

**Runway Friction and Aircraft Braking - The way forward**  
**11 – 12 March 2010**



**Friction Measurement at Munich Airport International**

**Joerg Simon**

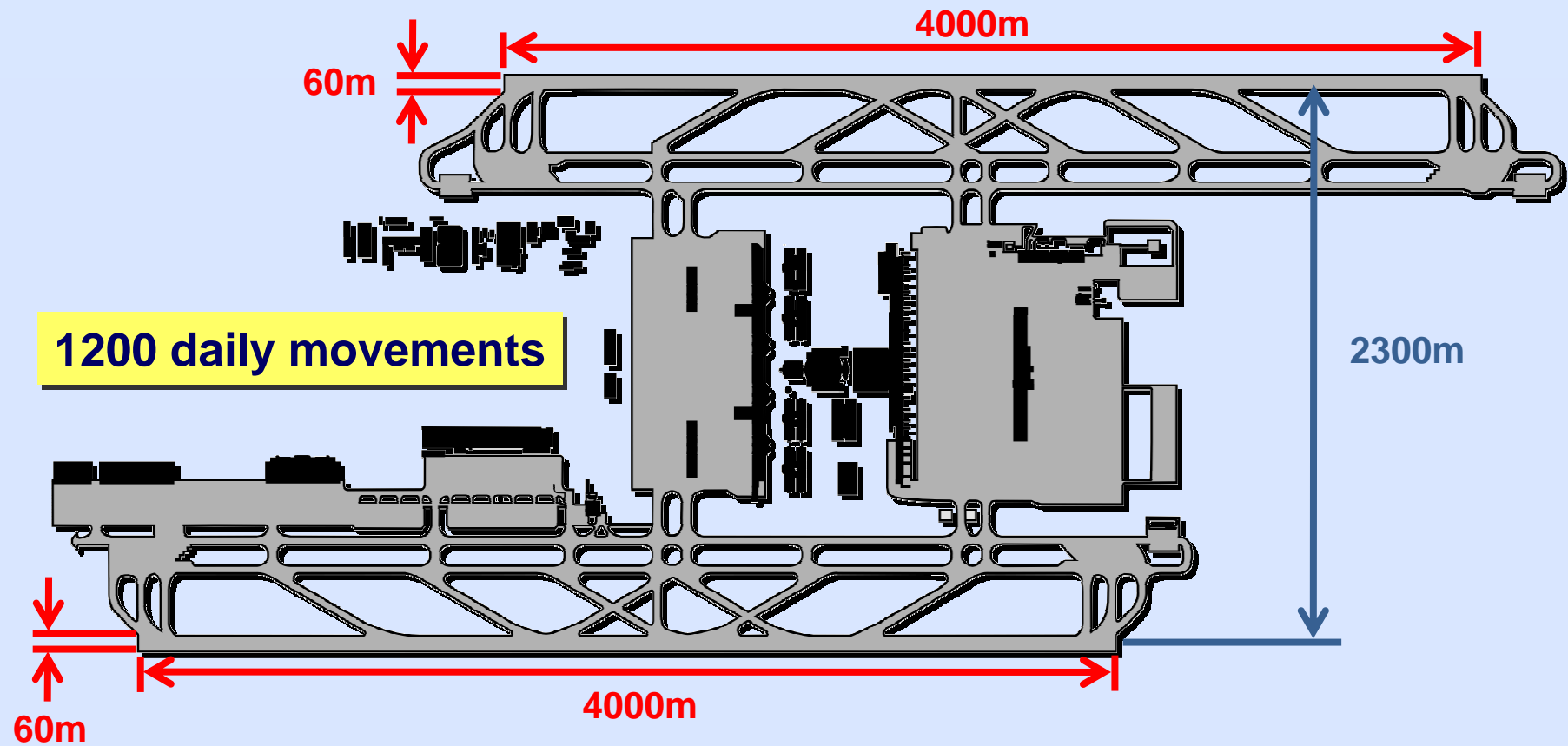
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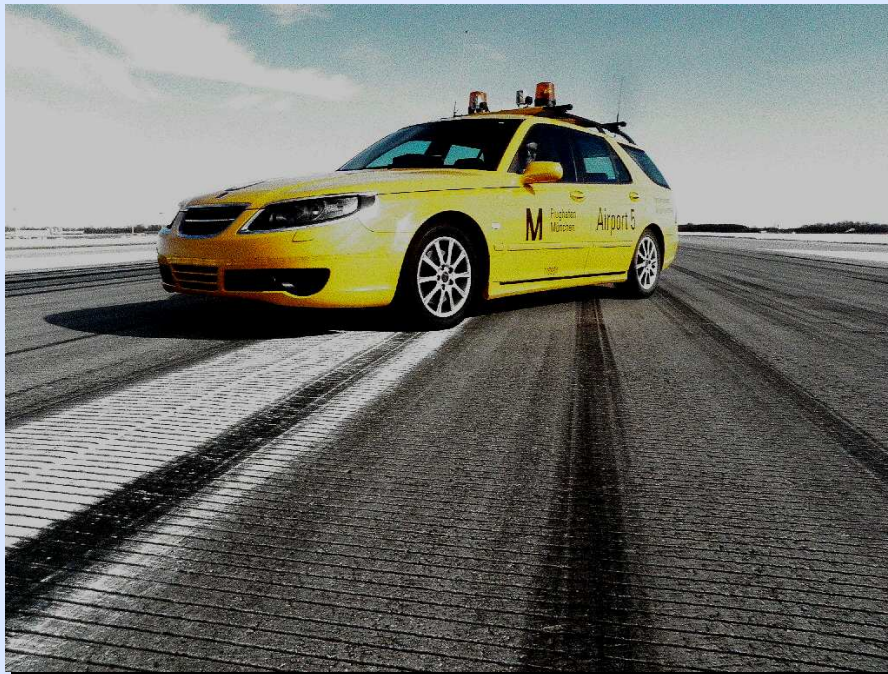


