

Reference Bullets and Cartridge Cases for Automated Ballistics Inspection Systems

T.V. Vorburger (tvtv@nist.gov), W. Chu, A. Zheng, T.B. Renegar, J. Yen, J.F. Song, J.A. Soons, R.M. Thompson National Institute of Standards and Technology (NIST) Gaithersburg, MD

M.G. Ols Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) Ammendale, MD



AAFS 66th Annual Scientific Mtg. Seattle, WA February 21, 2014





Contents

- Introduction to SRM Bullets and Cartridge Cases
- Topography and Microscopy Images of SRM Cartridge Cases
- Reproducibility
- Traceability and User Acquisition
- Availability



Funding Provided by

 National Institute of Justice NIST Law Enforcement Standards Office NIST Standard Reference Materials Program

Note:

Certain commercial equipment may be identified in this presentation in order to specify an experimental procedure. This does not imply recommendation or endorsement by NIST, nor does it imply that the equipment are the best available for the purpose.



SRM 2460 Standard Bullet and SRM 2461 Standard Cartridge Case

- For demonstrating consistency in image acquisitions of bullets and cartridge cases from place to place
- Aimed at automated ballistic inspection systems, such as those in the National Integrated Ballistic Information Network (NIBIN)
- Requires high degree of similarity from one SRM unit to another





SRM 2460 Standard Bullets manufactured by numerically controlled diamond turning









40 SRM Bullets were produced and distributed.



""" SRM 2461 Standard Cartridge Cases manufactured by commercial electroforming

- Negatives are made from a master cartridge case

- Positive replicas are then made from the negatives





SRM Cartridge Cases became available in July 2012.



Image Acquisition

Confocal microscopy used to acquire 3D surface topography images of SRM Cartridge Cases

NIBIN stations at ATF's National Laboratory Center used to acquire optical microscope images of SRM Cartridge Cases.





Photo: www.forensictechnology.com





Ejector mark



Breech Face

Topography Images for a SRM Cartridge Case



Firing Pin

These images should be essentially **the Same** for all units of the SRM.





Ejector mark



NIBIN *Golden Images* for the Standard Cartridge Case Using Optical Microscopy at ATF National Lab. Ctr.



Firing Pin

These images should be essentially **the Same** for all units of the SRM.

Breech Face



Contents

- Introduction to SRM Bullets and Cartridge Cases
- Topography and Microscopy Images of SRMs
- Reproducibility
- Traceability and User Acquisition
- Availability



SRM 2461 Analysis – Breech Face



Processing steps:

- -Trimming
- -Removal of outlier data
- -Form & noise filtering
- -Image registration
- -Correlation calculation



National Institute of Standards & Technology Certificate

Standard Reference Material® 2460

Standard Bullet

Serial No.: SAMPLE

Standard Reference Material (SEM) 2460 is a bullet signature standard comprising bullet profile signatures of Standard Saference Material (S2A) 2460 is a bullet signatur standard comprising bulle profile signatures of this had suggraved areas (LEAs) from fixed bullet. This S2AM is monoled primitely for use as a deal standard for traina laboratories to hady venify that the comparativel optical expension for the image and profile opperating property. A user of S2M 3460 consists of an S2A standard bullet that is mounted on a blue moni-(use Frome 11).

A Vietnak/Physical Bullet Signature Standard: The SEM 1460 physical bullet signature standard is derived from A Virtual/Physical Bullet Signaturer Standard: The SSM 2460 physical bullet signame standards and are with an virtual standard. The turned standard, as shown in Figure 2. Is as set of a figure bullet project and bullet provided the single-mainting the bullet signatures on the physical models. As SSM 2460 under bullet [1,1]. The virtual standard she prevides the reference profiles for comparison measurement of done bullet subscriptions.

