Collaborative Testing Services, Inc
FORENSIC TESTING PROGRAM

Shooting Reconstruction: Angle Determination (Demonstration) Test No. 17-5620 Summary Report

This test was sent to 58 participants. Each sample set contained a wooden box that consisted of one entrance hole, one exit hole, a label and an arrow to distinguish the top orientation of the box. In addition, one blue dot and one red dot was placed on the box to assist participants when reporting the entrance/exit holes and direction of travel. Participants were requested to determine the color associated with the entrance hole, the direction of travel and calculate the angles. Data were returned from 48 participants (83% response rate) and are compiled into the following tables:

Manufacturer's Information

Each sample set contained a wooden box that consisted of one entrance hole, one exit hole, a label and an arrow to distinguish the top orientation of the box. In addition, one blue dot and one red dot was placed on the box to assist participants when reporting the entrance/exit holes and direction of travel. Participants were requested to determine the color associated with the entrance hole, the direction of travel and calculate the angles. The color associated with the entrance hole was blue and the direction of travel was left to right, downward. The angles as measured during production are described below.

PRODUCTION: The sample was placed onto a fixed angle set up (jig). A .22 LR Ruger MKIII firearm was affixed above the jig and a digital angle finder was placed on the jig to confirm the angle to be shot.

The Horizontal (Azimuth) angle was measured as 8.5°(from perpendicular), 81.5°(left to right) or 98.5°(right to left) and the Vertical angle was measured as 39.6°(downward), -39.6° (horizontal = 0) or 50.4°(incident).

SAMPLE SET ASSEMBLY: After each sample was shot, it was securely placed in a sample pack box. This process was repeated until all of the desired samples were produced.

Summary Comments

This Demonstration test was designed to allow participants to assess their proficiency in shooting reconstruction, with a focus on angle determination. Each sample set consisted of a wooden box (Item 1) containing an entrance and exit hole. The wooden box was designated with a "TOP" label and an arrow on the side to assist participants with the orientation of the sample. In addition, one side was marked with a blue dot and the other side was marked with a red dot to assist participants in reporting and identifying the entrance/exit hole.

ENTRANCE HOLE: Of the 48 responding participants, 47 (98%) identified the blue dot as being the side containing the entrance hole. The remaining participant identified the red dot as being the side containing the entrance hole.

DIRECTIONALITY: Of the 48 participants, 42(88%) reported a left to right direction. Two participants reported a right to left direction and four participants did not provide a response. In regards to upward/downward directionality, 46 of the 48 participants reported a downward direction. One participant reported an upward direction and one participant had no response.

ANGLE DETERMINATION: CTS understands that there are multiple ways to measure/report angles and that differing responses were expected due to the fact that no specific angles were requested. For ease of review, the participants reported angles were separated into Horizontal or Vertical. Within these groupings, the majority of participants reported results that fell within one of three distinct measurements:

HORIZONTAL
Measurements from left to right, as you face the blue side of the box, where the 0° point is on the left. This was reported by the majority of participants (~63%) with an average of 81.5°.

Measurements from perpendicular to the plane of the face of the box, where the 0° point is the perpendicular plane that intersects the entrance hole. This was reported by approximately 20% of participants with an average of 9°.

Measurements from right to left, as you face the blue side of the box, where the 0° point is on the right. This was reported by approximately 10% of participants with an average of 97°.

VERTICAL
Measurements from the horizontal plane utilizing a negative angle to indicate downward trajectory. This was reported by approximately 44% of participants with an average of -38.7°.

Measurements from the horizontal plane without the use of a negative symbol to indicate trajectory. This was reported by approximately 44% of participants with an average of 39°. It should be noted that the majority of these participants also stated the directionality of the angle as “downward”.

Measurements from top to bottom, where the 0° point is at the top. Also reported by many as the “incident” or “acute” angle. This was reported by approximately 8% of participants with an average of 52°.

MOVING FORWARD: CTS believes that this demonstration test was successful and was pleased with the responses and feedback provided by all participants. Based on the information received, future CTS angle determination proficiency test data sheets will be more standardized and uniform to optimize the reporting for this aspect of shooting reconstruction.

Entrance Hole

Which color marked on the sample represents the side with the entrance hole?

TABLE 1

WebCode	Color	WebCode	Color
2N3UW4	Blue	KTCMUX	Blue
2XN3DK	Blue	KTW4BL	Blue
3EYYEY	Blue	KVZW6K	Blue
3KKUE4	Blue	M39CJX	Blue
6WQNMX	Blue	MBL7YZ	Blue
6YHQQZ	Blue	N3VZME	Blue
9G3KTY	Blue	NDDEQG	Blue
9WWALA	Blue	NDPFBU	Blue
AWQKQB	Blue	NH8FRV	Blue
C3QGVT	Blue	PG68VV	Blue
CL3787	Blue	PPZ9DU	Blue
CY62Y7	Blue	QEVFLE	Blue
CZ38J8	Blue	R266CE	Blue
D9BWYQ	Blue	TF64ZB	Blue
DXTL67	Blue	TNABDP	Blue
E4ERJR	Bue	TXHQFR	Blue
E74X4N	Blue	U6CDQN	Blue
EJPD8N	Blue	W8C8JP	Blue
ETBLM6	Blue	XEC6N8	Blue
EZWEY4	Blue	XTQE8N	Blue
FJLBUN	Blue	Y6LK2L	Blue
J4ZZD4	Blue	Y96QUW	Blue
KCAPQ3	$\boxed{\text{Red}}$	YBPPQK	Blue

WebCode	Color	WebCode	Color
ZDR3U4	Blue (front side)		
ZYT6PK	The entrance hole is on the blue side.		

Response Summary

Participants: **48**

Which color marked on the sample represents the side with the entrance hole?

Color:	Blue	Red
Number:	47	1
Percent:	98%	2%

Direction of Travel

What is the direction of travel of the bullet through the sample?

TABLE 2

WebCode	Direction of Travel as Reported	Direction of Travel Tabular Representation R to L	L to R	Upward	Downward
2N3UW4	Downward front(blue) to back(red) and slightly Left to Right.		✓		✓
2XN3DK	Front to Back, Left to Right with a Downward Direction of Travel		✓		✓
3EYYEY	Blue marked side to red marked side, left to right (as facing the blue marked side), downward.		✓		✓
3KKUE4	Front to back; Slight left to right; Downward		✓		✓
6WQNMX	front to back, right to left, downward	✓			✓
6YHQQZ	Front to back and downward				✓
9G3KTY	Front (blue=front) to back, left to right, downward		✓		✓
9WWALA	Projectile travels at a downward angle, left to right. (respectfully blue to red).		✓		✓
AWQKQB	Front to back (blue to red), slight left to right, downwards (top to bottom)		✓		✓
C3QGVT	Blue to red. Downwards and slightly to the right		✓		✓
CL3787	up to down (downward), left to right		✓		✓
CY62Y7	Back to front, left to right, downward (as a person faces the wall)		✓		✓
CZ38J8	blue to red, downwards, left to right (facing the entry hole)		✓		✓
D9BWYQ	Front (blue) to back (red); slight left to right directionality and moderate downward angle		✓		✓
DXTL67	left to right and downwards (blue dot entry- red dot exit)		✓		✓
E4ERJR	Downward, left to right		✓		✓
E74X4N	front to back, left to right, downward		✓		✓
EJPD8N	Front (Blue) to back (Red), left to right and downward.		✓		✓

TABLE 2

WebCode	Direction of Travel as Reported	Direction of Travel Tabular Representation: R to L	L to R	Upward	Downward
ETBLM6	From blue side to red side; downward; from left to right		✓		✓
EZWEY4	blue to red downward				✓
FJLBUN	front to back, right to left, downward	✓			✓
J4ZZD4	DOWNWARD, LEFT TO RIGHT AND BLUE WALL TO RED WALL		✓		✓
KCAPQ3	Upward and left to right		✓	✓	
KTCMUX	Downward and left to right		✓		✓
KTW4BL	Downward and left to right		✓		✓
KVZW6K	Front to Back.				
M39CJX	Bue to red, Left to right and top to bottom		✓		✓
MBL7YZ	Downward front to back and left to right		✓		✓
N3VZME	front to back/left to right/downwards		✓		✓
NDDEQG	Left to right and downwards		✓		✓
NDPFBU	Left to Right downward		✓		✓
NH8FRV	Blue side (front) to red side (back), downward, slightly left to right		✓		✓
PG68VV	Front to back, left to right and downward		✓		✓
PPZ9DU	If the blue side is the front, the direction of travel is from front to back, from left to right and downward.		✓		✓
QEVFLE	Front to back, slightly left to right, and downward		✓		✓
R266CE	blue side to red side, downward, left to right		✓		✓
TF64ZB	Front to back (provided the blue side is the front), downwards and slightly left to right		✓		✓
TNABDP	downward, left to right		✓		✓
TXHQFR	Downward, left to right		✓		✓
U6CDQN	downward and slightly from left to right		✓		✓

TABLE 2

WebCode	Direction of Travel as Reported	Direction of Travel Tabular Representation			
		R to L	L to R	Upward	Downward
W8C8JP	Front to Back, Left to Right, Downward		✓		✓
XEC6N8	front to back (blue to red), left to right, downward		✓		✓
XTQE8N	Front to Back, Top to Bottom, Left to Right		✓		✓
Y6LK2L	FRONT TO BACK and DOWNWARD				✓
Y96QUW	From blue side to red side, downward and from left to right (as you face the blue side)		✓		✓
YBPPQK	From blue to red, left to right and downwards		✓		✓
ZDR3U4	Front of the wall towards the back, left side towards the right side, and downward.		✓		✓
ZYT6PK	The direction of the bullet is from front to back, left to right, downwards.		✓		✓

Response Summary

Participants: **48**

What is the direction of travel of the bullet through the sample?

