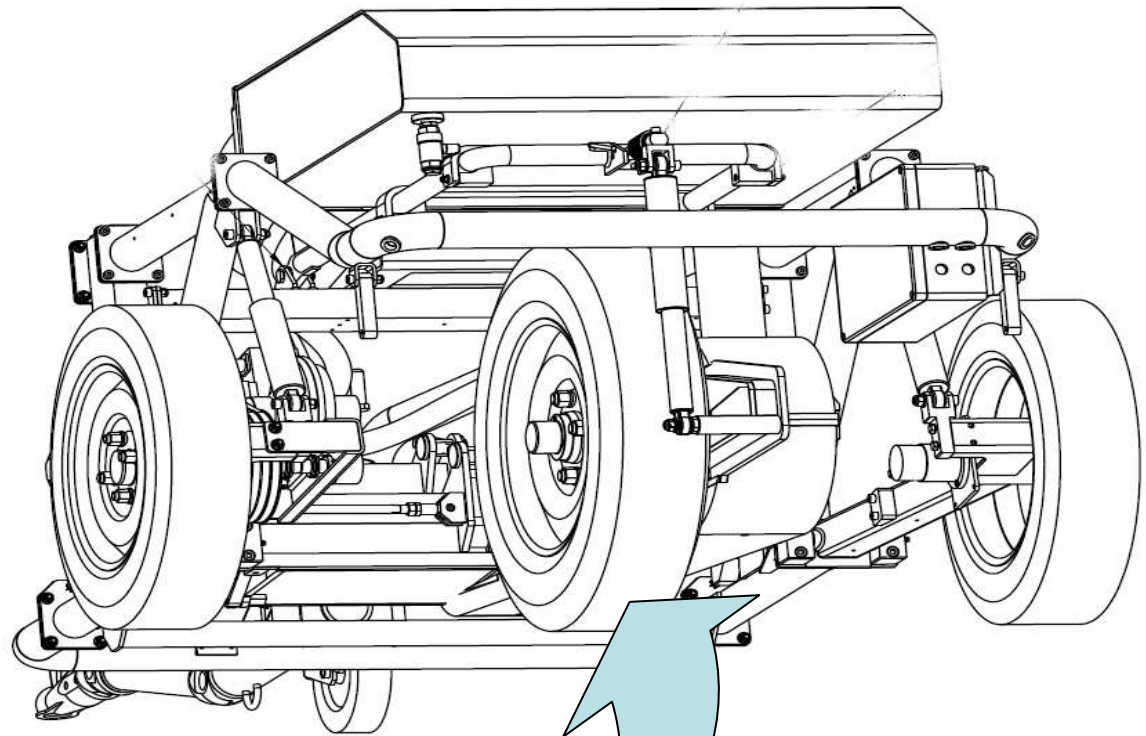
The IMAG can measure continuously
friction coefficient and contamination drag