Credited Crevi Correlations Functions Maximum CCF_m and Signature Different Di. The conduct values from profile Constructions functions maximum CCF_m and outparter different Di. The value of a much exclusion the profile maximum balance of the profile much between the balance much and more Constructions (and the standard Fore and State Constructions) and a state of the state of the state of the state outparts of the structure of the maximum difference D, for the state of the state of the state (and the structure Constructions) and the state of the state of the state of the state of the structure (Constructions) and the structure difference of the structure of the structure of the structure of the structure of the state of the structure difference D, for the structure of the structure of the structure of the structure of the structure difference D, for the structure of th correntions maxima CCF_{ac} and upparts differences D, for the its builts spanner were receipt for each SSM 3460 builts. These averages were designed \overline{CCF}_{-} and \overline{D}_{-} . For the 40.53M standard tables, the and and over outer. Loss average were sequence U_i^* are M_i^* , by the 40 SM standard table, the collective lower limit for \overline{CCF}_{and} and upper limit for \overline{D}_i^* with 15 % confidence limit ($a \neq 5^{+}$ %) [2] are represented to the set of the second state of the second stat collective lower limit for $\tilde{C}\tilde{C}\tilde{F}_{an}$ and upper limit for D_i with a 95 's conducter level (a = 95 's) (e) at special in Table 1. A NDT Contribution is a value for which NDT has the largest conducter a in accurate substance of largest system of 2.5 largest conductive limit is a value for which the contribution of the VNDT (D). The control environment SND 1.44 do constant of 2.5 largest conductive limit is an even stable and concentration provide matisfrand accurate limit the scharg process protected to descentia charge in the unitset superply material by the typina incrumant.

Expiration of Certification: The certification of SIM 3460 is expected to be tail, which do assume and as many specified, and 30 task 304 provided the SIM is lander, used, and as accelerates a million instructions provide the similar of specific and the similar to Unity. Therever, the single to enderwe, month or as supported was also it is damaged, commanded, or modified. MOIT reserve the sign to enderwe, month or specific distance at sufficience at sufficience. Maintenance of SIM Conflictions. NST will another this SIM one for panel of its confliction. If substance of SIM Conflictions. Not will be ended use the equation of the confliction, NST will another under changes occur that effect the confliction before the equation of the confliction, NST will active the parameter. Registrations (see mached beet) will believe before a

The confination of SEM 3460 production and the sociated memoryan landary to be reactioned of an entry performed by 1 stores and 7. I commer of an IST Parcine Exposering Densin, and 5. Balan et du (DES) of Law Endocrement Standards (OLES).

Gaithersburg, MD 20899 Certificate Issue Date: 30 October 2006

SRM 2460





National Institute of Standards & Technology

Certificate

Standard Reference Material® 2461

Standard Cartridge Case

This Standard Reference Material (SRM) is intended primarily for use as a check standard for crime laboratories: This founded forbranes Moneral (SRM) is mended primarily for use as a check standard for crime laboratoristic fine to help write the standard standard standard standard standard standard standard standard standard in operang property second with this increasement metabolicity and quality assumance; and durid, and cicina belaving with this increasement metabolicity and quality assumance; and durid, and activate plannessis, a finite during and accredition of 1-3. A use of SRM view for any standard during and durid, and activate plannessis, a finite grade management of the standard standard standard standard standard standard standard standard standard of a treach de impression, a finite grade management of the standard standard standard standard standard standard bran cylinder holder (see Figure 1) to duri the assembly resembles a real fixed cantidge case.

Consider the state (see space 1) to that the assumpty remains a state deviation of the state of Table 1. Certified Areal Cross Correlation Function Maximum