## Basic Airport Data

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### - Grooved Concrete Runways

**Grooves:**  
**6 x 6 mm**  
**Spacing 30 mm**





## Friction Testing Equipment



### Sarsys Friction Tester

- 3 x Saab 9-5
- 1 with a 540 ltr. watertank (runway calibration)
- 1 Saab 9000

- Fast readiness (no trailer hook-up)

- High measurement speed means less runway occupation time (~ 3 minutes)

- Useable for other purposes



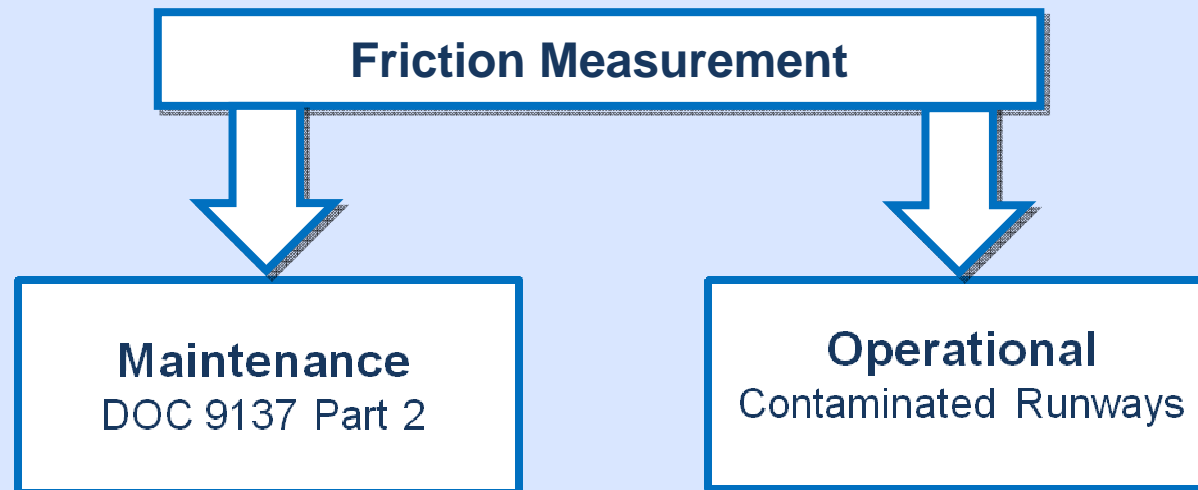
**Control Unit**

**Printer**



## § 45 Air Traffic Registration Rules (Certification and Licensing)

- (1) The airport management has to keep the airport in a **safe condition** and has to **operate** it in **accordance with the regulations**. Incidents, which restrict substantially the operation of the airport, have to be announced immediately to the approving authority. (...)





