ASFT Surface Friction Tester, and Weather Systems Presentation
ALACPA

Agenda
► Why Measure Friction?
   ▶ Operational measurement in winter condition
   ▶ Calibration/maintenance measurement in non-winter condition
► Parameters that will influence the friction testing
► ASFT in Focus?
   ▶ ASFT Continuous Friction Measuring Equipment (CFME)
   ▶ ASFT Mk IV rear-axle system, and New Generation Computer
   ▶ Weather Monitoring Equipment
► Q&A

Why Measure Friction?
   ► Operational measurement in winter condition

► To control and guide the snow removal, and deicing efforts
► Objective is to achieve acceptable landing and take-off conditions for airplanes, but also at, high speed exit area, taxi-way and apron.
► Frequency on test is correlated to change in weather conditions.

Why Measure Friction?
   ► Operational measurement in winter condition

Friction classification in Winter-Ops

<table>
<thead>
<tr>
<th>Measured Friction Value</th>
<th>Braking action to be reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40 or higher</td>
<td>Good</td>
</tr>
<tr>
<td>0.39 to 0.36</td>
<td>Good to medium</td>
</tr>
<tr>
<td>0.35 to 0.30</td>
<td>Medium</td>
</tr>
<tr>
<td>0.29 to 0.26</td>
<td>Medium to Poor</td>
</tr>
<tr>
<td>0.25 or lower</td>
<td>Poor</td>
</tr>
</tbody>
</table>

This table was created after Scandinavian Airlines System (SAS) sent out a questionnaire asking pilots how they experienced information on braking action, i.e. friction, and also on controllability in crosswind. 3000 answers were collected.
Why Measure Friction?
- Calibration/maintenance measurement in non-winter condition

Friction Deterioration
- The skid-resistance of runway pavement deteriorates due to a number of factors, the primary once being mechanical wear and polishing from aircraft tires rolling or braking on the pavement.
- Accumulation of contaminants, mostly rubber, but also dust particles, jet fuel, oil spillage, water, snow, ice, and slush, all cause friction loss on runway pavement surfaces.
- The most persistent contaminant problem is deposits of rubber from tires of landing jet aircraft.
- Rubber deposits occur at the touchdown, take-off and high speed exit areas on runways.
- The effects of these factors is directly dependent upon the volume and type of aircraft traffic.

Directional Control and Braking Power
- Crosswind
  - The wind tries to push the aircraft towards the sides of the runway
  - The aircraft needs friction to stay on the runway
  - Less friction = less crosswind capability Crosswind
- Reduced chance of reporting a “biased” braking power for runway surface
Rubber deposits
Primary rubber deposit area

- Main problems caused
  - Loss of braking action
  - Loss of directional control
  - Thermal up winds

- These problems will increase exponentially during rain. Measurements are therefore always done with water system to simulate rain for worst case scenario.

Why Measure Friction?
- FAA AC
  - 150.5200.30C (Operational/Winter Measuring)
  - 150.5320.12C (Maintenance Measuring)
  - Accident Investigation
  - Documents for Civil Litigation

- ICAO Annex 14 (Operational and Maintenance)
  - Accident Investigation
  - Documents for Civil Litigation

- UK CAA Cap 683
  - Maintenance
  - Accident Investigation
  - Documents for Civil Litigation

Why Measure Friction?
- Calibration/maintenance measurement in non-winter condition

<table>
<thead>
<tr>
<th>Number of Daily Minimum Turbojet Aircraft Landings Per Runway End</th>
<th>Minimum Friction Survey Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less Than 15</td>
<td>1 Year</td>
</tr>
<tr>
<td>16 To 30</td>
<td>6 Months</td>
</tr>
<tr>
<td>31 To 90</td>
<td>3 Months</td>
</tr>
<tr>
<td>91 To 150</td>
<td>1 Month</td>
</tr>
<tr>
<td>151 To 210</td>
<td>2 Weeks</td>
</tr>
<tr>
<td>Greater Than 210</td>
<td>1 Week</td>
</tr>
</tbody>
</table>

