Firearms Unit Manual

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1 UNIT DESCRIPTION

The Firearms Unit is located on the 6th floor in the Northwest corner and the Firearms Testing Facility is located on the P2 level. The unit is staffed from 0630-1700 hours, Monday through Friday by four criminalists and one laboratory technician.

UNIT FUNCTIONS

The Firearms Unit provides examination, analysis, identification, and expert testimony on firearms evidence in criminal matters and administrative and other special investigations. The unit also acts as a resource on firearms information.

Generally, criminalists will examine firearms evidence to make visual, microscopic, and chemical evaluations and comparisons. Their observations and conclusions will be reported in written reports and in courtroom testimony if called upon to do so. The laboratory technician will examine evidence to a more limited extent than the criminalist, and will testify in court when necessary.

Additionally, the firearms criminalists will be involved in crime scene processing and reconstruction when they are called out to an officer involved shooting or other firearms related case.

The Firearms Unit is staffed by one Supervising Criminalist position, four Criminalist positions, and one Laboratory Technician position.

CRIMINALIST

The list of duties of the criminalist include, but are not limited to, the following:

1) determining firearms operability
2) firearms identification
3) making appropriate trace evidence screens on the items being examined
4) bullet/missile comparisons
5) cartridge/cartridge case comparisons
6) gun shot residue (GSR) distance determination
7) determining possible firearms used in a case
8) firearm test fire
9) ammunition comparison
10) trigger pull determination
11) unloading impounded firearms

12) crime scene reconstruction
13) silencer evaluation
14) confirmation of identifications
15) preparation of reports
16) technical reviews of firearms related reports
17) training of new employees
18) rotation on the call-out team
19) assist in budget process for determining Unit needs
20) court room testimony
21) serial number restoration
22) maintenance of the ammunition reference library
23) gun write-offs with the Property Room
24) help with the annual inventory of the Firearms reference collection, if requested by the supervisor
25) IBIS Entry
26) caliber determination
27) any other task as needed by unit or unit supervisor

LABORATORY TECHNICIAN

The laboratory technician duties include, but are not limited to, the following:

1) unloading firearms upon request of the Property Room
2) assisting with the annual inventory of the firearms collection
3) maintenance of the ammunition and breakdown collections
4) assist the firearms unit as needed in other duties

UNIT SUPERVISING CRIMINALIST

The unit supervisor duties include, but are not limited to, the following:

1) assigning and prioritizing casework
2) interviewing and hiring employees
3) reviewing reports and examining case notes
4) evaluating employee performance
5) providing orientation for new employees or criminalists newly rotated into the unit
6) tracking the progress of assigned casework and status of backlogs
7) preparing budget requests, memos or reports as requested by the laboratory manager
8) compiling monthly statistics
9) reviewing and revising analytical procedure or unit policy as needed
11) keeping current with literature in all areas of criminalistics
12) providing information weekly and/or conducting weekly meetings to keep the staff informed about Department, laboratory, and criminalist events

12.1WORK REQUESTS

GENERAL

Work requests can be submitted on form PD-481 (general laboratory service request), the homicide request format, or other modified PD-481 request form. The requests are submitted through the Clerical Unit where it will be date stamped and then entered into the laboratory's case tracker database. the work request will be given to the unit supervisor.

Phone requests from detectives or DAs can be made but these must be accompanied by a hardcopy of a request form. All phone requests will be referred to the unit supervisor.

Walk-ins are a form of work request and they will be scheduled accordingly. No hardcopy of a request form is necessary.

FIREARM PROCESSING

Phone requests can be received from the Property Room indicating that the Watch Commander's Office has a firearm that needs to be unloaded. Also, forensic specialists may place an evidence transfer slip into the firearms unit supervisor's mail bin. The supervisor will assign a firearms unit criminalist or the laboratory technician to retrieve the firearm from the Crime Scene Unit gun locker for processing and release it back to the forensic specialist or the gun locker in the Crime Scene Unit.

TRACKING

The case status is tracked on the laboratory case management database. The supervisor will enter the case assignment information and case completion dates into the laboratory database.

ASSIGNMENTS

Cases generally will be assigned to the next available criminalist.

The supervisor will make assignments based on the priority of the case or, in the case of IBIS requests, by order of request.

12.2 EVIDENCE SECURITY

RECEIVING EVIDENCE

The Firearms Unit may receive evidence via the following routes:

1. The evidence may come directly from the Property Room.
2. A requesting officer can submit evidence directly to the examiner during walk-in examinations.
3. Firearms can be received either from the Watch Commander's Office or the designated cabinet in the Crime Scene Unit, or directly from a crime scene specialist.
4. The evidence may be received directly from crime scene investigation activity.

Evidence in the Firearms Unit is considered to be in a secure area.

12.3 CHAIN OF CUSTODY

GENERAL

Refer to the chain of custody policy in the quality assurance manual for general information.

INTERNAL CHAIN OF CUSTODY FOR 2ND OPINIONS

When the criminalist needs a second opinion on an identification, the custody of the evidence will be transferred to the criminalist providing the 2nd opinion, or to a cabinet in the Firearms unit designated "2nd Opinions." The transfer of evidence will be documented in the note packet of the original examiner and in the notes generated by the 2nd opinion examiner.

OFFICER FIREARMS IN OIS INVESTIGATIONS

The criminalist at the scene can request that the firearm be received through the forensic specialist. If the situation does not allow that transfer, the criminalist will accept the firearm. It will be incumbent upon the criminalist to document the chain of custody. The criminalist can still have the forensic specialist document the firearm in the evidence list.

LOADED FIREARMS RETRIEVED FROM THE WATCH COMMANDER'S OFFICE

The police property and evidence clerk (PPEC) from the Property Room will check the cabinet at the Watch Commander's Office for loaded firearms and contact the unit supervisor advising them of the need to unload a weapon.

The supervisor will assign an analyst to unload the firearm.

The analyst will go to the Property Room to check out the firearm

The analyst picks up the firearm from Property and unloads the firearm in the laboratory, documenting their work according to the laboratory notes taking and report writing policies.

The evidence is resealed and the analyst takes the firearm back to the Property Room and the Property Room personnel sign it as received per the Property Room procedures. The receipt of the evidence and the disposition of evidence will be recorded in the spaces on the walk-in report forms.

SEALING EVIDENCE

Refer to the evidence sealing and marking policy in the quality assurance manual.

12.4 EVIDENCE FREEZER PACKETS

Freezer packets are created to store evidence separated or prepared from other evidence that is customarily stored unfrozen.

Anytime a freezer packet is made, it will be prepared with the following information:

- barcode number
- victim's name
- case number and/or incident number

Freezer packets, along with the appropriate copy of the additional items form will be taken directly to the Property Room for storage.

3.1WALK-INS

Walk-ins are designed to be preliminary examinations to give the officer or detective an initial assessment of the evidence for an investigative lead. The documentation that is produced is considered a preliminary examination. No technical review or second opinion is necessary at this stage.

The exception to a preliminary report for a walk-in is a request for operability that the criminalist or laboratory technician will formally document on the short report form. The officer/detective will observe the process and, by agreement of the District Attorney's Office, provide the testimony in court.

The criminalist or laboratory technician will receive the evidence from the officer/detective and return it directly to them upon completion of the exam.

The walk-ins are intended to offer an exam of a limited amount of evidence. The analyst has the right to refuse service to anyone who brings in an amount or type of evidence not suitable for the process. Also, the analyst can refer the detective to the unit supervisor for scheduling the work if the request is for an exam that is not suitable for the walk-in process.

The walk-in report is given to the supervisor for an administrative review and to update the laboratory case tracker database. The supervisor gives the reviewed original report to the clerical staff for filing.

3.2 FIREARMS REFERENCE COLLECTION

The firearms used as a reference collection in the Firearms Unit are listed on an inventory list.

Anytime a firearm is taken out of the unit, the transaction will be recorded on the log that is maintained with the inventory list. If a person assigned to the Firearms Unit checks a gun out and **does not** remove it from the Headquarters building, he/she does not need to sign the check out log.

There will be an annual inventory of the collection. The unit supervisor and/or unit staff will conduct the inventory.

BARREL LENGTH AND OVERALL LENGTHS OF FIREARMS

The measurement of barrel length and overall length is a standard examination in length-altered firearms.

BARREL LENGTH

A. Revolvers

The barrel length is measured from the front face of the cylinder to the muzzle.

This measurement is done on the outside of the firearm.

B. All other firearms except revolvers

1. Close and lock the action of the firearm.
2. The barrel measurement is taken from the face of the breech to the muzzle in most cases (shotguns and most rifled firearms)

NOTE: The use of a wooden dowel greatly simplifies this procedure.

Insert the dowel down the barrel and mark the location of the muzzle. Measure the dowel for barrel length.

OVERALL FIREARM LENGTH

Firearms that have been altered by removal of the stock or part of the barrel are measured in the following manner:

1. Keep the measurement parallel to the bore of the firearm.
   a. The length of the firearm is determined to be the longest distance from the butt end to the muzzle.

   NOTE: The use of a "T" square helps set the geometry for a proper measurement.
2. The muzzle end of the barrel is where the rifling terminates.
   a. Removable barrel extensions, poly chokes, flash hiders, or muzzle brakes are not included in the barrel measurement or overall length.

EXCEPTION

If any of the above listed or similar devices are permanently attached to the end of the barrel, then they are considered part of the barrel and are included in the overall length measurement.

DISCUSSION

There are a number of firearms that have been sold in the United States that have collapsible or folding butt stocks. These firearms are measured in the manner in which they are "normally" used. Since these firearms are classified as rifles or carbines, the stocks should be extended when measured. In most cases all of these firearms are of sufficient length with their buttstocks folded except notably in the case of the IMI Model "A" or "B" semiautomatic carbines (UZI), and the folding stock "Kalashnikov" series of rifles. Since these firearms were approved for sale by both the Federal and State Governments, if the firearm is in its original unmodified condition, then the firearm must be measured with the stock in the extended or firing position. Measure only altered firearms with the stocks folded or collapsed.