		ALL LICCE	
		man and Signature	D. D.
	-4 CCF (4)	- Energy CT	e Difference (D)
	(B)		care (D)
Breech David	(76)	D. ^(*)	
Fining		(1)	
- ALDE PID	>0.1 2	(76)	
Electority			
The one of a long Mark	-98.0	(11.5	
Transition internal	0.0.2	44.2	
ALCONTRACTORY INCOME WITH OS AL	-93.1	<4.0	
respectively is the confiden	CP Temps	(10.5	
Bothing of IWO Gurface and Ihmge Cone	sepresents the men	-12.2	
(D, = () Calines La	sed from the the theast	Printers	
and the state of	similari we lower or	Uncertainty in the	
Lipitation	bertar she	upper limite to similari	
lined as of Certificati	the state p	erfort (100 perfort rimit	IV ID SRM DAR
September The		ACCF - 100 SHILLS	HIV or an 2401. The
certificate (certification		max = 100 %) on	of zero different
Or and (See "Notice" provided the	of SRM and		a difference
or otherwite me the and Warning the SRM is	246] is trall a		ence less than
audified to Utanti	billed and white	Within at	the day
Main (The stored in	the means	
austenanden ande	one certification	accordance assurement m	
Substantin of SRM	15 2	millie with the	Certainte
Bonic Surface Striftent		interned if the Case the Instru	sairy specified
would the much changes		SRM is do	CHODS Fillion
Purchaser Part occur that and I	Will me	13 Gal 2020	ged and in this
Course Course affect affect at	monitor at		ovu, contamination
Coordination of	e Certification Cols ST	214	autabed
performed in of the need	hear before	oter the	
R contraction of A 71	well will facily.	the aver period	
other of a cheng The and the bar	succiditate no	expiration of its	
Enforcement the MIST . D. Renewer Bechnic	1	dification of this	Certification
Stand Stand Semicand Sal, S. Money	al ineastrong	Cert	ficate lough If
auditos Ore auditocior and m	Vo-Dela cupents lead		NIST NIST
ounce (OI FC) and Dimen	dergado, C .	ing to the	W1[]
(10)	sional Men	ci z an une corrien	
	COLORY TH	Villan, Vi	-
	es Div	ition allova I c.	SRM
Guia		and P M Song T	2461
and the state of t		Thomas Thomas	Vorbase
Certification MD 20800		autopson a	f at 1981 and
and all itter to work			a the Micro and
OKM 244	0		Lan
	Semicon		
2015	0.0	difference of the second secon	

iemiconductor and Dime David G. Seiler, Chief onal Metrology Division . Chief Ces Th Page 1 of 11

NIST Statisticians participated in the analysis of the uncertainty estimates and control values, and preparation of the Certificate.

Both SRMs and their Certificates include User Guides as appendices







SRM 2461 Documentation Includes a User Guide mainly for NIBIN Users

APPENDIX

USER GUIDE FOR NIST SRM 2461 STANDARD CARTRIDGE CASES

A Draft Data Acquisition Procedure for the Integrated Ballistics Identification System (IBIS)

 The NIST SRM standard cartridge case is intended for quality testing of automated ballistics signature acquisitions. It is recommended that an acquisition of the standard cartridge cases be entered into IBIS once a month to verify the proper operation of the system. However, you should refer to your own laboratory's policy and procedure guidelines (PPG's) for the frequency of acquisition. The cartridge case should also be entered into the system during each software and hardware upgrade as well as after any scheduled or unscheduled maintenance. All entries and results should be documented.





