



ENFSI - Proficiency Testing Programme in Forensic GSR and Firearms Investigation

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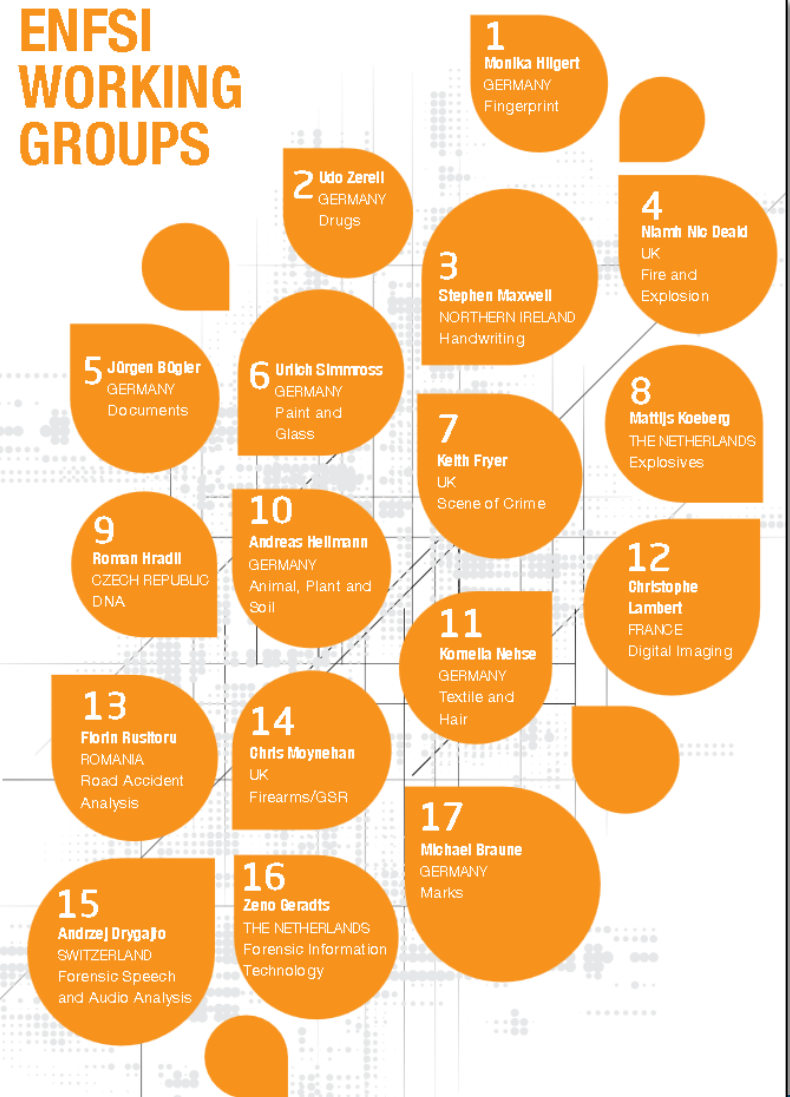


ENFSI

European Network of Forensic Science Institutes

- **63 members in**
- **36 EU countries**
- **17 working groups**
+ QC-C, R&D-C
- **EWG Firearms/GSR**

ENFSI WORKING GROUPS



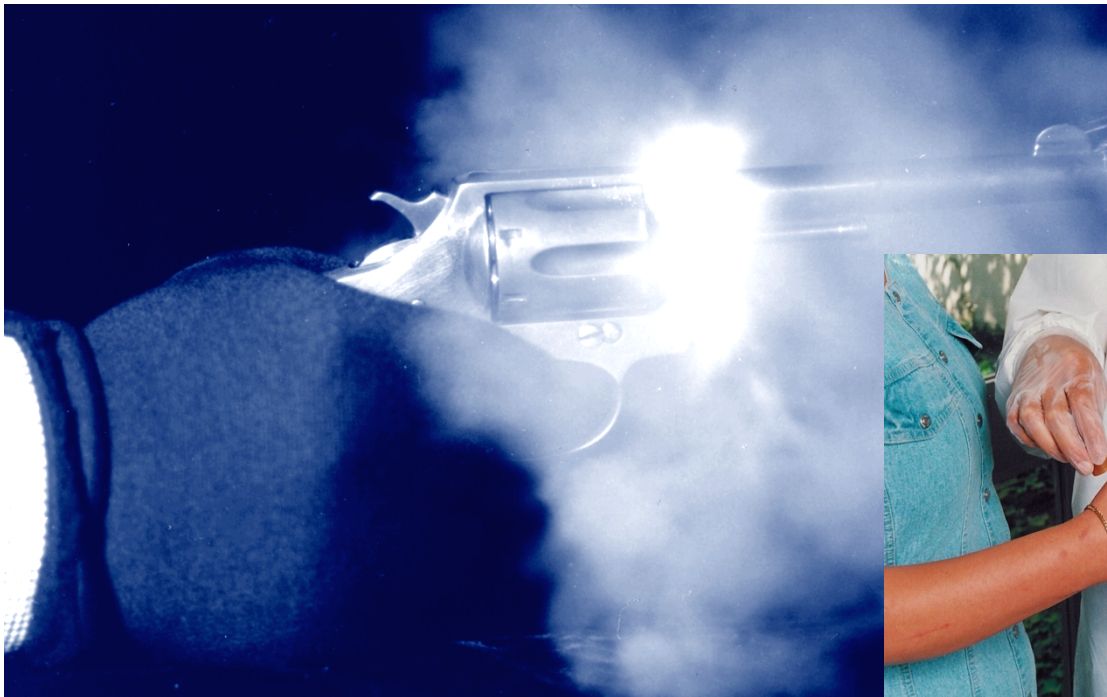


PT Programme of EWG Firearms/GSR

- **GSR 1999 – GSR2014**
- **FAID 2009 – FAID 2012**
- **FDSD 20012 – FDSD 2015**



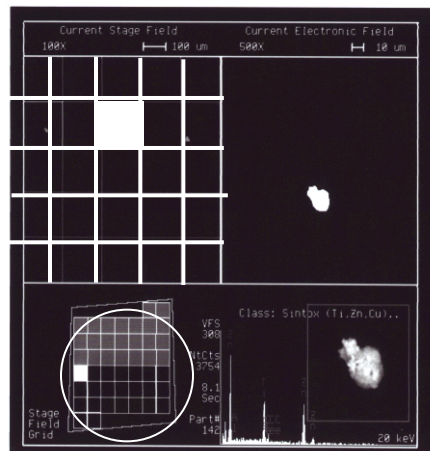
Sampling of GSR



Detection & ID of GSR by SEM/EDS



- The complete surface of a stub is searched using a motorized stage
- For each field a BSE image (Z contrast) is acquired
- Image analysis based on a defined brightness threshold
- All particles brighter than the threshold are analysed by EDS
- Particle classification and ranking based on their chemical composition
- Manual review and confirmation of possible GSR particles by the SEM operator based on EDS spectrum and particle morphology





Criteria to identify GSR

- The foundation for the identification of GSR by SEM/EDS was laid in the famous "Aerospace report" in 1977
Wolten, G. M., Nesbitt, R. S., Calloway, A. R., Loper, G. L., and Jones, P. F. "Final Report On Particle Analysis For Gunshot Residue Detection". Segundo, CA, Aerospace Corporation, **1977**.
- ASTM Standard Guide E1588-10^ε ; (2010)

ASTM INTERNATIONAL
Designation: E1588-10^ε
Standard Guide for Gunshot Residue Analysis by Scanning Electron Microscopy/Energy Dispersive X-ray Spectrometry
This standard is issued under the fixed designation E1588; the number 10 indicates the year of original adoption or, in the case of subsequent revision, the year of approval. A superscript epsilon (ϵ) indicates an editorial change since the original standard was approved.
e¹ NOTE—Sections 7.1.5.2 and 7.2.1.1.