Torque originates only from Grip



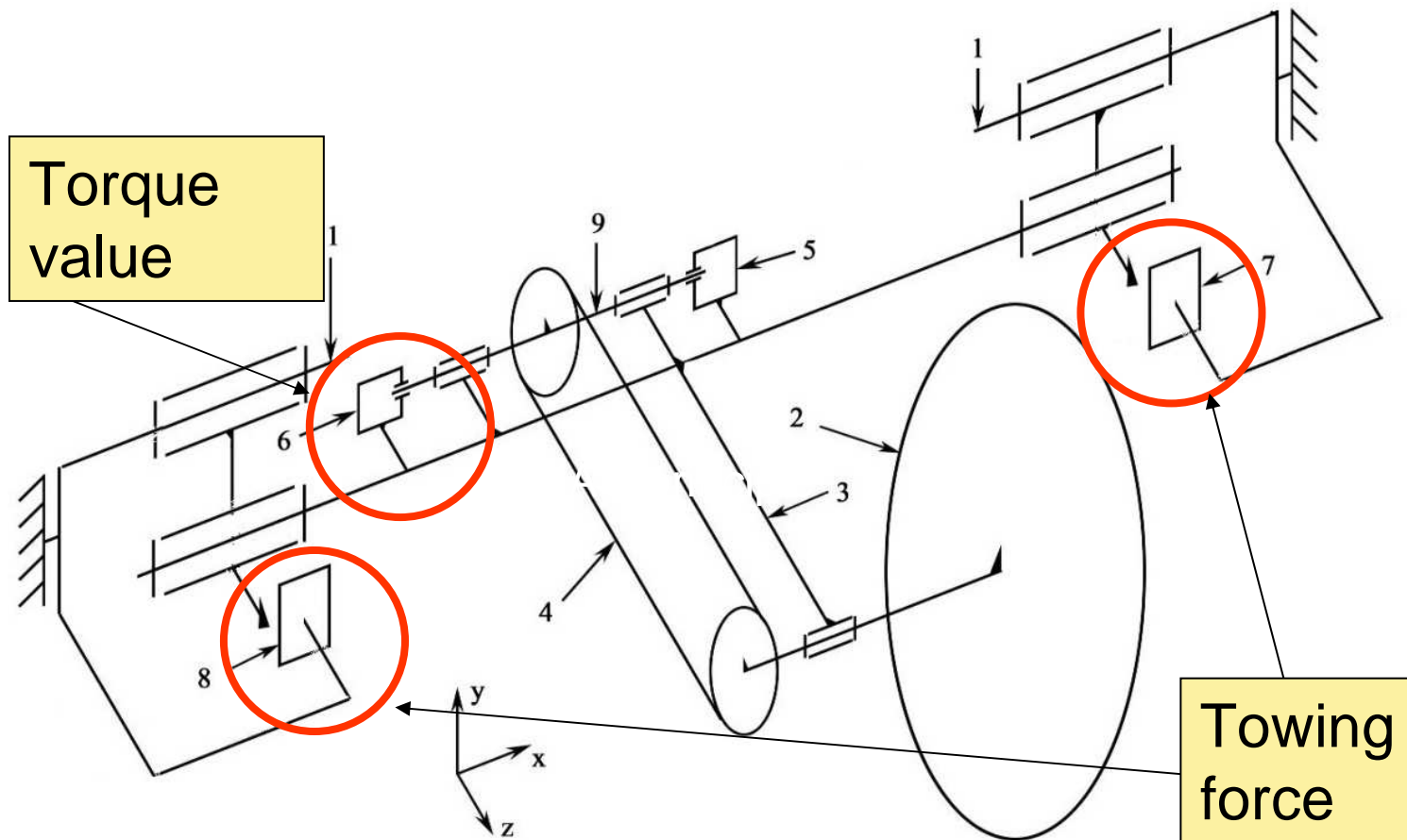
Friction Tester IMAG



Independant central wheel:

- Braking ratio 15%
- Brake torque measurement

Towing Force = Friction Torque/R + Drag + M.y



Drag Measurement with the IMAG

$$\text{Towing Force} = (\text{Friction Torque})/R + \text{Drag} + M.\gamma$$

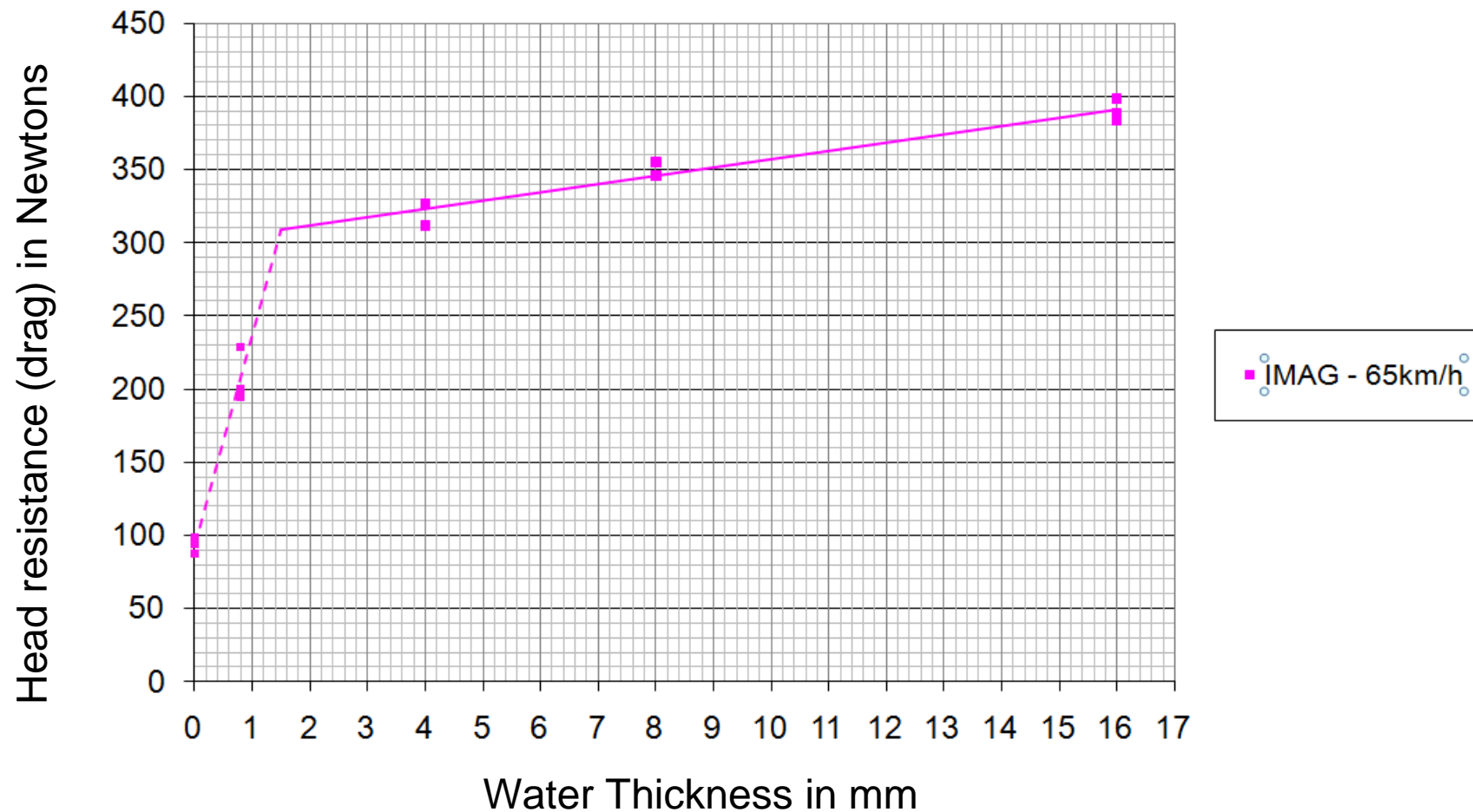
At a constant speed, $\gamma = 0$

$$\text{Drag} = \text{Towing Force} - (\text{Friction Torque})/R$$

Tests on wet pavements at the Michelin facilities



Drag vs Water Thickness



Tests at the Michelin facilities

Main outcomes

- ✓ Contamination detection from 1mm of water
- ✓ Contamination thickness measurement between 4 and 20 mm with an uncertainty of $\pm 2\text{mm}$

And what about the other winter contamination ?

	Grip	Drag
No contaminant	Y	N
Dry snow	Y	Y
Compacted snow	N	N
Ice	N	N
Water (thin)	Y	~
Water (thick)	N	Y

Tests on Dry Snow

A car-manufacturer testing facility
near Paris-Charles de Gaulle at Mortefontaine



- Large paved surface
- Easy access (near the motorway A1)

