35th INTERNATIONAL COTTON CONFERENCE BREMEN 2021

Presentation

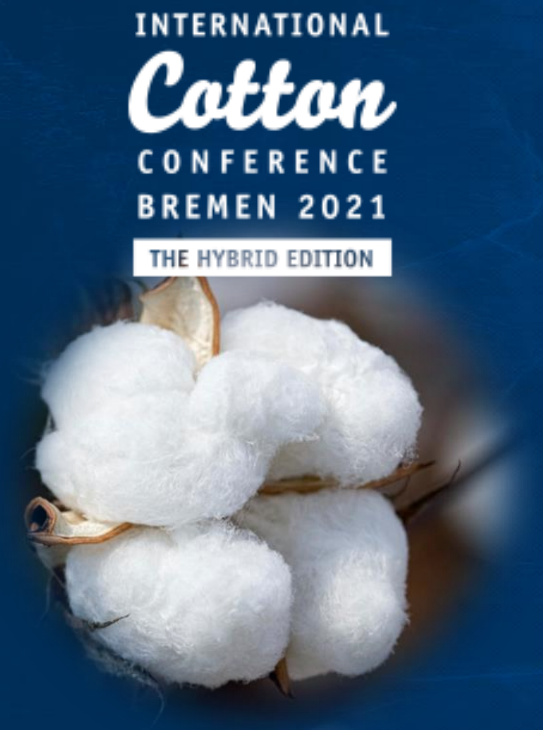
Session: **Cotton Quality & Testing 2 (T5)**

Title: **Stickiness measurement in the cotton quality testing**

Speaker: **Gabriele Salvinelli,** MESDAN S.p.A., Puegnago del Garda, Italy

Presentations are available on the conference archive: https://baumwollboerse.de/en/cotton-conference/lectures/

Conference Organization
Faserinstitut Bremen e.V., Bremen, Germany. E-Mail: conference@faserinstitut.de
Bremer Baumwollboerse, Bremen, Germany. E-Mail: info@baumwollboerse.de



STICKINESS TESTER

CONTEST-S

STICKINESS MEASUREMENT IN THE COTTON QUALITY TESTING

COTTON QUALITY & TESTING 2 (T5), MARCH 18, 2021

GABRIELE SALVINELLI

R&D DIVISION, MESDAN LAB

Mesdan

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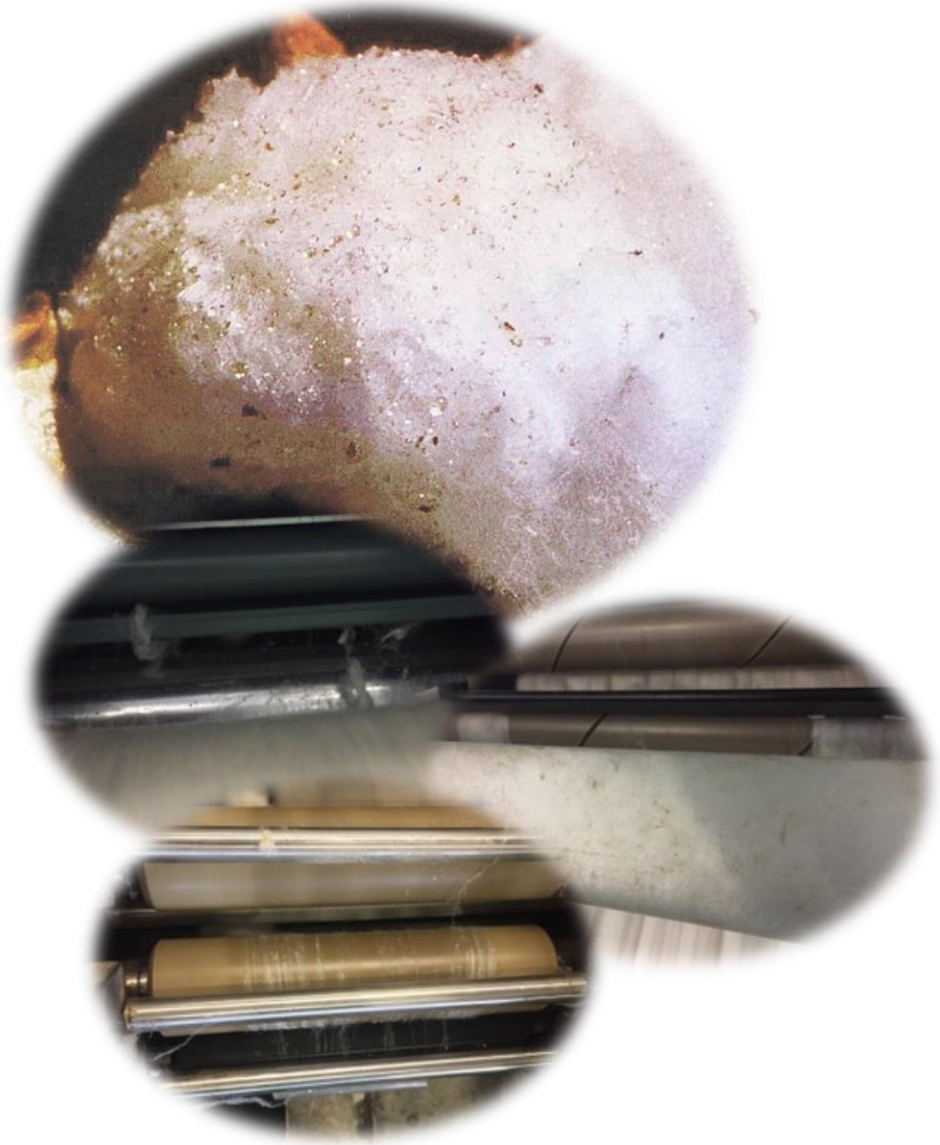

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STICKINESS TESTING METHOD

ITMF – ICCTM recognized
see: www.itmf.org

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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USEFULNESS / BENEFITS

- ❑ Measure and classify sticky points in cotton fiber
- ❑ Fully automatic high-speed tester;
- ❑ Spinning-like preparation of samples (cotton web);
- ❑ Thermodetector at typical T(°C) of spinning mill machines;
- ❑ Large mass testing for bale characterization before spinning;
- ❑ Reduction of the risk of issues during spinning due to stickiness;
- ❑ Almost operator-independent.