FIREARMS OF PROHIBITED LENGTH

During a standard examination, a firearm is measured to record barrel length and overall length. If the firearm is measured during the standard examination to be within 1 inch of, or shorter than, the applicable guidelines in regard to prohibited firearms, the examiner shall utilize the measuring device from Precision Forensic Testing Model MD-36 (S/N: 0926) that is fitted with the GEI Model 2020A Stainless Steel Ruler (S/N: C36543). This ruler is traceable to master standards at the National Institute of Standards and Technology (NIST), Washington, D.C.

BARREL LENGTH

1. With the action of the firearm in the closed and locked position, gently insert the metal rod into the barrel until it encounters the breechface.
2. Slide the adjustable collar until it contacts the end of the barrel and lock in the collar with the thumb screw.
3. Remove the barrel measuring rod and place it on the measuring device parallel to the ruler and flush against the rear plate.
4. Looking perpendicularly to the ruler, record the measurement on the ruler to the nearest 1/32 of an inch where the inside surface of the collar is positioned.

OVERALL FIREARM LENGTH

1. Place the rear of the firearm so that the rearmost portion of the firearm is contacting the rear fixed plate.

2. Align the firearm in the measuring device so that the barrel is parallel to the side plate.
3. Gently slide the movable plate until it contacts the end of the barrel.
4. Looking perpendicularly to the ruler, record the measurement on the ruler to the nearest 1/32 of an inch.

SAFETY

The examiner will observe all applicable safety handling rules when handling firearms as stated in this manual.

4.1 GUNSHOT DISTANCE DETERMINATIONS

ACCEPTANCE CRITERIA FOR STIPPLING AND/OR TATTOO PATTERNS ON SKIN

Gunshot residue patterns are formed on exposed skin surfaces in the same manner as gunpowder patterns are deposited on clothing. Accordingly, the muzzle to target distance can be determined in the same manner by the direct comparison of gunshot residue pattern standards fired at known distances on test targets to the pattern on skin.

Before an examination of gunshot residue by the Firearms Unit, the following criteria should be considered to determine if the evidence can be examined and reported in a meaningful way.

1. The medical examiner must testify to the identification of the pattern as being gunshot residue and identify the following effects:
2. SOOTING-- result of primer residues deposited on the skin. This should be supported by photography.
3. TATTOOING--the result of gunpowder particles embedded in the skin and supported by collected particles.
4. STIPPLING--the result of gunpowder particles striking the skin and producing a bruise type of injury. This should be supported by photography.
5. OTHER--material such as glass, paint, wads, grex (buffer material), or intermediate target fragments.
6. Acceptable documentation photographs are taken of the gunshot pattern.
7. There exists a set of overall photos meeting the following criteria:
8. They are perpendicular to the skin surface at the point of missile entry.
9. They are taken with the lens oriented in a “muzzle" view, that is, looking down the trajectory path of the missile. This angle would be determined by the medical examiner at autopsy.
10. There exists a close up photo of the wound area that is taken with a macro lens set 1:1 and illuminated with a ring strobe.
11. NOTE: All photos shall have a scale that is perpendicular to the axis of the lens.

12. The distance determination measurement will provide useful information beyond the medical examiner's range classifications of contact, close

range, intermediate range and distant range estimations. It should be understood that a distance determination that is done by comparison to test fire gunshot residue distance standards will have a range of at least plus and minus three inches at best due to the target material differences to living human skin.

13. A test fire gunshot residue distance standard that is to be used as a comparison pattern to the evidence gunshot pattern is valid only when the actual firearm and ammunition are used to make the test fire patterns. The evidence firearm and ammunition must be in evidence in order for the test to be considered a valid comparison.

REFERENCES

GSR Procedures Manual, on file in the Firearms Unit Library.

Kirk, Paul. *Crime Investigation*. Interscience Publishers, 1953.

4.2 IBIS REPORT PROTOCOL

ENTRY REPORT

Each IBIS case entry will require a basic note package and one of the following report formats:

1. This report will be used to notify the requesting Detective that the cartridge cases in the requested case have been entered. The IBIS sequential number will be reported.
2. This report will be used to notify the requesting Detective that the suspect firearm has been test fired and the testfire cartridge case was entered into the IBIS database.

In cases where there is no assigned detective the reports will be sent to the appropriate unit.

Found gun test fires will be entered into IBIS. They will have a written report and will be filed in the lab only.

In cases that are submitted by one detective unit and the case has a connection to another unit, the report will be sent to both units. The original report will be sent to the requesting unit.

REPORTING OF COLD HITS

At the time an IBIS case is entered into the database, the entry operator will search the local database for possible hits. If a possible "cold hit" is observed, the report will reflect the hit and be sent to the Firearms Unit supervisor for assignment to a Firearms Unit criminalist if it has not already been assigned.

4.3 BORE AND CHAMBER CASTING

GENERAL

In the examination of firearms evidence it may become necessary to determine the correct chamber caliber of the evidence firearm. This type of examination is usually done on foreign military rifles and war souvenirs that may have been customized. In these cases the caliber may not be known or may be different than is designated on the firearm or in the literature. In order to facilitate firing of test fire shots that are of correct caliber for the evidence firearm, it will be necessary to make a bore or chamber cast. The cast can then be compared to reference samples or the literature, and the correct cartridge for test firing can be determined.

PROCEDURE

1. Open the action and remove the bolt or slide from the firearm, exposing the chamber.
2. Check the bore and chamber to ensure that they are clear. Clean the chamber thoroughly.
3. Mix the casting material. Using the applicator. Be careful not to let the casting material to flow into the breech or the extractor recess. Extraction of the cast will be difficult to impossible.
4. When the casting material is set or cool, depending on which method is used, gently tap the end of a cleaning rod to loosen the cast from the chamber and remove from the breech.
5. Measure the basic case dimensions and compare to the data sheets in Cartridges of the World.
6. Silicone casting material has to be forced out or pushed out and is not salvageable. Measurements on Silicone casting should be done very carefully due to the compressibility of the cast. Silicone chamber casts are best used for outline comparisons.

4.4 CALIBER, SHOT AND WADDING DETERMINATION

CALIBER DETERMINATION

A caliber determination of relatively intact bullets is best done by direct measurement of the base of the bullet, weighing the bullet and comparison to known standards from the reference file. In this manner, the manufacturer of the bullet can also be identified in many cases. With bullets in which the base is mutilated, this determination may be somewhat more difficult if not impossible. With bullet fragments, comparison to reference standards is essential. The caliber may be determined based on base style, cannelure to base or nose distances, number of cannelures or style or size are also useful. In some cases, the nose shape or design may lead to the successful identification of the bullet and subsequently the caliber.

Procedure:

1. If the item is labelled "through and through" swab the item for DNA using the Laboratory's protocol for DNA swabbing. Care should be used when swabbing an item for DNA if trace evidence (i.e.: hairs, fibers, paint, glass, and other) is present
2. Photograph the item, preferably two (2) views showing the item's type of rifling and twist of rifling, or both sides of the item in its original condition.
3. Document, collect and retain any trace evidence removed from the item.
4. If the item is jacketed, straighten the jacket's petals into an "unfired" or "normal" view. This allows the examiner to observe any markings on the jacket, which could assist the examiner with the item's identification
5. If blood is present, soak the item in a Haemo-Sol ® saturated solution of Nano-Pure ® water and Haemo-Sol ® powder, preferably overnight to enhance its identification
6. If no blood is present, swab the item with alcohol or acetone to enhance its identification
7. Obtain the grain weight of the item. Factor in the possibly that some of the item's grain weight may have been lost due it impacting a target (i.e.: soft tissue, bone, sheetrock, wood, stucco, cement, pavement, sand, glass, and metal).
8. Determine the type of rifling (i.e.: conventional vs. polygonal rifling) the twist of the rifling (i.e.: right or left hand twist), and the number of land and groove impressions (i.e.: hexagonal for polygonal and six (6) for conventional) of the item
9. Determine if there is any presence of slippage at the nose (ogive) of the item, which may indicate a revolver, or any absence of slippage, which may indicate a pistol fired the item

10. Determine the manufacturer's brand of the item by comparing it to references in the Laboratory Ammunition Collection when available. Additional measurements (i.e.: cannelure to base or cannelure to tip) may assist the examiner with this determination. In addition, firing a brand of ammunition using the Laboratory Firearms Collection may further assist the examiner with the determination.
11. Using the procedures (i.e.: 7 through 10) listed above, identify the caliber of the item.
12. Using the procedures (i.e.: 7 through 9) listed above, preferably adding any cartridge cases that were/were not recovered, obtain a list of possible firearms ***normally*** encountered by this Laboratory using the General Rifling Characteristics (GRC) program.

EQUIPMENT

Micrometer or Dial Calipers

Optical Micrometer, EPOI

Stereo Microscope

Ammunition Reference Collection

Electronic Balance

PELLET SIZE DETERMINATION

Usually, evidence pellets are received somewhat mutilated and this examination is somewhat difficult and should be carried out with care. The examiner should choose the most intact (i.e. round) pellets for the examination. It is recommended that at least two of the following three basic techniques described below be utilized due to the nature of the shot being deformed by passage through the barrel and terminal deformation effects. Weighing individual pellets should be done carefully due to pellet to pellet weight variations and possible mass loss due to impact with the target.

The following methods are useful in this identification:

1. Direct comparison with reference standard shot size. This comparison should be done with a stereo microscope.
2. Weigh a number of pellets and compare the weight to the same quantity of known pellets of a specific size(s) established in literature references.
3. Measure the diameter and compare to measurements of known shot sizes or values established in literature references.

WADDING GAUGE DETERMINATION

Shotgun wads can be identified as to their gauge, manufacturer and shotcup size in most cases. Direct comparison with reference standards is recommended for gauge, brand, type or design determinations. In all gauge determinations, one standard gauge larger and one standard gauge smaller should be used to help isolate the gauge of the evidence sample. This is especially useful with the more difficult non-plastic wadding if mutilated or swollen from body fluids. The use of a stereo microscope is required to look for manufacturer symbols and/or numbers on plastic wads.

The following methods are useful in gauge identifications.

1. Direct comparison to the Ammunition Reference File components.
2. Use of additional evidence shotshells, which can be cut open and disassembled for examination and comparison.
3. Base measurement by the use of a micrometer, caliper, or optical micrometer.

*Note: wad size in rare cases can be different from shotshell gauge. (See AFTE publications)

SAFETY

No special safety procedures in the three above described methods are indicated other than routine laboratory safety rules in evidence handling or processing evidence that contains body fluids.