Tests in december 2009



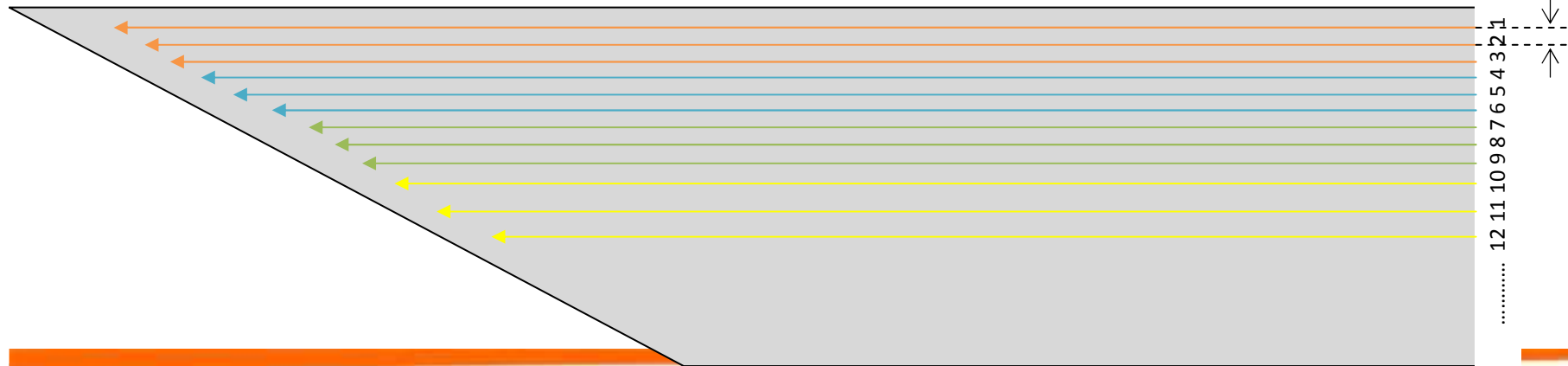
Testing program

- ✓ Tests on december 17, 2009
- ✓ Dry snow (density 0,10) with a uniform thickness of 24 mm.
- ✓ Some tests after removal of the snow (0 mm)
- ✓ and some other after addition of snow (up to 70 mm)

Condition 1 Condition 1 Condition 2 Condition 2
braked wheel free wheel braked wheel free wheel