Example of Correlation Results for BrassTrax Acquisitions of SRM 2461

Exhibit Number Caliber Site Nome Type Correlation Server Status Modifier 11-20074 2A 45 Auto IL-OHICSP6 Automatic Default Correlation done CMDAV C10-48660 2-3 9 mm Luger IL-OHICSP4 Automatic Default Correlation done OMDAV C10-48660 2-2 9 mm Luger IL-OHICSP4 Automatic Default Correlation done OMPA C10-48660 2-2 9 mm Luger IL-OHICSP4 Automatic Default Correlation done OMPA C10-48660 1-7 40 Smith & Wesson IL-OHICSP4 Automatic Default Correlation done DMPEA C10-48660 1-12 40 Smith & Wesson IL-OHICSP4 Automatic Default Correlation done MADNEA C10-48660 1-12 40 Smith & Wesson IL-OHICSP4 Automatic Default Correlation done MANAL C10-48660 Correlation done MANAL Correlation done MAANAL Corelation done	relation Requests				2022 21 22 20		LILLES OF LALERA		The second
C11-28074 2A 45 Auto LL-CHICS2P6 Automatic Default Correlation done CMDAY C11-28074 1A 9 mm Parabellum LL-CHICS2P6 Automatic Default Correlation done CMDAY C10-48660 2:3 9 mm Luger LL-CHICS2P6 Automatic Default Correlation done DMFPA C10-48660 2:2 9 mm Luger LL-CHICS2P4 Automatic Default Correlation done DMFPA C10-48660 1:7 40 Smth & Wesson LL-CHICS2P4 Automatic Default Correlation done DMFPA C10-48660 1:7 40 Smth & Wesson LL-CHICS2P4 Automatic Default Correlation done DMFPA C10-48660 1:2 40 Smth & Wesson LL-CHICS2P4 Automatic Default Correlation done TMPPA C10-48660 1:2 40 Smth & Wesson LL-CHICS2P4 Automatic Default Correlation done TMPPA C10-48660 1:2 40 Smth & Wesson LL-CHICS2P4 Automatic Default Correlation done TMPPA C10-39955 1:12 40 Smth & Wesson LL-CHICS2P4 Automatic Default Correlation done TLBPUC Correlation done TLBPUC C10-48660 1:2 50 Stellar Correlation done MANALL Correlation done TLBPUC Correlation done JAHAN C10-3270 Correlation Results Correlation done MANALL Correlation done JAHAN Correlation done JAHAN Correla	a Number	Exhibit Number	Caliber	Site Na	Type me	C	orrelation Server	Status	Modified By
Citizetest Svr.Psep 6 Correlation done TLBRU US2201 Svr.Psep 6 Correlation done MGOLS Citizettes for control chart scores tic Default Correlation done MAAL Citizettes for control chart scores tic Default Correlation done MAAL Citizettes correlation done JAHAN Correlation done JAHAN tic Default Correlation done JAHAN tic Trax GOLDEN MAGE TRAX GOLDEN 10/26/10 9 mm Parabellum MD-WAATE2 318 337 868 NIST GOLDEN IMAGE GOLDEN IMAGE 5/16/08 9 mm Parabellum MD-WAATE2 318 337 868 Coll-Se871-08 Ex-08018361-1C	C11-28074 C11-28074 C11-28074 C10-48660 C10-48660 C10-48660 C10-48660 C10-48660 C10-39956 C10-3956 C10-3956 C10-3956 C10-3956 C10-3000 C10-30000 C10-30000 C10-3000 C10-30000 C10-30000 C10-30000 C10-30000 C10-30000 C10-30000	A A 53 52 1-7 1-12	45 Auto 9 mm Parabellum 9 mm Luger 9 mm Luger 40 Smith & Wesson 40 Smith & Wesson		SP6 Autom SP6 Autom SP4 Autom SP4 Autom SP4 Autom SP4 Autom	ratic D natic D natic D natic D natic D natic D	etault etault etault etault etault etault	Correlation done Correlation done Correlation done Correlation done Correlation done Correlation done	CMDAVISOI CMDAVISOI DMPRATT DMPRATT DMPRATT KMMURRAY
Trest Exhibit Scores Dase Number Exhibit Number Caliber Site Name Breech Face ▼1 Fring Pin Ejector Mark TRAX GOLDEN CCIMAGE TRAX GOLDEN 10/26/10 9 mm Parabellum MD-WATFERI 372 344 2361 NIST GOLDEN IMAGE GOLDEN IMAGE 5/16/08 9 mm Parabellum MD-WAATF2 318 337 868 COLS-87-04 EX-04000271-1C 9 mm Luger OH-COLUMPD 24 49 N/A T05-764 2 9 mm Parabellum VA-NORFDFS 24 71 N/A COLS-6851-08 EX-08018361-1C 9 mm Parabellum OH-COLUMPD 23 20 N/A T08-4293 10 9 mm Parabellum VA-NORFDFS 23 40 N/A T08-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 03650517 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 040-5021494 0Cl_s 434-03 EX-03027195-1C 9 mm Luger 0H-COLUMPD 22 28 N/A	Use " Use for Use for	TRAX GO	LDEN C chart s	CC IMA scores	GE"	tic D tic D tic D tic D	vr-Reg 6 efault efault efault efault	Correlation done Correlation done Previously Viewed Correlation done Correlation done Correlation done	TLBRUBAKE MGOLS KLHUNTER MANALLY JAHANNA JAHANNA