REFERENCES

Saferstein, Richard. *Criminalistics, An Introduction to Forensic Science.* Prentice Hall, 1981.

Kirk, Paul. *Crime Investigation*, Interscience Publishers, 1953.

4.5 CHRONOGRAPH

The chronograph is used to determine the velocity of non-standard ammunition, reloaded evidence ammunition, or ammunition where the velocity performance is unknown. This may be done to help determine proper test fire standards for best striae formation for microscopic comparison work. Also in cases of determination of maximum range of the evidence missile, or the penetration ability of the evidence missile, the velocity of the evidence ammunition can be established by the use of the chronograph.

There are two Shooting Chrony chronographs available to measure velocity (in feet per second) and one Oehler Chronograph. The two Shooting Chrony chronographs vary only in the way the data is displayed and handled. Note: the velocity of BB's must be measured with the Oehler Chronograph.

OHELER CHRONOGRAPH PROCEDURE

EQUIPMENT

Oehler Research Model 33 Chronograph

Oehler Skyscreen III (two needed)

Artificial cloud (two needed for outdoors)

Light source for artificial cloud (two for indoors)

Skyscreen stands (two needed)

Four foot skyscreen spacing rod.

PROCEDURE AND METHOD

The chronograph is to be set up, calibrated and used in the following manner.

1. Attach the two skyscreens to the spacing rod by tightening the tension screws on the bottom of the skyscreens. It is critical that the skyscreens are placed so that the end of the spacing rod is flush with the outboard side of the skyscreen. This placement must be precise so a skyscreen spacing of four feet is maintained. It is critical for accurate velocity measurements that the distance between the skyscreens matches the internal distance setting in the chronograph.

   NOTE: The current distance that is set in the chronograph is four feet. This will give accurate velocity measurements to approximately 4000 feet per second.

2. Place the skyscreen unit on the skyscreen support stands by inserting the skyscreen spacing rod tension screws into the top of the supports. Make sure the separation rod is level.

3. Position the artificial cloud by inserting the supports into the slots provided in the skyscreen. The black side of the supports faces inward.

4. If the chronograph is to be used indoors, place the light source carrier on top of the artificial cloud with the light shield facing towards the shooter. Plug the light carrier into a power source and turn ON.

5. Plug the skyscreens jacks into the back of the chronograph.

   a. The front screen is plugged into START.

   b. The rear screen is plugged into STOP.

6. Turn ON the chronograph. At this time run the internal check of the chronograph by pushing the SUMMARY button and observing the following readouts.

a.	First display	=	0	00
b.	Push Summary	=	65535 LO	
c.	Push Summary	=	0	HI
d.	Push Summary	=	1	ES
e.	Push Summary	=	0	A
f.	Push Summary	=	0	Sd
g.	Push Summary	=	0	00 (top of summary)

   This sequence will complete the internal check of the chronograph. If this sequence does not check out, replace the batteries. If the sequence still does not check out, the chronograph should be sent to the manufacturer for repair.

7. Make sure the muzzle of the firearm is at least 10 feet from the “start screen” when shooting. Test fire a set of velocity standards that will represent a known high and low around the expected velocity of the evidence ammunition. Fire a minimum of 3 of each high and low velocity standards. If the values of these test fires appear to be inconsistent, fire additional rounds to obtain representative results. Fire the missile so that it passes through the center of the triangle formed by the supports for the artificial cloud. The missile should pass above and over the center of the screen window.

Standards:

Firearms	Ammunition	Expected/Actual (fps)	Acceptable Range (fps)
Smith & Wesson Model 10 .38 Special S/N: 631785 Lab # 1034	Federal Hi-Power .38 Special 158 grain lead (No.38B)	755/774	735-813
Ruger Model Speed six S/N: 157-33132 Lab # 0928	Federal Hi-Power 9mm Luger - Cu Jacketed Hollow Point (No. 9FA)	1280/1255	1192-1318
Winchester Model 94 30-30 Win S/N: 4950633 Lab # 1614	Remington Hi-Power 30-30 Win-170 Grain Soft Point (R30302)	2200/2011	1911-2111
German Model K-607 22-250 Rem S/N: 118631 Lab #1989	Remington 22-250 Rem -55 Grain Soft Point (R22501)	3680/3648	3466-3866

80% of the testfires should fall within the acceptable range. If they do not, then the chronograph needs to be serviced.

NOTE: Any velocity readings at approximately 1120 fps should be evaluated carefully. This is the speed of sound at sea level at standard temperature, humidity and pressure. This reading can be produced in error by placing the screens too close to the muzzle. The result is that the screens will read the velocity of the shock (sound) wave from the muzzle instead of the slower missile.

Reminder: The START screen must be placed at least 10 feet from the muzzle to reduce the effect of the muzzle shock (sound) wave.

The chronograph is also sensitive to muzzle blast. If the readings demonstrate great velocity differences from shot toshot, then check the placement of the chronograph. Place the chronograph further BEHIND the muzzle of the firearm. This is especially critical in test firing rifles.

8. With the chronograph checked for accuracy by the use of an internal check and external standards, the examiner can now fire the evidence standards for a velocity determination. These are fired so the missile passes at the center and above the screen. Shoot approximately in the center of the triangle formed by the artificial cloud support. As each test shot is discharged, the chronograph will display the velocity and the sequential number of the shot (eg. 1258 03 VEL. SHOT #).

NOTE:
Any velocity readings that appear to be well out of range may be deleted from the summary by using the FORGET button. When firing a run, pay attention to the SOUND of the muzzle blast and the amount of RECOIL. If there is no observed difference of these factors during the test fire sequence and there are significant velocity differences, then a call of ERROR is justified. The readings should be deleted by using the FORGET button and the cause of the error investigated before proceeding further.

If recoil and muzzle blast is observed to be different from shot to shot then the velocity differences are justified and are to be included in the velocity run.

If the chronograph records a velocity reading of 0, then delete this reading so the average and standard deviation calculations are not affected.

9. With the test fire run completed, use the SUMMARY button to retrieve the results of the test.

Push SUMMARY after the last shot has been fired.

a. VELOCITY (FPS) LO (low reading)
b. VELOCITY (FPS) HI (high reading)
c. VELOCITY (FPS) ES (extreme spread)
d. VELOCITY (FPS) A (average reading)
e. VELOCITY (FPS) Sd (standard deviation)

Pushing the SUMMARY will return the chronograph to the last shot fired. You can continue to test fire and add to the test fire run.

To delete the current test fire run from memory just turn the chronograph OFF.

Record the test fire velocities and the velocities of the standards. Secure the chronograph by switching to OFF.

SHOOTING CHRONY PROCEDURE

EQUIPMENT

Safe backstop for firing

Shooting Chrony, model Beta (blue)

Shooting Chrony, model F1 (green)

Wire rods with brass connectors

White plastic diffusers

Indoor Shooting Lighting Fixtures

Tripods (2 - for outdoor use with no table)

9 volt alkaline battery

Extension cord

Shooting Chrony user's manuals

PROCEDURE AND METHOD

Set Up

1. Establish a safe backstop.
2. Fully unfold the Chrony and check for a functional 9v battery.
3. Connect 1 short and 1 long wire rod with brass connector - you will need 4 sets of these
4. Insert these 4 rod assemblies at an angle into the outer holes on the black plastic boxes of the Chrony. These rods help form the two "V" shaped shooting areas in the front and rear sections of the Chrony.
5. Connect three white plastic diffuser pieces and attach (with the connecting legs pointing down) to the rod assemblies to form the enclosed top of the two "V" shaped shooting areas.
6. For indoor use: instead of the plain center diffuser piece, use an Indoor Shooting Light Fixture between the two diffuser end pieces to complete the top of each "V" shaped shooting areas. See Figure 1.
7. Use an extension cord to supply power to the two Indoor Shooting Light Fixtures.
8. Turn on the Chrony display.

9. See the Chrony user's manuals for further details

Firing

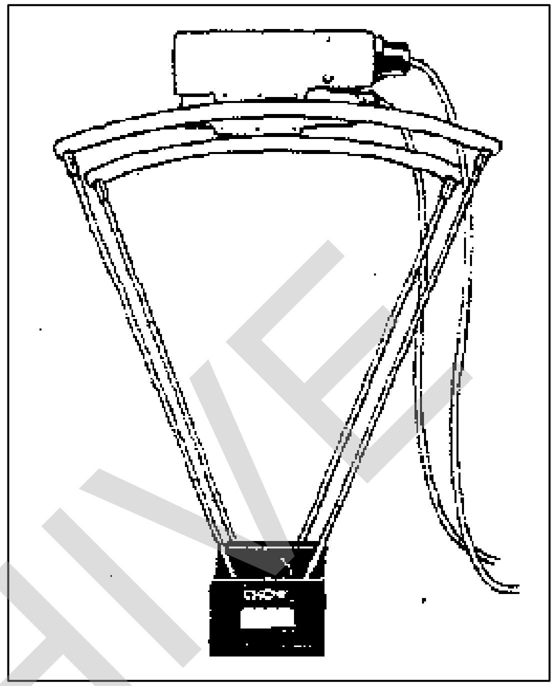
To safeguard the instrument (and to obtain the best results) the missile must pass between 4 and 6 inches directly OVER the twin lenses in the black plastic boxes at the front and rear of the Chrony.

1. Check for safe backstop with this alignment.
2. Fire a shot as described above and into the backstop. Note: The distance between the muzzle of the firearm and the Chrony is important to avoid readings or interference from the muzzle blast. The distances should be approximately 10 feet for rifles and 5 feet for handguns.
3. The velocity should be displayed on the LCD monitor (built in for the F1 model and portable for the Beta model). Note: If no velocity is displayed,
4. the missile may have failed to pass over one or both of the sensors.
5. Record the velocity. Continue firing and recording as needed.
6. The Beta model Chrony is capable of performing more advanced data handling/calculations. See the user's manual for further instructions.

Standards

Remington Model 541-S Custom Sorter Rifle (S/N :1275716, Lab #6141) and Federal High Velocity Power Flight No. 510 in .22 Long Rifle. The expected velocity is 1238 fps (this velocity was verified using Doppler Radar). The acceptable range for this ammunition and firearm is 1176-1300 fps. 80% of the test fires should fall within this range. If they do not, then the chronograph needs to be serviced.