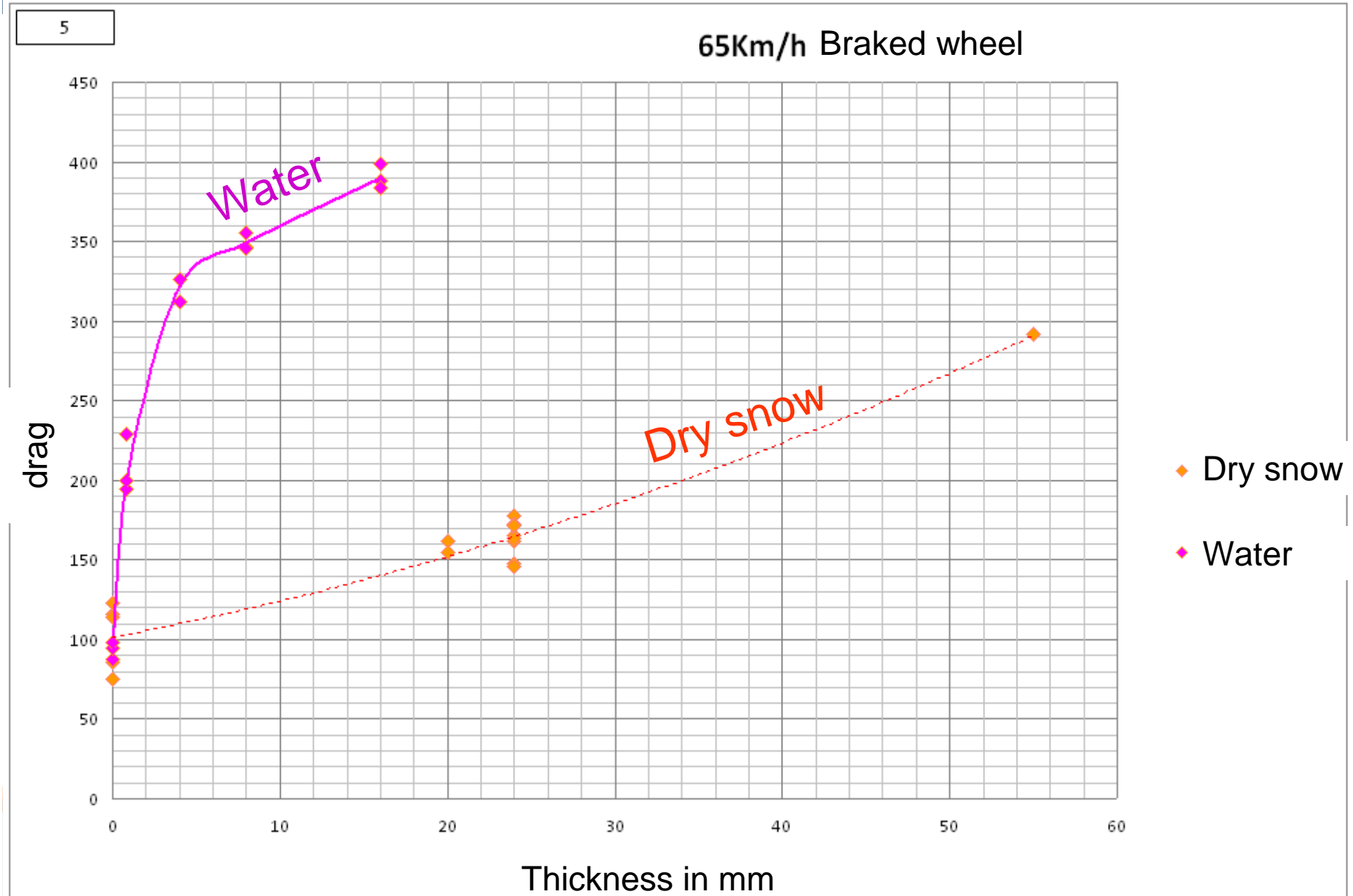


≈3,5m





Drag Force vs Dry Snow thickness



Other equipment tested at Mortefontaine

Device A

Use of Infra red reflection, for low thickness contamination

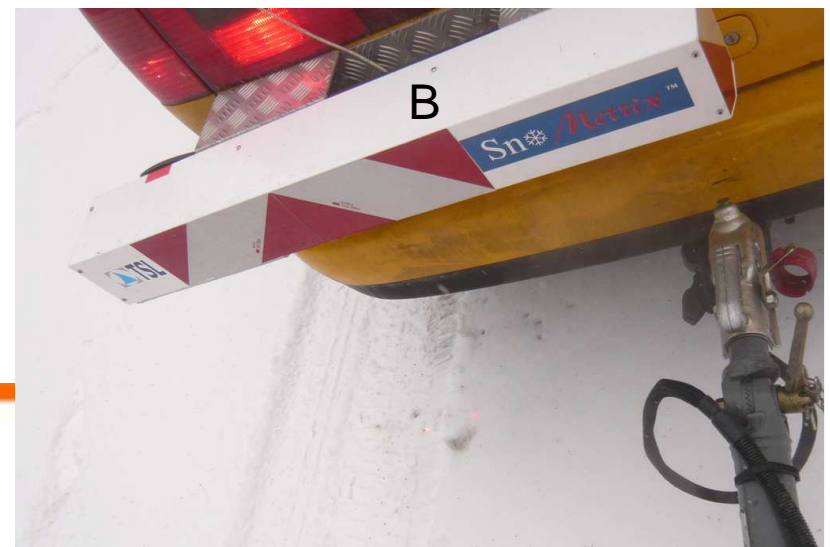
- o Many problems during testing
- >> the device A was designed for a static use...



Device B

Measure tyre footprint with laser

- o Difficult to use
- o The footprint depth may be different of the contamination thickness



Drag measurement Outcomes

Expectations from Aéroports de Paris

➤ Could the DGAC identify the fast and continuous measurement of contamination as a key issue to maintain capacity at major airports ?

➤ Does the EASA support the evolution of information given to pilots towards a direct measure of the head resistance (drag) instead of the undirect measure of the contamination thickness ?

Thank you for your attention