Direction:	Right to Left	Left to Right	No Response	Upward	Downward	No Response
Number:	2	42	4	1	46	1
Percent:	4%	88%	8%	2%	96%	2%

Angles

TABLE 3 - Horizontal

WebCode	Participant Defined Angle	Angle Measurement	Uncertainty (in degrees)
2N3UW4	Horizontal(Left of Vert. plane)	8	5
2XN3DK	Horizontal (Rightward)	10°	5
3EYYEY	Azimuth	97 (it's relative)	N/A
3KKUE4	Azimuth	81 Degrees	5
6WQNMX	Azimuth	81	5
6YHQQZ	Horizontal	83	5
9G3KTY	Horizontal (Azimuth)	81.5 degrees	0.5
9WWALA	Horizontal	85°	.5
AWQKQB	Horizontal	81°	5
C3QGVT	Azimuth angle	97 (83 left to right)	5
CL3787	Horizontal	9	1
CY62Y7	Horizontal	81,0°	3,0°
CZ38J8	Azimuth (left to right)	81	5
D9BWYQ	Horizontal	83 L - R	5
DXTL67	Azimuth	77	
E4ERJR	Horizontal	84	
E74X4N	Azimuth (left to right)	84	5
EJPD8N	Horizontal	5	1.5
ETBLM6	Horizontal angle (= Azimuth*)	+9°	3°
EZWEY4	Horizontal from wall	82°	3
FJLBUN	Azimuth (left to right)	82	5
J4ZZD4	Horizontal (Left To Right)	12	2
KCAPQ3	Horizontal	9° L to R	5°
KTCMUX	Azimuth	82	5
KTW4BL	Azimuth	99	1
KVZW6K	Horizontal Entry	80	5
M39CJX	Horizontal	81	5
MBL7YZ	Azimuth	84	5
N3VZME	Horizontal	81	5
NDDEQG	Azimuth (Horizontal)	82 (Left to Right)	5
NDPFBU	Azimuth	82	5
NH8FRV	Horizontal, left to right	81	5
PG68VV	Horizontal	100	2

TABLE 3 - Horizontal

WebCode	Participant Defined Angle	Angle Measurement	Uncertainty (in degrees)
PPZ9DU	From a horzontal plane	~81 degrees	2 degrees
QEVFLE	Azimuth	83° Left	N/A
R266CE	Azimuth	9	5
TF64ZB	Azimuth/Horizontal	83.5	5
TNABDP	Azimuth - left to right	9	5
TXHQFR	Horizontal (anticlockwise)	82	6
U6CDQN	Horizontal	7 (left to right)	5
W8C8JP	Horizontal	81°	5°
XEC6N8	Azimuth (Horizontal)	80	5
XTQE8N	Azimuth	80	3
Y6LK2L	Horizontal deviation	10	2
Y96QUW	Azimuth	81 (left to right)	5
YBPPQK	Horizontal	83	3
ZDR3U4	Horizontal	7° left of perpendicular to the front face	5°
ZYT6PK	Horizontal	83	

TABLE 3 - Vertical

WebCode	Participant Defined Angle	Angle Measurement	Uncertainty (in degrees)
2N3UW4	Vertical(above Hort. plane)	38	5
2XN3DK	Vertical (downward)	38°	5
3EYYEY	Vertical	-37	N/A
3KKUE4	Vertical	-42 Degrees	5
6WQNMX	Vertical / Elevation	-37	5
6YHQQZ	Vertical	39	5
9G3KTY	Vertical	-40 degrees	0.5
9WWALA	Vertical	54°	UNK
AWQKQB	Vertical	-37°	5
C3QGVT	Vertical angle	-39	3
CL3787	Vertical	39	1
CY62Y7	Vertical	38,6°	3,0°
CZ38J8	Vertical	-40	5
D9BWYQ	Vertical	negative 38	5
DXTL67	Vertical	-39	
E4ERJR	Vertical	37	
E74X4N	Vertical (downward)	41	5
EJPD8N	Vertical	40	1.5
ETBLM6	Vertical angle*	-38° (-38.3°)	3°
EZWEY4	Vertical from wall	52°	3
FJLBUN	Vertical angle	39	5
J4ZZD4	Vertical	-40	2
KCAPQ3	Vertical	40° upward	5°
KTCMUX	Vertical	-40	5
KTW4BL	Vertical	-38	1
KVZW6K	Vertical Entry	127	5
M39CJX	Vertical	37	5
MBL7YZ	Vertical	52	5
N3VZME	Vertical	-39	5
NDDEQG	Zenith (Vertical)	-39 (Downwards)	5
NDPFBU	Vertical	-38	5
NH8FRV	Vertical, downward	38	5
PG68VV	Vertical	51	2
PPZ9DU	From a vertical plane	~50 degrees	2 degrees
QEVFLE	Vertical	-39° Decline	N/A

TABLE 3 - Vertical

WebCode	Participant Defined Angle	Angle Measurement	Uncertainty (in degrees)
R266CE	Vertical	39	5
TF64ZB	Vertical	-40.40	5
TNABDP	Vertical - downward	38	5
TXHQFR	Vertical	-37.5	6
U6CDQN	Vertical	38 (downward	5
W8C8JP	Vertical	51°	5°
XEC6N8	Vertical	-38	5
XTQE8N	Vertical	40° degrees	3
Y6LK2L	Vertical inclination	40	3
Y96QUW	Elevation	40 (downward)	5
YBPPQK	Vertical	-37	3
ZDR3U4	Vertical	39° downward	5°
ZYT6PK	Vertical	52	3

Conclusions

TABLE 4

WebCode	Conclusions
2N3UW4	The trajectory data for Item Test No. 17-5620 Sample Pack AD was collected at the scene.
2XN3DK	Defect D-1 consists of a perforating 4mm x 6mm (approx) oval entry hole, located on the front side of the wall. The defect was approximately 4 1/8" up from the bottom of the wall and approx 1 1/2" from the left side of the wall. Defect D-1 is consistent with a projectile perforating the plywood wall and traveling left to right horizontal angle at approximately 10° and a downward angle of approximately 38°. Defect D-1A is consisted of a perforation located in the rear plywood wall. Defect -1A is an oval hole approximately 7mm x 8mm in size, located approx. 1 1/2" up from the bottom of the wall and approximately 2" from the left side of the wall. Defect D1A is consistent with an exit hole of defect D-1. No projectiles were recovered.
3EYYEY	Item 001 was determined to have two holes consistent with having been produced by the passage of a single bullet or similar type projectile that entered item 001 on the side marked with a blue ink circle at a relative azimuth angle of 97 degrees and a vertical angle of -37 degrees. This determination is based on the evaluation of the physical characteristics of those holes, their orientation to each other, and the results of chemical testing for the presence of copper and lead.
3KKUE4	The wall contains a single bullet hole that entered and perforated the blue wall (Evidence placard A)and subsequently perforated the red wall on the opposite side. The bullet traveled downward at an approximate angle of -42 degrees. The hole is through and through and no bullet was found. The bullet traveled slightly left to right in relation to the surface of the wall. The azimuth angle was approximately 81 degrees (left to right as measured in relation to the surface of the blue wall). The entrance hole in the blue wall is approximately 4 1/2" above the bottom edge of the wall sample and approximately 1 3/4" from the left edge of the wall sample.
6WQNMX	A small section of the wall partition was examined. For purposes of this examination, the panel containing the blue dot is designated as the front face. The blue dot is also designated as being in the lower right corner of the front face. Additionally the panel containing the red dot is designated as the rear face and the red dot is designated as being in the lower left corner. The following bullet hole was observed and assigned the indicated letter for documentation purposes: AAW-A One bullet hole in the upper right area of the front face. The bullet traveled downward in a front to rear and right to left direction and perforated the wall.
6YHQQZ	The section of wall submitted for analysis demonstrated a pair of defects reported to have been caused by a gunshot. Blue and red dots on opposite sides of the wall were observed. The side with the blue dot was determined to be the entry point and the red dot was determined to be the exit point. These angle represented by aligning these defects was measured. The horizontal angle was measured as 83 degrees, with 0 degrees on the left side of the wall, 180 degrees to the right. The vertical angle was measured as 39 degrees with 0 degrees oriented upwards and 180 degrees downward. The direction of fire was determined to be front to back, slightly left to right and downward.
9G3KTY	The projectile entered the "blue" side of the target surface producing a perforating defect located 44mm from the left vertical edge and 36mm down from the top horizontal edge of the wall covering. The bullet path has a -40 degree vertical (downward) angle and an 81.5 degree horizontal (azimuth) left to right angle. Disclaimer: Assuming vertical surface and a bullet is the projectile.

TABLE 4

WebCode	Conclusions
9WWALA	The conclusions expressed are based upon the information and evidence available at the time of this report. Based on the examination of evidence I observed two defects in this wooden structure. The use of a trajectory rod was utilized to determine flight path and incident angle. The projectile entered the wall and perferated the wall at a downward angle traveling left to right. The angle of impact was approximately between 49-54° utilizing a digital scale and trigonometry methods. The azimuth was measured at 85°. The projectile perforated the rear of the structure exiting to an unknown resting place. No projectile was recovered for examination.
AWQKQB	Trajectory analysis was performed on the shooting board. There was a single bullet hole on the board which measured 5 9/16" by 5 12/16". The bullet hole was measured for placement on board, its diameter (possible caliber of bullet), and its horizontal and vertical angles of trajectory. The angles of trajectory are based on plus/minus five degrees and the horizontal angle was read left to right (using the outer numbers on the protractor). The vertical angle was found to be -37°; level of uncertainty ±5°, and horizontal angle was found to be 81° Left to Right; level of uncertainty ±5°.
C3QGVT	Based on the positions of the primary and secondary bullet defects the following vertical and azimuth angle have been determined: Vertical angle: -39 degrees (downwards) with a 95% confidence interval ranging from -36 to -42 degrees Azimuth angle: 97 degrees with a 95% confidence interval ranging from 93 to 103 degrees.
CL3787	The entrance hole is in the box's blue side. The shot's direction is from up to down from left to right with a 39°±1° vertical and 9°±1° horizontal angle.
CY62Y7	The box (wall in the garage) received one shot on blue side surface, these shot cames from left to right,back to front, and downward (referenced as a person faces the wall). The bullet struck the wall on blue side surface, from left to right (81,0º), back to front and downward (38,6º).
CZ38J8	The "blue" surface of the partition wall was found to have an entry hole measuring approximately 6 millimetres (mm) by 5 mm, located at approximately 36 mm from the left side of the "blue" surface, at a height of 97 mm. The "red" surface of the partition wall was found to have an exit hole measuring approximately 9 mm by 5 mm, located at approximately 46 mm from the right side of the "red" surface, at a height of 36 mm. The trajectory were determined to be 81° (± 5º) from left to right (when viewed facing the "blue" surface) and 40° (± 5º) downwards.
D9BWYQ	The fired bullet struck the wall at a near perpendicular angle, with a slight left to right component and with a downward angle of approximately 38 degrees.
DXTL67	In our opinion the damage present is consistent with a single discharge from a small calibre firearm. The shot has been fired in a downward direction, slightly left to right when looking at the entry hole side (blue dot side).
E4ERJR	Approximate trajectory measurements were recorded.
E74X4N	One bullet perforated the garage door, with a downward and left to right directionality.