Desce Number Exhibit Number Calibet Site Name Breech Face I Fring Pin Ejector Mark TRAX GOLDEN CC IMAGE TRAX GOLDEN 10/26/10 9 mm Parabellum MD-WATFERI 372 344 2361 NIST GOLDEN IMAGE GOLDEN 11/26/10 9 mm Parabellum MD-WAATFERI 372 344 2361 OCLS-87-04 EX-04000271-1C 9 mm Parabellum MD-WAATFE 318 337 868 COLS-87-04 EX-04000271-1C 9 mm Luger OH-COLUMPD 24 49 N/A TD5-764 2 9 mm Parabellum VA-NORFDFS 24 71 N/A CANT02-83133DF 83133C 9 mm Parabellum OH-COLUMPD 23 20 N/A OCLS-6851-08 EX-08018361-1C 9 mm Parabellum VA-NORFDFS 23 47 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 03505157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 050LS6344-03<	tridge Case Correlation Re	sults				S.c.			
TRAX GOLDEN CC/MAGE TRAX GOLDEN 10/26/10 9 mm Parabellum MD-WATFER1 372 344 2361 NIST GOLDEN IMAGE GOLDEN IMAGE 5/16/08 9 mm Parabellum MD-WAATF2 318 337 868 COLS-87-04 EX-04000271-1C 9 mm Luger OH-COLUMPD 24 49 N/A T05-764 2 9 mm Parabellum VA-NORFDFS 24 71 N/A CANT02-83133DF 83133C 9 mm Parabellum OH-STARKCO 23 32 N/A COLS-6851-08 EX-08018361-1C 9 mm Parabellum OH-COLUMPD 23 20 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 03F05157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 0CULS-6843-03 EX-03027195-1C 9 mm Luger MD-BALTPD2 28 N/A 03F05157 01 JY 9 mm Luger MD-BALTPD2 28 N/A 099071341 0C1 9 mm Parabellum MD-RDATED2	Case Number	Exhibit Number	Caliber	Site Name	Breech Face	▼1 Firing	Pin Elector Mark		
NIST GOLDEN IMAGE GOLDEN IMAGE 5/16/08 9 mm Parabellum MD-WAATF2 318 337 868 COLS-87-04 EX-04000271-1C 9 mm Luger OH-COLUMPD 24 49 N/A T05-764 2 9 mm Parabellum VA-NORFDFS 24 71 N/A CANT02-63133DF 83133C 9 mm Parabellum OH-STARKCO 23 32 N/A COLS-6851-08 EX-08018361-1C 9 mm Parabellum OH-COLUMPD 23 20 N/A T06-4293 10 9 mm Parabellum VA-NORFDFS 23 47 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 03705157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 042951341 0Col_3-6434-03 EX-03027195-1C 9 mm Luger MD-BALTPD2 23 52 N/A 05157 01 JY 9 mm Luger MD-COLUMPD 22 28 N/A 050LS-8434-03 EX-03027195-1C	TRAX GOLDEN CO MAGE	TRAX GOLDEN 10/26/10	9 mm Parabellum	MD-WATFBR1	372	344	2361	AND REAL PROPERTY.	
CDLS-87-04 EX-04000271-1C 9 mm Luger OH-COLUMPD 24 49 N/A T05-764 2 9 mm Parabellum VA-NORFDFS 24 71 N/A CANT02-83133DF 83133C 9 mm Parabellum OH-STARKCO 23 32 N/A COLS-6651-08 EX-08018361-1C 9 mm Parabellum OH-COLUMPD 23 20 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 47 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 03F05157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 0CLS-8434-03 EX-03027195-1C 9 mm Luger MD-BALTPD2 28 N/A 099071341 0CL3 9 mm Parabellum VA-ROLEDD 22 41 N/A	O MICT COLDENIN (ACE	COLDEN IMAGE 5/16/08	O man Developellum	MEN MALE ATER	210	227	929		
TI5-764 2 9 mm Parabellum VA-NORFDFS 24 71 N/A CANT02-63133DF 83133C 9 mm Parabellum OH-STARKCO 23 32 N/A COLS-6051-08 Ex-08018361-1C 9 mm Parabellum OH-COLUMPD 23 20 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 036705157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 0CUS-8434-03 EX-03027195-1C 9 mm Luger MD-BALTPD2 23 52 N/A 0104-99497-1341 0C1 9 mm Restellum VA-NORFDFS 23 40 N/A	INIST GULUEN MAGE	GOLDLININAGE STOTO	3 mm Parabellum	MLI-WAATEZ	310	334	000		