## Friction Measurement for Maintenance



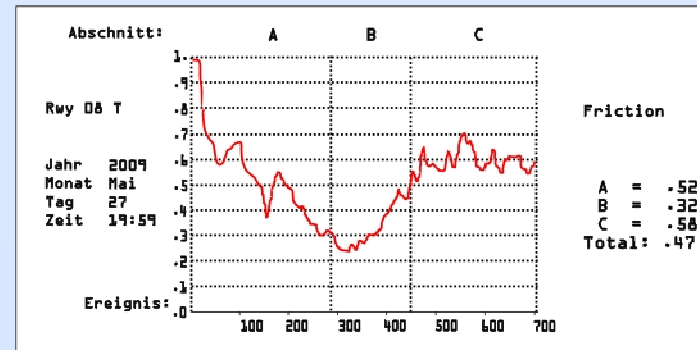
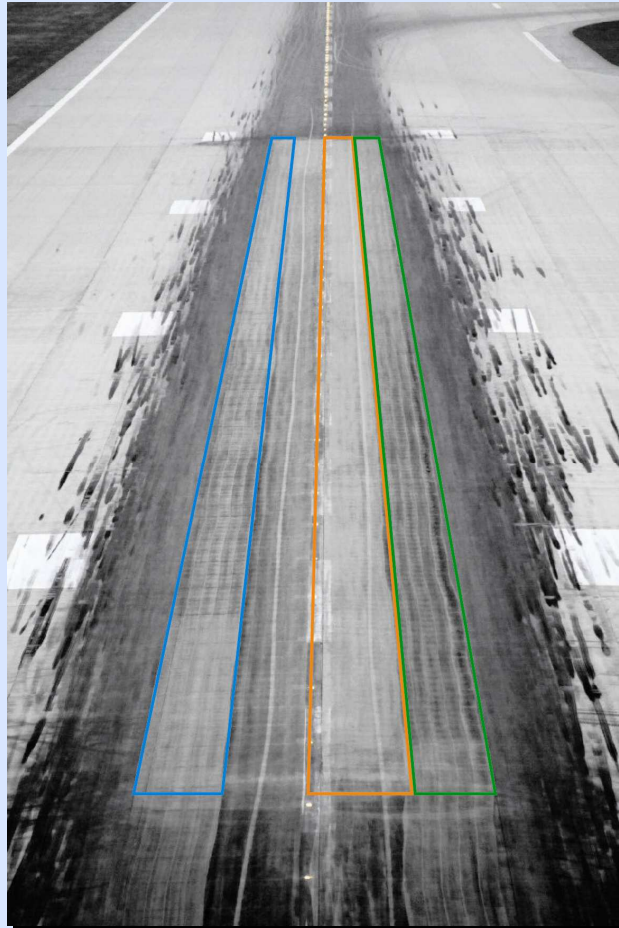
- Regular monthly measurements allow for a smooth preplanning of rubber removal
- Quick notification of aircrews if  $\mu$ -value is at or below minimum friction level
- Result can objectively be judged
- Easy comparision of different cleaning devices
- After mechanical treatment of surfaces, the new design friction level can easily be tested



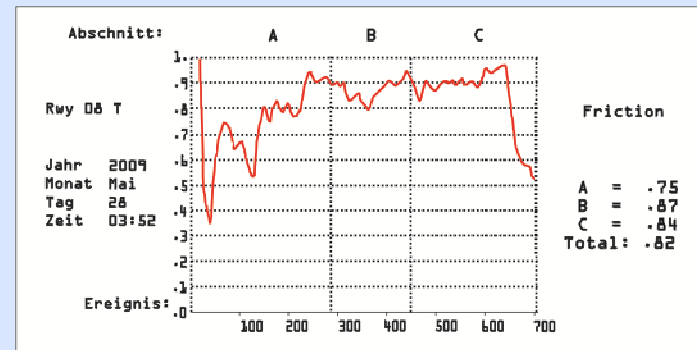


# Friction Measurement for Maintenance

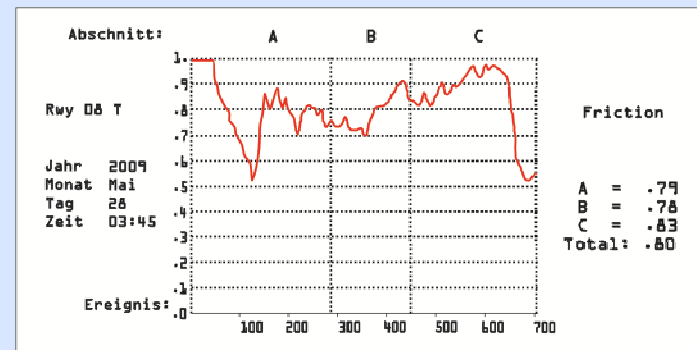
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**Before  
Rubber Removal**



**After  
Rubber Removal  
3 m right of centerline**



**After  
Rubber Removal  
7 m right of centerline**



## Operational Friction Measurement

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- Continuous monitoring of friction during winter operation

- Trend of breaking coefficient is important for the preplanning of „intime“ snow removal or surface deicing

- Decisive basis concerning the kind of treatment and the use of deicing chemicals

- Only available objective tool  
(Pilot reports are subjective and not empirical)





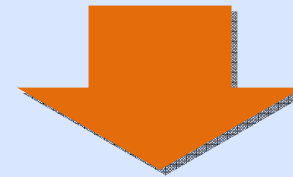
# Operational Friction Measurement

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## Operational limits\*

- Ice or wet ice
- Dry snow up to 25 mm
- Wet snow, slush, water up to **3 mm**
- Compacted snow