TABLE 4

WebCode	Conclusions
EJPD8N	From existing data, measurements and calculations and from the appearance of examined material the angle of the fired projectile have been approximated. The terminated projectile path is downwards from left to right, entering the blue marked panel thru the wall, and exiting thru the red marked panel. The downward angle is estimated to 40 degrees (+/- 1.5 degrees) related to the horizontal plane and 5 degrees (+/- 1.5 degrees) from left to right related to the orthogonal plane.
ETBLM6	The bullet penetrates the partition wall from blue surface to the red surface. It moved downward and from the left side of the partition wall to the right side. The measured vertical* angle is -38° with an uncertainty of ±3°. The measured horizontal** angle is +9° with an uncertainty of ±3°. A higher certainty can be achieved, but it seems not to be necessary from the scenario. Further angles (e.g. declination***) can be calculated from that data if there were addition information about the declination of the surface where the partition wall stood. A deflection of the bullet path during impact was not taken into account. If necessary, additional investigations can be made. * The vertical angle is the angle in the side wall plane relative to the top or bottom wall plane. Zero vertical angle means the bullet moves in the same height relative to the top or bottom wall. A negative vertical angle means the bullet went downward from top or bottom wall. ** The horizontal angle is the angle in top or bottom wall plane relative to the left or right side wall plane. *** Declination is the angle of the bullet path relative to the horizontal plane at the crime scene. It is not the vertical angle.
EZWEY4	The bullet hit the "blue" wall in a vertical angle of aprox. 52° (seen from the ceiling) and a horizontal angle of aprox. 82° (from the left when standing in front of the "blue" wall).
FJLBUN	The section of partition wall exhibits a perforating bullet hole with the entrance defect on the side marked as blue and the exit defect on the side marked as red. The bullet pathway through the section of partition wall, when facing the front of the wall (marked as blue), was determined through the use of trajectory rods/probes as being from front to back, left to right and at a downward angle. This suggest that the muzzle of the firearm was in front and to the left of the wall and pointed downward at the time of discharge. The absence of gunshot residues (powder particles, smoke and soot)suggest that this was a distant gunshot or a gunshot with an intermediary object between the muzzle and the section of partition wall. The vertical angle was measured at approximately -39 degrees (+/- 5 degrees)downward angle in relation to the horizontal plane. The azimuth angle or horizontal directionality was measured at approximately 82 degrees (+/- 5 degrees) when measured from left to right facing the front of the wall (marked as blue)and approximately 98 degrees (+/- 5 degrees) when measured from right to left. These angle measurements allows for an extrapolation of the bullet pathway in both directions to determine a possible point of origin (shooter position)or secondary impact point of the bullet after perforating the section of partition wall.
J4ZZD4	ENTRANCE HOLE DIAMETER APPROXIMATE 0.6*0.6 C.M. (WIDTH*LENGTH), DISTANCE FROM LEFT WALL 3.7 CM. AND HEIGHT FROM FLOOR 10.2 CM. EXIT HOLE DIAMETER APPROXIMATE 0.7*1.0 C.M. (WIDTH*LENGTH), DISTANCE FROM LEFT WALL 5.0 CM. AND HEIGHT FROM FLOOR 4.5 CM. THE ANGLE THAT THE BULLET TRAJECTORY WENT INTO THE BLUE WALL GOING DOWNWARD -40 DEGREE TO -42 DEGREE (VERTICAL ANGLE) (IF IT'S PERFECTLY LEVEL IT'S 0 DEGREE). HORIZONTAL 12 DEGREE TO 14 DEGREE (LEFT TO RIGHT) AND THE BULLET EXIT FROM THE RED WALL.
KCAPQ3	Impact site #1 is a perforating hole in the "red painted" garage wall. The hole is approximately 4.5cm x 5cm and consistent with the entry hole of a projectile. Impact site # 1A is a perforating hole in the "blue painted garage wall". This hole is approximately 4.5cm x 5.5cm and is consistent with an exit hole in relation to impact site #1. The direction of travel is upward at approximately 40° and left to right at approximately 9°

TABLE 4

WebCode	Conclusions
KTCMUX	A projectile pass through the wall, enter the blue side and exit the red side. At a vertical angle of -40 degres and an azimuth angle of 82 degrees left to right as one face the sample.
KTW4BL	Exhibit AD is a section of wall constructed of plywood bearing a hole on both wall surfaces. The hole in the wall surface marked with a blue dot is physically consistent with a bullet having entered this side. The hole in the wall surface marked with a red dot is physically consistent with a bullet having exited this side. The two holes are physically consistent with a single bullet path. The vertical impact angle is -38 degrees (downward trajectory) and the azimuth impact angle is 99 degrees (left to right trajectory).
KVZW6K	Shooting direction from up to down and from left to right.Entrance angles: vertical angle 127 degrees, horizontal angle 80 degrees. Exit angles: vertical angle 53 degrees, horizontal angle 100 degrees. Uncertainty 5 degrees for all directions.
M39CJX	The wall sample was perforated by a projectile that struck the blue side and travelled through and exited on the red side. The defect was at a downward angle of approximately 37 degrees and left to right at approximately 81 degrees.
MBL7YZ	Ex_ piece of wood was perforated at a downward angle of ~50 degrees +/- 5 degress and left to right at ~85 degrees +/- 5 degrees.
N3VZME	An area of damage consistent with being a bullet entrance hole to the blue coloured wall with a corresponding area of damage consistent with being a bullet exit hole to the red coloured wall. This damage was consistent with having being caused by the passage of a single fired bullet travelling from front to back, left to right and downwards.
NDDEQG	Based on the examination of the recovered section of partition wall, the bullet entered the wall at an approximate downward angle of -39 degrees, travelling left to right at an approximate angle of 82 degrees and continued on this trajectory through the wall before exiting on the other side.
NDPFBU	A bullet entered the wall at A and exited at A1. The direction of travel was left to right and downward.
NH8FRV	Evidence Item 17-5620: Is a small, roughly 6 inch square, by 3 inch deep, cut out section of wall. It is composed of plywood supports at the center covered by thin plywood veneer. A black arrow written on the surface denotes up. One veneer side is marked with a blue dot, the opposite side is marked with a red dot. A perforating defect is through both veneer sides. Assuming these defects were created by a single projectile passing through the wall, then the entrance was on the blue (front) side and the exit (back) was on the red side. The projectile was traveling downward at 38 degrees, and slightly left to right at approximately 81 degrees from the blue (front) surface of the wall. All angles reported are within (+/-) 5 degrees.
PG68VV	The projectile penetrated the sample by the face having the blue trace and exited the sample by the face having the red trace. The trajectory was from the front (side has been marked blue) to back (side has been marked red), from left to right and downward. The vertical angle of bullet path is 51°. The horizontal angle of bullet path is 100°. The Height of the entrance hole is 105 mm. The horizontal distance(form the left) of the entrance hole is 38 mm. The Height of the exit hole is 45 mm. The horizontal distance(form the left) of the exit hole is 50 mm.

TABLE 4

WebCode	Conclusions
PPZ9DU	A hole was observed on the face of the wall that has a blue dot. It is consistent in appearance with damage made by a projectile passing from the outside, into the wall. A second hole was observed on the face of the wall that has a red dot. It is consistent in appearance with damage made by a projectile passing from the inside of the wall, outward. The alignment of the holes is consistent with having been made consecutively by the passing of the same projectile. From the perspective of one facing the surface of the wall having a blue dot, the trajectory of the projectile was into the wall, downward, from left to right and exiting the side having a red dot.
QEVFLE	Item #01 - A section of partition wall with questioned bullet entry & exit hole. (Note: The submitted section of wall has orientation markers present: A label indicates the top side; a blue marking is found on the side that will be referred to as the front side; a red marking is found on the side referred to as the back side; and an arrow that points upward is found on the left side. The angular measurements reported relative to determined trajectories are offered for descriptive purposes.) Results and Conclusions: Item #01- Examination of the section of wall revealed the presence of physical damage consistent with a bullet perforating the wall, with a bullet hole entrance on the front/blue side and a bullet exit on the back/red side. The bullet causing this damage traveled front to back, slightly left to right, and downward. The bullet was fired on a downward angle (approximately -39 degree decline) from a position slightly left of the bullet hole entrance (approximately 83 degrees to the left relative to the plane of the walls surface / 7 degree left "NATO Angle").
R266CE	Perforating defects, consistent with defects produced by a fired bullet, were observed in the submitted wall portion. Examinations of the defects were conducted in an attempt to establish the trajectory of the fired bullet's path. The following trajectory was established: Measurements and examinations of the perforating defects in the wall indicate that a fired bullet entered the blue side of the wall and exited the red side of the wall at a 39 degree (+/- 5 degree) downward angle and a 9 degree left to right azimuth angle (+/- 5 degree). Note: The azimuth angle was determined by having the zero reference point be the perpendicular line coming out from the defect on the blue side of the wall.
TF64ZB	As a result of my examination of the section of a garage partition wall I formed the opinion that a projectile has perforated the side of the wall, labelled with a blue colour and then perforated the wall on the other side of the wall cavity, labelled with a red colour. A trajectory rod indicated that the projectile was travelling downwards and slightly left to right when facing the wall labelled with a blue colour.
TNABDP	The trajectory of the projectile was in a downward angle (~38 degrees) from left to right (~9 degrees) (+/- 5 degrees).
TXHQFR	The hole in the sample marked blue is consistent with being caused by the passage of a bullet/projectile from the exterior to interior of the partition wall. The hole in the sample marked red is consistent with the passage of a bullet/projectile from the interior to the exterior of the partition wall. The trajectory of a projectile entering the hole in the sample marked blue and exiting the hole in the sample marked red is from an upward to downward direction and from left to right, at approximately 37.5 degrees below the horizontal plane and approximately 82 degrees anticlockwise in the horizontal plane from the vertical plane of the sample marked blue.
U6CDQN	The direction of the projectile is downward and slightly from left to right. The entrance hole is on the side designated with the blue dot due to the wood fibers being forced inward. The exit hole is on the side designated with the red dot due to the wood fibers being forced outward.

TABLE 4

WebCode	Conclusions
W8C8JP	The bullet appeared to be traveling from the front (blue dot side) to the back (red dot side) of the wall at a downward angle and from left to right.
XEC6N8	A bullet entrance hole was observed on the blue side of the wall, and a bullet exit hole was observed on the red side of the wall. The path of the bullet's travel was determined to be above to below at a 38° angle and from left to right at an angle measured 10° left of midline. Note: All trajectories measured in this report reflect a ±5° variance. Alternatively, the actual angle measurements could be omitted and the report could read: A bullet entrance hole was observed on the blue side of the wall, and a bullet exit hole was observed on the red side of the wall. The path of the bullet's travel was determined to be above to below and slightly from left to right.
XTQE8N	The projectile enter the box traveling at a 40° degree angle going left to right at a 80° angle. Exit the back of the box.
Y6LK2L	Same words and references, basically.
Y96QUW	The wooden block exhibited a perforating entrance bullet defect to the blue face of the block with a corresponding perforating exit bullet defect to the red face of the block. The entrance measured 7mm by 8mm in size and was elliptical in shape with regular margins. The entrance defect was located 3cm The entrance defect tested positive for the presence of lead. The corresponding exit defect measured 1.5cm by 2cm in size and was irregular in shape with wood fragments protruding from the defect. The exit defect was located 5cm in from the right side (as you look at the red side) and 3.5cm up from in from the left side of the block (looking at the blue side) and 10cm up from the bottom surface. the bottom surface. The exit defect tested positive for the presence of lead. A trajectory rod was fit between the entrance and exit defects and measured both by hand with an inclinometer and a zero edge protractor and with a 3D laser scanner. Both techniques yielded the same elevation angle of 40 degrees downward (into the blue side) and the same azimuth angle of 81 degrees left to right (into the blue side). The bullet path was from blue side to the red side, downward, and left to right.
YBPPQK	There was an oval entry bullet hole in the partition wall (blue), 43mm from the left edge and 44mm from the top edge. No products of combustion were observed in or around the hole. There was an irregular exit bullet hole in the partition wall (red) 55mm from the left edge and 48mm from the bottom edge. The trajectory of the bullet was from blue to red, left to right and downwards. The angles of the tract were measured to be at a horizontal angle of 83 degrees (plus/minus 3 degrees) and 37 degrees (plus/minus 3 degrees) downwards from the horizontal plane. Nothing was observed in the partition wall that may have altered the trajectory of the bullet.
ZDR3U4	One hole, designated as hole A1, was found on the front face of the submitted wall section. Hole A1 is consistent with an entrance hole and is located approximately 1 7/8 inches right of the left hand side (from the perspective of facing the front of the wall section), 2 inches down from the top, and on the front face of the wall section. One hole, designated as hole A2, was found on the back face of the submitted wall section. Hole A2 is consistent with an exit hole and is located approximately 2 1/8 inches right of the left hand side (from the perspective of facing the front of the wall section), 4 1/8 inches down from the top, and 3 inches back from the front face of the wall section. A trajectory rod was placed through holes A1 and A2. The resulting angles were measured to be approximately 39° (+/- 5°) downward and 7° (+/- 5°) left of perpendicular to the front face of the wall section, traveling from the front of the wall towards the back of the wall, from the left side towards the right side, and downward.

