WHY ACCURATE RUNWAY SURFACE FRICTION MEASUREMENT SHOULD MATTER TO Airports

How this information can help set your airport apart
FRICTION UNRAVELED
// WHY FRICITON TESTING STILL MATTERS FOR WINTER MAINTENANCE
FRICTION & THE TIRE

Temperature of the compound

Pressure affecting contact patch size and driver feel

Degradation of the compound
FRICTION & TRACK SURFACE

- Concrete, asphalt and surface transition
- Aggregate surface area in contact with tire (macro texture)
- Surface friction changing with addition of rubber and contaminant
- Surface elevation change
What we have learned in racing applies to airport runway safety.

Testing equipment must be designed to eliminate as many variables that effect friction as possible.
FACTORS AT PLAY
WE ELIMINATE THE VEHICLE FACTORS

Diagram:
- Vehicle Weight
- Weight Distribution
- Wheel Load
- Dampening
- Spring Rate

END FRICTION

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THEN WE ELIMINATE THE DRIVER & TIRE FACTORS
WE ARE LEFT WITH THE FOLLOWING THAT THE RT3 CAN MEASURE

A well designed CFME leaves only the surface and environmental conditions affecting friction.
# RT3 FLIGHT TO DECELEROMETER

<table>
<thead>
<tr>
<th></th>
<th>RT3 FLIGHT</th>
<th>DECELEROMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operator dependent</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Affected by driver performance</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Results can be manipulated</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Accurate, repeatable reliable results</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Speed of test limited</strong></td>
<td>15-60 mph: operate a safe speed for the conditions when testing dry without water system</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Changes to the vehicle affect the results</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Change to CG</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Change in fuel level</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Change in brake condition</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Change in tire condition</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Change in number of occupants</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Change in weight of cargo</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## RT3 FLIGHT TO DECELEROMETER

<table>
<thead>
<tr>
<th>Feature</th>
<th>RT3 FLIGHT</th>
<th>DECELEROMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of readings</td>
<td>100 readings per second averaged to one second data output</td>
<td>Typically 9 spots tested on the runway</td>
</tr>
<tr>
<td>Additional wear and tear on the vehicle</td>
<td>None</td>
<td>Can be significant up to $4k per year when parts and labored are factored in with the vehicle requiring replacement in 3-4 years. Further changes in design impact ability to use decelerometers.</td>
</tr>
<tr>
<td>Hard on Operators</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Causes headaches and nasea</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can not be driven by pregnant women</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can not be driven by individuals with back problems</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Year round use</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Customizable software</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
FRICTION UNRAVELED
// RUNWAY MAINTENANCE
FRICITION MEASUREMENT

QUESTIONS BEING ASKED IN THE SUMMER

• What should my maintenance planning schedule be?

• Is rubber removal necessary?

• Is water draining?

• How has any surface restorative process worked?
FRICTION MEASUREMENT

THE RT3 CAN ANSWER YOUR QUESTIONS ASKED IN THE SUMMER

1. __________
   Measures changes to the surface

2. __________
   Identifies rubber contaminant on the surface

3. __________
   Shows how the surface is displacing water

4. __________
   Aids in budgeting prioritization planning
**GREAT LAKES REGION AIRPORTS**

- WI, ND, SD, MI, MN, ILL
- OH, IND

<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>16-30</td>
<td>6 MONTHS</td>
</tr>
<tr>
<td>31-90</td>
<td>3 MONTHS</td>
</tr>
<tr>
<td>91-150</td>
<td>1 MONTH</td>
</tr>
<tr>
<td>151-210</td>
<td>2 WEEKS</td>
</tr>
<tr>
<td>Greater than 210</td>
<td>1 WEEK</td>
</tr>
</tbody>
</table>
WORN RUNWAY EXAMPLE

Crack sealing changed micro, macro and mega texture of the surface!