**$\mu$  - Value**

\*by manufacturer, acc. To FAA recommendations

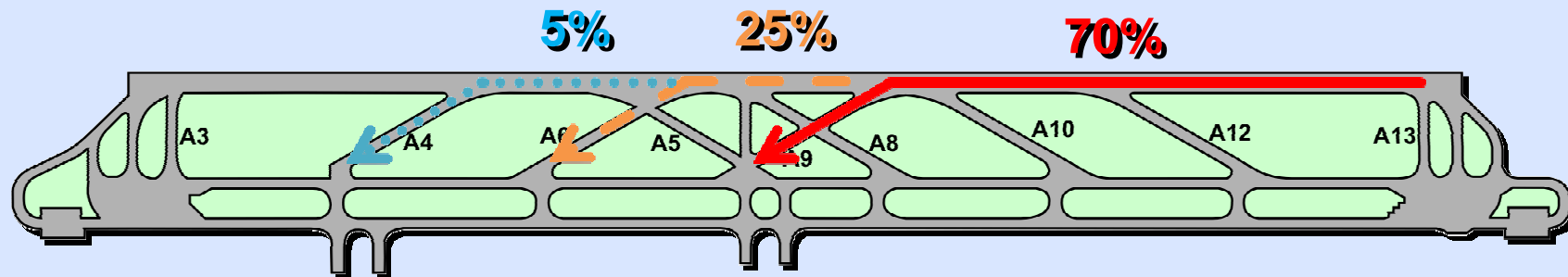


# Operational Friction Measurement

Assessment Criteria for the Runway Condition Report			
RWY Condition	Braking Coefficient ( $\mu$ )	Deceleration and Directional Control Observation	Reported Braking Action
<b>3mm or less of:</b> <ul style="list-style-type: none"> <li>• Wet</li> <li>• Frost</li> <li>• Water</li> <li>• Slush</li> <li>• Dry Snow</li> <li>• Wet Snow</li> </ul>	40 - <b>Measured</b>	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal	Good
	39 - 36	Brake deceleration and controllability is between Good and Medium	Medium to Good
<b>At or below -3°C :</b> <ul style="list-style-type: none"> <li>• Wet (Slippery)</li> <li>• Dry or wet snow greater than 3mm</li> </ul>	35 - 30	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be slightly reduced.	Medium
<b>Greater than 3mm:</b> <ul style="list-style-type: none"> <li>• Water</li> <li>• Slush</li> </ul> <b>Above -3°C:</b> <ul style="list-style-type: none"> <li>• Dry or wet snow greater than 3mm</li> <li>• Compacted Snow</li> </ul>	29 - 26	Brake deceleration and controllability is between Medium and Poor. Potential for hydroplaning exists.	Medium to Poor
<b>At or below -3°C:</b> <ul style="list-style-type: none"> <li>• Ice</li> </ul>	25 - 21	Braking deceleration is significantly reduced for the wheel braking effort applied. Directional control may be significantly reduced.	Poor
<b>Above -3°C:</b> <ul style="list-style-type: none"> <li>• Wet Ice</li> <li>• Ice</li> </ul>	0 - 20	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.	NIL