TABLE 4

WebCode	Conclusions
ZYT6PK	The bullet has entered the blue side of the wall with a horizontal angle of 83 degrees from left to right, and 52 degrees downwards. The bullet has exited through the red side of the wall. Due to the rudimentary form of the exit hole, there is an uncertainty of 3 degrees vertically.

Additional Comments

TABLE 5

WebCode	Additional Comments
2N3UW4	Our lab does not do shooting reconstruction as part of the Crime Scene Response(CSR) report. The report only documents the scene information, personnel preforming analysis and procedures/type of analysis performed. Additionally, notes, drawings and photos are collected and retained as part of the analysis.
3EYYEY	The issued report also includes photographic documentation that clearly demonstrates the relationship of the measured azimuth angle to item 001.
9WWALA	Entrance (Blue): 6mm width, 8mm length; oval shape. Exit (Red): 9mm width, oval shape; 11mm length, splintered. [Participant provided a drawing with measurements that could not be reproduced within the report].
C3QGVT	The azimuth angle has been measured while using the front of the box (blue dot) as a reference plane. When looking towards this box the angle has been measured from the right. The smallest angle in relation to the box would have been 83 degrees from left to right.
CL3787	Because of the diameter of the entrance hole the bullet probably was .22 caliber.
CY62Y7	Vertical angle`s direction is descendent
D9BWYQ	Angles and measurements used in the caluculation of trajectory determinations are not normally referred to in reports/statement issued within our jurisdiction. This type of information is contained within our notes to suppport any opinion/conclusions reached regarding the probable postion of the shooter/firearm at the time of discharge. In our reports/statements we would only comment on the probable position of the shooter/firearm relative to the area of damage and within the context of the scene. I.e. The area of damage was caused by a fired bullet (charge of shot etc.) that had originated from an area in the vicinity of the front gate located south-east of the damaged wall/window/door etc.
DXTL67	Reporting of angles is not standard operating procedure in our laboratory. The tools used in our determination of the angles are not calibrated to a traceable standard, therefore we are unable to provide an accurate error estimation.
EJPD8N	Our standardized wording is connected to our evidence theory and is really not compatible or suitable for direct translation. We choose to focus on explaining our result in a way that we believe is suited for this test rather than trying to find the correct wordings, as we would if we where targeting our court system.
ETBLM6	With a second method I achieved an uncertainty of ±1°. But from the case there is no need to make it smaller. [Participant provided measurements for a Declination angle as follows: Declination ***: -38° (-37.9°), 3° Uncertainty]
FJLBUN	Standard bullet trajectory kit used for bullet pathway determination using the 3mm pink colored rods, zero edge protractor, inclinometer and plumb bob and string. All measurements are considered as approximations. [Participant provided a secondary measurement for Azimuth (right to left) 98°, 5 Uncertainty]
J4ZZD4	I THINK THAT ENTRANCE HOLE DIAMETER IN THIS TEST WILL HAVE LOOK LIKE OVAL SHAPE. BECAUSE VERTICAL ANGLE OF TRAJECTORY ROD -40 DEGREE. IF IN THE BODY ENTRANCE WOULD HAVE "ABRASION RING"

TABLE 5

WebCode	Additional Comments
KVZW6K	[Participant provided measurements for the Exit as follows: Horizontal Exit - 100°, 5 Uncertainty; Vertical Exit - 53°, 5 Uncertainty]
NH8FRV	For reporting purposes I referenced the side of the wall marked blue as the front.
PG68VV	The shape of entrance hole is oval with 6 mm of length and 7 mm of width.
QEVFLE	Our laboratory has had a internal proficiency test program in place for Firearm Section personel who perform "Shooting Incident Reconstruction" Examinations utilizing a vehicle that has had trajectory rods secured. Results are reported for incline or decline angular measurements and azimuth reported relative to the axis of the vehicle with front being 0-degrees and rear 180 degrees and right or left. [Participant provided measurements for the NATO Angle as follows: 7° Left, N/A Uncertainty]
TNABDP	The entrance was the side with the blue dot and the exit was the side with the red dot.
TXHQFR	If necessary/required, the limits of uncertainty would be included in the report, but this was not done because the amount of space provided for the conclusion was not adequate to include the limits of uncertainty.
U6CDQN	Item 1 – One square section of a wood wall measuring approximately 5 ¾ inches by 5 7/8 inches by 3 inches. The frame consists of plywood and the sheathing consists of lauan. The top of the wall is designated by an arrow on the side of the frame and a sticker on the top of the frame labeled “Test No. 17-5620 Top”. There is a hole on each side of the sheathing. Hole #1 is located on the side with the blue dot and measures approximately 1 9/16 inch from the left edge of the frame and approximately 4 1/8 inches from the bottom edge of the frame. Hole #1 measures approximately 3/16 inch by ¼ inch. Hole #2 is located on the side with the red dot and measures approximately 3 13/16 inches from the left edge of the frame and approximately 1 ¾ inches from the bottom edge of the frame. Hole #2 measures approximately ¼ inch by 3/8 inch. Holes #1 and 2 appear to be in a line and form one projectile path. A trajectory rod was inserted and the following measurements were taken. The horizontal angle is approximately 7 degrees (+ or – 5 degrees) from left to right. The vertical angle is approximately 38 degrees (+ or – 5 degrees) downward.
XEC6N8	The azimuth angle is measured 10 degrees left of midline or 80 degrees out from the plane of the wall. The vertical angle is 38 degrees off of level/horizontal and downward so it was reported as a negative angle in question 3. Clarifying which angle you would like reported would increase consistency, and indicating whether you would like the negative symbol included for downward angles would also increase reporting consistency. Having four lines for section 3 on the printed answer sheet is confusing because there are only 2 angles to report.

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	How does your laboratory define/describe the reported angle types? (azimuth, vertical, horizontal)
2N3UW4	Vertical-above/below the horizontal plane and Horizontal- Left/Right of the vertical plane
2XN3DK	Vertical = Upward or downward path. Horizontal = Traveling right to left or left to right path
3EYYEY	We generally measure and report two components of trajectory, azimuth and vertical.
3KKUE4	We use vertical and Azimuth.
6WQNMX	Vertical/elevation: the angle at which a bullet impacts a vertical surface, with 0 degrees being designated as horizontal or parallel to the ground. Azimuth: the angle representing the "bird's eye view". Generally described using compass directions (e.g. north to south) or reference directions (e.g. front to rear)
6YHQQZ	Horizontal and vertical
9G3KTY	Horizontal and vertical angles are reported.
9WWALA	The vertical and horizontal angles are reported to document flight path and incident angle (pre-impact path).
AWQKQB	Azimuth/horizontal - an angle or bearing lying in the horizontal plane, described on the basis of compass direction (north, south, east, west). Vertical - the vertical component of a projectile's reconstructed flight path. The angle is given a negative sign if the path followed by the projectile is downward. The angle is given a positive sign if the path followed by the projectile is upward
C3QGVT	Vertical angle: The ascending or descending angle possessed by the bullet as it penetrates or perforates one or more objects Azimuth angle: The compass direction as one views the bullet's path from above (measured from the right)
CL3787	We define the horizontal and vertical angles.
CY62Y7	Elevation or vertical angle, measured in the plane formed between the line of the horizon and the line of the trajectory. Horizontal angle, obtained from a plan view or projection of the trajectories to a horizontal plane, is measured between a set reference line up to the line of the trajectory. The reference line can be a cardinal point or a line adjusted to the geometry of the object.
CZ38J8	Vertical Angle: An angle that describes the vertical component of a projectile reconstructed flight path. The angle is negative if the path followed is downwards and positive if the path followed is upwards. A trajectory parallel to ground has vertical angle of 0°. Azimuth Angle: An angle lying in the horizontal plane, with respect to an arbitrary reference line (e.g. parallel to wall or length of a car)

