ITMF, ICCTM
Stickiness Working group

Comparison of Stickiness results from different instruments, observations based on an International Round-trial

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✓ Reasons for organizing a round-test

✓ Experimental design and its implementation

✓ Data analysis and results
✓ Reasons for organizing a round-test

✓ Experimental design and its implementation

✓ Data analysis and results
For stickiness measurement, several types of instruments exist:

- Mini-card
- Fibre Contamination Tester (FCT) and Fibre Quality Tester (FQT),
- Stickiness Cotton Thermodetector (SCT),
- High Speed Stickiness Detector (H2SD)
- ...
Reasons for organizing a round-test

The goals of the proposed round-test are:

- to quantify the accuracy of the results obtained from each type of instrument for a given cotton
- to check the relationship between results obtained from various types of instruments.
Lack of accuracy is usually splitted into two components: (ISO 5725-1)

- Bias (<> trueness)
- Variability (<> precision)

The bias is the mean departure from a true value determined with a reference instrument.

The variability is the departure between measurements made with the same instrument type.
3.10 bias of the measurement method: The difference between the expectation of test results obtained from all laboratories using that method and an accepted reference value.

3.12 precision: The closeness of agreement between independent test results obtained under stipulated conditions.

NOTES

9. Precision depends only on the distribution of random errors and does not relate to the true value or the specified value.

10. The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results. Less precision is reflected by a larger standard deviation.

11. “Independent test results” means results obtained in a manner not influenced by any previous result on the same or similar test object. Quantitative measures of precision depend critically on the stipulated conditions. Repeatability and reproducibility conditions are particular sets of extreme conditions.
• Here the reference instruments are minicard and SCT...

• ... but the other instruments are not aimed at measuring the same quantity.

• Even the two reference instruments differ: the minicard output is qualitative, the SCT is quantitative, and so are the other instruments tested.
The variability of measurements has several components:

- within samples
- within laboratories
- between laboratories
Outline

✓ Reasons for organizing a round-test

✓ Experimental design and its implementation

✓ Data analysis and results
Experimental design

Basics assumptions for preparing the round test:

- homogenizing the material has been shown (ITMF, 2002) to reduce the variance of this distribution: separate round tests should be carried out for mixed and raw cotton.
Experimental design

We then included various cottons

- covering a range of stickiness
  with 6 cottons min, 10 recommended

- contrasting between two sample preparations
  Raw cottons
  Mixed cottons

- With at least 8 laboratories

The recommended number of laboratories has not been achieved and these results should be considered as preliminary before a larger round test can be organized.

Otherwise, the round test design is not different from the one suitable for gaussian measurements: randomized in blocks within laboratories, with blind measurements.
## Range of stickiness

<table>
<thead>
<tr>
<th>Cotton</th>
<th>Stickiness level (H2SD)</th>
<th>Mixed Cotton (M)</th>
<th>Coton Raw (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>M1 (2 blocks)</td>
<td>R1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>M2 (2 blocks)</td>
<td>R2</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>M3 (2 blocks)</td>
<td>R3</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>M4 (2 blocks)</td>
<td>R4</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>M5 (2 blocks)</td>
<td>R5</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>M6 (2 blocks)</td>
<td>R6</td>
</tr>
<tr>
<td>7</td>
<td>17</td>
<td>M7 (2 blocks)</td>
<td>R7</td>
</tr>
<tr>
<td>8</td>
<td>20</td>
<td>M8 (2 blocks)</td>
<td>R8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td></td>
<td>R9</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td></td>
<td>R10</td>
</tr>
<tr>
<td>11</td>
<td>45</td>
<td></td>
<td>R11</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td></td>
<td>R12</td>
</tr>
</tbody>
</table>
Fiber bank
(Cotton, Stickiness data)

Cottons selection (1 to 12)

Cotton 1 to 12

Manual homogenization

Sampling

Raw cotton (R)

Mixed cotton (M)

Card without flats + large drum

Samples preparation (R1)

Samples preparation (M1)
Organization of the round-test

Envelopes are randomized in complete blocks within each box

Cotton 1
- Envelopes R1
- Envelopes M1

Cotton 2
- Envelopes R2
- Envelopes M2

Cotton ...