## Allocation of landing aircraft on turn-offs (exemplary RWY 26R)

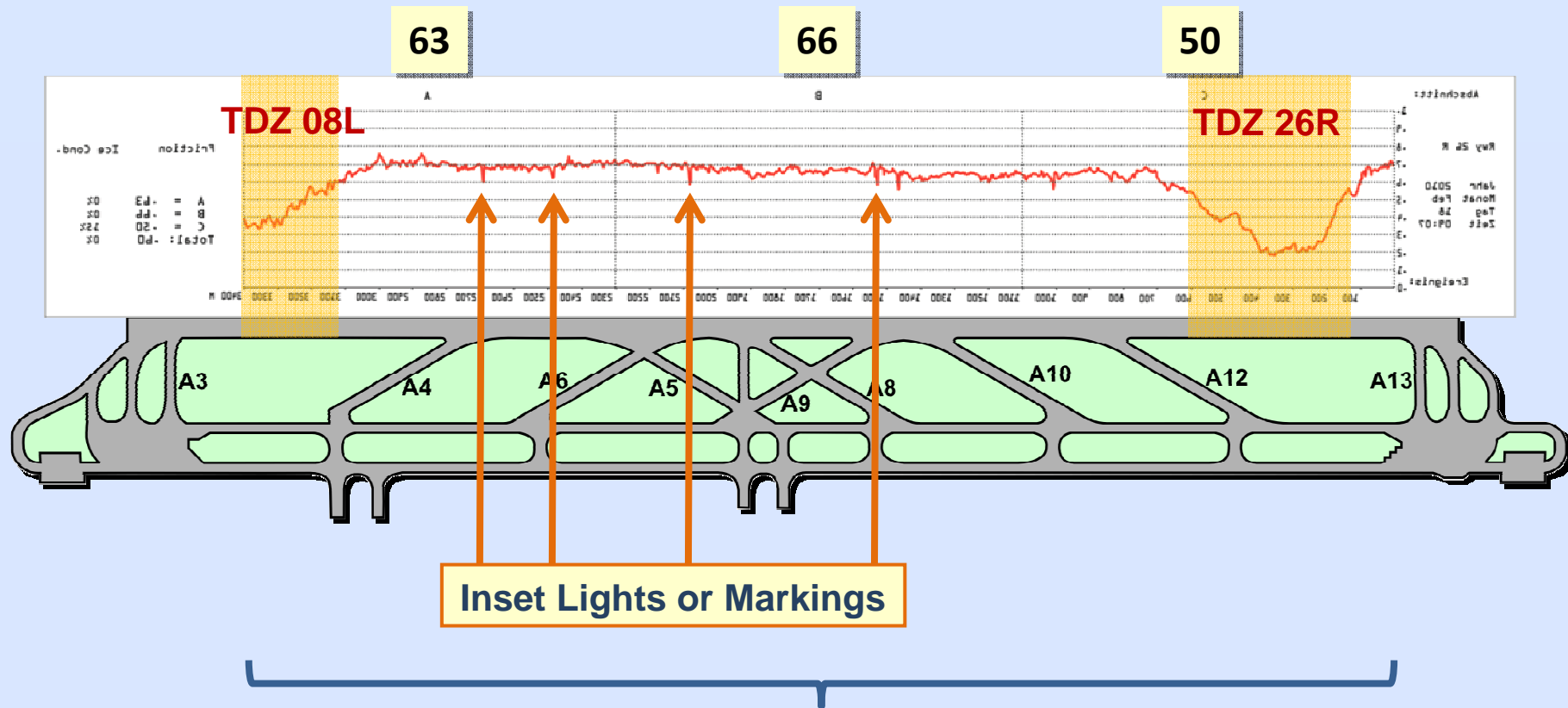






# Operational Friction Measurement - Practice

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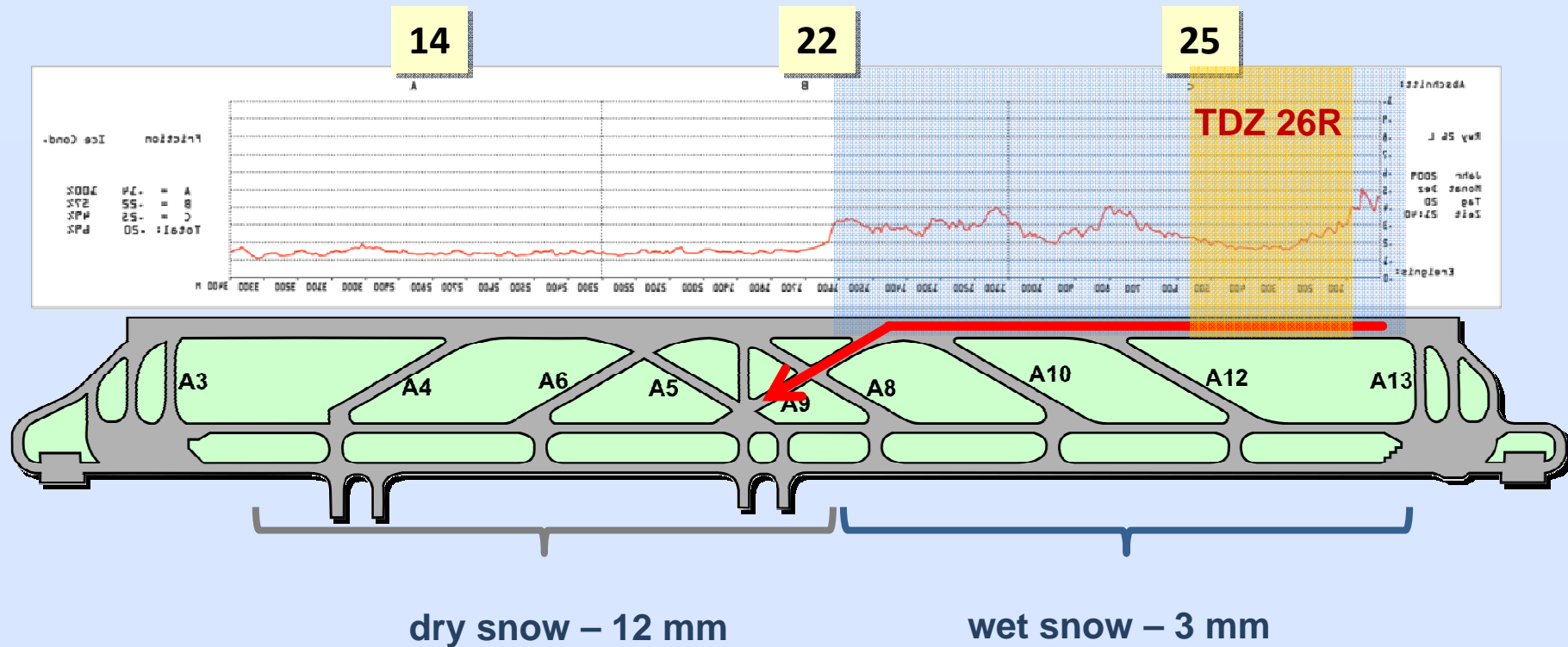