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	How does your laboratory define/describe the reported angle types? (azimuth, vertical, horizontal)
D9BWYQ	Horizontal angle - the acute angle, in a horizontal plane, formed between the estimated bullet path/trajectory rod and the plane of the struck surface or other frame of reference. Vertical angle - the angle formed between the estimated bullet path/trajectory rod and a horizontal plane located through the entry damage. Descirbes the upward or downward nagular component of a fired bullet within a vertical plane. Postive angles = up & Negative angles = down. Azimuth angle - the direction of travel of a fired bullet within a horizontal plane described as a compass bearing relative to the area of entry damage. Sometimes use interchangeably but incorrectly with horizontal angle.
DXTL67	reporting of angles is not carried out in our laboratory. We would only report general direction of fire.
E4ERJR	We do not report angles.
E74X4N	vertical- describes the upward or downward angle of a bullet azimuth- describes the horizontal angle of the bullet (i.e. right to left)
EJPD8N	Vertical, Horizontal.
ETBLM6	1) The vertical angle is the angle in the side wall plane relative to the top or bottom wall plane. Zero vertical angle means the bullet moves in the same height relative to the top or bottom wall. A negative vertical angle means the bullet went downward from top or bottom wall. 2) The horizontal angle is the angle in top or bottom wall plane relative to the left or right side wall plane. If you look from top to bottom it starts from the perpendicular of the blue surface clockwise. So a positive horizontal angle means bullet went from the left side to the right side. 3) Declination is the angle of the bullet path (trajectory) relative to the horizontal plane (at the crime scene). It is not the vertical angle. 4) Azimuth is the angle in horizontal plane relative to a user defined vertical side wall. If there is no wall or something else you can use the north direction of a compass. In this case you can define zero azimuth so that it points perpendicular from the blue surface into the partition wall: than the azimuth is equal to the horizontal angle.
EZWEY4	we usualy don't give an angle. We report the probable point of origin in a image or sketch.
FJLBUN	Vertical angle defines the up or down component of the bullet pathway in relation to the horizontal plane. The angle is reported as a negative value for downward pathways e.g. -39 degrees and a positive value for upward pathways e.g. 39 degrees. The directionality or birdseye view of the bullet pathway is measured as the azimuth angle (compass angle)either from left to right or right to left. It is recommended that the examiner stay consistent when determining if he /she is going to measure the azimuth angle from left to right or right to left e.g. if it is decided to measure from left to right, all other azimuth angles on a particular shooting incident/reconstruction should be measured from left to right and not vice versa.
J4ZZD4	- VERTICAL ANGLE (UP TO DOWN), THE ANGLE THAT THE BULLET WENT INTO THE WALL MEASURED GOING UP OR DOWN. THE DEGREE OF FLIGHT PATH IS PRECEDED WITH A MINUS SIGN IF THE PATH GOES DOWNWARD (-40 DEGREES) AND IS GIVEN A POSITIVE SIGN IF GOING UP WARD (+40 DEGREES). IF IT'S PERFECTLY LEVEL IT'S 0 DEGREES. - HORIZONTAL, A TYPICAL WAY OF EXPRESSING THIS IS THE NUMBER OF DEGREES AWAY FROM PERPENDICULAR EITHER "LEFT TO RIGHT" OR "RIGHT TO LEFT"
KCAPQ3	Vertical + Horizontal

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	How does your laboratory define/describe the reported angle types? (azimuth, vertical, horizontal)
KTCMUX	Azimuth and vertical
KTW4BL	Azimuth: horizontal angle measured with a protractor. Protractor is placed against the surface with the 90 degree graduation at the center of the hole. Viewing from above, the angle is measured working clockwise - right of hole=0 degrees, perpendicular to hole=90 degrees, left of hole=180 degrees. Vertical: measured by placing an angle finder on trajectory rod.
KVZW6K	Vertical 0 degrees down, 180 degrees up. Horizontal 0 degrees left, 180 degrees right.
M39CJX	Vertical and Horizontal
MBL7YZ	Azimuth and vertical
N3VZME	Azimuth - An angle or bearing lying in the horizontal plane, usually described on the basis of compass direction. Vertical - plane/angle/side on profile. Horizontal - plane/angle/overhead view.
NDDEQG	The Azimuth/Horizontal angle is the horizontal angle at which the bullet is moving as it penetrates a substrate, obtained by measuring the angle of the probe to the substrate with the substrate serving at 0 degrees. The Zenith/Vertical angle is the vertical angle at which the bullet is moving as it penetrates a substrate, obtained by measuring the angle of the probe to the substrate with a perpendicular line from the entry point in the substrate serving as 0 degrees. With downwards trajectories the recorded value is given a negative value (i.e. "-"), while upwards trajectories are given a positive value.
NDPFBU	for downward vertical angles the angle is a negative number. for upward vertical angles the angle is a positive number for orthogonal or straight on the angle is 0 for azimuth angles lower than 90 degrees are left to right, angles that are greater than 90 degrees are right to left, and 90 degrees is orthogonal or straight on
NH8FRV	Vertical or elevation - uses downward or upward in the description Azimuth or horizontal - uses left to right or right to left for stationary objects and walls. A 360 degree approach is used for movable object like vehicles.
PG68VV	The vertical angle is defined as the angle between the path of the bullet and the vertical axis. The horizontal angle is defined as the angle between the projection of the path of the bullet on the horizontal plane and the line of intersection of the horizontal plane with the plane of impact.
PPZ9DU	The base line for recorded angles depend on the surface. For flat surfaces, such as walls, the surface itself represents the vertical and the horizontal base lines. For other surfaces, the horizontal base line is created based on two reproducible reference points. The vertical base line is determined with an angle finder or plumb line.
QEVFLE	Our laboratory reports vertical angle as a "+" or "-" also indicating incline or decline. We prefer to use "NATO Angle" where perpendicular is "0"; rather than "Forensic Angle" where perpendicular is "90°". Note: Orthogonal is 0°, 0° in NATO Angle.
R266CE	vertical angle=the degrees up or down from the horizontal horizontal=parallel to level ground or right angle to the vertical azimuth angle=degrees right or left

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	How does your laboratory define/describe the reported angle types? (azimuth, vertical, horizontal)
TF64ZB	Vertical with – indicating a downward angle and + indicating an upward angle a 0 degree angle is orthogonal. The azimuth or horizontal angle is 90 degrees or less and is measured in relation to the struck surface and not from the shooters position (i.e. NATO method).
TNABDP	Veritical/elevation - upward or downward (using 90 degrees as the zero mark, and angles in <90 degrees) Azimuth - left to right or right to left (using 90 degrees as the zero mark, and angles in <90 degrees)
TXHQFR	The laboratory does not define how angle types are reported, therefore angle types are reported based on the decision of the reporting officer.
U6CDQN	Horizontal and vertical angles
W8C8JP	Vertical = The acute angle is recorded. Horizontal = The acute angle is recorded
XEC6N8	Azimuth and horizontal are defined as the same angle. The other angle that is measured is the vertical angle.
XTQE8N	Vertical, Horizontal
Y6LK2L	Vertical inclination and horizontal or side deviation.
Y96QUW	We use the term elevation angle to describe the bullet path in terms of upward or downward trajectory. We use the term azimuth angle to describe the bullet path in terms of horizontal trajectory
YBPPQK	Horisontal angle (in relation to the vertical plane) Vertical angle (in relation to the horizontal plane)
ZDR3U4	Vertical = upward and downward. Horizontal = left or right of perpendicular
ZYT6PK	Our laboratory uses the terms vertical and horizontal angle in order to describe the trajectory of a bullet.

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	What type of equipment did you use to determine the angles? (e.g. probe, dowel, string, laser, 3D scanning, Total Station, cameras)
2N3UW4	Trajectory rod, angle finder, protractor with string and plumb bob and camera
2XN3DK	Trajectory rod, angle finder, protractor, string & weight, ruler, tape measure
3EYYEY	We generally use trajectory (or similar dowel) rods with measuring tools described below in question eight. We have the tools and capability to use string and/or lasers but use those less frequently. We routinely document the angles photographically with cameras, tripods, etc.
3KKUE4	Dowel, Inclinometer, Camera, Protractor.
6WQNMX	Trajectory rod, protractor, inclinometer
6YHQQZ	Probe, Protractor, Digital Angle Finder
9G3KTY	Probe
9WWALA	Digital angle gauge (Inclinometer), 1/2 protractors, trajectory rods/dowel, ruler (mm)
AWQKQB	Plumb line, protractor, trajectory (flight path) rods, Inclinometer (Angle finder)
C3QGVT	Probe, protractor, plumb bob and string, digital inclinometer
CL3787	probe
CY62Y7	LTF-100 Trajectory Kit from SIRCHIE: vertical angle meter, laser, rods, strings. Rule graduated in millimeters.
CZ38J8	Probe
D9BWYQ	- trajectory rods - baseline protractor, plumbline and inclinometer - tape measure and calculators - dividers and ellipse templates
DXTL67	Protractor, spirit level, plumb bob, trajectory rod and inclinometer.
E4ERJR	trajectory rods
E74X4N	- trajectory rod - protractor - inclinometer - drop string
EJPD8N	Probe, laser.
ETBLM6	Ruler, caliper gauge, set square, rod, (laser)
EZWEY4	rods, angle finder, ruler, and 3D-Scanning
FJLBUN	3mm pink colored trajectory rod/probe, zero edge protractor, inclinometer, plumb bob and string.

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	What type of equipment did you use to determine the angles? (e.g. probe, dowel, string, laser, 3D scanning, Total Station, cameras)
J4ZZD4	MEASURING THESE ANGLES REQUIRES THE USE OF TRAJECTORY RODS AND CONS. THE PLASTIC RODS ARE INSERTED INTO THE BULLET'S FLIGHT PATH THROUGH THE WALL. USE PROBE OR TRAJECTORY RODS, HALF TRAJECTORY, ANGLE FINDER, PLUMB BOB AND LINE, CENTERING COME AND SOMETIME USE COLORED TRAJECTORY STRING AND TRIPOD.
KCAPQ3	Probe
KTCMUX	A probe, a digital inclinometer, protractor and plum line
KTW4BL	Trajectory rod
KVZW6K	Evipaq, strings, dowels, lasers, blumb line.
M39CJX	Dowel, String and Laser depending on application.
MBL7YZ	dowel and elipses template.
N3VZME	Probe and protractor
NDDEQG	Probes, protractors, plum bob, rules, scales, camera, inclinometer.
NDPFBU	Probe, string, protractor, and angle finder.
NH8FRV	Metal rod/dowel
PG68VV	Usually we use dowel and laser.
PPZ9DU	A probe (rod), camera, plumb line, protractor and an angle finder.
QEVFLE	Trajectory rod, camera, plumb bob, protractor. Note: A digital level was used to select surface. Box was placed on prior to taking photographs used for measurements.
R266CE	probe, plumb bob, protractor, angle finder/inclinometer
TF64ZB	Trajectory rod, protractor, plum bob, level, digital inclinometer and camera
TNABDP	Trajectory rod and documented with camera
TXHQFR	Digital inclinometer, rod, protractor, string with plumb bob, camera, spirit level
U6CDQN	Probe, dowel (trajectory rod), inclinometer, protractor, plumb bob and a drop string.
W8C8JP	Trajectory rod, inclinometer, zero-edge protractor, level, plumb bob with string, laser with fog
XEC6N8	I primarily used a probe with a plumb bob; however, a laser and camera were also used to check the reported angles.
XTQE8N	Probes dowel, rods, inspection camera

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	What type of equipment did you use to determine the angles? (e.g. probe, dowel, string, laser, 3D scanning, Total Station, cameras)
Y6LK2L	It depends on the every reconstruction. Our equipment include laser, cameras, dowels, ballistic strings,...
Y96QUW	A metal trajectory rod was fit between defects. An inclinometer and zero edge protractor were used with plumbs, levels, and strings to perform hand measurements. A camera was used for photo documentation. The trajectory rods and target surfaces were 3D scanned as a secondary form of measurement.
YBPPQK	Probe, plumb bob, flat edge protractor, digital inclinometer, camera.
ZDR3U4	Metal rod
ZYT6PK	First we used a probe to illustrate the angle. Then a protractor was used in order to read the angles of the probe. This combined with a camera with a bubble level attached to document the angles. We also used a plumb line in order to get accurate measures. Afterwards we confirmed our results by using 3D scan equipment.