RANGE OF APPLICATION:

- ❑ 100% raw cotton fibers (also sliver can be processed);
- ❑ From short to extra-long staple fibers (20 mm < UHML < 40 mm).

RECOGNITED PARAMETER:

- ❑ Stickiness Grade

NECESSARY SURROUNDING:

- ❑ Standard atmosphere, ASTM D1776 (21 ± 1°C, 65% ± 2% RH);
- ❑ Pre-conditioning for at least 24 hours.

Instrument Description

Sample Preparation

- Remove large foreign particles (barks / entire seeds);
- Fluff the fibers to eliminate dense clumps or knotty balls;
- Weight a portion of **3.5 ± 0.2 g**;
- Stretch the fibers, as to reach the proper length of **30 ± 3 cm**;
- Roll the material to obtain a cylindrical shape;
- Insert the sample onto the conveyor belt.

CONTEST-S measures only stickiness

- Sample preparation: 30 sec
- Sample transfer: 20 sec
- **Testing time: 30 sec**

CONTEST-F is a high volume cotton testing equipment, which integrates the stickiness tester

Additional parameters :

- UHML, UI, Strength, Elongation, SFI, Moisture
- Rd, +b, Color Grade
- Trash Count, Trash Area, Leaf Grade
- Micronaire, Maturity, Fineness

Stickiness measurement

- Sample preparation: 30 sec
- Sample transfer: 30 sec
- **Testing time: 60 sec**

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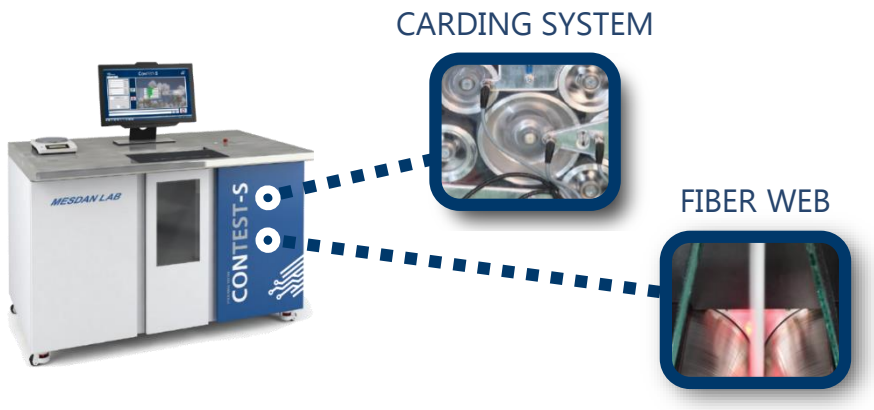
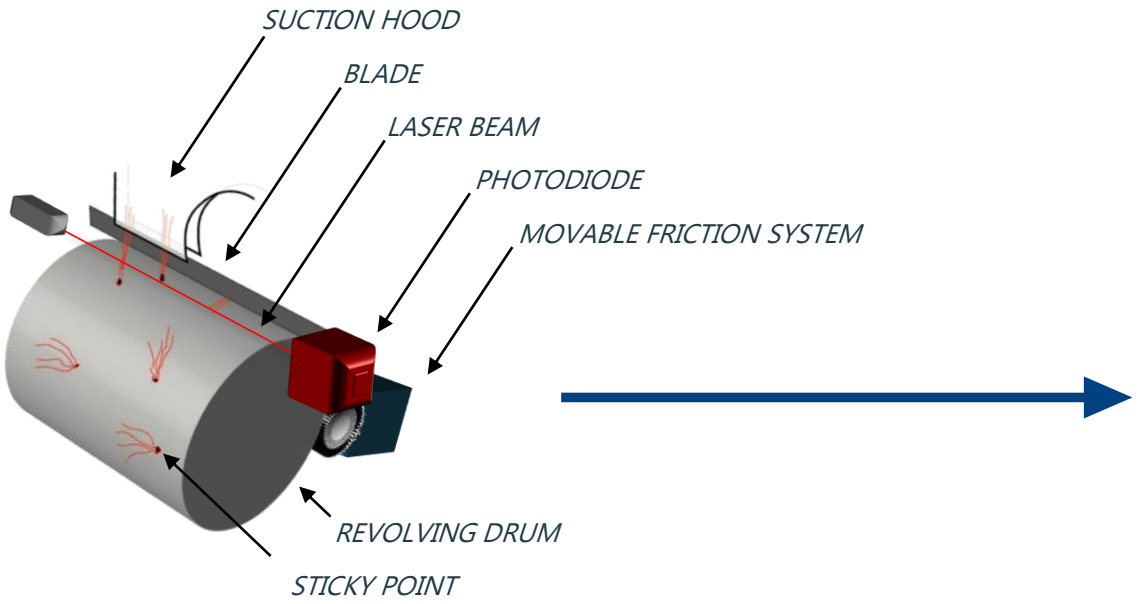
FUNCTION PRINCIPLE