CANT02-83133DF 83133C 9 mm Parabellum OH-STARKCO 23 32 N/A COLS-6851-08 EX-08018361-1C 9 mm Parabellum OH-COLUMPD 23 20 N/A T08-4293 10 9 mm Parabellum VA-NORFDFS 23 47 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 03F05157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 0CLS-8434-03 EX-03027195-1C 9 mm Luger OH-COLUMPD 22 28 N/A 0990721341 0C1 9 mm Parabellum MD-BALTDQ 22 41 N/A	COLS-87-04	EX-04000271-1C	9 mm Luger	OH-COLUMPD	24	49	N/A		
COLS-6851-08 EX-08018361-1C 9 mm Parabellum OH-COLUMPD 23 20 N/A T08-4293 10 9 mm Parabellum VA-NORFDFS 23 47 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 0 03F05157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 0 00LS-8434-03 EX-03027195-1C 9 mm Luger OH-COLUMPD 22 28 N/A 0 99-092-1341 0 C1 9 mm Parabellum MD-BALTPD2 23 52 N/A	COLS-87-04 T05-764	EX-04000271-1C 2	9 mm Luger 9 mm Parabellum	OH-COLUMPD VA-NORFDFS	24 24	49 71	N/A N/A		
T08-4293 10 9 mm Parabellum VA-NORFDFS 23 47 N/A T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 0 03F05157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 0 00LS-8434-03 EX-03027195-1C 9 mm Luger OH-COLUMPD 22 28 N/A 0 95-092-1341 0 C-1 9 mm Parabellum MD-BALTCO 22 41 N/A	COLS-87-04 T05-764 CANT02-83133DF	EX-04000271-1C 2 83133C	9 mm Luger 9 mm Parabellum 9 mm Parabellum	OH-COLUMPD VA-NORFDFS OH-STARKCO	24 24 23	49 71 32	N/A N/A N/A		
T06-13202 3A 9 mm Parabellum VA-NORFDFS 23 40 N/A 0 03F05157 01 JY 9 mm Luger MD-BALTPD2 23 52 N/A 0 00LS-8434-03 EX-03027195-1C 9 mm Luger 0H-COLUMPD 22 28 N/A 0 05-092-1341 0 C-1 9 mm Parabellum MD-BALTCO 22 41 N/A	COLS-87-04 T05-764 CANT02-83133DF COLS-6851-08	EX-04000271-1C 2 83133C EX-08018361-1C	9 mm Luger 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum	OH-COLUMPD VA-NOREDES OH-STARKCO OH-COLUMPD	24 24 23 23	49 71 32 20	N/A N/A N/A N/A		
0.03F05157 0.1 JY 9 mm Luger MD-BALTPD2 23 52 N/A 0.00LS-8434-03 EX-03027195-1C 9 mm Luger 0H-COLUMPD 22 28 N/A 0.03F091-1341 0.0-1 9 mm Parabellum MD-BALTPD2 23 52 N/A	COLS-87-04 T05-764 CANT02-83133DF COLS-6851-08 T08-4293	EX-04000271-1C 2 83133C EX-08018361-1C 10	9 mm Luger 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum	MD-WAATE2 OH-COLUMPD VA-NORFDFS OH-STARKCO OH-COLUMPD VA-NORFDFS	24 24 23 23 23	49 71 32 20 47	N/A N/A N/A N/A N/A		
© COLS-8434-03 EX-03027195-1C 9 mm Luger OH-COLUMPD 22 28 N/A	COLS-87-04 T05-764 CANT02-83133DF COLS-6851-08 T08-4293 T06-13202	EX-04000271-1C 2 83133C EX-08018361-1C 10 3A	9 mm Luger 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum	MD-WAATE2 OH-COLUMPD VA-NORFDFS OH-STARKCO OH-COLUMPD VA-NORFDFS VA-NORFDFS	24 24 23 23 23 23 23	49 71 32 20 47 40	N/A N/A N/A N/A N/A		
09-097-1341 00-1 9 mm Parabolium MD-PALTCO 22 41 N/A	COLS-87-04 TB5-764 CANT02-83133DF COLS-6851-08 T08-4293 T08-4293 T06-13202 03F05157	EX-04000271-1C 2 83133C EX-08018361-1C 10 3A 01JY	9 mm Parabellum 9 mm Luger 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum	MD-WAATE2 OH-COLUMPD VA-NORFDFS OH-STARKCO OH-COLUMPD VA-NORFDFS VA-NORFDFS MD-BALTPD2	24 24 23 23 23 23 23 23	49 71 32 20 47 40 52	N/A N/A N/A N/A N/A N/A		
Stim Palabelium MorbActoo 22 41 1VA	COLS-87-04 TB5-764 CANT02-83133DF COLS-6851-08 T08-4293 T06-13202 03F05157 COLS-8434-03	EX-04000271-1C 2 83133C EX-08018361-1C 10 3A 01JY EX-03027195-1C	9 mm Parabellum 9 mm Luger 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum 9 mm Parabellum 9 mm Luger 9 mm Luger	MD-WAATE2 OH-COLUMPD VA-NORFDFS OH-STARKCO OH-COLUMPD VA-NORFDFS VA-NORFDFS MD-BALTPD2 OH-COLUMPD	24 24 23 23 23 23 23 23 23 22	49 71 32 20 47 40 52 28	N/A N/A N/A N/A N/A N/A N/A		