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	What method(s) did you use to measure the angles? (e.g. trigonometry, drop string, protractor, angle finder/inclinometer)
2N3UW4	Trajectory rod, angle finder, protractor with string and plumb bob
2XN3DK	Trajectory rod, angle finder & protractor. Trigonometry - hole size measurements (vertical) height of the entry + exit hole and (horizontal) measurements of the entry + exit hole and distance of travel.
3EYYEY	In this test I measured the azimuth angle with a zero edge protractor and the vertical angle with an inclinometer. Angles are generally documented photographically using appropriate references (e.g. plumb bob on a drop string) for additional case documentation. We have procedures that allow for mathematical determination or measuring directly from photographs at the examiners discretion.
3KKUE4	Vertical angle was measured using inclinometer (manual). Azimuth angle was measured using camera and protractor.
6WQNMX	Protractor and inclinometer.
6YHQQZ	Protractor and Digital Angle Finder
9G3KTY	Protractor and plumb bob
9WWALA	For Vertical angle the use of a digital angle gauge was utilized. Trigonometry was use to verify finding within 5°. A protractor was used for determining the horizontal angle.
AWQKQB	Vertical: inclinometer placed on the trajectory rod. Horizontal: zero-edge protractor placed under the bullet hole such that the 90° is under the center of the hole. A plumb line is dropped against the outside edge of the trajectory rod and held so that the line touches the outer edge of the protractor and trajectory rod simultaneously. The angle is read from where the vertical plumb line touches the protractor. Azimuth is defined in the Horizontal angle.
C3QGVT	Trigonometry, Lead-in method, Ellipse method and Probing. The reported measures were based on probing as this method was considered to be the most precise for this box.
CL3787	protractor
CY62Y7	For the vertical angle, it was measured by two methods, one direct by means of the vertical angle meter, and by trigonometric method. For the horizontal angle, it was measured by trigonometric method.
CZ38J8	Drop string, protractor and inclinometer
D9BWYQ	- Trajectory rods - Trigonometery, & - Ellipse of best fit & clock face
DXTL67	Drop string and protractor (vertical angle checked with inclinometer.
E4ERJR	trigonometry, protractor, and inclinometer
E74X4N	- protractor - inclinometer - drop string
EJPD8N	Trigonometry, laser (Leica Disto D8, with inclinometer function), ruler.
ETBLM6	Triginometry and length measuring, angle finder

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	What method(s) did you use to measure the angles? (e.g. trigonometry, drop string, protractor, angle finder/inclinometer)
EZWEY4	angle finder, trigonometry, 3D-Messurement with Faro Scene with the Bullet Trajectory plugin.
FJLBUN	Drop string, protractor, angle finder/inclinometer
J4ZZD4	- ANGLE FINDER FOR VERTICAL ANGLE. - HORIZONTAL ANGLE USE PLUMB BOB AND LINE, PROTRACTOR.
KCAPQ3	Protractor, Inclinometer
KTCMUX	With a probe insert into holes, a digital inclinometer for the vertical angle and a protractor and plum line for the azimuth angle.
KTW4BL	Angle finder, protractor, drop string
KVZW6K	Drop string, protractor, angle finder.
M39CJX	Protractor, Angle finder and Trigonometry depending on situation.
MBL7YZ	Protractor, angle finder, and trigonometry
N3VZME	Protractor
NDDEQG	Trigonometry, photographic method, physical measurement of trajectory using protractor, plum bob and probe.
NDPFBU	Drop string with protractor for azimuth. Angle finder for vertical.
NH8FRV	Vertical angles - a manual inclinometer, cross checked with a digital inclinometer Horizontal angles - a manual zero-edge protractor with string, cross checked with a digital protractor
PG68VV	To measure the angles we use protractor, inclinometer, angle finder and trigonometry.
PPZ9DU	Drop string (plumb line), protractor and an angle finder.
QEVFLE	Two photos were taken and printed: Photo for Incline/Decline was taken Orthogonal to intersection of plumb bob string and trajectory rod. Azimuth/Horizontal was taken straight down above intersection of trajectory rod and boxes surface. Photos used for measurements
R266CE	protractor, plumb bob and inclinometer (checked answer with trigonometry)
TF64ZB	Protractor and camera method for horizontal and digital inclinometer and protractor for vertical
TNABDP	Protractor and digital angle gauge
TXHQFR	Digital inclinometer, (protractor, drop string, spirit level and trigonometry).
U6CDQN	Probe, dowel (trajectory rod), inclinometer, protractor, plumb bob and a drop string.
W8C8JP	Zero-edge protractor, plumb bob with string, inclinometer

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	What method(s) did you use to measure the angles? (e.g. trigonometry, drop string, protractor, angle finder/inclinometer)
XEC6N8	I primarily used a probe with a protractor, inclinometer, and plumb bob. I also used a camera and measured the angles on the resulting photographs with a protractor, and I used a laser in combination with a protractor, plumb bob, and inclinometer.
XTQE8N	Protractor, angle finder
Y6LK2L	Protactor and inclinometer.
Y96QUW	Protractors and inclinometers are used to measure trajectories by hand. 3D scanning is used to scan trajectory rods to determine trajectory angles.
YBPPQK	Drop string and protractor for horizontal angle and inclinometer for vertical angle.
ZDR3U4	Angle finder and protractor with plumb bob.
ZYT6PK	We used several methods. First we determined the angle by using a probe that was fitted through the entry hole and further through the exit hole. Then we used a protractor in order to read the horizontal and vertical angle. We used photography. The box with the probe was scanned with 3D laser scan equipment. The results of this scan confirmed our results from the previous method.

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	Were there any circumstances present that affected your conclusions? (e.g. target damage, equipment issues, fitting of dowels/rods)
2N3UW4	The base the wood box was slightly unstable which required shimming to insure the face of the box was perpendicular to the level surface where the analysis was performed.
2XN3DK	No
3EYYEY	No - except for the lack of sample marking (front, back, right, left, etc.) which I expect will yield more variation in the way in which azimuth angles are reported.
3KKUE4	The bullet hole size was not a perfect match to the available trajectory rods. This might have impacted the accuracy of the angularity determinations.
6WQNMX	No.
6YHQQZ	No
9WWALA	Unknown calibration of digital gauge.
AWQKQB	Terminology: per training, the horizontal angle and azimuth were defined as the same angle.
C3QGVT	As the caliber of the bullet was unknown this could not sufficiently be taken into account when assessing the confidence interval (uncertainty).
CL3787	No.
CY62Y7	The standard work methodology in the laboratory includes the collaboration of Forensic Engineering personnel, who are responsible for the measurement of angles. Not having this support staff and not having specialized equipment for the measurements could have affected the results.
CZ38J8	Nil
D9BWYQ	Entry and exit hole damage required the use of an improvised trajectory rod of smaller diameter than the .22 calibre rods supplied within our trajectory kit. Howver, this is not unusual give the calibre/substrate combination and was not great hardship.
E4ERJR	Our thinnest trajectory rod barely fit through the defects.
E74X4N	no
EJPD8N	Not really. Usually, or when possible, we perform reconstruction shootings in order to be able to consider unknown parameters, such as projectile deviation. Reconstruction is often helpful in confirming or discarding certain hypothesis regarding unknown parameters.
ETBLM6	No. The damages fits (rod). Obviously corresponding damages (one shot).
EZWEY4	the fitting of our rod was not perfect so we had some issues with accuracy.
FJLBUN	None.
J4ZZD4	EXIT HOLE AFFECT TO BULLET TRAJECTORY, THAT INCREASE UNCERTAINTY DEGREES.
KCAPQ3	No

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	Were there any circumstances present that affected your conclusions? (e.g. target damage, equipment issues, fitting of dowels/rods)
KTCMUX	no
KTW4BL	No
KVZW6K	Target damages. If bullet holes are clear and neat then the typical uncertainty angle is 5 degrees (plus-minus). If target hole is more damaged uncertainty angles grows (case specific speculation).
M39CJX	no issues observed.
MBL7YZ	No
N3VZME	Nil
NDDEQG	No.
NDPFBU	No
NH8FRV	No
PG68VV	There were not any circumstances present that affected our conclusions.
PPZ9DU	No
QEVFLE	Angular measurements are offered for descriptive purposes and no determination has been made as to amount of deflection might have occurred as a result of bullet(s) impacting surface.
R266CE	it took some thought to find a rod small enough to fit the defect
TF64ZB	No
TNABDP	No
TXHQFR	Target damage, fitting of rod, precision of measuring instruments and the respective uncertainties of measurement would have affected the uncertainty of the reported angles.
U6CDQN	The section of wall being square and the surface where the section of the wall was placed.
W8C8JP	No
XEC6N8	No
XTQE8N	No
Y6LK2L	Yes, there are circumstances than can affect our reconstruction angles. Mainly the fitting of dowels. We use two types of plastic cones but, specially with damages or formless holes, the fitting is really critical.
Y96QUW	No issues with the equipment provided by CTS or equipment on hand in the laboratory.

TABLE 6

Questions regarding the angles reported in Question 3

WebCode	Were there any circumstances present that affected your conclusions? (e.g. target damage, equipment issues, fitting of dowels/rods)
YBPPQK	No
ZDR3U4	The holes in the wall section we too small for the smallest rods in our trajectory kit. The only straight rod I had that fit the holes was almost too short to get a good reading on the protractor.
ZYT6PK	By observing both holes, we noticed that one of the holes seemed more rudimentary than the other and cone shaped. Based on our experience, we concluded that this was the exit-hole. What we perceived to be the entry-hole looked more defined and even shaped.

TABLE 6

General Test Questions

WebCode	Do you believe this is a practical test? If not, why?
2N3UW4	Yes
2XN3DK	Yes
3EYYEY	Yes.
3KKUE4	Yes
6WQNMX	The test is practical in that the angles may not vary significantly between examiners. However since limited orientation information is provided, there may be differences in reporting the bullet's direction of travel (left to right, right to left).
6YHQQZ	No. Measuring angles with a protractor is only a small part of examining a shooting scene.
9G3KTY	Yes
9WWALA	Yes, for determining angle measurements.
AWQKQB	Yes. It provides the basic scenario for shooting reconstruction.
C3QGVT	Yes
CL3787	Yes.
CY62Y7	Not entirely because many factors can be improved. This test does not reflect in a good way everyday case work. At least a frame of reference must be specified for angle's measurements.
CZ38J8	Yes.
D9BWYQ	Yes
DXTL67	yes
E4ERJR	Yes, very basic. This test does not work for all trajectory measurements like those for a vehicle.
E74X4N	I think there should have been an object with multiple shots. Also, calculating the distance of how far away the shooter was standing would have been beneficial.
EJPD8N	Yes. In it´s limited form.
ETBLM6	Yes, but it is not clear how the crime scene looks like and what is asked. A higher certainty can be achieved, but seems not to be necessary as the assumed shooting distance is less than 2m.
EZWEY4	yes, because we had to think about how to measure an angle. Like sad before on the crime scene we usually don’t measure angles because we make projections with rods,lasers or virtual in 3D so we can see in the real or 3D environment where approximately the bullet is coming from.
FJLBUN	Yes

TABLE 6

General Test Questions

WebCode	Do you believe this is a practical test? If not, why?
J4ZZD4	YES
KCAPQ3	Yes
KTCMUX	yes
KTW4BL	Yes
KVZW6K	Yes.
M39CJX	I do.
MBL7YZ	Yes
N3VZME	Yes
NDDEQG	Yes
NDPFBU	Yes, however it was simple and straightforward.
NH8FRV	Yes, I use a similar approach when training others.
PG68VV	Yes.
PPZ9DU	Yes.
QEVFLE	Yes.
R266CE	yes
TF64ZB	Yes
TNABDP	Yes
TXHQFR	Yes
U6CDQN	Yes, the section of the wall was well made and the damage was clear.
W8C8JP	Yes
XEC6N8	Yes
XTQE8N	Yes
Y6LK2L	Yes. Thoug the real cases used to be a bit more complex.
Y96QUW	The test is practical in that you can measure elevation and azimuth angles, but is not practical for shooting incident reconstruction as there are elements missing in the narrative background. Knowing the heights of each defect would allow an examiner to attempt to place the muzzle of the gun a certain distance away from the target surface.