ENFSI
Expert Working Group on Firearm Residue Analysis
SWGGSR

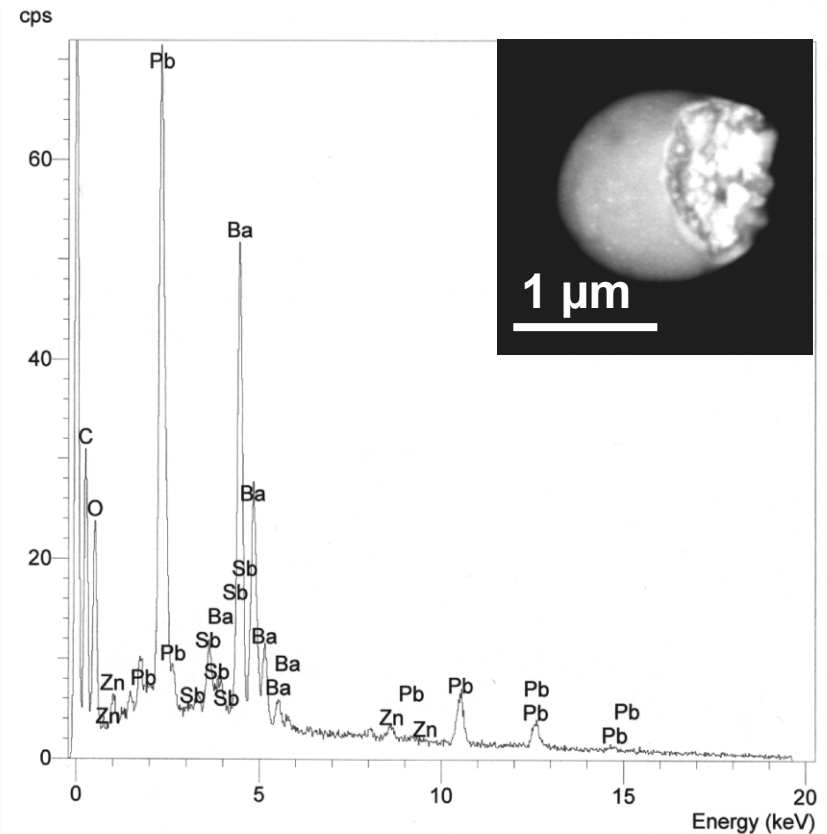
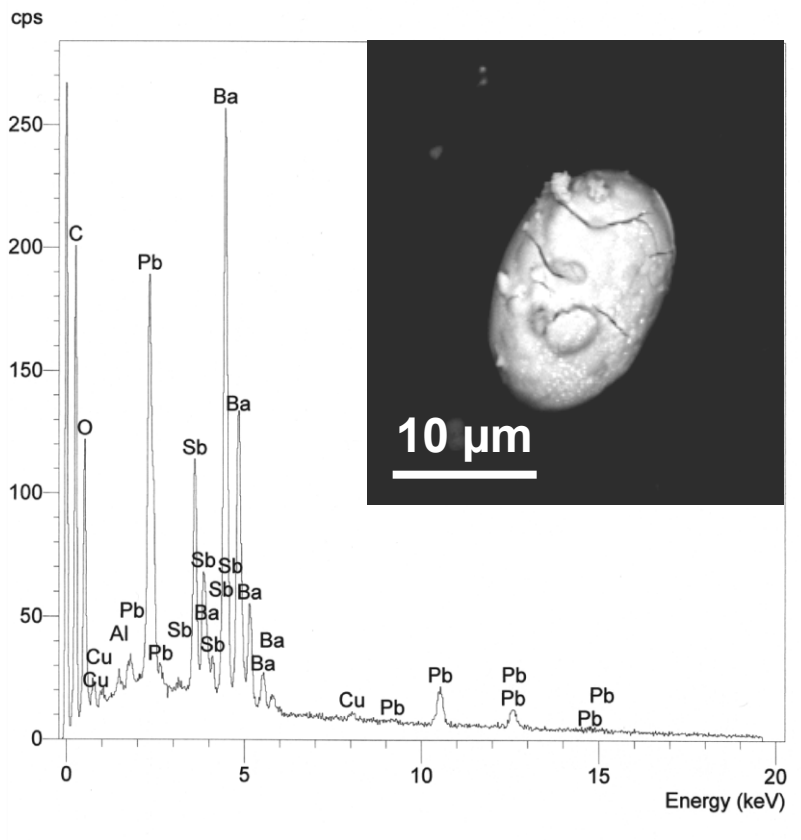
ENFSI—Guide for Gunshot Residue Analysis by Scanning Electron Microscopy/Energy Dispersive X-ray Spectrometry 11-29-11

Bundeskriminalamt
Justitie
Nederlands Forensisch Instituut



PT on GSR - obstacles

SINOXID-type (Pb Ba Sb)



PT on GSR – test sample

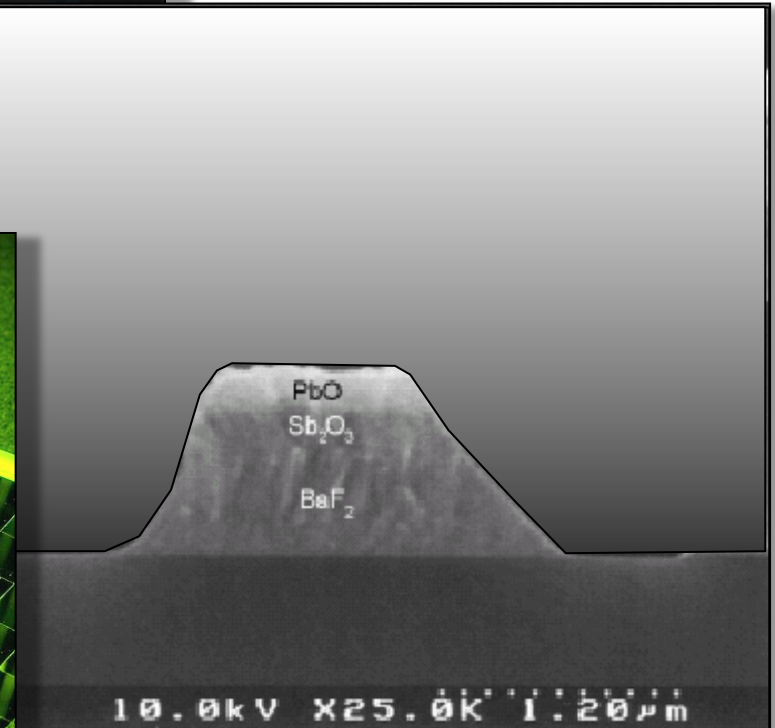
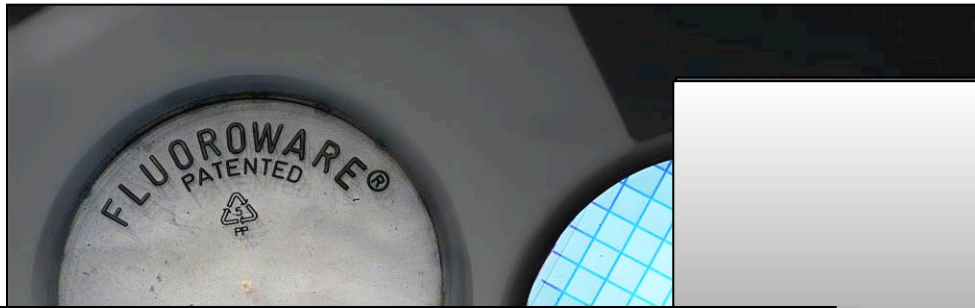
- The synthetic GSR samples used in the PTs is a key element in validation and surveillance of the particle detection process.
- Important features of the GSR-standard as reference material:
 - Defined number, size, position of the particles
 - Defined chemical composition
 - High sample stability
 - Can be examined in the same way as samples from real cases.