Wet surface, no standing water



# Operational Friction Measurement - Practice

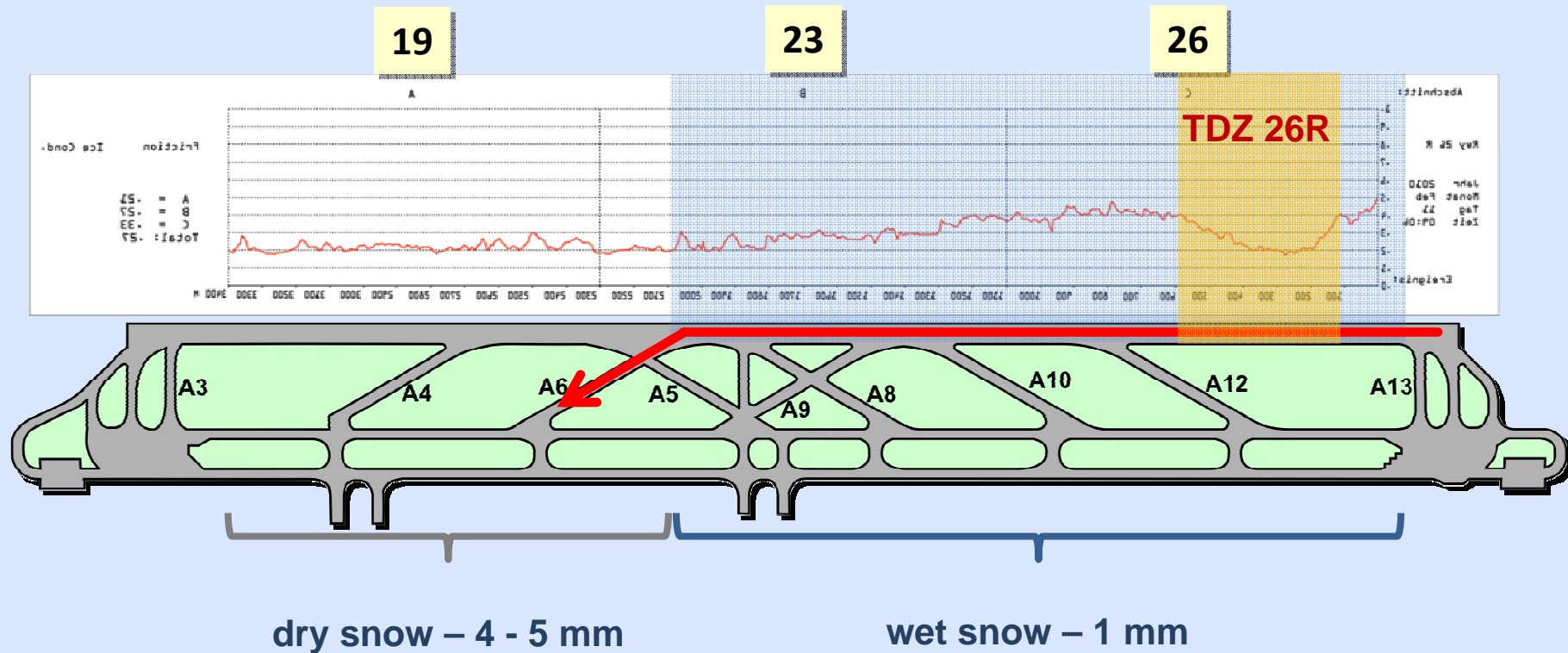
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# Operational Friction Measurement - Practice