TABLE 6

General Test Questions

WebCode	Do you believe this is a practical test? If not, why?
YBPPQK	Yes
ZDR3U4	It is probably as practical as you can get in a test that has to be mailed out to people. It is not very realistic for our lab since we mainly do vehicles which rarely have flat surfaces to work off of.
ZYT6PK	We thing this is a relevant test in order to test our methods in determining angles, but not very challenging.

TABLE 6

General Test Questions

WebCode	Does the quality of the samples meet your lab's requirements for testing? If not, in what way is it lacking?
2N3UW4	The base needs to be stable so the surface which the bullet strike occurs is at the angle CTS expects. If it is supposed to be perpendicular, then it needs to sit that way with stablity.
2XN3DK	No. We perform GSR on defect sites.
3EYYEY	Yes.
3KKUE4	Yes
6WQNMX	Yes
6YHQQZ	Yes
9G3KTY	Yes
9WWALA	Yes.
AWQKQB	Yes the quality of the test was adequate
C3QGVT	Yes
CL3787	Yes.
CY62Y7	Our laboratory does not have quality requirements for angle determination test.
CZ38J8	Yes.
D9BWYQ	Yes. However, the test does not allow the examiner to infer teh proable position of the shooter/firearm within the context of a scene which is the ulitmate purpose of a trajectory determination.
DXTL67	yes
E74X4N	yes
EJPD8N	Yes. We think so. At least regarding this limited question.
ETBLM6	Yes
EZWEY4	yes
FJLBUN	Yes
J4ZZD4	YES
KCAPQ3	Yes
KTCMUX	yes
KTW4BL	Yes

TABLE 6

General Test Questions

WebCode	Does the quality of the samples meet your lab's requirements for testing? If not, in what way is it lacking?
KVZW6K	Yes.
M39CJX	It met all requirements.
MBL7YZ	Yes
N3VZME	Yes
NDDEQG	Yes
NDPFBU	Yes
NH8FRV	Yes
PG68VV	Yes.
PPZ9DU	Yes.
QEVFLE	Yes.
R266CE	yes
TF64ZB	Yes
TNABDP	Yes
TXHQFR	The quality of the samples are adequate for testing purposes.
U6CDQN	Yes
W8C8JP	Yes
XEC6N8	Yes
XTQE8N	Yes
Y96QUW	Yes the sample had adequate defects that clearly illustrated entrance and exit defect characteristics.
YBPPQK	Yes
ZDR3U4	Yes.
ZYT6PK	We think that the test met our requirements.

TABLE 6

General Test Questions

WebCode	Is the packaging adequate? If not, in what way is it lacking?
2N3UW4	Yes
2XN3DK	Yes
3EYYEY	Yes.
3KKUE4	Yes
6WQNMX	Yes
6YHQQZ	Yes
9G3KTY	Yes
9WWALA	Yes
AWQKQB	Yes the packaging was adequate
C3QGVT	Yes
CL3787	Yes.
CY62Y7	Yes, it is adequate for a wooden box. If wood is changed for any other material, then the package must be reconsidered.
CZ38J8	Yes.
D9BWYQ	Yes.
DXTL67	yes
E4ERJR	yes
E74X4N	yes
EJPD8N	Yes.
ETBLM6	Yes
EZWEY4	yes
FJLBUN	Yes
J4ZZD4	YES
KCAPQ3	Yes
KTCMUX	yes
KTW4BL	Yes

TABLE 6

General Test Questions

WebCode	*Is the packaging adequate? If not, in what way is it lacking?*
KVZW6K	Yes.
M39CJX	It was adequate.
MBL7YZ	Yes
N3VZME	Yes
NDDEQG	Yes
NDPFBU	Yes
NH8FRV	Yes
PG68VV	Yes.
PPZ9DU	Yes.
QEVFLE	Yes
R266CE	yes
TF64ZB	Reasonable could possibly be bubble wrapped.
TNABDP	Yes
TXHQFR	Yes
U6CDQN	Yes
W8C8JP	Yes
XEC6N8	Yes
XTQE8N	Yes
Y6LK2L	Yes
Y96QUW	Yes the packaging was adequate.
YBPPQK	Yes
ZDR3U4	Yes.
ZYT6PK	The package seems to be adequate.

TABLE 6

General Test Questions

WebCode	What improvements, if any, could be done to improve the sample?
2N3UW4	I think the test should have had multiple trajectories to document, and not all to a vertical surface. Possibly even a rounded surface.
3EYYEY	A sample with no clearly marked "front", "back", "right", or "left" could make describing/reporting the azimuth angle a tad confusing. I have no issue with reporting a "relative 97 degree" azimuth angle with accompanying photographs (that are part of the report in my circumstance) that make the meaning clear but I can understand why someone else might find that narrative a bit confusing on its own.
3KKUE4	Multiple impact points may have been more helpful.
6WQNMX	Either provide more scenario information (e.g. this sample was extracted from the north interior wall of the garage with the blue dot representing the interior side of the garage)OR a more complete orientation of the sample (e.g. add "left," "right," or compass directions directly onto the sample as "TOP" was). Additionally, part of shooting reconstruction analysis includes the initial determination of whether something is actually bullet related damage. Perhaps the information sheet should explicitly state the partition wall contained one "bullet" entry hole and one "bullet" exit hole, unless the participant is to further examine the sample and separately conclude whether this is bullet related damage.
6YHQQZ	None
9G3KTY	Identify front (see question #2)
9WWALA	None
AWQKQB	The sample was fine. The wording of the questions needs to be improved.
C3QGVT	None
CL3787	Doesn't need any improvements.
CY62Y7	Box material should be changed every year. In this way, it can be performed an evaluation of personal abilities in shooting reconstruction over different materials. Ammunition, caliber and gun type could be also different.
CZ38J8	Nil.
D9BWYQ	Nil.
DXTL67	n/a
EJPD8N	-
ETBLM6	What is the intention of the measurement? What accuracy should be reached? See 10.) [Table 6- Do you believe this is a practical test? If not, why?]
FJLBUN	Ensure the bottom edge of the sample is flat when placed down on a flat and level surface.
J4ZZD4	YOU COULD REPLACE BLUE WALL WITH FRONT OR INDOOR AND REPLACE RED WALL WITH OUTSIDE WALL.
KCAPQ3	-

TABLE 6

General Test Questions

WebCode	What improvements, if any, could be done to improve the sample?
KTW4BL	None
KVZW6K	It could be more complicate.
M39CJX	None
MBL7YZ	None
NDDEQG	In respect to Question 2, "What is the Direction of travel of the bullet through the sample (i.e. front to back, left to right, upwards)?", unable to provide a front to back response due to the lack of labelling of the front and back surfaces.
NH8FRV	None
PG68VV	We have not any suggestion.
PPZ9DU	Well done.
R266CE	N/A
TF64ZB	Adequate
TNABDP	None
TXHQFR	Using spacers to prevent any of the surfaces with the holes from coming into contact with the packaging.
U6CDQN	In the future use a variety of materials and calibers of firearms.
W8C8JP	With the steep downward angle it made it difficult to run the trajectory rod through with the wall piece placed on a table. I used several 2x4s under it for elevation. Maybe a taller wall piece, less angle (vertical), more horizontal angle.
XEC6N8	None - the quality of the sample was good. The holes were in wood that was of sufficient quality to stand up to the rod being placed in the hole. Please continue to ensure the product quality is high so that the rods can be inserted multiple times without altering the holes and resulting angle measurements.
Y6LK2L	To try to define the bullet caliber.
Y96QUW	Provide more information on background scenario or questions to be answered. For example, if the defect on the blue side was located 45" up from the ground of the garage, is it reasonable that the muzzle of the gun (i.e. approximate shooting position) could have been 15 feet away from the wall. This would allow examiners to give an opinion and explain what went into the shooting recon aspect.
YBPPQK	None
ZDR3U4	Make the holes with a larger caliber.
ZYT6PK	We don't have any suggestions for improvements.

TABLE 6

General Test Questions

WebCode	What discipline does Angle Determination fall under within your laboratory?
2N3UW4	Crime Scene Response is responsible for collecting the measurements and the firearms section is generally responsible for interpreting the data.
2XN3DK	Ballistics
3EYYEY	Firearms/Toolmarks
3KKUE4	Crime Scene Reconstruction and Shooting Incident Reconstruction.
6WQNMX	Crime Scene Investigation / Firearms Identification Section
6YHQQZ	Crime Scene
9G3KTY	Crime Scene Response
9WWALA	Crime Scene Reconstruction/Analysis
AWQKQB	Angle Determination is completed by the Firearms Examiner and Crime Scene Supervisors.
C3QGVT	Shooting scene reconstruction / Ballistics
CL3787	accuracy in $\pm 2°$.
CY62Y7	Angle determination in shooting reconstruction is a discipline inside trajectory path determinations.
CZ38J8	Firearms/Toolmarks
D9BWYQ	Forensic Firearm Examination/ Firearm & Toolmark Section/ Ballistics Unit etc.
DXTL67	firearms
E4ERJR	Crime Scene Response
E74X4N	crime scene reconstruction
EJPD8N	Shooting reconstruction.
ETBLM6	Ballistics
EZWEY4	Ballistics
FJLBUN	Crime Scene/Firearms and Toolmark within sub discipline of shooting incident reconstruction.
J4ZZD4	CRIME SCENE RECONSTRUCTION UNIT
KCAPQ3	Firearm & Toolmark Examination
KTCMUX	Firearms section
KTW4BL	Firearms

TABLE 6

General Test Questions

WebCode	What discipline does Angle Determination fall under within your laboratory?
M39CJX	Crime scene investigation.
MBL7YZ	Firearms/ballistics
N3VZME	Crime Scene Reconstruction
NDDEQG	Forensic Firearms Examiners
NDPFBU	Firearms for bullet path determination only.
NH8FRV	Trajectory analysis
PG68VV	the Angle Determination fall under crime scene reconstruction of shooting incidents
PPZ9DU	Firearms and Tool Mark Identification
QEVFLE	Shooting Incident Reconstruction.
R266CE	crime scene reconstruction
TF64ZB	Crime Scene Examination
TNABDP	Trajectory Analysis - Crime Scene
TXHQFR	Firearm and Toolmark Examination
U6CDQN	Criminalistics Section
W8C8JP	Crime Scene Investigation Unit
XEC6N8	Crime Scene Investigation
XTQE8N	Firearm ID
Y6LK2L	Operational Ballistics
Y96QUW	Crime scene response.
YBPPQK	Firearms - Crime scene reconstruction
ZDR3U4	Firearm/Toolmark
ZYT6PK	We use the method of angle determination in our firearms unit with support from our 3D-scan unit.