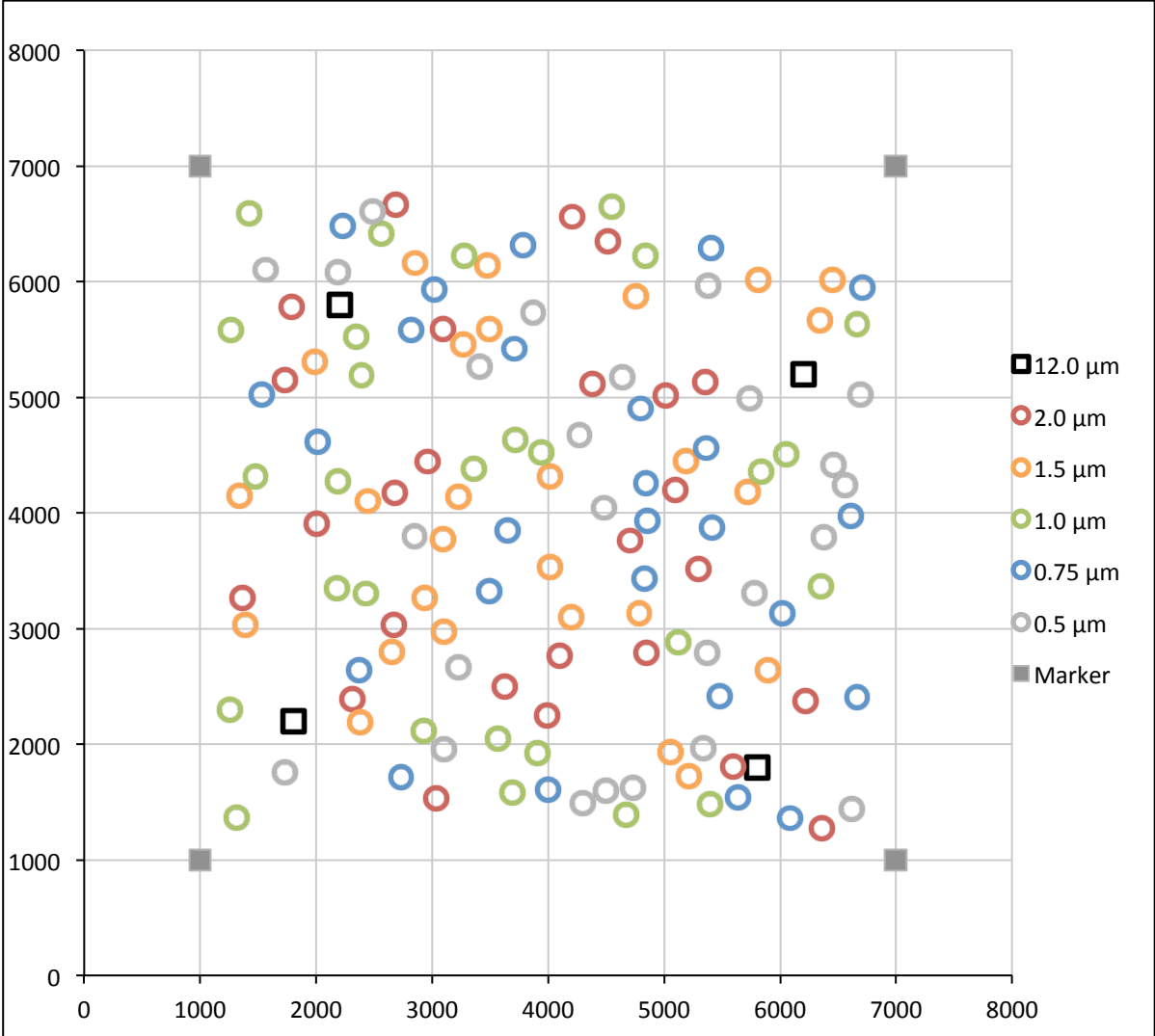


PT on GSR – production process

Deposition on Si or glassy carbon wafers structured by photo lithography



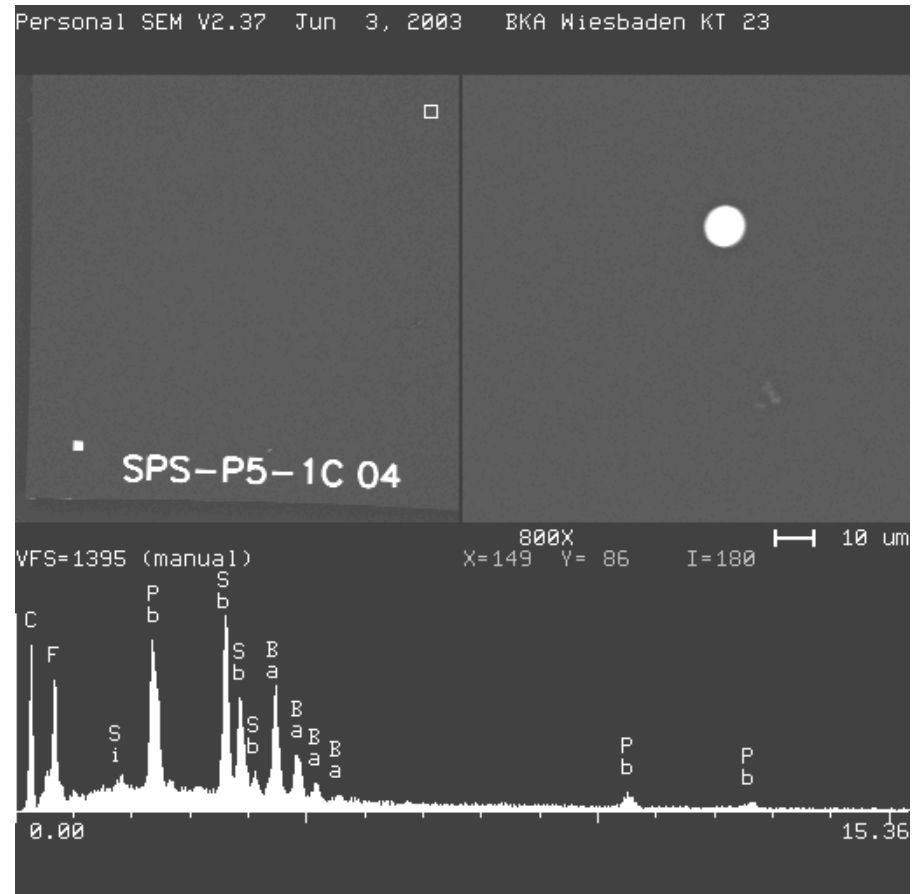
PT on GSR (2015)





PT on GSR

PT sample 2003





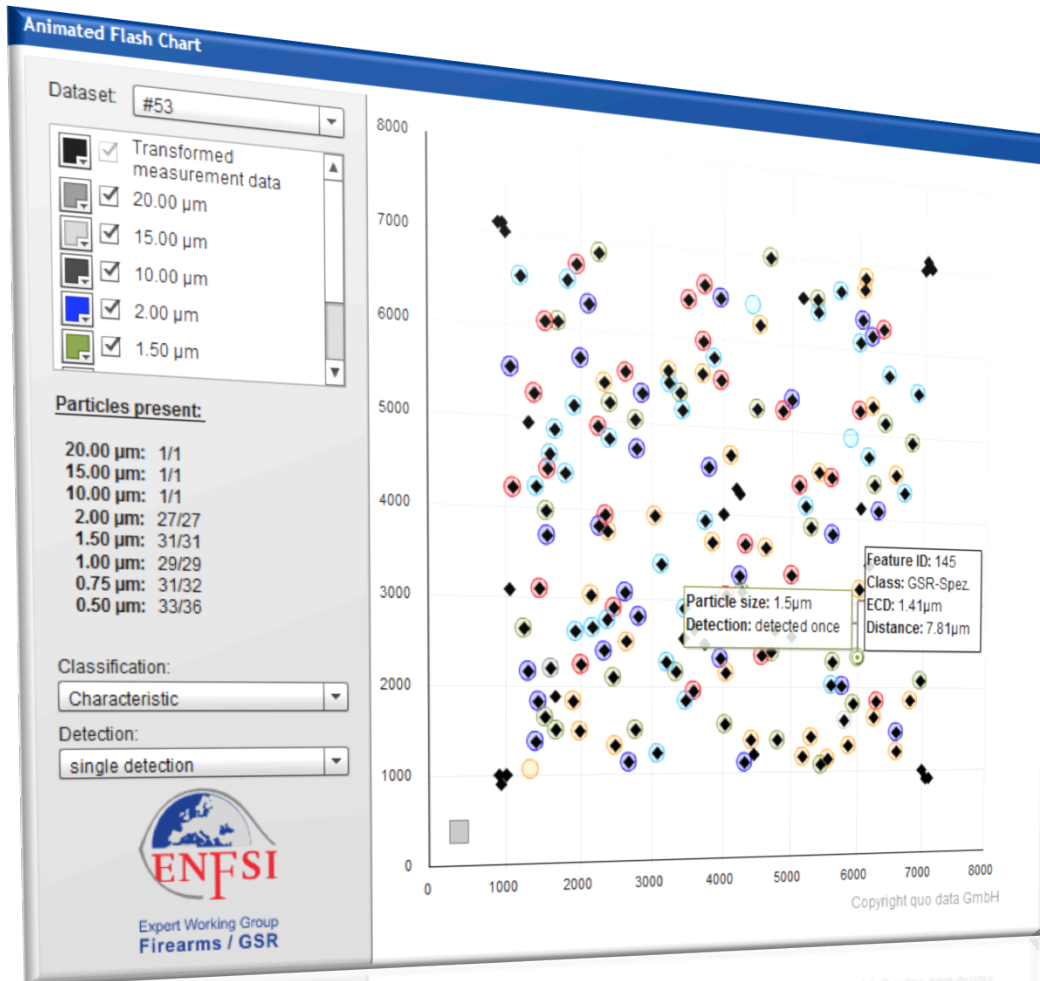
PT on GSR

- A test scheme for a PT for the identification of GSR using SEM/EDS was developed in EU-funded projects by the ENFSI WG Firearms/GSR based on a synthetic particle standard.
- International PTs: GSR2003, GSR2005, GSR2008, GSR2010, GSR2011, GSR2012, ..., GSR2014
- In 2009 the organisation has been transferred from the EWG FA/GSR to the company quodata in Dresden.
- GSR2015 just finished