FIGURE 1



REFERENCES

See Chronograph Manuals

4.6 CLASS CHARACTERISTIC DETERMINATIONS

INTRODUCTION

One of the common examinations is the determination of class characteristics of a bullet and cartridge case. The determination of class characteristics of a bullet allows the examiner to produce a list of firearms with similar rifling specifications. Class characteristics of firearms evidence can be broken down into two areas: missile and cartridge case examinations.

MISSILE CLASS CHARACTERISTIC DETERMINATIONS

Missile class characteristic examinations consist of the following determinations.

A. Caliber
B. Number of lands and grooves
C. Direction of Twist
D. Land and Groove measurements
E. Determination of method of rifling manufacture

CALIBER

Caliber determinations are usually made by direct measurement of the base of the missile and the bullet weight. This is done by the use of an optical micrometer, or caliper, to measure the diameter and by retained weight measurement with a balance or scale. In many cases, caliber determination can also be helped by observing the number and location of cannelures, the shape of the base or nose of the missile, or other manufacturing details such as surface coatings or materials used in the manufacture of proprietary products.

EQUIPMENT

1. EPOI Measuring Projector (Optical Micrometer)
2. Vernier Caliper or Dial Caliper
3. Stereomicroscope
4. Laboratory Ammunition Reference Collection

NUMBER OF LANDS AND GROOVES

This is the physical counting of the number of land and groove impressions. This is done by physical observation or a mathematical determination by using the bullet diameter and the measurement of one land and one groove impression.

DIRECTION OF TWIST

Twist direction is determined by observing the left or right direction of the land or groove of the missile when viewed along the missile axis. In cases where the missile is damaged, the base can be used as a horizon line. In missiles that have a cannelure, the cannelure is useful as a horizon. Care must be taken to ensure that these horizons are not distorted by impact. A useful optical instrument is the EPOI Measuring Microscope.

EQUIPMENT

Stereomicroscope
EPOI Measuring Microscope

LAND AND GROOVE MEASUREMENT DETERMINATION

The dimensions of the land and grooves of the missile are made. This information is entered into the General Rifling Characteristics (GRC) database. Land and groove measurements are done optically and care must be taken to orient the land or groove surface perpendicular to the axis of the optical path. The measurements are taken at the bottom edge of the land impression (groove in the missile) to the opposite bottom edge of the land impression. The groove impressions are measured using the same beginning and ending locations.

The number of land and groove impressions that should be measured will be determined by the examiner to determine the range of variation in the rifling specifications of the barrel of interest. This will help the examiner to determine the average land and groove measurement and the amount of tolerance that will be factored into the search parameters. The amount of tolerance factored in will increase when a missile is damaged or shows significant variation in the land and groove measurements.

All land and groove measurements should be taken as close to the base as possible. Measurements taken close to the nose area are most likely to be in error due to slippage during bullet translation into the rifling of the barrel.

In the case of impact damaged missiles, the area of least distortion should be used. Larger tolerance values should be factored in for setting search parameters especially in cases were fragments containing only one or two complete land or grooves are used and the rifling is indistinct.

MEASUREMENT AND SEARCH EXAMPLE

This technique is used as a guide for computerized search screens that use land and groove impression measurements. The range of these measurements will be determined by the analyst and entered into the computerized database for searching.

EQUIPMENT

EPOI Measuring Projector (Optical Micrometer)

FBI CLIS GRC Manual

FBI GRC Computer File (In IBIS) (Lab Computer)

DETERMINATION OF METHOD OF RIFLING MANUFACTURE

This class characteristic has only two choices. (C)ONVENTIONAL rifling (described as CUT in the IBIS GRC computer file), or (P)OLYGONAL rifling. These two styles of rifling are generally quite easy to determine by examination of the evidence missile.

CAUTION

Caution should be used in examining missiles fired from well worn conventionally rifled barrels, especially with lead bullets. Polygonal rifling is somewhat unusual and is generally found only in Glock, Heckler & Koch, IMI Desert Eagle, Sites Spectre, Dornaus & Dixon - Bren Ten, and Steyr GB semiautomatic pistols. There are also some Heckler & Koch traditional hunting rifles and one Franchi rifle that uses polygonal rifling. No revolvers are known at this time to be rifled with polygonal rifling.

EQUIPMENT

Stereomicroscope with side lighting.

CARTRIDGE CASE CLASS CHARACTERISTIC DETERMINATION

Cartridge case class characteristic determinations are made using the following factors:

A. Firing Pin Impression.
B. Extractor Position.
C. Ejector Position.
D. Breechface Markings.

FIRING PIN IMPRESSION

The methods of determining the shape and size of the firing pin impression are found in the FBI CLIS GRC manual and will not be repeated here. Please refer to the GRC manual for shape codes and shape examples.

When determining the shape of rimfire firing pin impressions, measure the width of the firing pin impression as it is an important part of the classification. This is not necessary in centerfire firing pin impressions, since the width of centerfire impressions can vary because of differences in chamber pressure, and primer hardness variations.

Firing pin shape examples are:

A. FP = H (hemispherical)
B. FP = C13 (circular with .13" diameter, rimfire)
C. FP = R09 (rectangular, rimfire, .09" width)

EXTRACTOR POSITIONS

The position of the extractor is determined by stereoscopic examination of extractor markings on the rim of the cartridge case or in the extraction groove of the case. This is expressed as an "O'clock" position relative to "normal" which is assumed to be at 3 O'clock. Other extractor positions can be determined based on parallel breechface markings which are usually oriented from 12 O'clock to 6 O'clock with the 12 O'clock position being consistent with the front sight of the firearm. Drag markings on the firing pin impression are indicators of the 12 O'clock position.

Extractor position examples are:

A. EXT = 3C (extractor at 3 O'clock with cutout)
B. EXT = 39 (extractor at 3 & 9 O'clock)

EJECTOR POSITIONS

The position of the ejector is determined by stereoscopic examination of the ejector impression on the head of the cartridge case. The position is determined relative to the normal 3 O'clock of the extractor. This position is expressed as an 0'Clock position. If a cutout is observed it should be reported.

Ejector position examples are:

A. EJT = 7C (ejector at 7 O'clock with a cutout)
B. EJT = 6 (ejector at 6 O'clock, no cutout)
C. EJT = FP (firing pin used as ejector)

BREECHFACE IMPRESSION DETERMINATIONS

The breech or bolt describes impressions caused by the character of the machining of the breech or bolt face. These machining marks are transferred to the primer and sometimes the head of the cartridge. The impressions are caused by the primer and case head being pushed into the breech by the chamber pressure of the fired cartridge. Generally, the higher the chamber pressure, the more distinct the markings. Centerfire high pressure cartridges, as a rule, impress well and low pressure cartridges, such as shotgun cartridges, as a rule, do not impress well. The breechface impression is usually found on the primer, but sometimes can be seen on the case head.

Breechface markings are classified under the following three categories:

A. Parallel (P)
B. Circular (C)
C. Smooth (S)

The shapes of these impressions are self explanatory and represent the actual impression shapes observed on the primer of the evidence case. In some cases, combinations of impressions can be observed. Also, bi-directional markings, that is two different angles of parallel markings, are sometimes seen, and, are best described as crosshatching.

EQUIPMENT

Stereoscope.

Comparison Microscope.

REFERENCES

CLIS, FBI General Rifling Characteristics Manual, located in the Firearms Unit Library.

IBIS Operations Manual, located in the Firearms Unit Library.

The 9MM Matrix **.** R. Kennington. CCI.

SAFETY PRACTICES

No special safety practices are enumerated other than standard laboratory

safety practices in handling evidence samples that may be contaminated with biological tissues.

4.7 COMPARISON PROTOCOL

When evidence in a shooting case is examined, the evidence and all necessary equipment and supplies should be removed to the appropriate work area. Before a comparison examination is to proceed, the evidence exhibit should be examined for trace evidence. If any trace evidence is noted, it should be collected according to standard laboratory procedures.

The firearms examiner should establish the following basic techniques in order to facilitate the comparison examination:

A. Verify that the comparison microscope is properly adjusted.
B. Verify that the test fire ammunition is compatible with the evidence ammunition.
C. Collect the test fire standards according to the Test Fire Protocol (Firearms policy 3.21). All laboratory safety standards shall be adhered to as established within this manual.
D. As a minimum, label test fire standards and/or containers.
E. Intercompare test fire standards to establish the reproducibility of rifling class characteristics and individual characteristics prior to comparing the test fire standards to the evidence exhibits.
F. With the individual characteristics identified, compare the evidence exhibits to the test fire standards.
G. Document your findings by drawing or photography indicating areas of agreement or phase.
H. Report findings by written report. The final report must be technically and administratively reviewed prior to releasing the report to the requestor.

NOTE:

A. All evidentiary identifications must be verified by another qualified firearms examiner prior to reporting.
B. Evidentiary inconclusives and eliminations may be left to the discretion of the primary examiner to have his/her findings verified by another firearms examiner.

In cases where the class characteristics are similar and the result of the examination is an elimination, it is recommended that the primary examiner seek a second opinion.

4.8 INTEGRATED BALLISTICS IDENTIFICATION SYSTEM (IBIS) PROTOCOL

BACKGROUND

Through its National Integrated Ballistic Information Network (NIBIN) Program, ATF deploys Integrated Ballistic Identification System (IBIS) equipment into Federal, State and local law enforcement agencies for their use in imaging and comparing crime gun evidence.

This equipment allows firearms technicians to acquire digital images of the markings made by a firearm on bullets and cartridge casings; the images then undergo automated initial comparison. If a high-confidence candidate emerges, firearms examiners compare the original evidence to confirm a match. By minimizing the amount of non-matching evidence that firearms examiners must inspect to find a confirmable match, the NIBIN system enables law enforcement agencies to discover links between crimes more quickly, including links that would have been lost without the technology.

CRITERIA FOR IBIS FIREARMS ENTRY

All semi-automatic firearms submitted to the Crime Laboratory for testing will be test fired, and the images of the resulting cartridge case(s) will be entered into the IBIS system.

Images of all casework test fire cartridge cases or bullets of evidence guns, evidence cartridge cases, and bullets can be entered by the analyst working the case.