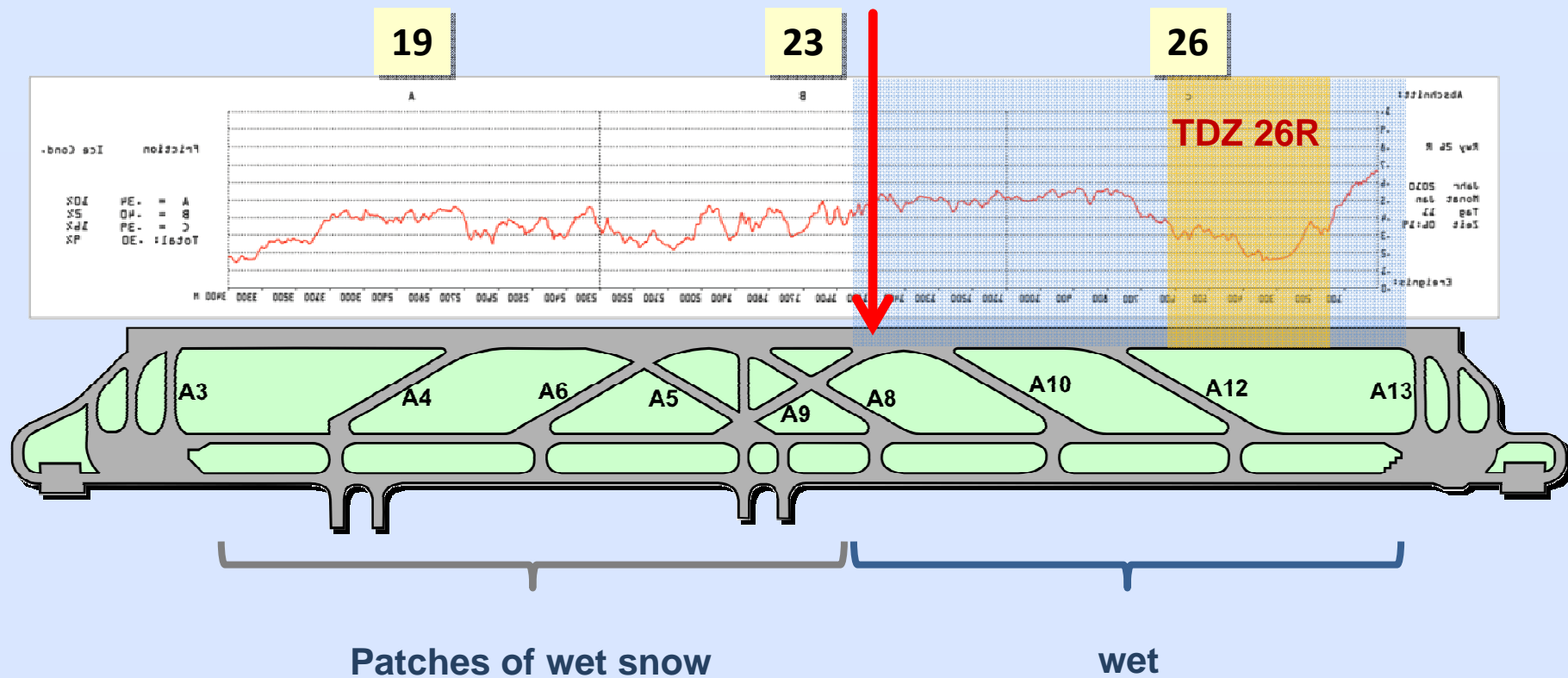
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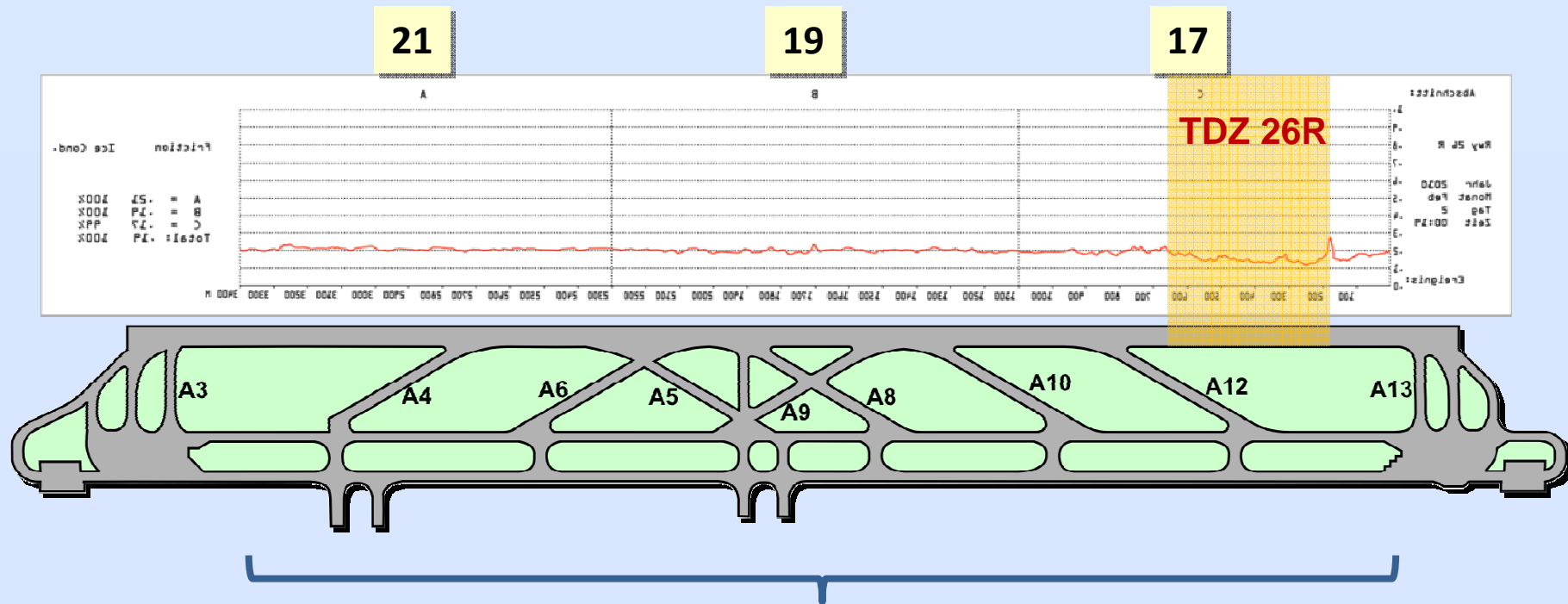


