European Aviation Safety Agency

Runway Friction and Aircraft Braking: the way forward

Subject Notes of the workshop
Date 11-12 March 2010
Location DGAC Auditorium, Paris

Organised by **Name, Directorate.Department.Section**
E.2.3 **Safety Analysis and Research Deptment**

List of Participants

Attendees	List available at http://easa.europa.eu/ws_prod/g/doc/Events/2010/mar/RuFAB%20Workshop%20-11-12%20March%202010%20-%20Final%20Participant%20List.pdf

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Related Links/ Documents:

The presentations made during the workshop are available at:
http://easa.europa.eu/ws_prod/g/doc/Events/2010/mar/RuFAB%20Workshop%20Presentations.zip
The final report of the EASA Runway Friction Aircraft Braking (RuFAB) study is available at:
http://easa.europa.eu/ws_prod/g/g_sir_research_projects_airports.php#2008op28

MoM Distribution:

All workshop participants.
Approved version published on EASA website.

MoM prepared by	EASA Research Section	**Date 19/03/10**	**Signature**
MoM reviewed by	Werner Kleine-Beek	**Date 17/12/10**	**Signature**

1. Opening and Welcome

Mr. Jean-Michel Aubas, Director of the DGAC Technical Center for Aviation welcomed the attendees and briefed them about the Technical Center missions.

Mr. Werner Kleine-Beek, EASA Research Project Manager, introduced the workshop and presented its background and objectives.

2. Conduct of the Workshop

The workshop was composed of 5 main sessions as follows:

1. **Runway Friction – Aircraft Braking: An Evolutionary Context**
2. **Recent initiatives**
3. **EASA Research Project RuFAB**
4. **Stakeholders' perspectives: Authorities, Airport Operators, Airlines, Aircraft and Equipment Manufacturers**
5. **Round Table Discussion with Stakeholders and Audience**

The audience was composed of more than 140 participants representing the main aviation stakeholders concerned with operations on contaminated runways.

Twenty eight (28) speakers provided a broad view of the key issues and stakeholder perspectives in this subject.

The following current initiatives from regulatory authorities or standardisation groups were presented:

- TALPA ARC
- ICAO Friction Task Force (FTF)
- EASA RuFAB research project
- French DGAC and Aeroport de Paris
- ASTM Committee on Vehicle-Pavement Systems (E17)

The presentations made during the workshop are available at:

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3. Key Issues Addressed and Observations

The following key issues were raised during the presentations or from the questions of the audience.

- **Aircraft braking performances and access to AC manufacturers data**

  Some aircraft operators report that insufficient braking performance data are provided in aircraft flight manuals (e.g. certification data missing, cross-wind situations not fully covered), leaving operators to develop their own guidelines for correlating reported runway conditions or friction measurements to braking actions. Other aircraft manufacturers make data available for all contaminant types in AMJ 25X1591 and equivalences for the new types of AMC 25.1591.

  Current regulations for flight dispatch operations (covering safety margin for landing distance on dry runways) are deemed adequate. However, they are not conservative for wet in hot and high conditions and on down-sloping runways, as well as for contaminated (standing water) in hot conditions and on down-sloping runways.

- **Aircraft Directional Control**

  Currently certification standards only address cross-wind limitations for a dry runway.

Although directional control issues on contaminated runways are sufficiently addressed by the existing regulatory definition of the minimum control speeds the maintenance of directional control on contaminated runways needs to be considered as well.

- **Information required other than contaminant type, location and depth**

  The assessment of runway condition should not focus only on contaminant type and depth but it should also include the surface wind (in particular cross- or tail-wind components) and surface temperature. Rapidly changing surface conditions are observed in cases where the temperature ranges between +2 and –2 °C.

- **Need for an harmonised format for reporting conditions to Flight Crews**

  The definition of a global reporting format for runway surface conditions is a key requirement identified by the ICAO Friction Task force (FTF). Currently the SNOWTAM form (annex 15) does not enable consistent reporting across airports of runway contamination and the use of friction measurement is only for compact snow and ice. The FAA Takeoff and Landing Performance Assessment Aviation Rulemaking Committee (TALPA ARC) initiative has assessed the issues of efficient runway condition reporting considering the whole chain of stakeholders involved (airport operator, AIS, ATM, and Flight Crews) as well as the harmonisation issues. The TALPA ARC runway surface condition matrix for landing movements is currently being validated by a number of airlines at some US airports. The TALPA ARC approach, although primarily designed for landing performance analysis handling braking capability and not drag caused by the contaminant, is a valuable asset especially in changing conditions (snowfall), when thick contaminants exist and friction testers become unreliable and the situation is dynamic.

- **Role of friction-measuring devices**

  The current friction measurement devices have several limitations regarding the accuracy and repeatability of the measurements as well as not being able to operate reliably on all types of contaminants of concern. However, they offer a practical means to reduce the uncertainty of assessment by human beings.