BASIC PROCEDURE

Images of the firearms evidence are captured and entered into the IBIS system. This entry is followed by a database search for any possible matches. If a possible match occurs, the analyst will confirm the match by evidence examination and comparison.

Each examiner must follow the IBIS protocol, provided by the manufacturer and the ATF, located in the reference material provided.

SAFETY CONSIDERATIONS

When preparing to test fire an evidence firearm, all normal safety procedures are in order. The firearm should also be carefully checked for mechanical and functional integrity.

NOTE: All test fire cartridge cases will be retained with the evidence firearms and returned to the property room.

REFERENCES

IBIS Operations Manual, located adjacent to the IBIS system in the Firearms Unit.

4.9 GUNSHOT RESIDUE DISTANCE DETERMINATIONS

The examination around missile holes in skin and clothing for gun shot residues of gun powder and primer residues, and the subsequent determination of the firearm to target distance, is a common examination.

Any deviations from the use of the actual case firearm, ammunition or target when conducting distance determination tests, should be documented in the notes. The procedure should include the examination of the area around any holes for gunshot residues, both visually and microscopically.

"At" or "Near Contact" ranges may be based on observations of the evidence alone. Ranges greater than these must be based on the comparison of test patterns to the evidence pattern.

Lacking any obvious visual patterns, techniques from the following list may be conducted:

A. Microscopic examination and plotting.
B. Modified Griess.
C. Sodium Rhodizonate.
D. Infrared photography or video.

All range determinations for ranges other than contact will be reported using upper and lower limits around an average range. Outside factors such as powder deflection, intermediate targets, handling or moving of an article, may affect the powder pattern.

THE MODIFIED GRIESS TEST

The Modified Griess Test is used to determine the muzzle to target distance in gun powder pattern determinations. The Griess test detects nitrites, a product of incomplete burning of gunpowder, by reacting with acetic acid to form nitrous acid. This acid combines with alpha-napthol and produces an orange-red azo dye.

GRIESS TEST PROCEDURE AND REAGENT PREPARATION

The test procedure that will be used in conducting the modified griess test is the standard FBI modified griess test procedure: TITLE: THE MODIFIED GRIESS TEST, A Chemically Specific Chromophoric Test for Nitrite Compounds in Gunshot Residues, FBI Academy, Quantico Va, Forensic Science Training Unit.

The test procedures will include a blank (known negative) and a standard (gunshot residue pattern/stain containing nitrites-this can be determined by previous testing).

A solution of sodium nitrite is prepared by adding 0.6 grams of $NaNO_3$ to 100mls of distilled water.

THE SODIUM RHODIZONATE TEST

Fired bullets passing through clothing often leave traces of lead and, if close enough, leave patterns of primer residues around the entry hole; that is if the cartridge primer is not of the lead free primer type. This residue can be in the form of fine minute particles or a fine cloud of vaporized lead. Sometimes it is an obvious ring or wipe around the missile hole, but more often it is invisible to the human eye.

The sodium rhodizonate test is specific for lead and can effectively be used in determining the physical characteristics of bullet holes including possible entrance versus exit.

THE SODIUM RHODIZONATE TEST PROCEDURES AND REAGENT PREPARATION

The test procedure that will be used in conducting the sodium rhodizonate test is the standard FBI sodium rhodizonate test procedure: TITLE: THE SODIUM RHODIZONATE TEST, A Chemically Specific Chromophoric Test for Lead in Gunshot Residues, FBI Academy, Quantico Va. Forensic Science Training Unit.

The test procedures will include a blank (known negative) and a standard. The standard will be a gunshot residue pattern or stain containing lead. This can be a simple wipe mark on filter paper with a lead bullet. The lead bullet will be from the ammunition collection in the firearms laboratory. The notes will reflect the origin of the bullet to include the manufacturer, caliber, and lot number (if available).

STANDARDS AND CONTROLS

The chemicals are made fresh for each test of nitrites or lead, so no reagent logbook is kept for these chemicals. Each time a test is performed, the chemicals are checked with:

A. A blank that is usually a clean piece of filter paper with no nitrites, lead, or gunshot residue.
B. A lead standard (for sodium rhodizonate test). A lead bullet from the ammunition collection in the firearms section will be used as the standard.

C. A GSR standard containing nitrites (for the Greiss test). The $NaNO_3$ solution will be used as the nitrite standard.

The chemicals are made fresh each time an analysis is done, with the exception of the buffer solution and some acid solutions. Since they are checked with standards and blanks, any problems will be detected and the solutions remade. The results of the standards and blanks will be entered into the analyst's notes.

The buffer is prepared by adding 1.9 grams of sodium bitartrate and 1.5 grams of tartaric acid to 10 mls of distilled water.

A listing of the other additional reagents and their preparation instructions can be found in the references.

REAGENT LOG

A reagent preparation log will be kept for gunshot residue testing. The buffers will be logged in when prepared. A known lead sample and a blank will be run before any reagent is applied to a case sample. The results of the testing of the blank and the known will be recorded in the analyst's notes. The reagent preparation log will list the reagent prepared, the date, and the analyst's initials.

REFERENCES

GSR Procedures Manual, located in the Firearms Unit Library.

4.10 MACHINE RESTS

The Firearms Identification Unit presently utilizes two firearms machine rests for the following uses:

1. To provide a method of remote fire for safety reasons when discharging firearms in poor mechanical condition.
2. To be able to mount firearms used in distance determination testing to provide accurate distance spacings.
3. To be able to mount firearms in a precise and repeatable manner to judge:
    a. Accuracy of any given ammunition.
        i. Sight settings in relation to barrel alignment. This is needed in determining aim point verses impact point in long range shootings.

EQUIPMENT

Ransom Handgun Machine Rest and grip inserts.

Miller Shooting Machine for long gun use.

HANDGUN MACHINE REST

The laboratory uses the Ransom Rest to mount handguns. The rest is mounted to a table stand.

1. Mount the rest on the shooting table and secure.
2. Remove the grip panels from the evidence firearm.
3. Select from the grip inserts, the correct model of insert and place the firearm frame into the insert.
4. Mount the handgun with insert on to the Ransom Rest.
5. Secure the insert by tightening the three mounting screws.
6. Adjust the elevation screw so the barrel is aligned with the target.
7. Adjust the trigger bar so the remote trigger lever will pull the trigger of the firearm.
8. The Ransom Rest is now ready to use. After each shot, push the barrel back down into battery.

RIFLE MACHINE REST

1. Place the Miller Shooting Machine on any flat and secure surface.
2. Place the evidence long gun into the machine rest.
3. The rest is adjustable for stock length. Adjust as needed.

4. Use the padded spacers to secure the firearm in the forward and rear clamps to:
   a. provide a secure clamp on the firearm.
   b. to prevent marring or scratching of the firearm.
5. If the firearm has a removable/detachable magazine, remove the cover plate over the magazine well in the machine rest.
6. The rest is ready to use. The machine rest has a recoil dampening mechanism built into the rest to attenuate the firearm recoil.
7. Use the cord provided and attach to the trigger if remote fire is required for safety reasons.

4.11 OFFICER-INVOLVED SHOOTINGS

The investigation of officer-involved shootings is a priority investigation for the Firearms Unit. This activity is handled on a call out basis with the call out duty being rotated weekly.

INVESTIGATION RESPONSIBILITIES

The primary responsibilities of the Firearms Criminalist are the examination of the firearms evidence and the examination of the shooting scene with the goal of a shooting scene reconstruction.

EVIDENCE EXAMINATION

The examination of the firearms evidence is a priority, especially the examination of the officer's firearm. The following examinations will be conducted:

1. Gun shot residue collection (barrel gun shot residue reference standard "bore swab")
2. Condition of the officer's firearm
    a. Mechanical status, (cocked, magazine, slide position, safety position.)
    b. Operability status of the officer's firearm
    c. Identification of the ammunition remaining in the officer's firearm and in the magazines.

       NOTE: The ammunition should be consistent with the Department issue ammunition.

    d. Determination if the firearm has been fired (look for residue in the barrel, note any odor, other residues in barrel).

The criminalist will also examine the firearms evidence from the crime scene to determine the following:

1. Identification of all ammunition components.
2. Gun powder patterns.
3. Missile impacts and any ricochets.
4. The location of all cartridge cases.
5. Determination of all trajectories.
6. Determination of direction of missile travel in:
    a. Inanimate objects (car bodies, fences, walls, clothing, etc.).
    b. Wound path through bodies.

NOTE: If the suspect is deceased, the wound direction may be determined by the Medical Examiner at autopsy.

7. The examination of all suspect's firearms to determine if:
    a. The firearm has or has not been fired.
    b. How many times the firearm has been fired.
    c. An assessment of the ammunition components used by the suspect.
8. Measurements of angles of an object's inclination, other than trajectories, that the criminalist feels should be documented. Examples include the street, car seats, etc.

4.12 OPERABILITY

In cases where the function of the firearm is in question, the examiner should conduct the following examinations using the following checklist as a guide. Not all of the examinations may be necessary or appropriate to the situation. All efforts necessary to determine the cause of a malfunction that is related to the case will be carried out.

1. Physical Check:
    a. Cocked/uncocked.
    b. Safety position.
    c. Loaded/unloaded.
    d. Cartridge position.
    e. Stuck cartridge or case.
    f. Magazine seated or not seated.
2. Visual Abnormalities:
    a. Barrel (loose).
    b. Receiver (condition).
    c. Slide (condition).
    d. Parts broken or missing.
    e. Screws, loose, gone.
    f. Alterations.
    g. Sights.
3. Action (External) :
    a. Are the relationships of action parts correct?
    b. Is the assembly correct?
    c. Does the action lock normally on closing?
    d. Cylinder rotation (securely locks).
    e. Hand relationship to ratchet (worn).
    f. Trigger (not returning, sticks, broken springs).
    g. Check trigger pull and striking pressure of the hammer.
    h. Check for the function of a disconnector to determine if the gun is automatic, semi-automatic, or both.
4. Safeties:
    a. Check all 3, 2 cock and any false seating positions.
    b. Grip, magazine, disconnector functions.
    c. Thumb/Finger - note positions when firearm will fire.
    d. Rebound hammer or inertia firing pin – will firing pin ride on primers?
    e. Is the firing pin frozen or bent? Drop hammer several times to check hammer block or transfer bar safeties.
    f. Does the slide or bolt have to be completely closed (in battery) for the gun to fire?
    g. Can the safeties be bypassed?

   h. Will a light blow on the rear of the hammer discharge the firearm?
   i. Can the firing pin safety be overridden by holding the trigger while dropping the hammer?
   j. Is the firing pin impression off center? Why?