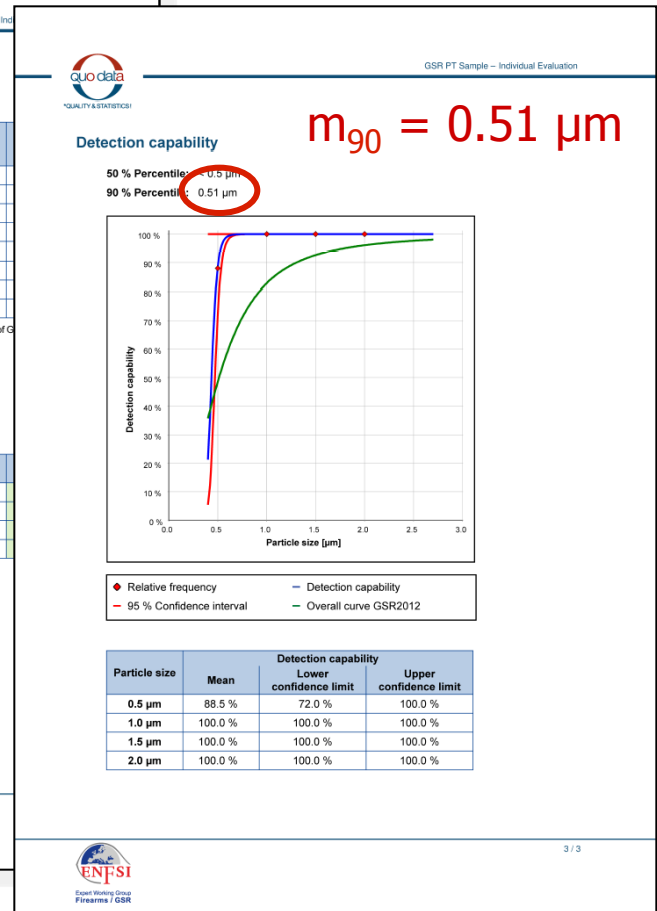
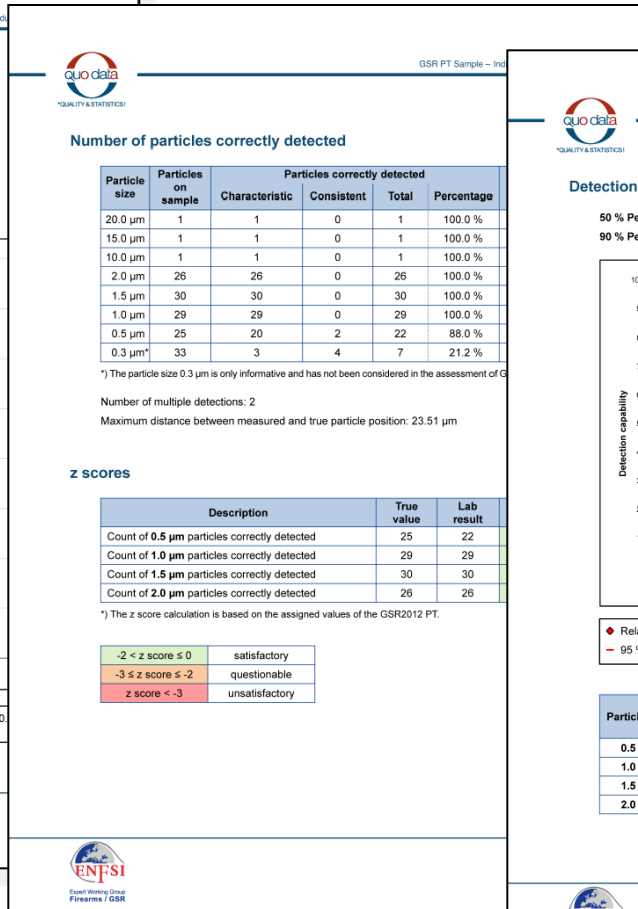
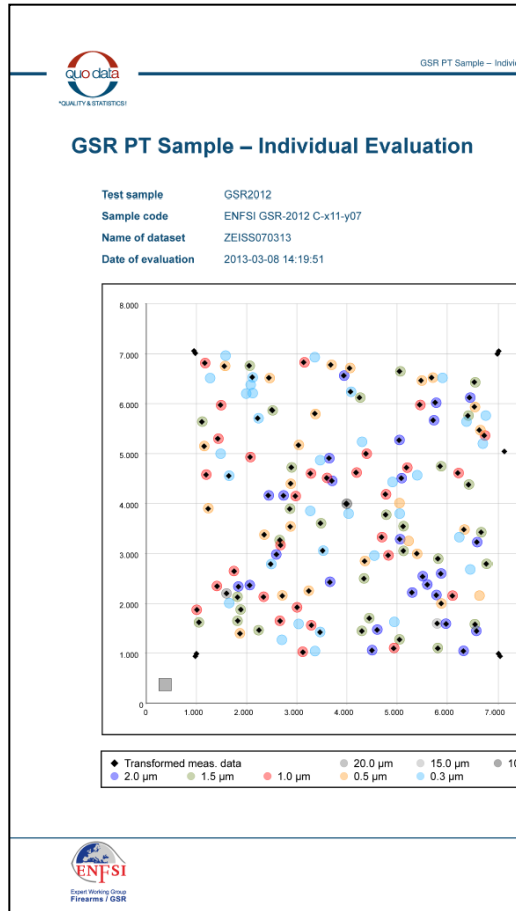
PT on GSR - evaluation



- GSR PT Sample – Individual Evaluation provides a web interface for the automatic online evaluation of data in the context of GSR PT samples.
- The website address is
- <http://gsr-ie.quodata.de>
- This tool is intended for the purpose of quality assurance.
- For participants of GSR2015 this tool is available free of charge for one year.



PT on GSR - evaluation





Additional applications

- Quality control / quality check
- System monitoring
- System validation



Monitoring System Performance

- Case 1: $m_{90} \leq 0.8 \mu\text{m}$
 - **Continue with case work**
- Case 2: $0.8 \mu\text{m} < m_{90} \leq 1.0 \mu\text{m}$
 - Happened the first time: **shorten control intervall**
 - Happened the second consecutive time: continue with case 3
- Case 3: $m_{90} > 1.0 \mu\text{m}$
 - **Stop case work with the instrument, inform head of the section**
 - Find appropriate corrective actions, check relevance for previously issued results, document the actions.
 - Run the GSR-standard again and check the results
 - If the results now fulfill the requirements, the head of section can authorize the continuation of case work.
 - All actions have to be recorded.

Geräteüberwachung REM/EDX KT23

Sachbearbeiter/- in: _____ Messdatum: _____

Gerätebezeichnung: _____ Geräte-ID: _____

Verwendete GSR-Standardprobe: 23NR021_001 (GSR2012-C)
 23NR021_002 (GSR2012-A)

Ergebnis der letzten Kontrollmessung: bestanden verkürztes Intervall nicht bestanden

Ergebnisse der Kontrollmessung:

Größenklasse	Anzahl (Soll)	Anzahl (gef.)
2,0 μm	26	
1,5 μm	30	
1,0 μm	29	
0,5 μm	25	
0,3 μm	33	

$m_{90} = \text{_____} \mu\text{m}$

Hat das Gerät die Kriterien für den Einsatz in der Fallarbeit erfüllt? ja nein
Die Kriterien gelten als erfüllt, wenn $m_{90} \leq 0.8 \mu\text{m}$ erzielt wird. Wenn $0.8 \mu\text{m} < m_{90} \leq 1.0 \mu\text{m}$ erreicht werden und die letzte Kontrollmessung bestanden wurde, gelten die Kriterien ebenfalls als erfüllt. In diesem Fall ist das Gerät nach einem verkürzten Kontrollintervall (i.d.R. 14 Tage) erneut zu prüfen.

Verkürztes Kontrollintervall erforderlich? ja nein

Zusatzinformationen: *Hinweise auf Feldüberlappung (Doppeldetektion)?* ja nein

Anlagen: Messprotokoll, Auswertung

(Datum, Unterschrift SB)

Bei Nichterfüllung der Kriterien:

	Datum	Unterschrift
Kennisnahme Fachbereichleiter/-in		
Sperrung des Gerätes für die Fallarbeit		
Maßnahmen zur Fehlerkorrektur / Relevanz für bereits erstellte Berichte und Gutachten (ggf. Anlage):		
Erneute Geräteüberprüfung (→ neues Formular)		

Formular zu AA-23007 Version 7 Seite 1 von 1
AA-23007_Geräteüberwachung REM 001.doc



PT Programme of EWG Firearms/GSR

Overview

- **GSR 1999 – GSR2014**
- **(FAID 2005) - FAID 2009 – FAID 2012**
- **FDSD 2012 – FDSD 2015**



FAID 2012

49 participants, 25 countries:

Europe:

Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France (2), Georgia, Germany (6), Greece, Ireland, Italy (5), Lithuania (2), Netherlands, Norway, Portugal, Slovenia, Spain (3), Sweden, Switzerland, United Kingdom (9)

Other:

Australia / New Zealand (2), Israel, USA (3)

47/49 results sent in (response: 96%)

FAID 2012 – test sets

- 10 test sets, 2 controls and 1 unknown
- Castings of bullets (6) and cartridge cases (4)
- 5 sets copper-coated





FAID 2012 – conclusion scale

A: identification, positive, one firearm used

B: a possible identification, the examination still raised some doubts, the amount of matches found is insufficient for an identification or there is some doubt about the distinctive value of the marks matching

C: inconclusive, one or two firearms used

D: a possible exclusion, the examination still raised some doubts, the amount of differences found is insufficient for an exclusion or there is some doubt about the distinctive value of the marks mismatching

E: exclusion, negative, two firearms used

(for FAID2005: different class characteristics, FAID2009: also same class characteristics, different characteristic marks)

Z: not useable for comparison



FAID 2012 - results

test set	castings of bullets or cartridge cases	number of times a conclusion was given						one or two weapons
		A	B	C	D	E	Z	
A	bullets	40 (4*)	3	0	0	0	0	1
B	bullets	32 (2*)	8	4	0	1	0	1
C	bullets	2	5	25	8	7	0	2
D	cartridge cases	1	2	3	13	28	0	2
E	cartridge cases	1	7	32	2	1	4	1
F	bullets	35	9	2	0	0	1	1
G	bullets	0	3	5	11	28	0	2
H	cartridge cases	47	0	0	0	0	0	1
J	cartridge cases	0	1	1	2	43	0	2
K	bullets	7 (1*)	9	17	9	4	0	1

FAID 2012 - results

With mismatched LI# removed (correct conclusion reached)

Group	error	FAID2009	FAID2012
1	none	56% (36)	55% (26)
2	tendency	11% (7)	30% (14)
3	1 false ID or exclusion	19% (12)	11% (5)
4	2 false IDs / exclusions	11% (7)	4% (2)
5	3+ false IDs / exclusions	3% (2)	0% (0)