PARAMETERS AND DEFINITIONS

Stickiness Count (St Cnt) [1/g] : tot num. of sticky points

St Count 1 [1/g] : num. of sticky points of CLASS 1

St Count 2 [1/g] : num. of sticky points of CLASS 2

St Count 3 [1/g] : num. of sticky points of CLASS 3

St Count 4 [1/g] : num. of sticky points of CLASS 4

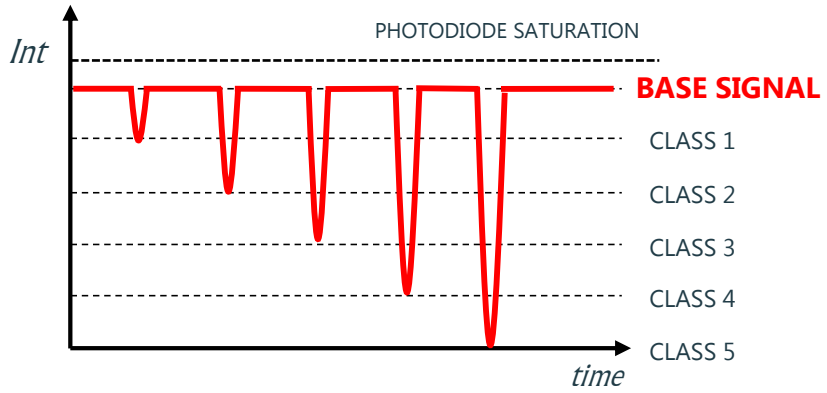
St Count 5 [1/g] : num. of sticky points of CLASS 5

St Avg Size (St Size) [a.u.] : the mean class of St Cnt

STICKINESS GRADE (St Grade) $= \sum_{i=1}^{5}(i \cdot S_i)$

S_i = num. of sticky points of class i

ITMF – ICCTM recognized
see: www.itmf.org



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ITFM – International Committee on Cotton Testing Methods Recognition

ITMF

INTERNATIONAL TEXTILE MANUFACTURERS FEDERATION
FÉDÉRATION INTERNATIONALE DES INDUSTRIES TEXTILES
INTERNATIONALE VEREINIGUNG DER TEXTILINDUSTRIE

The ITMF **International Committee on Cotton Testing Methods (ICCTM)** recognizes for spinning mill / research purposes the following method / instrument:

Stickiness Testing Method for Contest Instruments

manufactured by:

Mesdan Spa.
Via Masserino 6
IT–25080 Puegnago del Garda (BS) / Italy
Tel.: +39(0)365/653142
Fax: +39(0)365/651011
Email: sales@mesdan.it
Website: www.mesdan.it

The Stickiness Testing Method for Contest Instruments is a method for the determination of the stickiness of cotton, based on the thermo-mechanical principle on an automatically prepared thin fibre web.

Recognition of a testing method or instrument means that according to the Committee the instrument manufacturer has provided sufficient information and results from instrument comparison of multiple testing units in order to assess whether the instrument can be usefully applied in textile mills or for research purposes.

Axel Drieling, Committee Chairman
Mona Qaud, Committee Vice Chairwoman
Christian Schindler, ITMF Director General

Mesdan may use this logo for Contest instruments including this recognized method.

ITMF - ICCTM recognized

Zurich, April 2020

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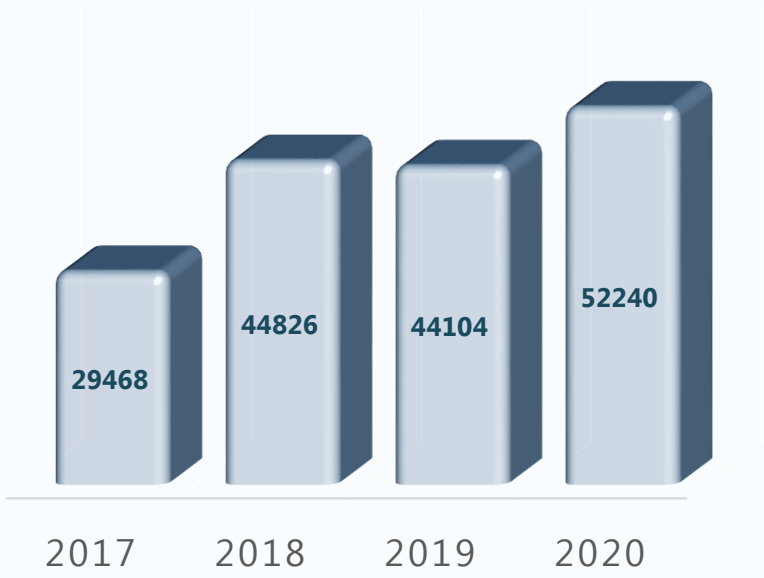
April 2020