USE CAUTION WHEN FIRING LIVE AMMUNITION OR PRIMED EMPTIES

5. Action Check:
   a. Check feeding from the magazine.
   b. Will cartridge fire on closing of the bolt or slide?
   c. Extractor and ejector mark on the cartridge consistent or normal?
   d. Are there any unusual marks exhibited on the cartridges or cartridge cases?
6. Check for any inherent "quirks" known about the particular firearm based on literature or case data.
7. Test fire the firearm:
   a. Note any operational problems or malfunctions.
   b. Ammunition involved, proper for the firearm?
   c. Check consistency of impression on test and compare to the evidence.
   d. Check for misfires as to cause.
8. Special Situational Tests:
9. Discretion should be considered in situational testing if the force needed could disturb the internal action and cause changes which might prevent determining the exact cause of the malfunction.
10. Action (Internal) (remove side plate):
    a. Hammer notch (worn, burrs, dirt, etc.)
    b. Sear (worn, broken, burrs, etc.)
    c. Safeties (relationships of action parts)
    d. Springs (weak, broken, altered, etc.)
    e. Signs of any tampering or faulty assembly or non-factory alterations to the firearm.

4.13 REMOVING DEBRIS FROM BULLETS AND CARTRIDGE CASES

In many cases, missiles and cartridge cases which are submitted for evidence examinations, contain various forms of debris that cover the characteristics of the evidence item. In order to determine class or compare individual characteristics this debris must be removed in order to complete the examination. It should be understood that this debris may constitute trace evidence or blood evidence and that the removal will in some cases involve the collection and preservation of this evidence.

NOTE: First, photograph the evidence to document the original condition before removal or alteration.

MATERIALS AND EQUIPMENT

Ethanol.

Cotton swabs.

Distilled water.

Biodegradable liquid soap.

Dilute Ammonium Hydroxide NH_4OH 5%.

Dilute Acetic Acid CH_3COOH 15%.

Ultrasonic Cleaner (Bath type).

MECHANICAL AND SOLVENT REMOVAL

1. Attempt to remove any loose material with tweezers or a probe. Use ethanol if necessary. If the material removed is trace evidence, package this material and retain with the evidence.
2. Missiles sometimes contain much tissue and blood that adhere to the surface. This can generally be removed by swabbing the surface with a swab soaked in ethanol. Gently swab the surface, taking care not to polish the missile surfaces possibly damaging the individual characteristics.
3. Soaking the missile in a solution of ethanol and biodegradable soap will usually soften and allow easy removal of any stubborn blood and tissue. Rinse with distilled water. Use a 1:1 solution of ethanol and liquid soap. Dilute to a 10% final solution with distilled water.

CHEMICAL REMOVAL

1. In order to dissolve blood, the following mixture is effective and will not harm individual striae. Place the missile in a solution of 5% ammonium hydroxide (NH_4OH) for five to ten minutes. Rinse with distilled water.
2. A method for removing plaster or drywall is to soak the missile in dilute acetic acid (15%), (CH_3COOH), for several minutes. Inspect the missile while chemical removal proceeds. Rinse with distilled water. This method has been shown to be very effective and will not damage the missile surfaces.

ULTRASONIC REMOVAL

Ultrasonic removal of debris should be considered the last resort of debris removal because of the damage that ultrasonification can do, especially to lead bullets and plated (copper flashing) .22 rimfire missiles.

1. Place the missile in a beaker in a 1:1 solution of ethanol and liquid soap. Dilute this cleaning solution to a 10% solution with distilled water. Place the beaker into the sonic cleaner with distilled water at the same level as the cleaning solution in the beaker. Run for a few minutes, but do not run longer than three minutes without inspecting the missile surface for sonic erosion damage of the individual striae. Caution should be exercised for lead missiles and especially plated .22 caliber rimfire missiles.

The sonic cleaner can flake off the surface coating if not used with some discretion. Extreme caution must be used for longer periods to prevent damage to the evidence missile individual characteristics. It is a good practice to check the evidence every few minutes by stereomicroscope inspection for progress and to prevent Ultrasonic damage.

Copper jacketed missiles fare much better but this method still should be used with caution.

SAFETY

No special safety practices are required except for standard safety practices when handling chemicals and laboratory equipment.

Disposal of chemical wastes should conform to standard laboratory guidelines.

4.14 SERIAL NUMBER RESTORATION

Serial numbers on most firearms, as well as many other objects are usually die stamped. This process, if done after the metal has been heat treated, produces a compression of the metal in the area immediately surrounding and a short distance below the penetration of the die. Even though the number is obliterated by grinding or filing, it may be restored if the removal of metal is not past this compression. If the obliteration is beyond this area or if the numbers are drilled out or welded over by torch, restoration is impossible. Restoration methods are also ineffective on etched or engraved numbers.

The techniques for chemical restoration are generally the same for all metals. The reagents used are based on the metal to be treated.

SAFETY

Because the reagents used are etching solutions or acids, they are of a potentially dangerous nature, and therefore should be used under a fume hood or in a well-ventilated area only by qualified trained personnel. Storage of these reagents must follow established laboratory storage procedures as listed elsewhere in this manual.

RESTORATION PROCEDURES

1. Preliminary Inspection and Preparation
    a. Inspect the serial number area for coating, trace material, or any character remnants.
    b. Record the initial condition of the obliterated serial number area by notation and/or photography.
    c. Clean the serial number area of any coatings using solvent. Attempt to determine the method of obliteration and document this information. Inspect for any character remnants.
    d. Polish the serial number area to a mirror-like finish with any variety of abrasives or abrading tools. Inspect the serial number area for any character remnants. If any remnants are present, document these characters.
2. Initial Processing Method
    a. Determine whether the surface the serial number is on is magnetic or non-magnetic.
    b. Select the appropriate restoration method based on the magnetic state of the surface, and begin processing.

c. For magnetic media use Fry's Reagent, Turner's Reagent, Davis' Reagent, and Nitric acid.

d. For non-magnetic media use Ferric Chloride, acidic Ferric Chloride, Sodium Hydroxide, and Nitric acid.

    i. Use a cotton-tipped swab and dip the swab into the desired reagent. Swab the serial number area in ONE direction until the chemical reaction appears to be complete. Continue with fresh swabs and reagents as needed. The chemicals can be used in any order and repeated as necessary to obtain the desired results. Document the development of any characters.

e. During the processing, continually inspect and note any character remnants recovered and document.

3. Recording of Results and Conclusions

a. Record all recovered processed characters and/or character fragments by notation. Photograph if possible.

b. With restored character fragments, render any conclusions as to the possible character types or combinations.

c. In the case of a partially restored number, research the serial number make-up for the firearm and attempt to exclude certain characters based on their location in the number. This is accomplished through various resources such as the manufacturer or the firearm, the ATF Tracing Center, the ATF Firearm Serial Number Structure Guide, or through a firearms reference collection.

d. Through research and all appropriate processing methods, render a final conclusion. Have the conclusion corroborated by another examiner and document this corroboration in the examiner's notes.

e. Issue a laboratory report reflecting the examiner's restoration results.

MATERIALS NEEDED FOR RESTORATION

Cotton tip applicators.

Wet/Dry sandpaper and emery cloth.

Dremel tool and rubber abrasive wheels*.

Etching reagents and acids.

Fume hood or ventilated area.

* = Used only for trimming excess material

Safety glasses and laboratory coat.

Camera to document restoration.

While the examination of the recovered serial number can be done with unaided visual examination, a low powered stereomicroscope and side lighting is useful.

REAGENTS

Fry's Reagent – 90 grams $CuCl_2$, 120 mls HCl, 100 mls distilled water.

Turner's Reagent – 2.5 grams $CuCl_2$, 40 mls HCl, 25 ml ethyl alcohol, 30 mls distilled water.

Davis Reagent – 5 grams $CuCl_2$, 50 mls HCl, 50 mls, distilled water.

Ferric Chloride – 25 grams $FeCl_3$, 100 mls distilled water.

Acidic Ferric Chloride – 25 grams $FeCl_3$, 25 mls concentrated HCl, 100 mls distilled water.

10% sodium hydroxide – 10 grams NaOH, 90 mls distilled water

ZINC ALLOY REAGENTS

1. 98 mls concentrated H_3PO_4, 2 mls concentrated HNO_3
2. B Dilute Nitric Acid (5 – 10%) – 5 or 10 mls HNO_3 to 95 or 90 mls of distilled water.
3. Griffins' Reagent – 30 grams $CuCl_2$, 30 mls HCl, 120 mls methanol, 30 mls distilled water.
4. 25% Nitric acid – 25 mls concentrated HNO_3 added to 75 mls distilled water.

NOTE: When chemicals are prepared, an entry into the Reagent Preparation Log will be made indicating the name of the reagent, the date, and the initials of the person preparing the reagent. The chemicals used in this procedure are stable acid-based chemicals and do not have an expiration date. They are designed to etch metal that is easily seen in the bubbling of the metal. If no etching is taking place, the chemicals will have to be remade. When chemicals are made the containers will be labeled as to the contents, the date made, and the analyst's initials. Results of the etching will be recorded in the analyst's notes.

REFERENCES

See the Serial Number Restoration materials provided by CCI.

4.15 SILENCER EVALUATION

The examination of silencers/suppressors is a technical and operational examination that is performed by the firearms analyst. The purpose of the examination is to determine if the submitted evidence item is:

1. constructed with the elements that will allow the item to function as a silencer/suppressor.
2. has a method for the silencer/suppressor to attachto a firearm.

TECHNICAL DESCRIPTION

Silencers/Suppressors are designed to decrease the sound signature of a firearm discharge.