P. Pauw-Vugts, et al.; "FAID2009: Proficiency Test and Workshop";
AFTE Journal - -vol 45, no 2 - - Spring 2013



PT Programme of EWG Firearms/GSR

Overview

- **GSR 1999 – GSR2014**
- **FAID 2009 – FAID 2012**
- **FDSD 2012 – FDSD 2015**



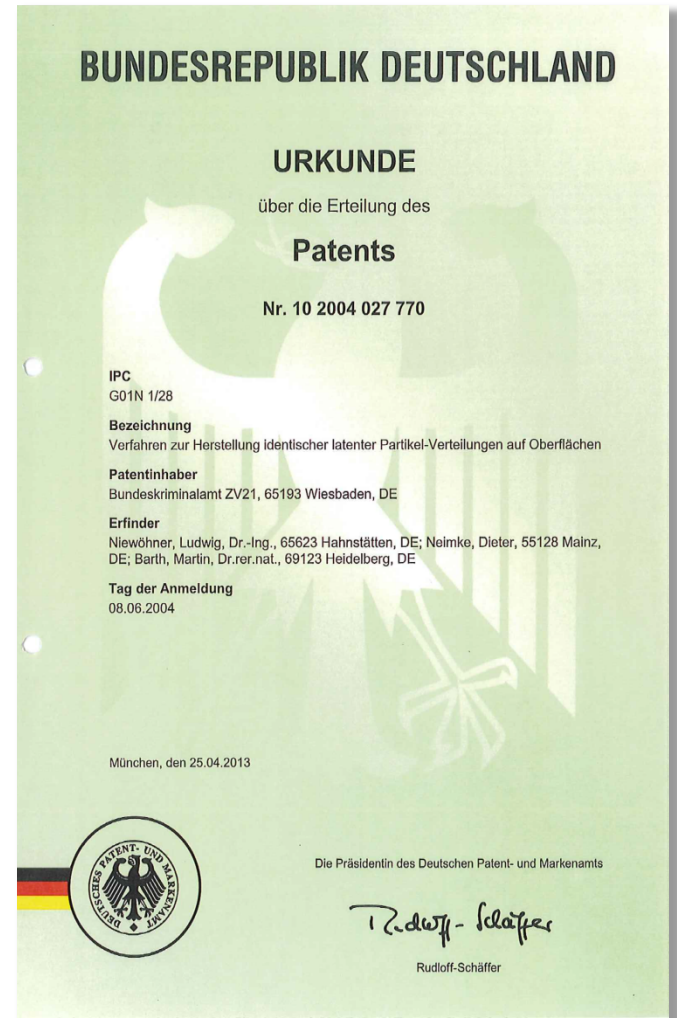
FDSD 2015

Specific features:

- Identical copies of "real" pattern
- Produced on fabric
- Using own SOPs
- Patent protected method (BKA)

Assessment on:

- Colouring process
- Shot range estimation





FDSD 2015

49 participants, 25 countries:

**Europe:
40 participants**

**Other:
Australia (2), Israel (1), Russia (2), USA (4)**

45/49 results sent in (response: 92%)



FDSD 2015

Sample sets:

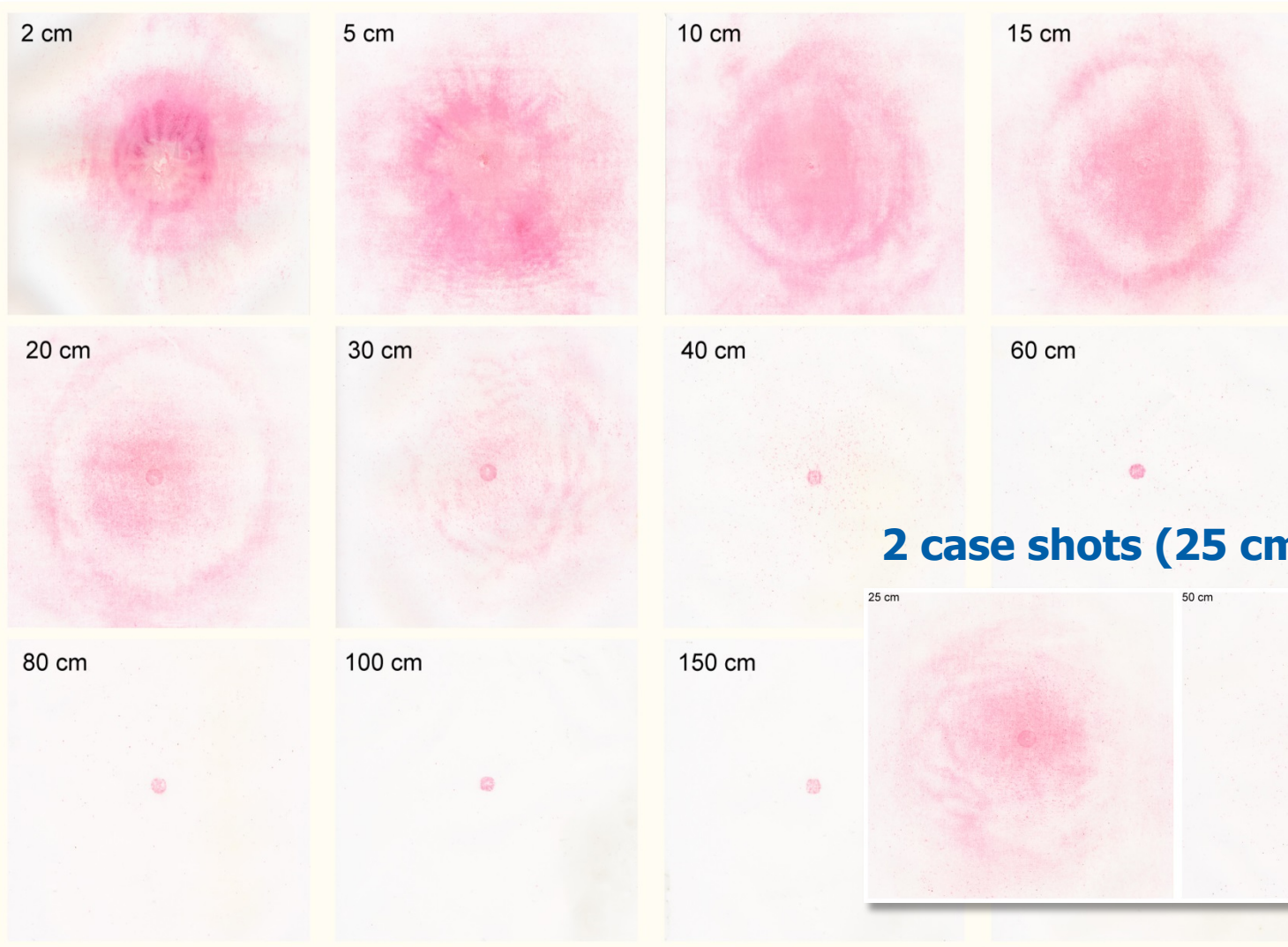
- **10 comparison shots, 2 case shots**
- **description, colour chart, questionnaire**

Assigned task:

- **Perform colouring process according to SOP**
- **Rank the 2 case shots**
- **Estimation of shooting range (upper/lower limit)**
- **Wording in the report**