TABLE 6

General Test Questions

WebCode	How often do you perform Angle Determinations (trajectory) on evidence/at scenes?
2N3UW4	About 50% of the time.
2XN3DK	Approximately five (5) times a year
3EYYEY	It varies. Generally 3-4 times a year.
3KKUE4	It is performed at all Homicide and Major Case Investigations/shooting scenes when it is determined that the examination would be probative.
6WQNMX	Angle determination is performed at every crime scene / vehicle examination, provided the substrate/media is appropriate for such analysis.
6YHQQZ	4-5 times per year
9G3KTY	3/year
9WWALA	Approximately 2x month.
AWQKQB	Rarely, The Forensic Manager tends to do that analysis
C3QGVT	Approximately 1 time a year per examiner
CL3787	Approximately 10 times a year.
CY62Y7	There are two o three cases by month.
CZ38J8	Rarely
D9BWYQ	At nearly every scene we attend
DXTL67	regularly
E4ERJR	Once or twice a year
E74X4N	0-2 times a year
EJPD8N	A few times a year.
ETBLM6	In almost every crime scene, where shooting damages occurs.
EZWEY4	approx. 2 to 8 times a year
FJLBUN	Always when defects and target substrate allows.
J4ZZD4	EVERY CASE IF I CAN MADE BULLET TRAJECTORY.
KCAPQ3	5-6 times a year
KTCMUX	on evidence, rarely, but at scene most of the time.
KTW4BL	Rarely

TABLE 6

General Test Questions

WebCode	How often do you perform Angle Determinations (trajectory) on evidence/at scenes?
KVZW6K	4-5 times/year.
M39CJX	Two to three times a week.
MBL7YZ	3 - 5 times a year
N3VZME	Sometimes - 2-3 times per year
NDDEQG	At each scene where it is relevant.
NDPFBU	1-5 times per year
NH8FRV	Whenever possible, which amounts to approximately a dozen times a year.
PG68VV	Sometimes.
PPZ9DU	About twice a year.
QEVFLE	Generally limited to vehicles involved in police officer involved shooting and homicides; or by special request of District Attorney's Office,
R266CE	approximately 5 per year
TF64ZB	Frequently
TNABDP	When applicable to the crime scene
TXHQFR	Approximately 2 to 6 times per year.
U6CDQN	3-6 times a year
W8C8JP	It's variable. We process a wide range of Crime Scenes. Angle Determinations would be done anytime a scene meets our SOP requirements.
XEC6N8	Frequently - typically whenever bullet holes are observed that are suitable for angle determinations to be made.
XTQE8N	As required
Y6LK2L	According to the nature of this central or national laboratory ([Laboratory]), the procedure let us to face angle reconstructions of those main real cases (terrorism, organized and serious crime, crimes made/suffered by law/police officers, social/media repercussions crimes,...).
Y96QUW	Every shooting scene that has bullet defects with trajectories that can be measured.
YBPPQK	At least twice per month
ZDR3U4	We do not go to scenes.
ZYT6PK	I will estimate that we have about 2-3 cases each year. In addition we make our own tests.

TABLE 6

General Test Questions

WebCode	How many years of experience do you have in Angle Determination? (in years)
2N3UW4	14
2XN3DK	10
3EYYEY	About 16.
3KKUE4	2
6WQNMX	~6
6YHQQZ	25
9G3KTY	25
9WWALA	2
AWQKQB	1.5 years
C3QGVT	An average of 10 years for the 5 involved examiners
CL3787	20
CY62Y7	Twenty one years.
CZ38J8	0
D9BWYQ	10
DXTL67	5
E4ERJR	Approximately 1.5 years
E74X4N	3 years
EJPD8N	10 to 15.
ETBLM6	>20 years
EZWEY4	15
FJLBUN	23
J4ZZD4	11
KCAPQ3	8
KTCMUX	6
KTW4BL	15
KVZW6K	8

TABLE 6

General Test Questions

WebCode	How many years of experience do you have in Angle Determination? (in years)
M39CJX	Three years
MBL7YZ	10
N3VZME	9
NDDEQG	1 year
NDPFBU	17
NH8FRV	13
PG68VV	Seven (07) years.
PPZ9DU	23
QEVFLE	30+
R266CE	2 years
TF64ZB	16
TNABDP	16
TXHQFR	13
U6CDQN	14 years
W8C8JP	16
XEC6N8	11
Y6LK2L	27
Y96QUW	8
YBPPQK	20+
ZDR3U4	12
ZYT6PK	We have worked with Angle Determination for 2 and 3 years.

TABLE 6

General Test Questions

WebCode	Additional Comments on Overall Test Design.
6YHQQZ	Adding additional elements to the test would better represent an analyst's ability; review photographs of bullet impacts for instance.
AWQKQB	Per firearm examination training, the horizontal angle and azimuth were defined as the same angle. This made it confusing when asked to define and calculate them separately.
C3QGVT	- Ask to measure the trajectory of the bullet between two bullet defects, not the original trajectory before impact. Possible to ask this, in which case an additional systematic deviation might be taken into account. - It might be good to describe how the angle should be measured (especially for the azimuth/horizontal angle) to ensure similar responses. Accompanying this description with a sketch would be most informative. - Interesting test and well appreciated initiative
CY62Y7	A frame of reference must be specified for angle and directions determinations. For uncertainty estimation, laboratories must indicate if they use ISO-GUM guide or another one.
D9BWYQ	- Good test overall for establishing consistency/variability of angle determinations/calculations across examiners. - Limited value for interpreting within scene context information. - Great training tool for new examiners/trainees.
J4ZZD4	GOOD TEST
M39CJX	A larger caliber would make the use of a dowel rod a little easier.
NDDEQG	I think this was a valuable test which certainly has scope within the tests provided by CTS.
PPZ9DU	Results would be more easily assessed with clearer, more direct questions, such as: When facing the surface marked with a blue dot, is the trajectory: Outward?(Y/N) Inward?(Y/N) Unknown?(Y/N) Perpendicular to the surface?(Y/N) From left to right(Y/N) From right to left(Y/N) The acute angle relative to the vertical plane is ___ degrees +/- ___ degrees. The acute angle relative to the horizontal plane is ___ degrees +/- ___ degrees.
QEVFLE	We will look forward to reviewing the "Manufacturer's Information" as soon as it is made available. Since a bullet that strikes a surface can be deflected slightly and the amount of deflection can vary from shot to shot, will the manufacture include information as to the range of angular deflection they determined when generating these question samples?
U6CDQN	Overall this was a great PT (for the first time being offered). My conclusions would be different than an actual case report because in addition to the angles we would draw conclusions and opine on the location of the muzzle of the firearm. It is difficult to do that in this case because we have a small section of the wall with no context. In the future you give the horizontal and vertical angles and the height of the bullet hole and ask to report on the height of the muzzle at different distances.
Y96QUW	If the goal is only to provide angle determination and not shooting incident reconstruction, it may be useful to provide more samples to examine, or multiple defects for a given sample so that multiple trajectory measurements can be made.
ZYT6PK	We don’t have any further comments.

Appendix: Data Sheet

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Collaborative Testing Services ~ Forensic Testing Program

Test No. 17-5620: Shooting Reconstruction: Angle Determination (Demonstration)

DATA MUST BE RECEIVED BY ***May 01, 2017*** TO BE INCLUDED IN THE REPORT

Participant Code: WebCode:

Scenario:

Investigators have submitted a section of a partition wall from a garage in which a shooting took place. They are asking you to conduct your analysis using your laboratory's procedures.

Please note:
-For this exercise, the sample contains a "TOP" label for orientation purposes.
-The sample has been marked with two different colors (blue and red) in which participants can use as reference in reporting.
-Make sure to place the sample on a flat surface when measuring angles.

Item Submitted (Sample Pack AD):

- A section of the partition wall which contains one entry hole and one exit hole.

1.) Which color marked on the sample represents the side with the entrance hole? ________________

2.) What is the direction of travel of the bullet through the sample (i.e. front to back, left to right, upward)?

____

3.) Please record your angles below.

Angle Type (*i.e. Azimuth, Vertical, Horizontal*)	*Angle Measurement* (*in degrees*)		*Uncertainty* (*in degrees*)
____________	____________	±	________
____________	____________	±	________
____________	____________	±	________
____________	____________	±	________

Please return all pages of this data sheet.

4.) What would be the wording of the Conclusions in your report?

5.) Additional Comments

Questions regarding the angles reported in Question 3:

6.) How does your laboratory define/describe the reported angle types? (azimuth, vertical, horizontal)

7.) What type of equipment did you use to determine the angles? (e.g. probe, dowel, string, laser, 3D scanning, Total Station, cameras)

8.) What method(s) did you use to measure the angles? (e.g. trigonometry, drop string, protractor, angle finder/inclinometer)

9.) Were there any circumstances present that affected your conclusions? (e.g. target damage, equipment issues, fitting of dowels/rods)

Please return all pages of this data sheet.

General Test Questions:

10.) Do you believe this is a practical test?
If not, why?

11.) Does the quality of the samples meet your lab's requirements for testing?
If not, in what way is it lacking?

12.) Is the packaging adequate?
If not, in what way is it lacking?

13.) What improvements, if any, could be done to improve the sample?

14.) What discipline does Angle Determination fall under within your laboratory?

Please return all pages of this data sheet.

15.) How often do you perform Angle Determinations (trajectory) on evidence/at scenes?

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16.) How many years of experience do you have in Angle Determination? ____________ (in years)

17.) Additional Comments on Overall Test Design.

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Return Instructions: Data must be received via online data entry, fax (please include a cover sheet), or mail by ***May 01, 2017*** to be included in the report. Emailed data sheets are not accepted.

Participant Code:

QUESTIONS?
TEL: +1-571-434-1925 (8 am - 4:30 pm EST)
EMAIL: forensics@cts-interlab.com
www.ctsforensics.com

ONLINE DATA ENTRY: www.cts-portal.com
FAX: +1-571-434-1937
MAIL: Collaborative Testing Services, Inc.
P.O. Box 650820
Sterling, VA 20165-0820 USA

Please return all pages of this data sheet.