Cotton n
- Envelopes Rn
- Envelopes Mn

Box R(A)
Box M(A)
Labo aa

Box R(B)
Box M(B)
Labo bb

Round-test 2008
Plan of presentation

- Reasons for organizing a round-test
- Organisation of the Round Test
- Results
<table>
<thead>
<tr>
<th>Instrument</th>
<th>Raw</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planned</td>
<td>Achieved</td>
<td>Planned</td>
<td>Achieved</td>
</tr>
<tr>
<td>Mini-card</td>
<td>3</td>
<td>1 (2?)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>SCT</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>FCT/FQT</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>H2SD</td>
<td>5</td>
<td>4 (5?)</td>
<td>6</td>
<td>4 (5?)</td>
</tr>
<tr>
<td>HPLC</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Mean to variance relationship

LogN(1+variance) vs LogN(1+mean)

etat=mixed Appareil=FCT_FQT
Mean to variance relationship

LogN(1+variance) vs LogN(1+mean)

etat=raw Appareil=FCT_FQT
Mean to variance relationship
LogN(1+variance) vs LogN(1+mean)
etat=mixed Appareil=H2SD
Mean to variance relationship

LogN(1+variance) vs LogN(1+mean)

etat=raw Appareil=H2SD
Mean to variance relationship

LogN(1+variance) vs LogN(1+mean)

etat=mixed Appareil=SCT
Mean to variance relationship

$\log(N(1+\text{variance}))$ vs $\log(N(1+\text{mean}))$

$\text{etat}=\text{raw Appareil}=\text{SCT}$
3.10 Bias of the measurement method: The difference between the expectation of test results obtained from all laboratories using that method and an accepted reference value.

3.12 Precision: The closeness of agreement between independent test results obtained under stipulated conditions.

NOTES

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10 The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results. Less precision is reflected by a larger standard deviation.

11 "Independent test results" means results obtained in a manner not influenced by any previous result on the same or similar test object. Quantitative measures of precision depend critically on the stipulated conditions. Repeatability and reproducibility conditions are particular sets of extreme conditions.
- $E[Y_{ijk}] = M_i$.
• $E[Y_{ijk}] = M_i \cdot B_j$.
Cotton x lab interaction

- $E[Y_{ijk}] = M_i . B_j . (MB)_{ij}$. 
Block within lab effect

• \( E[Y_{ijk}] = M_i \cdot B_j \cdot (MB)_{ij} \cdot C_{jk} \)
- $E[Yijk] = M_i \cdot B_j \cdot (MB)_{ij} \cdot C_{jk}$

- $\log(E[Yijk]) = m + a_i + b_j + (ab)_{ij} + c_{jk}$
• $E[Y_{ijk}] = M_i \cdot B_j \cdot (MB)_{ij} \cdot C_{jk}$

• $\log(E[Y_{ijk}]) = m + a_i + b_j + (ab)_{ij} + c_{jk}$

• $Y \mid E[Y] = \text{given its expectation, } Y \text{ follows a negative binomial of parameter } k \text{ with overdispersion } \phi$

  \[ \text{Var}(Y|\mu) = \phi \cdot \mu (1 + \mu/k) \]
• Results were analyzed with the generalized linear model procedure of Sas (proc genmod).

• One device had incoherent results, and broke down shortly after the test: its data was discarded.

• Otherwise, the inspection of residuals did not show any outlier.
Overdispersion as a linear function of the mean

\[ \text{overdisp} = \alpha \times \text{mean} \]
Within-sample repeatability standard deviation

![Graph showing within-sample repeatability standard deviation with multiple lines representing different instr_prep categories: FCT-FQT, H2SD, and SCT. The graph plots mean on the x-axis and stddev on the y-axis.]
Within-sample coefficient of variation
### Blocks and lab effects

<table>
<thead>
<tr>
<th>Instrumen</th>
<th>Max difference between blocks means</th>
<th>Max difference between labs means</th>
<th>Labxcot inter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>Mixed</td>
<td>Raw</td>
<td>Mixed</td>
</tr>
<tr>
<td>H2SD</td>
<td>+25%</td>
<td>+33%</td>
<td>+43%</td>
</tr>
<tr>
<td>FQT</td>
<td>+41%</td>
<td>+85%</td>
<td>+310%</td>
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<tr>
<td>SCT</td>
<td>+28%</td>
<td>+63%</td>
<td>+230%</td>
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</tr>
</thead>
<tbody>
<tr>
<td>H2SD</td>
<td>+25%</td>
<td>+33%</td>
<td>+43%</td>
<td>+85%</td>
<td>No/No</td>
</tr>
<tr>
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<td>+85%</td>
<td>+310%</td>
<td>+300%</td>
<td>Yes/No</td>
</tr>
<tr>
<td>SCT</td>
<td>+28%</td>
<td>+63%</td>
<td>+230%</td>
<td>+192%</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>
interaction plot H2SD mixed

Log(# sticky points)

Log (mean # of sticky points)

device

- 11
- 7
- 9
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<td>230%</td>
</tr>
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interaction plot FCT_FQT mixed

Log(# sticky points)

Log (mean # of sticky points)

device 15 16 4
Summary

• These are preliminary results, too few labs per instrument

• Single CV calculation of analysis of variance are not appropriate, but a generalized linear model gives sensible results:
  – Within lab precision is not the same for all the instruments
  – Serious calibration problems