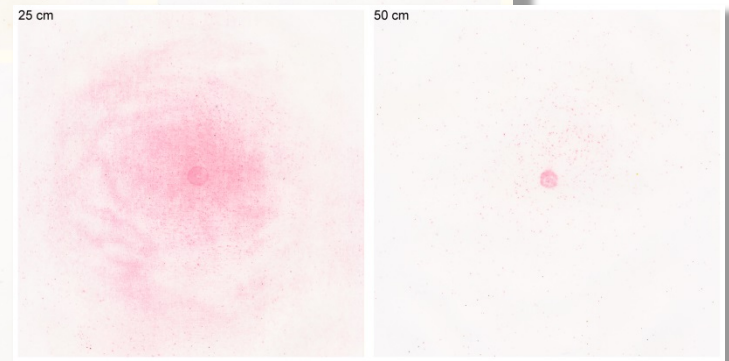


FDSD 2015



**Test
shot
series;
12 dist.**

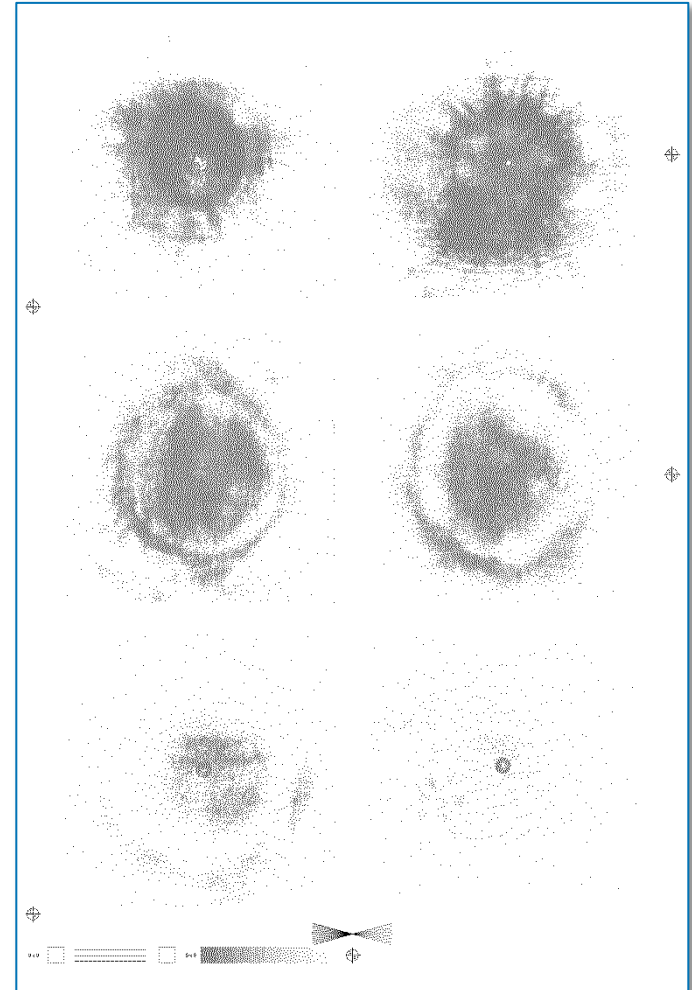
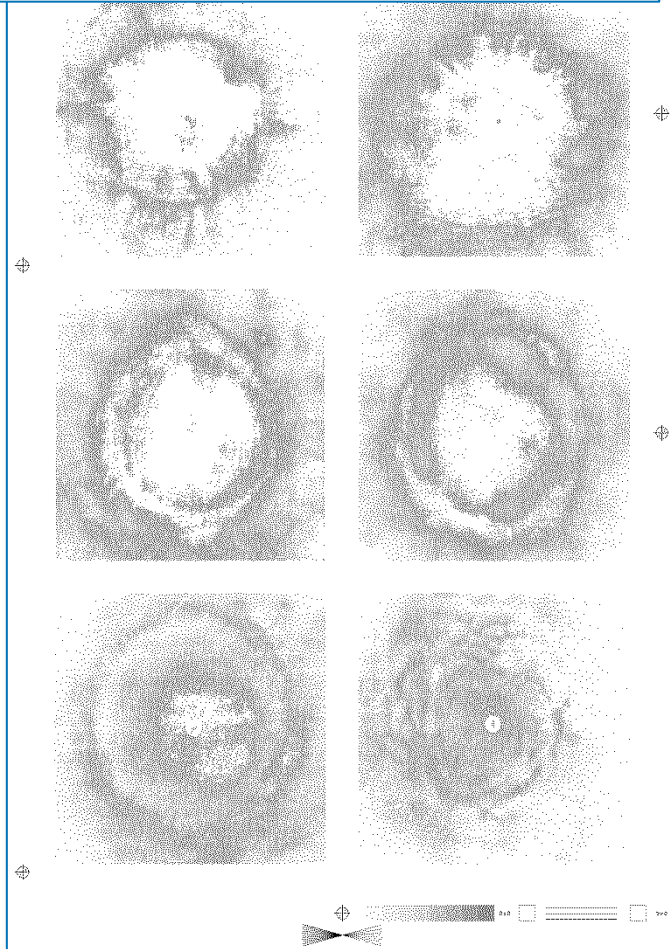
2 case shots (25 cm, 50 cm)





FDSD 2015

correlated sieves (A1 format)

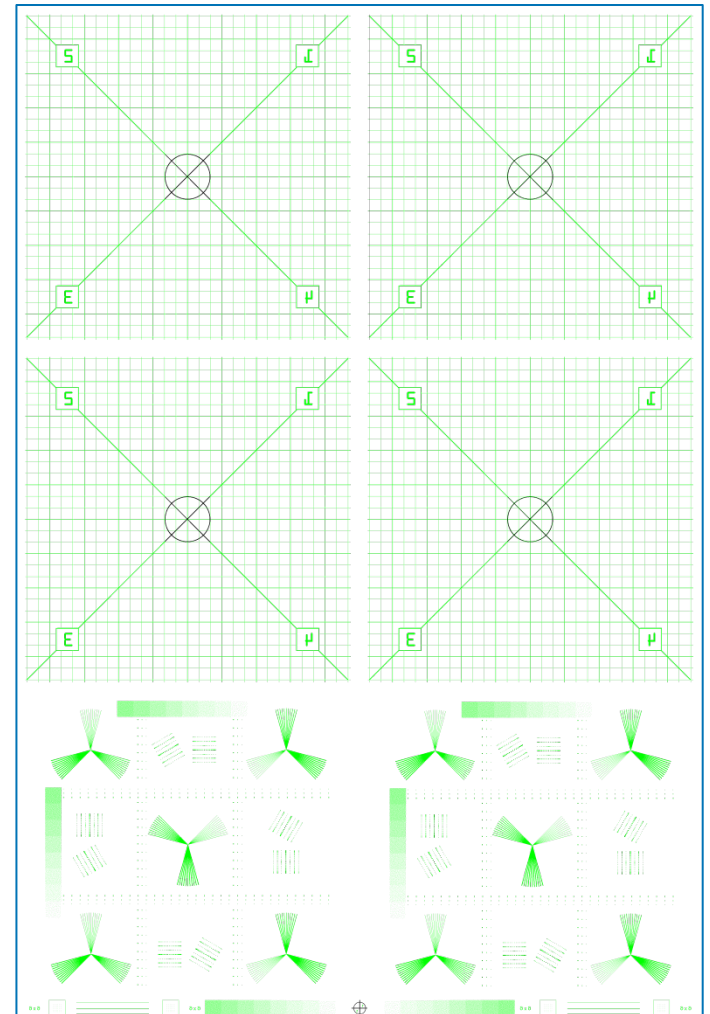




FDSD 2015

2 extra samples:

- Homogeneity test
- Resolution test





Screen printing machine



Inserting the sieve



Applying the PbCO_3 paste for areas of lower saturation...



Printing...

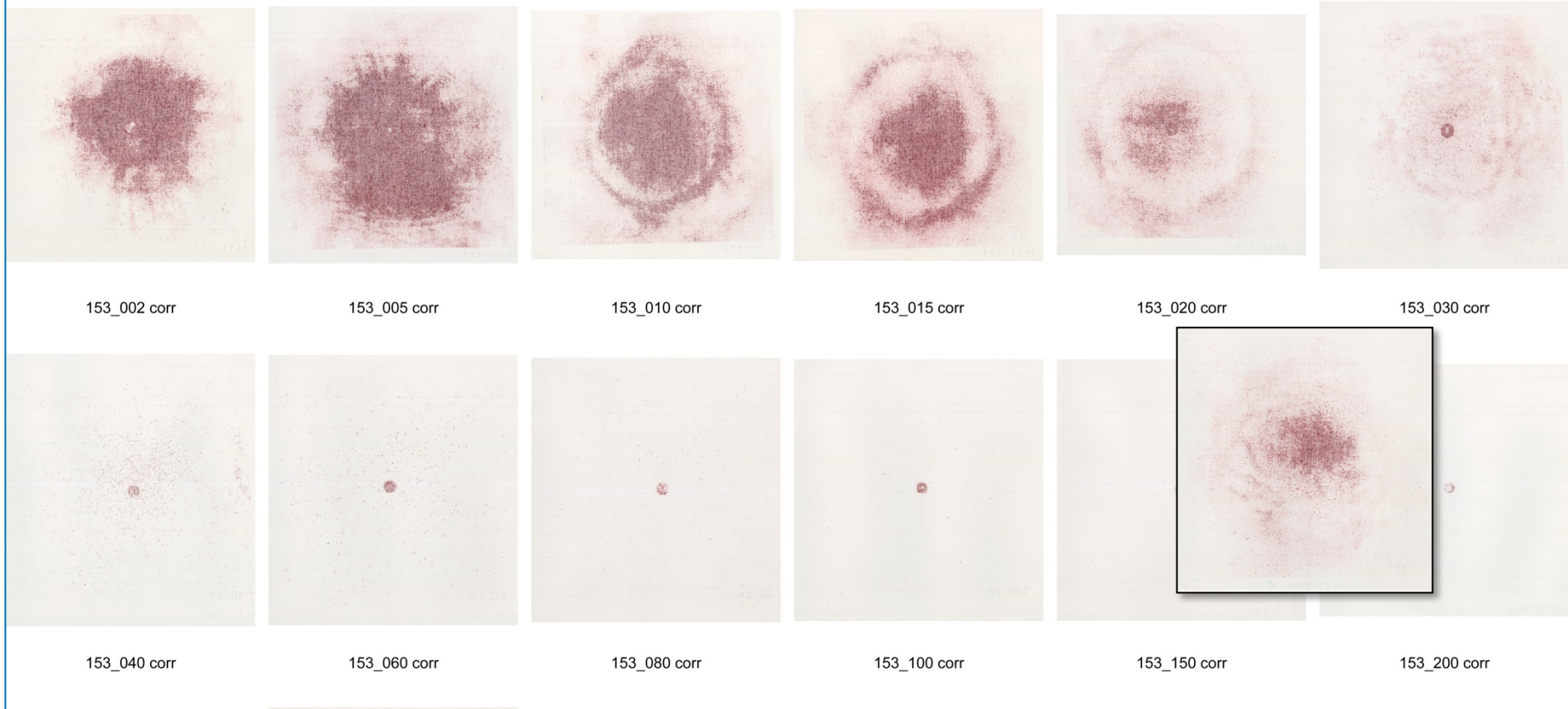


Cutting the fabric into pieces...