Example graph showing texture changes:
- Test 7. 10. 60mph. 1mm.
- Test 8. 10. 60mph. 1mm. Approx 7 feet from center line.
WORN RUNWAY EXAMPLE
RUNWAY EDGE EXAMPLE
FRICTION UNRAVELED
// WINTER MAINTENANCE
FRICTION MEASUREMENT

QUESTIONS BEING ASKED IN THE WINTER

• Can I land planes?
• Is there black ice?
• Has treatment worked?
• Has surface restored?
• Is my surface slippery when wet?
FRICTION MEASUREMENT

THE RT3 CAN ANSWER YOUR QUESTIONS ASKED IN THE WINTER

1. ____________
   Provides an objective value

2. ____________
   Identifies patches of black ice

3. ____________
   Tests chemical/treatment effectiveness

4. ____________
   Identifies when the surface is restored to an acceptable level of friction.
RCAM IS FINALLY HERE!

RUNWAY CONDITION ASSESSMENT MATRIX

▪ We no longer report Mu Values to pilots
  ▪ Number system based on visual inspection of the runway
  ▪ Friction testing values from an approved friction device
    ▪ Downgrade or upgrade your surface
  ▪ Experience

SO WHY DO YOU NEED A CFME DEVICE?
WHAT HAS REALLY CHANGED?
RCAM CHANGES EXPLAINED

YOU STILL HAVE TO KNOW:

1. Is it safe to land a plane?

2. Have the chemicals we have put down done the job?
   i. Do I need more chemicals or to stop?
   ii. If I add more chemical/sand will it decrease friction?

3. How to validate pilot feedback on braking action?

4. Is my surface slippery when wet?
   i. 1.12.20 of AC 150/5200-30D
TOOLS WE USE

SUBJECTIVE - EXPERIENCE DRIVEN

- Visual inspection of the surface and conditions
- The trusted foot test
- Vehicle handling on the surface
- Reports back from pilots
- Experience

SOMETIMES INACCURATE

- Decelerometers
- Competitors equipment
CUSTOMER WISH LIST

CUSTOMER CFME REQUIREMENTS

▪ Friction result to be representative of surface conditions
▪ Reliable & repeatable result
  ▪ Not operator performance dependent
  ▪ Changes to the vehicle do not affect the result
▪ Runs with minimal maintenance
▪ Does not put additional wear and tear on host vehicle
▪ Easy to use
CUSTOMER WISH LIST

CUSTOMER CFME REQUIREMENTS

- Friction result easily interpreted
  - Software is customizable
  - Interface to existing reporting systems is possible
  - GPS positioning
- Operate in severe conditions
- To measure friction without water
- Have a system that attaches to the vehicle but can be removed
NOT ALL DEVICES ARE EQUAL

A well designed CFME device adds to the tools that we use everyday by providing an objective measurement that is repeatable, reliable and OPERATOR INDEPENDENT.
DATA OUTPUT - WINTER

Broomfield  4/3/2015 12:21:42 AM

Friction

Speed

500' Mu Speed

.51 .54 .46 .61 .61 .77 .57 .54 .51 .50 .48 .47 .45 .48 .45 .40 .43

27 39 40 40 39 40 40 40 40 40 39 40 39 40 39 39

3/3 total average friction .52
1/3 average friction .56
2/3 average friction .55
3/3 average friction .45

Surface conditions

Good >0.4
Detonating, Monitor .30-39
Detonated, Monitor closely/treat .21-29
Very dirty, Take caution <=0.2

Rubber removal: False
Name: 12L
Distance: 8000
Surface type: Grooved Asphalt

Conditions: Slush
Surface temp: 31
Dew point
Air temp: 29
Dist from center line: 10

Depth of Contaminant: 1/8
Last treatment:
Measurement trigger:
Last Time Cleared:
Treatment Time:

End text:
Average until stop: .52

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COMPARATIVE DATA - WINTER
CONDITION CHANGES WITH TREATMENT

Runway 3 Testing

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QUESTIONS
HALLIDAY TECHNOLOGIES INC.

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