Source: FAA AC 150/5320-12C, Section 1, Table 3-1.
Why Measure Friction?
- Calibration/maintenance measurement in non-winter condition

Average friction values
Changi Airport, Runway 2, Direction 20L

Parameters that will influence the friction testing
- Weather conditions, i.e. wet/dry/ice
- Tyre pressure, contact area, tread pattern
- Measuring Speed
- Micro and macro texture of the tested surface
- Frictional characteristics of the tested surface
- % braking slip on the test wheel (ASFT CFME has 13%)
  - If using one type of friction testing equipment then this will not be issue
- Type of friction testing equipment
  - If using one type of friction testing equipment then this will not be issue
  - Make sure it has participated in the JWRFMP and has an IFI

ASFT in Focus
- ASFT is a small company, but we are the largest, and leading CFME Manufacturer in the World
- Head office and factory in Ystad, Sweden
- 17 years experience with develop and manufacture different kinds of CFME
- 300 units worldwide in more than 35 countries
ASFT in Focus

ASFT & Saab Automobile AB

- The owners of ASFT acquired May 20th 1991 the Saab CFME division from Saab Automobile AB
- This since General Motors had acquired Saab Automobile AB, and did not want to keep any special vehicles
- Manufacture 95% of all parts our selves

ASFT Inds. AB
Factory (Sweden)

1 CEO
4 Managers
2 Admin/office
2 Computer Engineers
1 Designer
4 SFT Specialists
3 Welders & CNC operators

ASFT Swiss AG
Head office/Int Sales

1 CEO
2 Marketing Managers
2 Support Staff

ASFT Inc.
North American Distributor

1 Sales Manager
1 Service Engineer

ASFT Service
World Wide Service

2 Phone Support
3 Service Engineers

ASFT in Focus

Introduction of project managers and executive personnel

- Leif Graflind  CEO  e-mail: leif.graflind@asft.se
- Fredrik Graflind  BDO  e-mail: fredrik.graflind@asft.se
- Mats Balke  CFO  e-mail: mats.balke@asft.se
- Mats Andersson  COO & Project Manager  e-mail: mats.andersson@asft.se
- Magnus Josefsson  Admin & Marketing Manager  e-mail: magnus.josefsson@asft.se

ASFT T2GO CFME
ASFT T-10 Trailer CFME

ASFT Saab 9-5 CFME

ASFT Ford Taurus CFME

ASFT VW Sharan CFME
ASFT Ford Galaxy CFME

ASFT Skoda Octavia CFME

T-5 Trailer CFME

ASFT Measuring System

ASFT Vehicle based CFME Advantages:
- Unmatched repeatability
  - 140 kilos absolutely constant vertical ground pressure on test wheel
- Ford Galaxy and VW Sharan has high seating level which makes it ideal as inspection vehicle
- Can be used as a Follow Me Vehicle
- Guaranteed constant ground contact pressure of test wheel at 140 kilos
- Can measure at 160 kph, and recommended maximum speed is 96 kph
- High-speed refilling of water tank
- 500-800 liter water tank capacity
- Saab available with 580 liter
- 1000 liter water tank capacity but with speed restrictions (Only available with Ford Galaxy)
ASFT Flow Chart for Vehicle Based CFME

ASFT Flow Chart for Trailer CFME

ASFT Trailer Measuring Systems

ASFT Production, Computer and Mk IV rear-axle system.

ASFT Flow Chart for Vehicle Based CFME

ASFT Flow Chart for Trailer CFME

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ASFT Flow Chart for Vehicle Based CFME

ASFT Flow Chart for Trailer CFME

ASFT Trailer Measuring Systems

ASFT Production, Computer and Mk IV rear-axle system.
ASFT Skiddometer principle

- ASFT Skiddometer principle
  - Two reference wheels
  - One test wheel.
- MK IV have slip ratio of 13%
  - Friction wheel is brake by 13% against both reference wheels.
- This principle only needs one test tire. It will thereby only consume half the amount tire and water compared to systems that have two test tires.