Overview images / examples: photo paper

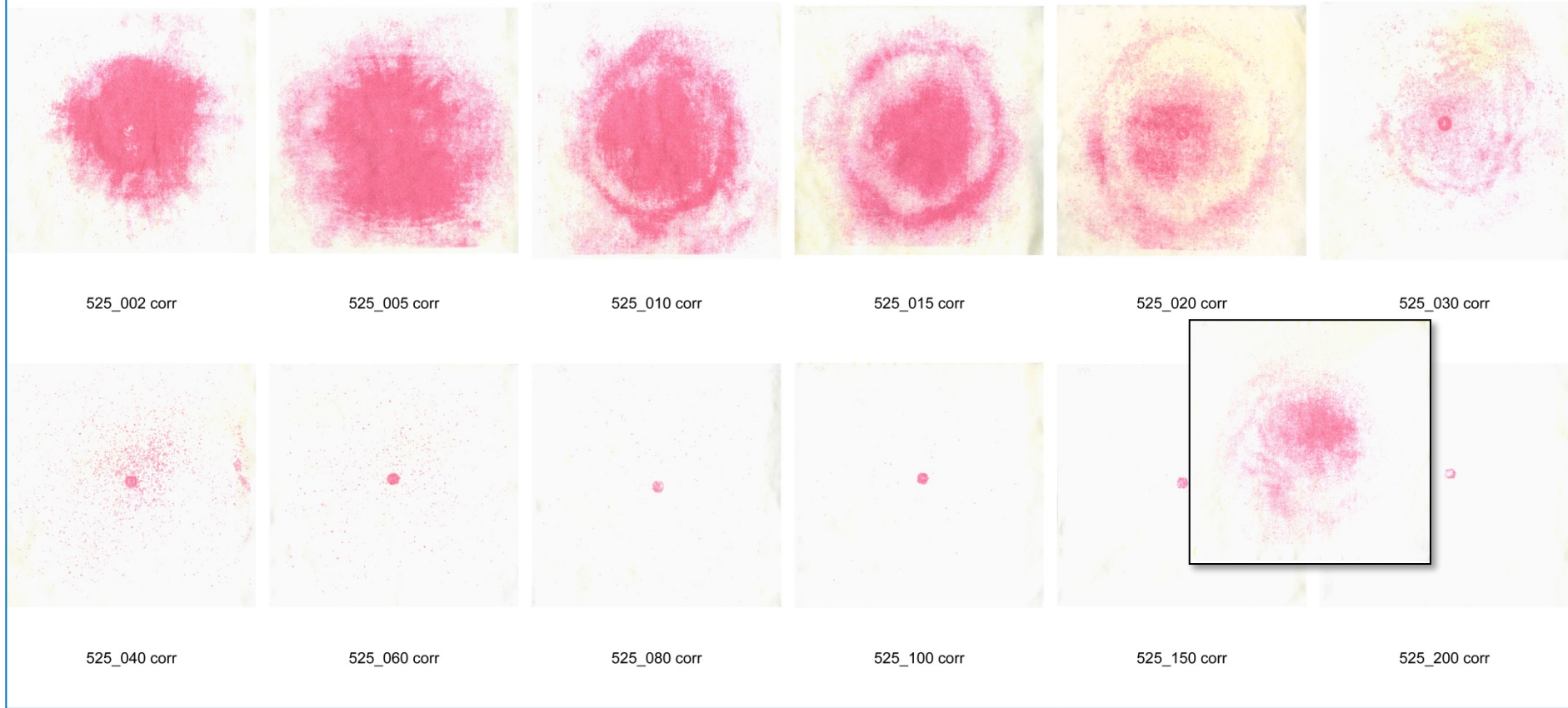
153 photopaper





Overview images / examples: filter paper

525 filter paper





Overview images / examples: filter paper

107 filter paper



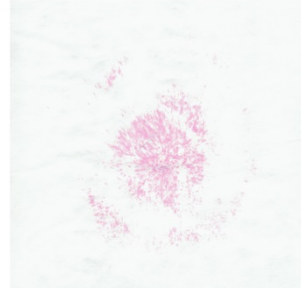
107_2 corr



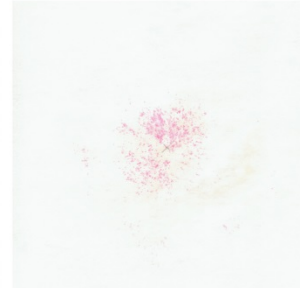
107_5 corr



107_10 corr



107_15 corr



107_20 corr



107_30 corr



107_40 corr



107_60 corr



107_80 corr



107_100 corr



107_150 corr

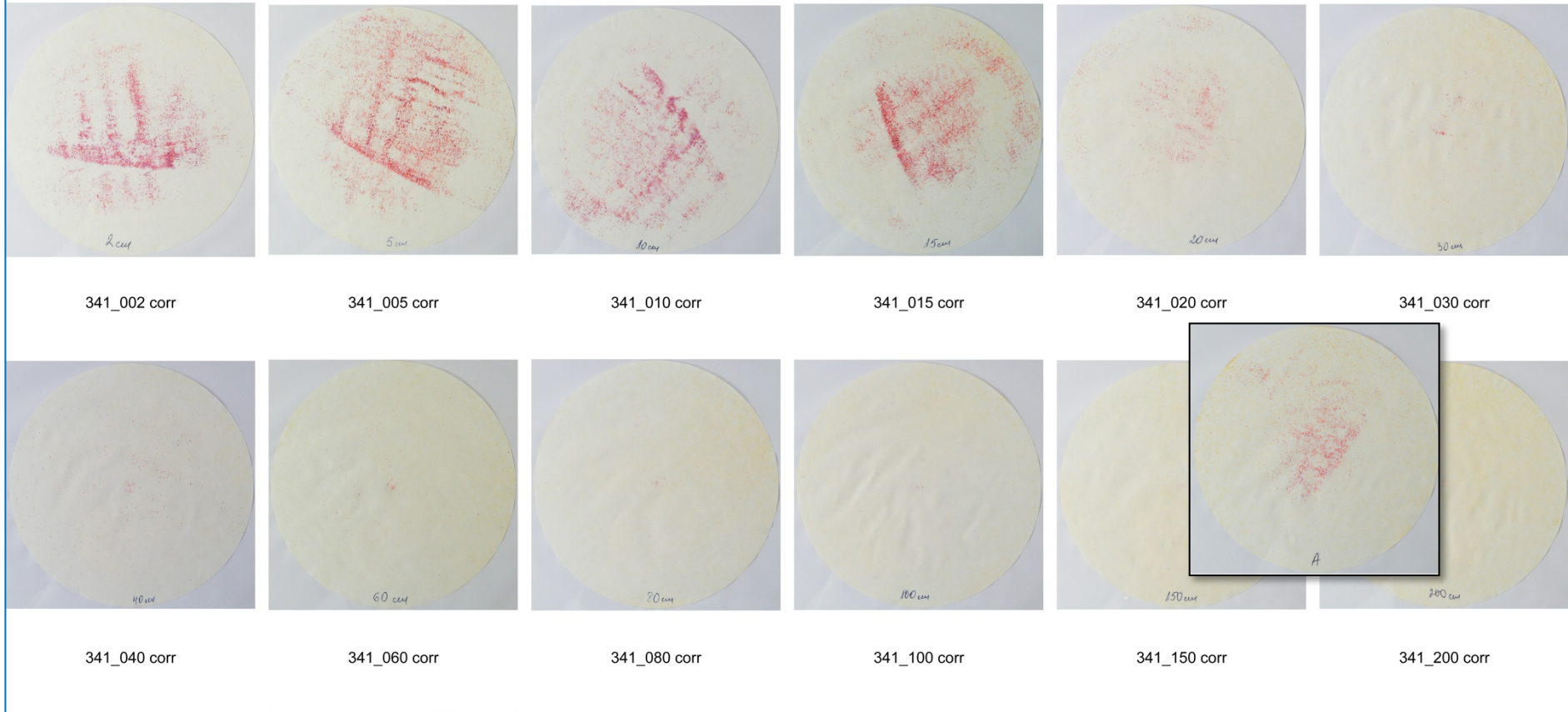


107_200 corr



Overview images / examples: filter paper

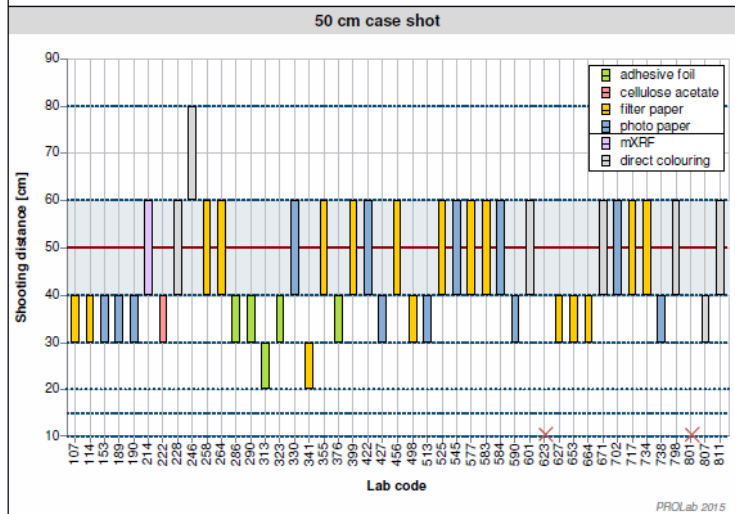
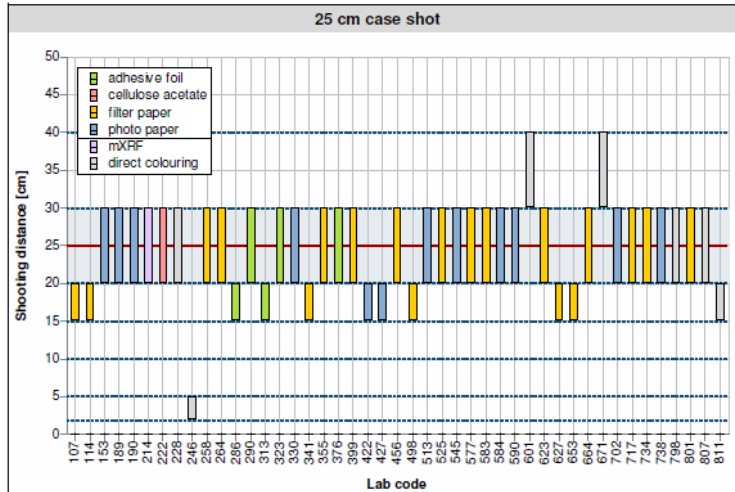
341 filter paper