Mesdan

Test Volume in 4 Years of Field Testing

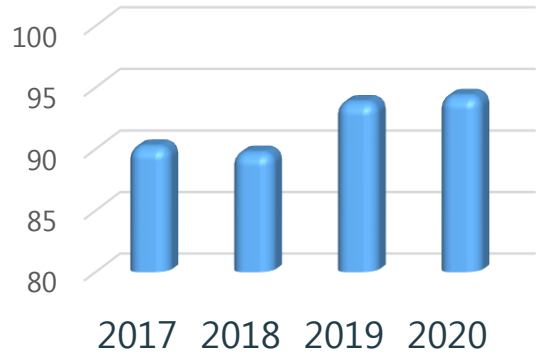
TOTAL NUMBER OF TESTS

170638

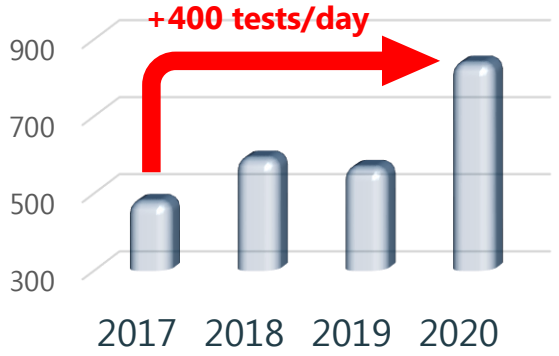


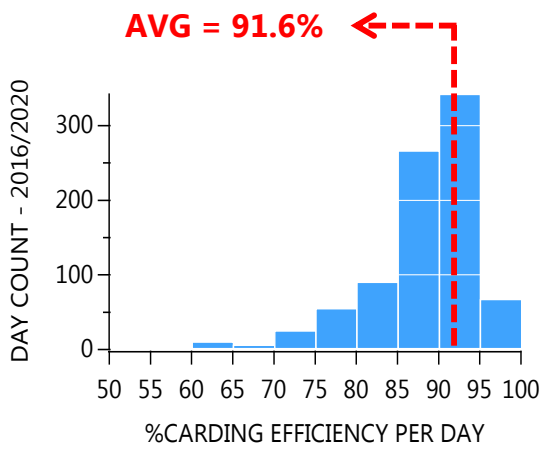
- **Enhanced Volume Test**
- Improved Carding Efficiency
- Doubled Max Num. Test Per Day in 4 Years

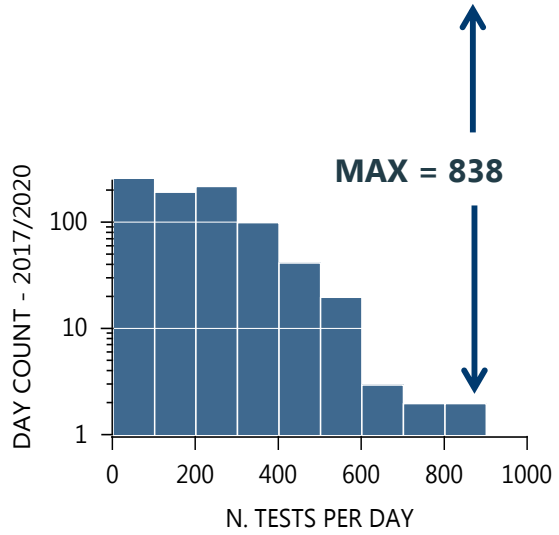
AVG %EFF PER DAY



MAX N. TESTS PER DAY







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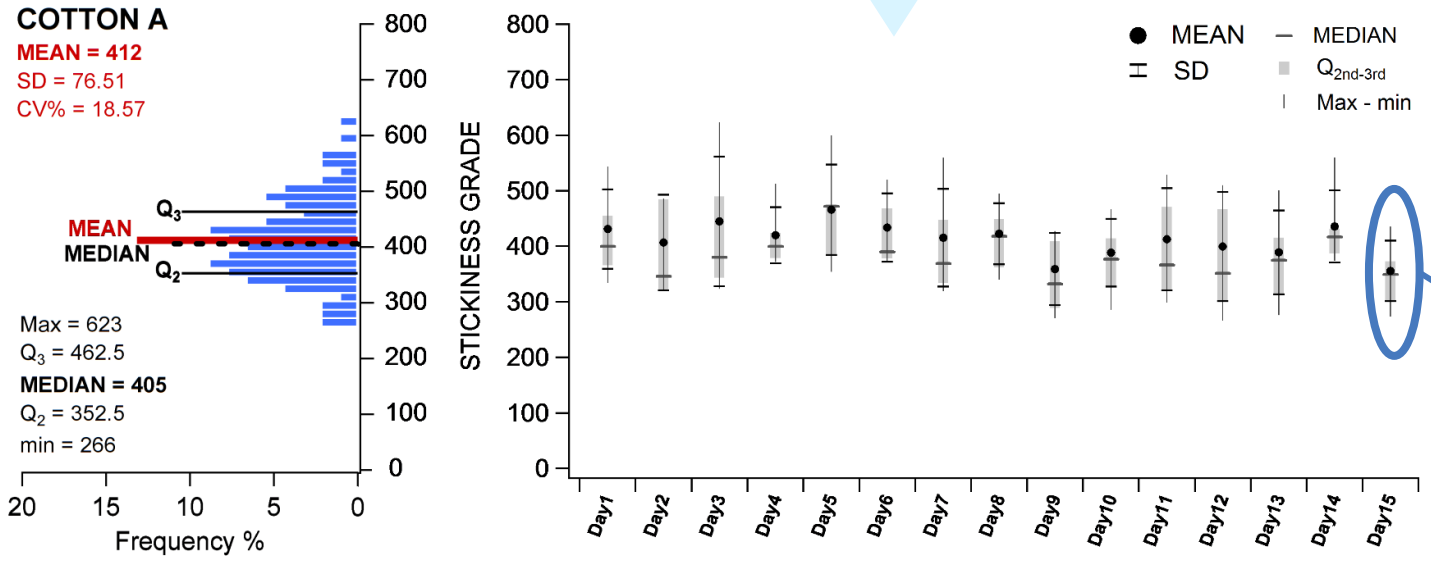
REPEATABILITY

- 5 cotton samples, A-E*
- Fully covered the detection range
- 6 tests/sample for 15 consecutive days (3 weeks)
- Alternating testing sequence (A_1, B_1, …, D_6, E_6)
- Same operator
- Same instrument (CONTEST-S)
- Same laboratory (at manufacturer)