ASFT Mk IV Rear-axle

- Solid tube design can’t collapse as a split rear-axle can when heavy loaded (water-system). 
- Not attached to the body of the host vehicle, or trailer 
- Only attached to the rear axle via a spring 
- This unique design prevents the friction wheel to pick-up any disturbance from moments in the host vehicle.
- This design allows the friction wheel to have an absolute constant ground contact pressure at 140 klos. Which is ensured by the vertical load sensor, and hydraulic system.

ASFT Mk IV Rear-axle

- Mk IV is retracting friction wheel when not in use, and is also equipped with free wheel hub, so all rotation stops when wheel is in elevated position. This will lead to less maintenance and wear and tear.
- Test wheel is automatically retracted when going in reverse.
- Mk IV is built with differentials, so it can measure accurately when turning. This since the slip ratio will not change.
  - High speed exit areas
  - Apron
  - Taxiway
- Two reference wheels. Test wheel is attached to both rear-wheels which results in better control of the slip ratio (13%).
ASFT New Generation Computer System

- This is a completely new method of Receiving, Presenting and Storing friction data.
- Embedded Windows gives “unlimited” capability to integrated with other systems on airport.
- “Unlimited” capability to store data.
- One platform for all data, friction, position, air and ground temperature, etc.
- Real time viewing of data on digital map of airport in car and on the internet.
- Friction and temperature is painted in color (red, yellow and green) for quick glance which makes it possible for stakeholders to take rapid action.
- Each operator has a unique id and password which has to be used in order to operate the tester. This information is permanently stored with test results for complete traceability.

- Ground and ambient temperature is automatically recorded and stored.
- Remote support via Internet via secure session.
- The position of each measuring result is automatically recorded by a built in GPS.
- Friction test can be viewed in real-time from any internet connection.
- Full pdf and XML report can be downloaded to USB stick.
Presentation Computer

The driver of the CFME is controlling and monitoring the system through a 10.5” rugged Touch screen computer. The GPS and GPRS gives the ability to see the friction values as well as the temperature values in the map view of the screen in real time on its accurate position.
Weather Monitoring Equipment
- A Cooperation between ASFT and Saab Security

► Freezing Point Detection (Frensor)
► Precipitation Monitoring (Optic Eye)
► Ground Frost Measuring
► Ice Warning (Advisy)
► Ice Deposit Growth
► Colour/IR Camera Systems
► This technology is purpose built for stationary or mobile use
► Open system
  - Can be integrated with other Weather Systems

OpticEye™

Precipitation sensor
- Classifies rain, sleet and snow
- Intensity
- Amount

Frensor - Freezing point (Active sensor)

Independent to which
Anti-icing agent used
- by measuring the actual freezing point temperature
- Active sensor only needs to be factory calibrated.
- It’s constantly taking sample and cooling it down until freezing point is reached. Sensor is then heating up again.
- Three or more sensors are installed in a cluster at three locations on runway (take-off, middle, and touchdown).
- Exceptional MTBF and MTR
Weather Monitoring System

RWIS 1

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<tr>
<td>Pressure</td>
<td>0.00 mm</td>
</tr>
<tr>
<td>Surface Temp</td>
<td>7.7 °C</td>
</tr>
<tr>
<td>Wind dir 10</td>
<td>390 °</td>
</tr>
<tr>
<td>Wind speed min</td>
<td>2.9 m/s</td>
</tr>
<tr>
<td>Air temp</td>
<td>12.0 °C</td>
</tr>
<tr>
<td>Air humid</td>
<td>4.0 %</td>
</tr>
<tr>
<td>Freezing point</td>
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Threshold parameters can be set to generate alarms.

How to use and interpret the RWIS data - table

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Precipitation – Type and amount (Actual snowdepth, not melted form)
Need for snow clearance resources?

Wind conditions
Risk of snow drift?
Dangerous wind gusts?

Runway condition – Wet / Dry / Frost
Need for friction enhancement resources?

Arrows show trend for each parameter

Frensor – Freezing point
Thank you for your time and we look forward to working with you in the future.

For more information please visit www.asft.se