# Operational Friction Measurement - Practice





# Operational Friction Measurement - Practice

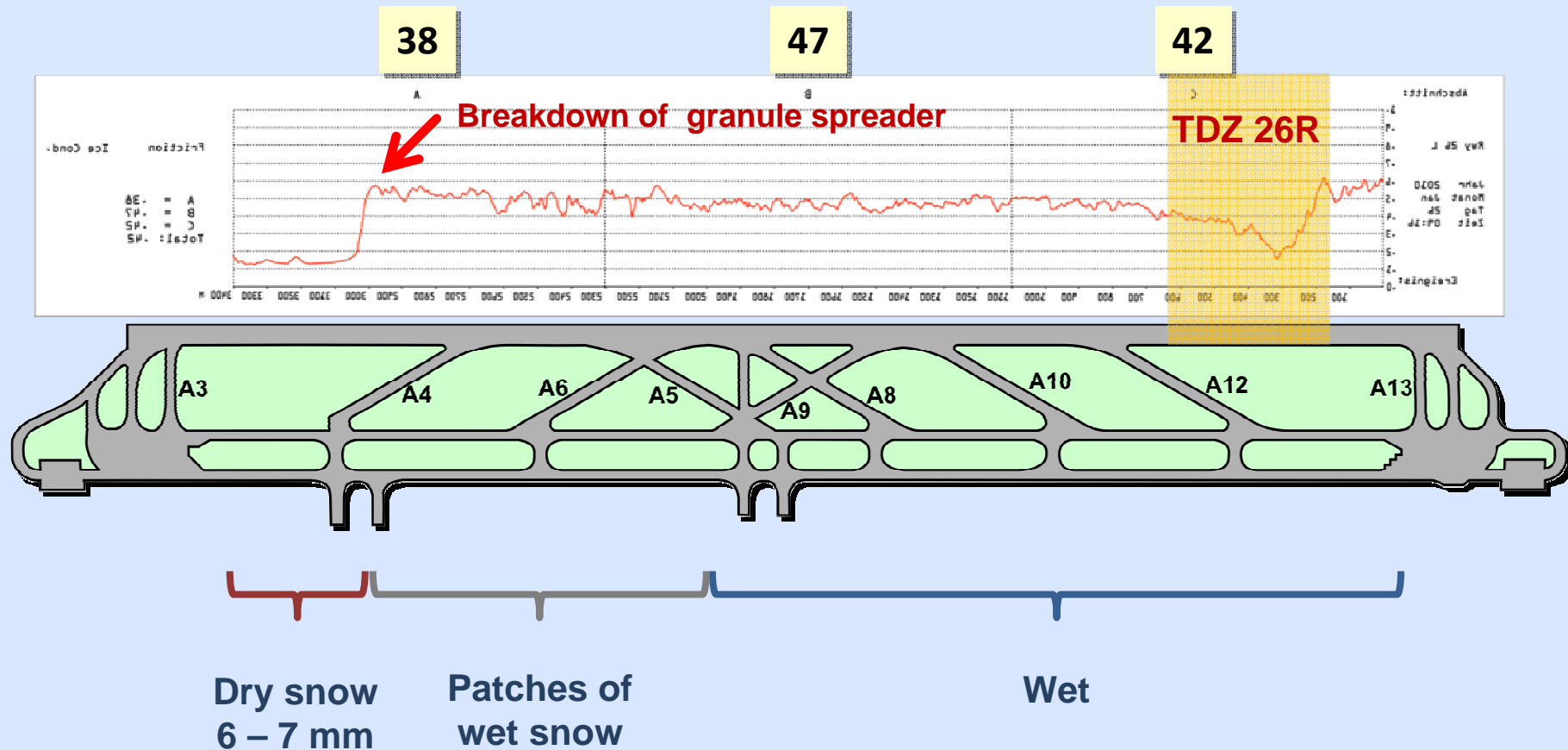


Snow covered 10 - 15 mm



# Operational Friction Measurement - Practice

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## Conclusions



- Regular measurements increase the safety of operations
- Using one system provides repeatable results
- A pirep should be a replenishment not a replacement for a measurement
- Friction values are an indication, not the absolute truth
- Standard procedures are necessary



**Thank you for your attention**



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