GLOSSARY TERMINOLOGY

1. SILENCER = This term is best used to describe a device that is designed to do two separate effects.
   a. Is attached to a ported barrel so that propellant gases are bled from the barrel while the bullet is still in the rifled barrel. This results in the reduction of the exit velocity to speeds less than the speed of sound. This will eliminate the Mach wave from calibers that have an initial velocity greater than the speed of sound.
   b. The silencer also reduces the muzzle exit noise by the same technology as a suppressor. This is accomplished by heat transfer, baffling and gas volume containment.
2. SUPPRESSOR = This device is best used to describe a device that is designed to deal with only one effect.
   a. Is attached to the end of a non-ported barrel and is designed to only handle the muzzle exit noise. Suppressors are used in subsonic applications where Mach wave noise is not a factor. Suppressors can be used in supersonic applications where the Mach wave noise is not a consideration.

NOTE: This distinction of technical use is not recognized by all examiners and the terms are sometimes used interchangeably. The advanced student will recognize the applicability of the terms when attached to the design function of each type of device.

The term "silencer" is used to describe both types of devices in the Penal Code, PC 12500.

EVALUATION AND REPORTING

The examination of a suspected silencer must establish and demonstrate the two factors of design and attachment. What is not necessary is to establish the degree of sound reduction.

Therefore, it is not necessary to test fire the system to establish any sound reduction. In many cases of homemade silencers, it may be dangerous to test fire the firearm/silencer system due to barrel and silencer misalignment. Commercially manufactured silencers, while mechanically better constructed, still need to be checked for proper barrel alignment before test firing.

SAFETY CONSIDERATIONS

If the silencer is to be tested by live firing, it is imperative that the examiner makes certain that the bore of the barrel and the silencer bore are in alignment. Check by inserting a properly fit cleaning rod down the barrel and check that there is no interference with the silencer. Alignment is critical to the safe operation of a silencer/suppressor equipped firearm. If you cannot establish proper alignment, do not attempt to fire the firearm with the silencer attached!

4.17 TEST FIRE PROCEDURE

The examiner will load the firearm with the appropriate ammunition in the shooting room. The examiner will determine which of the following bullet traps to use.

- Water tank – if this trap is to be used, be sure to turn on exhaust fan prior to use.
- Kevlar trap
- Backstop – primarily for shotguns

The examiner will determine the type of ammunition and the number of test fires.

The examiner will fire into the appropriate trap. The examiner will retrieve the missiles and cartridge cases. No missiles can be retrieved from the backstop.

SAFETY CONSIDERATIONS

- Prior to test firing any firearm, the examiner will ensure that the firearm is safe to operate.
- The gun will be transported from the lab to the shooting room and back in an unloaded condition.
- The actual test fires will be done in the shooting room located on P2.
- The examiner doing the test fire must have another individual in attendance during the actual firing.
- Both the examiner and the attendant will wear eye and ear protection.

4.18 BIOLOGICAL EVIDENCE

BULLETS/MISSILES

If the examiner is informed that the bullet is a through and through, or if a specific request is submitted, the bullet will be swabbed for DNA prior to any work being done.

FIREARMS AND SHOTSHELL DNA EVIDENCE

If firearms or shotshells are obtained by the Firearms Unit for processing and do not have a sticker on the container indicating that they have been swabbed for DNA, the unit examiners initiate one of the following protocols:

1. If the evidence has a request to be processed for prints, the firearms evidence will be forwarded to the Crime Scene Unit for fingerprint and DNA processing.
2. For evidence that has been processed for fingerprints on older cases prior to DNA swabbing, or for firearms cases that have no request for latent fingerprint processing, the Firearms Unit examiners will swab the firearms and/or shotshells for DNA

MATERIALS

1. Sterile cotton swabs (Fisher Scientific cat. #14-959-96B or equivalent)
2. Nanopure water (dropper bottle obtained from Forensic Biology)
3. Manila envelopes

NOTE

The following procedure is meant to guide an analyst in collecting possible DNA from a firearm, if the analyst is the first to handle an evidentiary firearm. The goal of this procedure is to swab for any DNA that may yield information on who may have handled the firearm. Care should be taken in the collection to minimize possible contamination, so a sterile technique (lab coat, gloves, and masks) must be used. This procedure does not apply to the collection of visible biological stains such as blood.

The textured areas of a firearm may be swabbed for possible DNA evidence, however as weapons can vary tremendously, the areas of the firearm to be swabbed should be judged on a case-by-case basis. In general, only smooth surfaces are suitable for obtaining latent prints and swabbing those should be avoided to preserve possible latent print evidence that may be on a weapon.

PROCEDURE

1. Lay the firearm on a sheet of butcher paper in a clean area.
2. Moisten a cotton swab with 1 or 2 drops distilled or nanopure water.
3. Swab the portions of the firearm deemed suitable for collection of possible DNA. Swabbing should be done to maximize the possibility of transfer of DNA from the firearm to the swab (i.e. more than a cursory swab the firearm is required). The swab may be rolled so that so that a larger surface area is available for DNA collection.
4. After swabbing, place the swab into a manila envelope labeled with case information and the location(s) on the firearm that were swabbed. The swab of the firearm will be placed into an appropriately labeled Freezer Packet for submission to the Property Room.

4.19 TRIGGER PULL EXAMINATION

The determination of the trigger pull is a routine examination that is made on firearms submitted as evidence. The purpose of conducting this type of an examination is to determine the weight of the pull needed to discharge the firearm and to establish if this pull is within the "normal" range for the firearm being tested. The following procedure is recommended as a method of conducting this test:

TESTING EQUIPMENT

1. Arsenal trigger weights (NRA weights).
2. Electronic Force Gauge.
3. Dvorak Triggerscan System

SAFETY CONSIDERATIONS

Check to make sure that the firearm is UNLOADED.

SINGLE ACTION TRIGGER PULL DETERMINATION

1. Cock the firearm. Position the muzzle according to the instrument chosen. If the static methods are used, point the muzzle vertically.
1. Rest the hanger or gauge bar on the trigger at its natural finger position. This is usually at the bottom end of the trigger. Position the hanger in the center of the finger position. Make sure that the testing device is not touching any other part of the firearm.
2. With static testers, add weights one increment at a time until the firing mechanism releases. Reset the hammer and sear after each test.
3. With dynamic testers, apply the force on the trigger in a direction parallel the barrel.
2. With the NRA arsenal type of weights, position the hanger and start with the MINIMUM weight. Lift the firearm by the barrel slowly. Add weight one increment at a time until the firearm will not hold the weight on the tester. Report as "weight held" and "weight not held."

DOUBLE ACTION TRIGGER PULLS

Complete the test as described in the Single Action test except, do not cock the firearm. Insure that if a semiautomatic firearm is being tested, that the magazine is inserted before the test is done.

All tests should be completed a sufficient number of times so that consistency in trigger pull weight is shown. If necessary, a test can be done on a Laboratory Reference Standard, or the manufacturers' information can be consulted to determine the "normal" range of the trigger pull on the tested firearm.

Dvorak Triggerscan System Procedure

The instrument is set up in the firearms lab. It includes the mounting fixture. For complete explanations, see the Triggerscan User's Manual.

1. Turn on the Triggerscan device (TS).

2. Perform the trigger pull measurement with the use of the mounting fixture. [It is possible to use the TS without the mounting fixture (hand-held).]

3. **Ensure the firearm is unloaded and pointed in a safe direction.**

4. Securely mount the firearm and the TS on the fixture as described on page 13 of the manual. (If hand-held, the instrument is held in the left hand and the gun in the right.) If both the single action (SA) and double action (DA) measurements are to be performed, mount the firearm for DA testing first. Be sure the TS is parallel to the barrel of the firearm.

5. The two arms of the TS are positioned between the trigger and the inside front of the trigger guard. The fixed arm must rest solidly against the trigger guard. The RETURN and GO buttons on the TS are used to position the sensor arm. The sensor arm is placed near the trigger at the point where a finger would normally approach the trigger. The sensor arm has a v-shaped roller which must be horizontally centered in front of the trigger. This sensor arm positioning is critical, see page 14 of the manual.

6. Ensure the reading on the TS is 00.0 and that the sensor arm is close but not in contact with the trigger, by readjusting with the RETURN and GO buttons on the TS itself. This is the sensor arm "home" position.

7. Select the GO button on the TS, initiating the movement of the sensor arm of the TS. As it moves, the arm senses and translates the movement and resistance into a digital display on the TS. During the run, the

firearm should remain stationary on the fixture and the sensor arm should not ride high on the trigger. After the run, the sensor arm will automatically return to the “home” position.

8. Repeat the test by repeating steps 5 thru 7.

9. If needed, cock the hammer and reposition the sensor arm (step 5) for SA testing. Repeat steps 5 thru 7.

4.20 HILTI PD42 LASER RANGE METER

Serial Number: 207080028

1. To begin, press the On/Off Button located on the top right-hand corner of the unit.
2. Once the rangefinder is turned on, press the Measure Button, the button with the series of arrows, just below the Graphic Display. Pressing this button activates the laser, which is emitted from the front of the rangefinder.
3. Aim the laser light at the target surface, whose distance from your current position you are trying to measure. **Note: the measuring reference begins from the back of the rangefinder itself, not at the front.** Line up the back edge of the rangefinder with the starting position for the measurement and ensure that the Horizontal Bubble Level on the bottom, right edge of the rangefinder is centered.
4. Press the Measure Button again to take a reading. The measured distance will appear on the Graphic Display.
5. Repeat steps 2-4 if you wish to make consecutive readings. The last three measurements will continue to appear on the graphic display. To clear the screen, press the Delete (clear) Button to the right of the Measure Button.
6. If taking a reading from a corner, or any surface where the back of the rangefinder cannot sit flush against the surface, fold out the measuring spike from the underside of the unit. The measuring reference is automatically set to the end of the spike when it is folded out. Position the spike against the corner starting position and proceed through steps 2-4 to take a measurement reading.
7. When taking measurements in unfavorable light conditions (e.g. in strong sunlight), over long distances, or when taking measurements on curved or inclined surfaces use the target plate to increase the accuracy of measurements in these conditions.
8. To power down the unit, press the On/Off Button.

5.1 PHILOSOPHY OF IDENTIFICATION

The results of a microscopic comparison of an evidence sample and the test fire reference standards from a suspected firearm source will fall into the following four categories.