ANOVA (ANALYSIS OF VARIANCE) of daily mean values between the 3 weeks

COTTON	F-calculated	F(0.95;2;12)	EVALUATION
A	0.8510		No significant difference between weeks
B	0.7953		No significant difference between weeks
C	2.7441	**3.8853**	No significant difference between weeks
D	0.6699		No significant difference between weeks
E	0.2980		No significant difference between weeks

EXAMPLE



COTTON A (6 tests)

Day	min	Max	Q2	Q3	Median	Mean	SD	CV%	T (°C)	RH(%)
1	334	544	366	455	400	431	71.4	16.6	21.1	66
2	319	486	320	485	346	407	86.2	21.2	21.3	65
3	323	623	343	490	380	445	116.9	26.3	21.3	66
4	372	513	379	425	400	420	50.3	12.0	21.3	66
5	354	600	386	476	472	466	81.4	17.5	21.4	66
Mean (of 5 days)						**433.6**			**21.3**	**65.8**
Median (of 5 days)						431.0			21.3	66.0
Standard Deviation						22.7			0.11	0.45
CV% between the days						5.2			0.51	0.68
6	373	520	378	468	390	434	61.4	14.2	21.1	66
7	319	559	335	448	369	416	88.2	21.2	21.3	66
8	339	495	363	449	418	423	55.1	13.0	21.1	66
9	270	427	289	409	332	359	64.9	18.1	21.2	66
10	286	467	330	415	377	389	60.8	15.6	21.5	67
Mean (of 5 days)						**403.9**			**21.2**	**66.2**
Median (of 5 days)						415.5			21.2	66.0
Standard Deviation						30.1			0.17	0.45
CV% between the days						7.4			0.79	0.68
11	298	529	320	471	366	413	91.7	22.2	21.1	67
12	266	510	302	467	351	400	98.6	24.7	21.6	65
13	276	501	314	416	375	389	75.6	19.4	20.9	66
14	374	560	387	432	417	436	65.1	14.9	20.6	68
15	273	435	302	373	349	356	54.2	15.3	21.2	65
Mean (of 5 days)						**398.5**			**21.1**	**66.2**
Median (of 5 days)						399.7			21.1	66.0
Standard Deviation						29.7			0.37	1.30
CV% between the days						7.4			1.76	1.97

(*) D = homogenized ; A-B-C-E = mixed

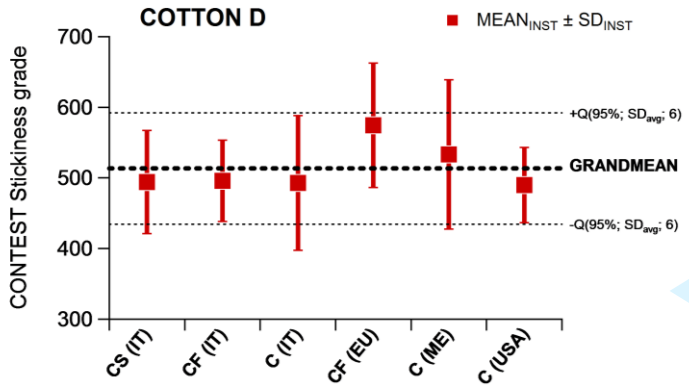
REPRODUCIBILITY

ASTM D1776
T = 21±1°C
RH = 65±2%

COTTON D (6 tests per instrument)						
LABORATORY	MANUFACTURER			CUSTOMERS		
LOCATION	*ITALY*			*EU*	*ME*	*USA*
INSTRUMENT	CS	CF	C	CF	C	C
TEMP (°C)	21.4	21.3	21.6	21.2	20.7	19.4
RH (%)	65.3	64.9	66.2	68.5	64.0	64.0
test 1	419	439	488	680	712	501
test 2	421	444	426	646	565	531
test 3	612	344	379	505	387	494
test 4	489	444	528	544	527	386
test 5	488	488	656	453	498	530
test 6	536	513	480	619	512	497
Mean	**494**	**445**	**493**	**575**	**534**	**490**
Median	489	444	484	582	520	499
SD	73.1	57.8	95.4	88.0	105.9	53.4
CV%	14.8	13.0	19.4	15.3	19.9	10.9
Q95%	73.0	57.8	95.3	87.9	105.8	53.4

Grand Mean of all instruments (6)	**505.0**
Median of all results (36)	497.5
SD of all results (36)	85.6
SD between instruments (6)	44.0
CV% between instruments (6)	8.7

- 4 different laboratories: manufacturer + 3 customers
- 6 different Stickiness Testers involved
- 5 cotton, A-E*, (35 g per sample per lab)
- Delivered with random labels
- Fully covered the detection range
- **<u>6 tests/sample</u>**
- Alternating testing sequence (A_1, B_1, …, D_6, E_6)
- Pre-conditioning of 48 h at least (ASTM D1776)
- Cleaning before starting the RT
- In one day by one operator



EXAMPLE

ANOVA (ANALYSIS OF VARIANCE) within/between instruments for each cotton

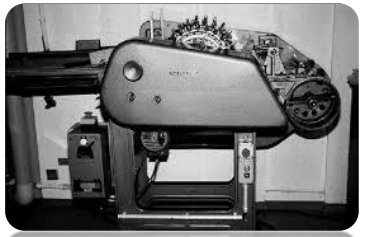
COTTON	F-calculated	F(0.95;5;30)	EVALUATION
A	5.8316		Significant difference between instruments
B	1.8262		No significant difference between instruments
C	2.3177	**2.5336**	No significant difference between instruments
D	1.0486		No significant difference between instruments
E	0.4029		No significant difference between instruments