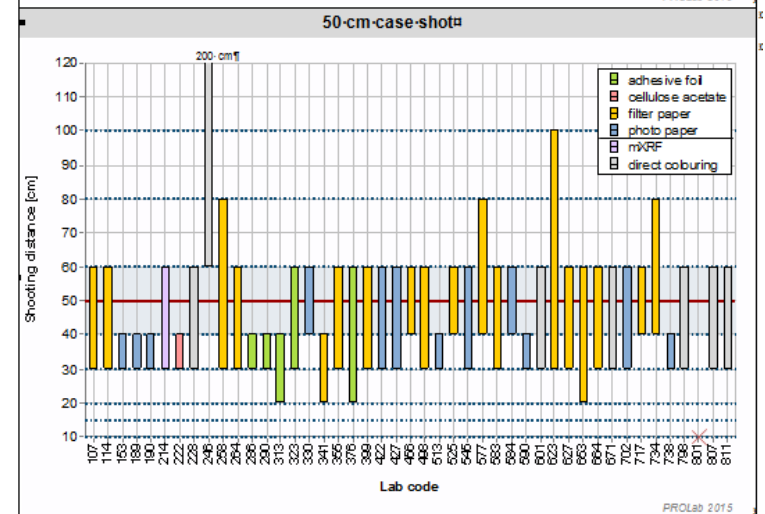
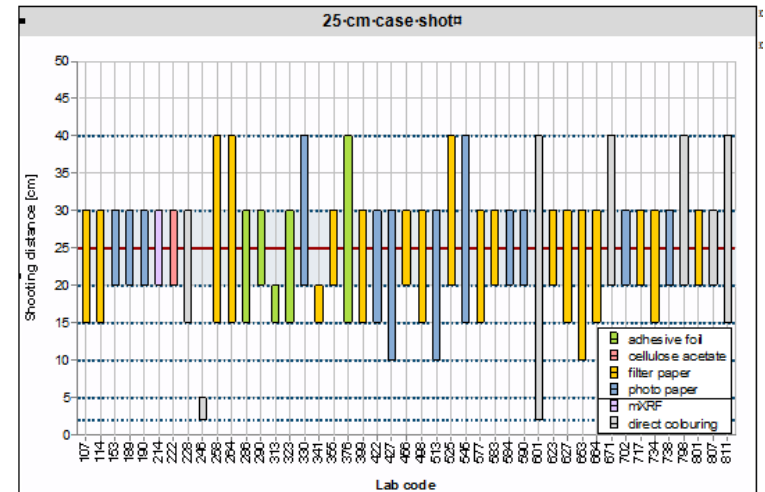


FDSD 2015

Allocation of shot distance



Estimated range of shot distance





Case shot 25 cm (10")

Case shot A	
category	
	2 – 5 cm
	5 – 10 cm
	10 – 15 cm
	15 – 20 cm
X	20 – 30 cm
	30 – 40 cm
	40 – 60 cm
	60 – 80 cm
	80 - 100 cm
	100 – 150 cm
	150 – 200 cm

Case shot was ranked between ...	25 cm case shot	50 cm case shot
... 2 and 5 cm	unsatisfactory (1)	unsatisfactory
... 5 and 10 cm	unsatisfactory	unsatisfactory
... 10 and 15 cm	unsatisfactory	unsatisfactory
... 15 and 20 cm	satisfactory (11)	unsatisfactory
... 20 and 30 cm	satisfactory (31)	questionable (2)
... 30 and 40 cm	satisfactory (2)	satisfactory (19)
... 40 and 60 cm	unsatisfactory	satisfactory (21)
... 60 and 80 cm	unsatisfactory	satisfactory (1)
... 80 and 100 cm	unsatisfactory	questionable
... 100 and 150 cm	unsatisfactory	unsatisfactory
... 150 and 200 cm	unsatisfactory	unsatisfactory

Case shot	Satisfactory	Questionable	Unsatisfactory	No results
25 cm	44 (98 %)	0	1 (2 %)	0
50 cm	41 (95 %)	2 (5 %)	0	2



Case shot 25 cm (10")

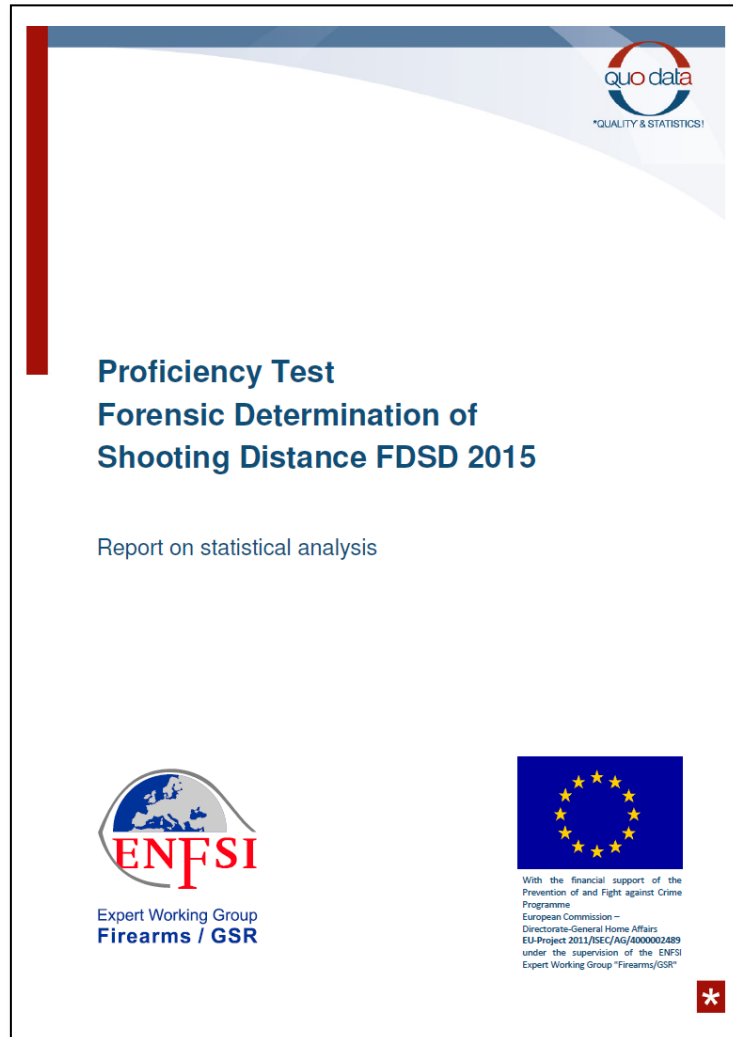
Case shot A												
	2 cm	5 cm	10 cm	15 cm	20 cm	30 cm	40 cm	60 cm	80 cm	100 cm	150 cm	200 cm
Min. distance				X								
Max. distance							X					

Test shot	25 cm case shot		50 cm case shot	
	Lower limit	Upper limit	Lower limit	Upper limit
2 cm	unsatisfactory (2)	unsatisfactory	unsatisfactory	unsatisfactory
5 cm	unsatisfactory	unsatisfactory (1)	unsatisfactory	unsatisfactory
10 cm	questionable (3)	unsatisfactory	unsatisfactory	unsatisfactory
15 cm	satisfactory (19)	unsatisfactory	unsatisfactory	unsatisfactory
20 cm	satisfactory (21)	unsatisfactory (2)	unsatisfactory (4)	unsatisfactory
30 cm	unsatisfactory	satisfactory (32)	satisfactory (32)	unsatisfactory
40 cm	unsatisfactory	satisfactory (10)	satisfactory (7)	unsatisfactory (11)
60 cm	unsatisfactory	unsatisfactory	unsatisfactory (1)	satisfactory (28)
80 cm	unsatisfactory	unsatisfactory	unsatisfactory	satisfactory (3)
100 cm	unsatisfactory	unsatisfactory	unsatisfactory	questionable (1)
150 cm	unsatisfactory	unsatisfactory	unsatisfactory	unsatisfactory
200 cm	unsatisfactory	unsatisfactory	unsatisfactory	unsatisfactory (1)

Case shot	Lower/upper limit	Satisfactory	Questionable	Unsatisfactory	No results
25 cm	Lower limit	40 (89 %)	3 (7 %)	2 (4 %)	0
	Upper limit	42 (93 %)	0	3 (7 %)	0
50 cm	Lower limit	39 (89 %)	0	5 (11 %)	1
	Upper limit	31 (71 %)	1 (2 %)	12 (27 %)	1



Statistical evaluation



Detailed presentation of results:

Annual Meeting of the
ENFSI EWG Firearms/GSR at Cyprus,
03. – 05. Nov. 2015



PT Programme of EWG Firearms/GSR

Outlook (ENFSI)

- **GSR** → **GSR 2015**
- **FAID** → **FAID 2016**
- **FDSD** → **FDSD 2017**

comparable PTs

- **FTS-15-GSRSTUB**
- **CTS 526 Firearms Exam.**
- **CTS 530 GSR Dist. Det.**



With support of the Prevention of and Fight against Crime Programme
European Commission – Directorate-
General Justice, Freedom and Security



Project JLS/2008/ISEC/110 under the supervision of the
ENFSI Expert Working Group "Firearms/GSR"