Excel Sheet available from NIST with Control Chart for Tests of SRM Cartridge Cases

able 2. A Control Chart for Breech Face (BF) Scores of SRM Cartridge Case (Sheet 3 "BF")							
	-	· ·					
Date	BF Score	Dynamic CL	Fixed CL	File Name	Notes		
2/22/2010	276		014				
3/23/2010	3/0	359	214 214	SRIVI2401-010-23MARTUA			
5/23/2010	368	352	214	to be added			
6/23/2010	422	351	214				
7/23/2010	357	341	214	A Control Char	t for IBIS Breech Face	(BF) Score	es
8/23/2010	398	347	214	500			
9/23/2010	447	344	214	500	1.000		
0/23/2010	382	345	214	450	× *		
1/23/2010	363	342	214	y 400			
2/23/2010	427	344	214	% 350			BE Scores
1/23/2011	414	348	214	8 300			BF Stores
2/23/2011	379	348	214	250			Dynamic CL
			214	5 200	* * * * *		
			214	8 150			
				= 100			
				50			
				12012 12012 12012 12012 12012	1201 1201 Por Por Por Por	12011 12011	
				3/2 0/2 3/2 6/2 1/2 8	12. 312, 2012, 2712, 213, 213	2/2	



Proposed Fixed Control Limits for Acquisitions of SRM 2461 (and 2460) Established by the National Ballistics Imaging Comparison Project Involving about 30 NIBIN Participants and their Systems

	Mean	Std. Dev.	95 % Control Limit
Breech Face	329	53	243
Firing Pin	344	44	273
Ejector Mark	1476	562	552



Availability of SRM 2461

- Available from the NIST Standard Reference Materials Program (www.nist.gov/srm) since July 2012
- 37 units distributed
- 100 units available
- The certification of SRM 2461 is valid until 30 September 2021, with proper handling.



SRM 2460 Bullets not presently available

 Currently developing a polymer replication method for restocking



 See: Today, 10:40 a.m. - 11:00 a.m., Paper A170 An Improved Vacuum Casting Method for the Replication of Reference Bullets Thomas B. Renegar et al.