(*) D = homogenized ; A-B-C-E = mixed

Correlation with Reference Methods

Sharing a Similar Principle of Functioning

Mechanical Detector



Minicard

Thermodetector

SCT

Thermodetector

H2SD

"The tendency of cotton fibers to stick to textile working surfaces"

cen
EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

UNI EN 14278-1 (SCT)
UNI EN 14278-2 (H2SD)
UNI EN 14278-3 (CONTEST)

Stickiness Round Trial from 2017-1 to 2019-2

- 4 different methods (MINICARD, SCT, H2SD, CONTEST)
- About 23 instruments involved
- 26 homogenized samples by CIRAD
- 6 tests per cotton
- Recommended: alternating testing sequence
- Pre-conditioning 24-48 h in ASTM D1776 or ISO-139
- In one day and by one operator

(!) DIFFERENT UNITS
(!) NO DIRECT COMPARISON AVAILABLE

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ITMF-ICCTM RECOGNITION DOCUMENT : *https://www.itmf.org/images/dl/icctm/recognition/Recognition_MESDAN_20200429.pdf*

CORRELATION WITH REFERENCE METHODS

WITHIN METHOD

- Mean values for each RT cotton

BETWEEN METHOD

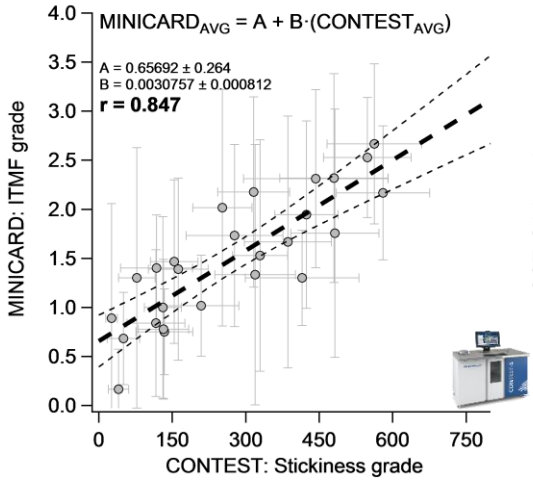
- Bravais-Pearson correlation r

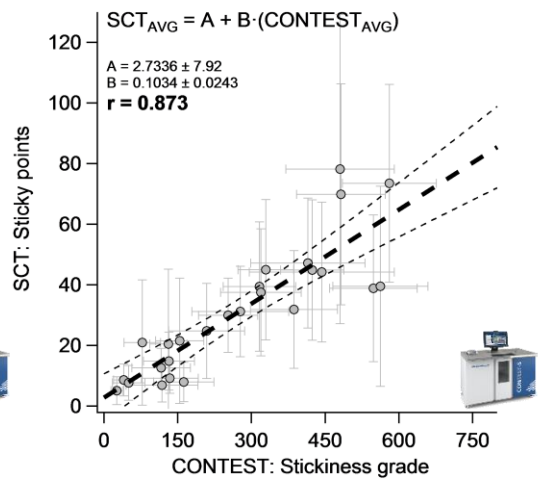
r		x-axis			
		MINICARD	SCT	H2SD	CONTEST
y-axis	MINICARD	1	0.701	0.884	0.847
	SCT	0.701	1	0.822	0.873
	H2SD	0.884	0.822	1	0.901
	CONTEST	0.847	0.873	0.901	1

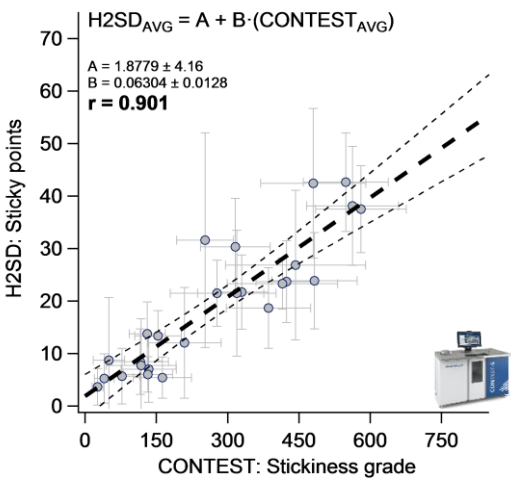
- Conversion Rule :

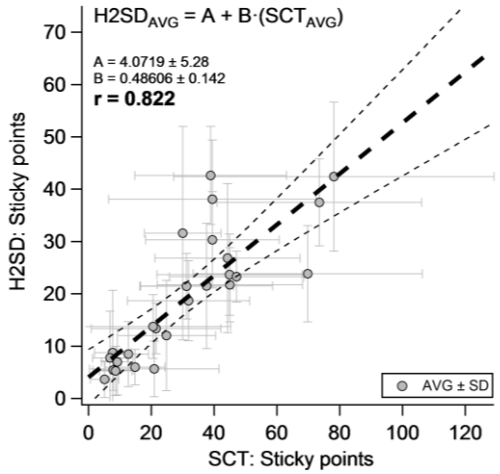
REF METHOD = A + B · **CONTEST**

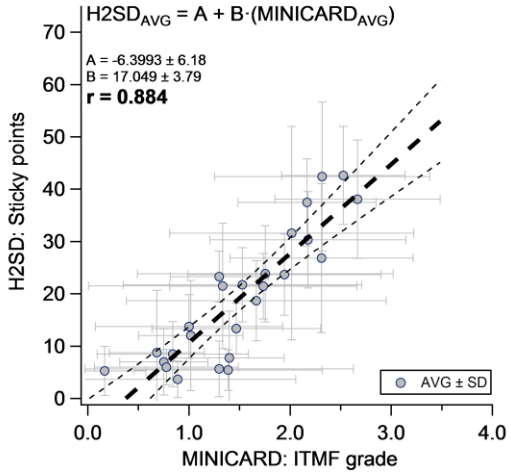
METHOD	r	A	B
H2SD	**0.901**	1.8779	0.06304
SCT	**0.873**	2.7336	0.1034
MINICARD	**0.847**	0.65692	0.0030757