  The use of devices for runway surface assessment (functional friction measurement) is current practice to assess maintenance actions (e.g. rubber removal). The definition of common reference standards (test protocols and calibration surfaces) are sought to harmonise between the different measurement techniques and support the use of different equipments.

  The lessons-learnt from airport operators using devices for operational surface assessment in case of contamination show that they may effectively support decision-making of runway inspectors in defined cases but their operational limitations for 'middle-latitude' airports (with rapidly changing conditions for wet snow, slush and water in winter) are a key issue. In addition the provision of Mu (μ) values to Flight Crews leaves significant uncertainties with respect to their correlation to aircraft braking performance. However, friction measurements will always be a vital part of airport operations and a solid backbone for runway condition reporting (Munich and all Finnish airports are good examples of this). For the airport as well as for the pilots it would be beneficial that all friction testers would give equal results on equal surfaces with "reasonable" accuracy; a calibration seems to be possible.

  Several developments are currently on-going for alternatives techniques including the monitoring of aircraft braking performances. Regular briefings from the involved partners and exchanges with stakeholders are encouraged.

- **Airport preparation**

  The preparation and operational facilities required from individual airports depend largely on the type of conditions encountered locally (winter but also summer events) and their impact on scheduled traffic. Only specific airports located at middle-latitude or high latitudes, or in mountainous regions, need to follow standardised plans for winter operations in order to support the decision-making of flight dispatchers (flight diversion – cancellation).

  Contaminant measurement: Only a portion of Airport operators own devices to measure contaminants characteristics. Moreover, this operation is sometime considered imprecise,

very time consuming and requires closing the runway during circa 20 minutes; therefore some airports don't measure contaminants depths.

Surface friction assessment device: only high traffic airports own such devices. Among airports owning a friction measuring device, some of them use it on any type of contaminants and thus make wrong assessments.

- **Training of Runway Inspectors**

  Assessments of runway condition based on descriptions of surface contaminants requires that adequate training is provided to runway inspector to ensure that reliable and consistent reporting is done. No measuring equipment will be available in the near term to provide rapid assessment for all contaminants.

  In addition the analysis of the human factors associated to the performance of manual assessment of surface contaminant in the context of high traffic level (runway occupancy time lost) need to be performed and the associated issues mitigated.

4. Conclusion and roadmap to "A Way Forward"

The main conclusions and recommendations from the speakers and the audience of the workshop are summarised as follows:

- **Standardisation action:** one single runway condition reporting format for Flight Crews shall be developed including the harmonisation of the definitions of deposits / contaminants used in ICAO, in aircraft certification and flight operations standards. As soon as possible the SNOWTAM format (annex 15) should be revised. The reporting shall cover landing and take-off operations as well as situations where runway conditions evolve rapidly.
  The presented reporting schemes from TALPA ARC, TCCA or Munich Airport and "operators' wish list" provide the basis for such harmonisation.
  Future amendments of ICAO standards should consider not leave current braking action classes "to float in the space".
  Aviation industry needs one way forward, not 3 different ones from EASA, ICAO and FAA; airports need a simple process that is easy to assess and report runway information that is understood by pilots to calculate safe landing distances.
  If standardization efforts are made, current regulations for dispatch should not be excluded from the considerations, and criteria for operational use should be clarified.
- **Aircraft braking performances data** published shall match with the different contaminants addressed during certification and with the harmonised runway condition reporting. Additional data such as the corrections for runway slope or surface temperature and guidance for cross-wind situations are also sought.
- **Policy Decisions Regarding Operational Friction Measurements**: the current divergence of views regarding the utility of operational friction measurements needs to be addressed. A policy decision needs to be made regarding whether or not friction measurements are required and how best to harmonize the various viewpoints on this matter.
- **Operational use of friction-measuring devices or real-time aircraft braking performance monitoring**: presuming that the above investigation concludes that friction measurements are indeed necessary, further actions are required to validate the use of friction measurement completed by alternative techniques, addressing the need to cover all types of contaminants and conditions encountered and allowing to compare measurements across different equipments. In the short term such information is reserved for runway inspectors to support their assessment of runway condition (no transmission to Flight Crews).
- **Airport regulations**: the development of new regulations for operational runway condition assessment and reporting shall consider safety objectives and the existing practices.
- **EU OPS**: pilots, but also to airports like Manchester and aircraft manufacturers like Airbus shared the opinion that regulations regarding "damp runways" are unclear and leave room for interpretation. Making changes in EU-OPS 1.475(d) and 1.480(a)(4) could be a quick win regarding safer operation on runways that are not dry, reducing the risk of runway overruns.
- A combination of the best in friction calculations and the best out of the TALPA ARC approach sounds like a good way to go.

5. Closing

Werner Kleine-Beek thanked the speakers and participants for their contributions providing a wide exposure to the issues, views, proposals and recommendations from a multi-disciplinary perspective aiming for improvement of runway safety. He encouraged the participants and all stakeholders to use the momentum of this workshop to continue the standardisation and harmonisation process through existing forums such as the ICAO FTF, standardisation bodies as ASTM and new to be developed networks.