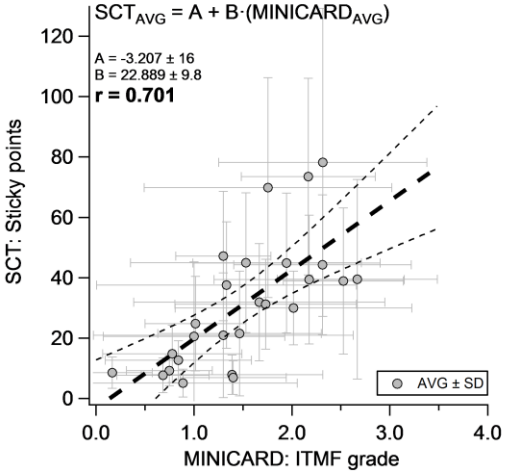












CORRELATION WITH REFERENCE METHODS

WITHIN METHOD

- Mean values for each RT cotton

BETWEEN METHOD

- Bravais-Pearson correlation r

r		x-axis			
		MINICARD	SCT	H2SD	CONTEST
y-axis	MINICARD	1	0.701	0.884	0.847
	SCT	0.701	1	0.822	0.873
	H2SD	0.884	0.822	1	0.901
	CONTEST	0.847	0.873	0.901	1

- Conversion Rule :

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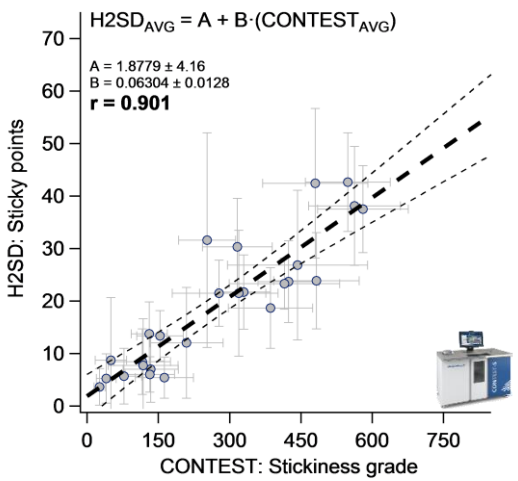
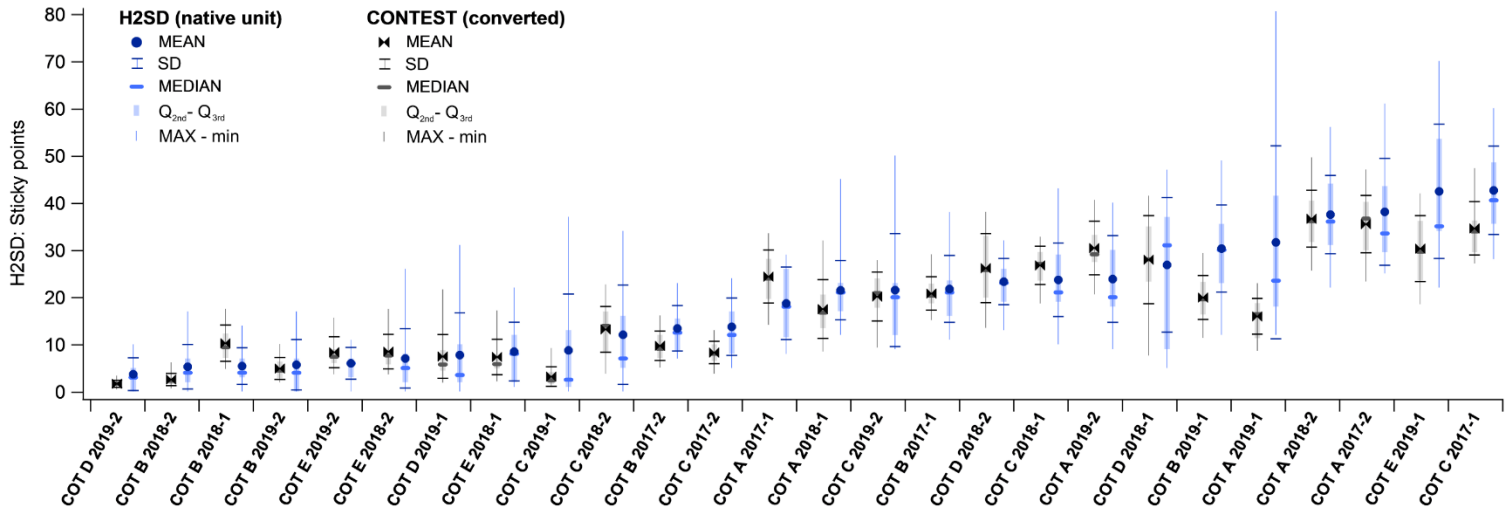
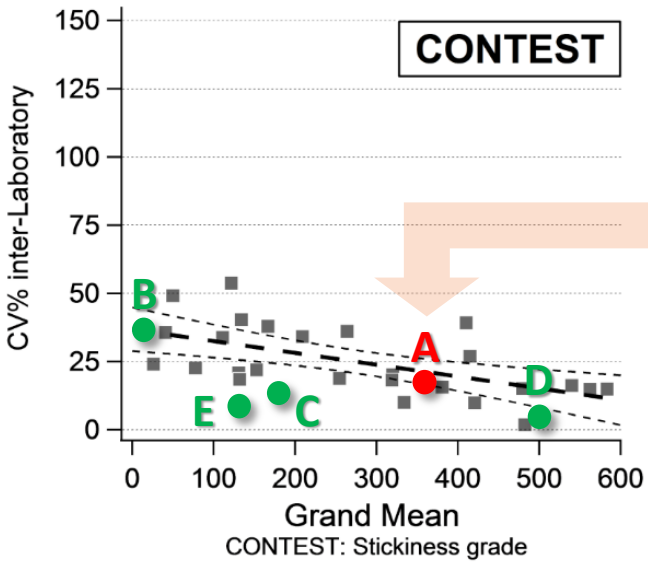




INTER-LABORATORY VARIABILITY

FOR EACH COTTON OF THE STICKINESS ROUND TRIAL FROM 2017-1 TO 2019-2

- Inter-Laboratory CV% of mean values
- vs Stickiness Grand Mean
- Direct comparison among methods
- Independent of method unit



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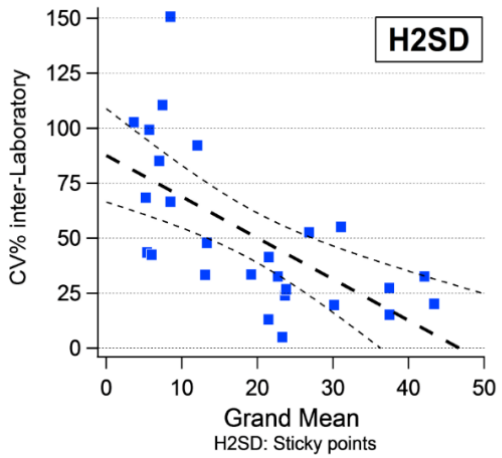
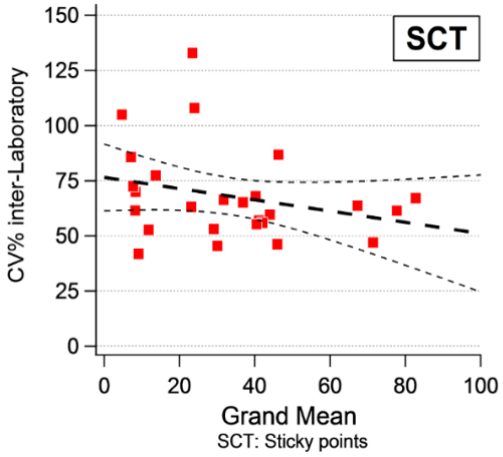
A	5.8316	
B	1.8262	
C	2.3177	**2.5336**
D	1.0486	
E	0.4029	

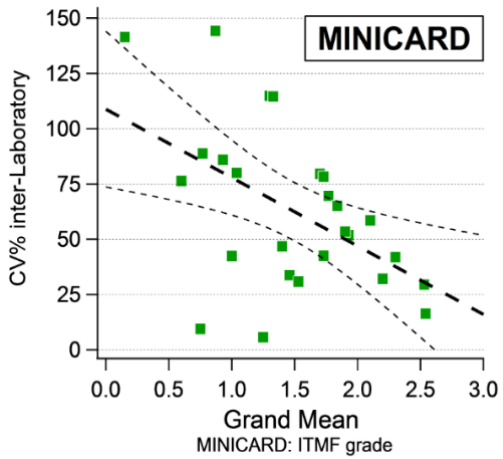
STICKINESS GRADE

CV%(6)	GMEAN (6)
23%	358
34%	28
14%	187
9%	505
11%	136

METHOD	$\overline{CV}_{interLab}$
CONTEST	25.0%
H2SD	51.6%
SCT	68.0%
MINICARD	62.8%







FINAL SUMMARY

- ❑ 4 year field testing >170000 tests
- ❑ Carding Efficiency >90%
- ❑ Max num. tests > 800/day
- ❑ ITMF-ICCTM recognized in April 2020
  - *5 cotton samples (homogenized/mixed)*
  - *26 homogenized cottons (ITMF Stickiness RT)*

❑ REPEATABILITY PASSED

- ANOVA: 5/5 samples
- 15 days

COTTON	F-calculated	F(0.95;2;12)	EVALUATION
A	0.8510	**3.8853**	No significant difference between weeks
B	0.7953		No significant difference between weeks
C	2.7441		No significant difference between weeks
D	0.6699		No significant difference between weeks
E	0.2980		No significant difference between weeks

❑ REPRODUCIBILITY PASSED

- ANOVA: 4/5 cottons
- 6 instruments

COTTON	F-calculated	F(0.95;5;30)	EVALUATION
A	5.8316	**2.5336**	Significant difference between instruments
B	1.8262		No significant difference between instruments
C	2.3177		No significant difference between instruments
D	1.0486		No significant difference between instruments
E	0.4029		No significant difference between instruments

❑ REFERENCE METHODS & ROUND TRIALS

- 3 reference: SCT, H2SD, MINICARD
- High correlations with all methods

r		x-axis			
		MINICARD	SCT	H2SD	CONTEST
y-axis	MINICARD	1	0.701	0.884	0.847
	SCT	0.701	1	0.822	0.873
	H2SD	0.884	0.822	1	0.901
	CONTEST	0.847	0.873	0.901	1

- Lowest CV% inter-lab

METHOD	$\overline{CV}_{interLab}$
CONTEST	25.0%
H2SD	51.6%
SCT	68.0%
MINICARD	62.8%

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