1. IDENTIFICATION
2. EXCLUSION or ELIMINATION
3. INCONCLUSIVE
4. UNSUITABLE FOR EXAMINATION

EXAMINATION PROCESS AND METHODOLOGY

The process of a microscopic identification begins with the identification of the evidence missile. The examiner will compare the missile to the Ammunition Reference Standard File in an attempt to identify the caliber, the caliber loading, the manufacturer of the ammunition component and the approximate era of manufacturer. The goal is to match as best as possible test fire ammunition that is the same as the evidence missile. This is done to give the best chance for individual striae and impression characteristic reproducibility.

Step two is the intercomparison of the test fire standards. The examiner will identify the class characteristics of the ammunition component and also determine the individual characteristics and the degree of transference from one sample to another.

Step three is the intercomparison of the test fire standards to the evidence sample. This should be done using the best representative test fire sample. The comparison begins by "phasing" the test fire standard and the evidence sample. In cartridge cases fired from semiautomatic firearms, this is accomplished by aligning the extractor and ejector markings or other class markings that are well represented, or in the case of revolvers, chamber markings or gross breechface markings. Missiles are phased by aligning gross markings on the missile as a "starting point" for the examination.

With the evidence sample in phase, the examiner will now proceed to intercompare the reproducible individual characteristics of the tool marks of the test fire standards to the evidence sample. Tool marks are described as striae or impressions transferred from the tool (firearm breech or barrel) to the evidence sample (missile or cartridge case).

THEORY OF IDENTIFICATION

The theory of identification as it pertains to the comparison of toolmarks enables opinions of common origin to be made when the unique surface contours of the two toolmarks are in "sufficient agreement."

This "sufficient agreement" is related to the significant duplication of random toolmarks as evidenced by the correspondence of a pattern of combination of patterns of surface contours. Significance is determined by the comparative examination of two or more sets of surface contour patterns comprised of individual peaks, ridges and furrows. Specifically, the relative height or depth, width, curvature and spatial relationship of the individual peaks, ridges and furrows within one set of surface contours are defined and compared to the corresponding features in the second set of surface contours.

Agreement is significant when it exceeds the best agreement demonstrated between toolmarks known to have been produced by different tools and is consistent with the agreement demonstrated by toolmarks known to have been produced by the same tool

The statement that "sufficient agreement" exists between two toolmarks means that the agreement is of a quantity and quality that the likelihood that another tool could have made the mark is so remote as to be considered a practical impossibility.

The interpretation of individualization and identification is subjective in nature, but is founded on scientific principles and is also based on the criminalist examiners training and work experience.

RANGE OF CONCLUSIONS

The following represents the spectrum of conclusions:

1. IDENTIFICATION
    a. When the agreement of a combination of individual characteristics and all discernible class characteristics is greater than that which can occur in toolmarks made by different tools.
2. INCONCLUSIVE
    a. Where there is agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility.
    b. Where there is agreement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for an elimination.
3. ELIMINATION/EXCLUSION
    a. Significant disagreement of discernible class characteristics and/or individual characteristics.

4. UNSUITABLE
    a. When the evidence sample, due to impact damage or missile condition, is unsuitable for microscopic examination.

DEFINITIONS OF TERMS

1. IMPRESSION - Contour variations on the surface of an object caused by a combination of force and motion where the motion is approximately perpendicular to the plane being marked. These marks can contain CLASS and/or INDIVIDUAL characteristics.
2. STRIATION - contour variations, generally microscopic, on the surface of an object caused by a combination of force and motion where the motion is approximately parallel to the plane being marked. These marks can contain CLASS and/or INDIVIDUAL characteristics.
3. INDIVIDUAL CHARACTERISTICS - Marks produced by the random imperfections or irregularities of the tool (barrel, breechface) surfaces. These random imperfections or irregularities are produced incidental to manufacture and are caused by use, corrosion, or damage. They are unique to that tool and distinguish it from other tools.
4. CLASS CHARACTERISTICS - Measurable features of a specimen which indicate a restricted group source. They result from design factors and are therefore determined prior to manufacture.
5. SUBCLASS (FAMILY) CHARACTERISTICS - These are discernible surface features of an object which are more restrictive than Class Characteristics in that they are:
    a. produced incidental to manufacture
    b. are significant in that they relate to a smaller group source (a subset of the class to which they belong)
    c. can arise from a source which changes over time.

EXAMPLES

1. bunter markings on cartridge cases
2. extrusion markings on cases
3. cannelure markings on missiles

CAUTION

Great care must be exercised in distinguishing subclass characteristics from individual characteristics. The examiner should have a clear understanding of the manufacturing process of the evidence specimen before making this identification.

NOTE: All definitions are consistent with and have as their source the AFTE Glossary of terms, 1992 edition.

6.1 EQUIPMENT

1. Comparison Microscope
2. Stereomicroscope
3. Bore And Cylinder Scope
4. Optical Micrometer
5. Ibis System
6. Electronic Trigger Pull
7. Electronic Dial Calipers
8. Electronic Scales
9. Micrometer (2)
10. Lasers
11. Water Tank
12. Chronograph (2)
13. Ultrasonic Cleaner
14. Ductless Fume Hood And Regular Fume Hood
15. Missile Safety Backstop
16. Inertia Bullet Puller
17. Shotshell Dismantler Tool
18. Miller Shooting Machine
19. Ransom Machine Rest
20. Video Floppy System
21. Kevlar Bullet Trap

GENERAL EQUIPMENT USE

1. COMPARISON MICROSCOPE - allows the examiner to simultaneously examine and compare two items of evidence (missiles or cases) from 10x-40x magnification
2. STEREO MICROSCOPE - allows examiner a 3-d view of an item of evidence with anywhere from 10x-60x magnification
3. BORE AND CYLINDER SCOPE - allows inspection of a gun's inner surface of a barrel or cylinder
4. OPTICAL MICROMETER - allows for measuring of items on the microscope. This includes the bullet measuring microscopes (EPOI)
5. IBIS IMAGE System - this is a completely integrated system that provides a means of cartridge case image entry, storage, comparison, and image retrieval in the Crime Labs of Southern California
6. ELECTRONIC TRIGGER PULL DEVICE - used to measure the force, in approximate ranges, that is necessary to fire a firearm

7. ELECTRONIC DIGITAL CALIPERS - used to precisely measure small distances
8. ELECTRONIC SCALES - weighs chemical amounts, projectile weights and other items
9. MICROMETER - used to precisely measure small distances, controlled by a threaded screw
10. LASERS - device that produces a laser light stream used for trajectory analysis and crime scene reconstruction
11. WATER TANK - system that uses water as a capture device for missiles from test firing of firearms
12. CHRONOGRAPH - device that measures the velocity of a bullet as it passes between two measuring points on screens
13. ULTRASONIC CLEANER - device that uses sound waves to clean items of evidence such as missiles or rusted guns
14. DUCTLESS FUME HOOD - a bench top enclosure that ensures a safer storage area for chemicals
15. MISSILE SAFETY BACKSTOP - a metal enclosure containing rubber baffles to safely stop missiles fired from a firearm
16. INERTIA BULLET PULLER - a device that separates a bullet from its case to facilitate primer only firing or other needs
17. SHOTSHELL DISMANTLER TOOL - a tool used to cut open and allow removal of the shotshell components
18. MILLER SHOOTING MACHINE - a rifle rest for distance determination or remote firing
19. RANSOM MACHINE REST - handgun rest for distance determination or remote firing
20. VIDEO FLOPPY SYSTEM - attaches to microscope and allows for image capture in a digital image form of the evidence
21. KEVLAR BULLET TRAP - System for trapping bullets from test fires

The microscopes, balances, and optical micrometers are subject to the equipment maintenance policy in the quality assurance manual.

7.1 DIGITAL CALIPER CALIBRATION CHECK

The digital calipers were initially checked for calibration using Starret traceable gauge blocks. The documentation of this initial calibration check, and the traceability certificate, are maintained in the Firearms Calibration Log Book.

Any calipers that are used during firearms analyses must have their calibration checked quarterly**.** The calibration check procedure will be done either by the analyst or the firearms laboratory technician.

The following procedure will be used:

1. Measure the diameter of the secondary standard bullets of 25, 9mm, and 45 caliber. The bullet diameters were established after the calipers were initially checked for calibration. The measured values must be within +/- .002" of the established diameter values of the secondary standards.
2. The analyst will record their initials, the expected values, the measured values, and the date of the measurements in the logbook.
3. If the calipers do not fall within .002" of the established value, then another analyst will measure the secondary standards with the same calipers. If those measurements also fall outside .002" range of the established value, the calipers will not be used until they have been recalibrated.
4. The analyst will mark the log sheet as either “pass” or “fail.”

7.2 CALIBRATION CHECK PROCEDURE FOR THE AMETEK FORCE GAUGE TRIGGER PULL DEVICE

The calibration check on the trigger pull device will be conducted with the floor scale (O'Haus balance) in the Narcotics Vault. This scale is checked for calibration quarterly with a traceable 25-pound weight. In addition, the scale is provided with an annual service by an outside vendor. The Vault keeps the records of the balance checks.

The Ametek Force Gage is used for trigger pull determination. The Ametek trigger pull device will be pressed against the balance and readings will be taken when the scale hits 5 lbs. and 10 lbs. The device reading must be within +/- 5% of the balance reading. All of the readings will be recorded on the "Trigger Pull Device Calibration" form. The calibration checks will be done quarterly with two repetitions each of the chosen weights.

7.3 CALIBRATION CHECK OF THE BULLET MEASURING MICROSCOPES

The Laboratory Technician or Firearms Criminalist will check the calibration of the measuring microscopes quarterly. A log is maintained showing the quarterly calibration records. This log also has the result of the ruler used for calibration checks when compared, one time, to the NIST traceable ruler kept by the Quality Assurance Manager.

The calibration check is performed simply by placing the ruler (verified against the NIST traceable ruler) under the objective of the measuring microscope. The distance of 1/16th of an inch is measured and then compared to the results of the digital readout on the microscopes. The measurements are repeated three times and must read within .005" of 1/16th of an inch (.0625). Results are recorded as "P" for pass or "F" for fail.

NONCONFORMANCE OF CALIBRATION CHECKS

Should any calibration check of any device fall outside the acceptable limits of measure, the analyst will repeat the measure to determine if the device needs calibration or if the occurrence was an isolated event.

7.4 MANUAL MICROSCOPE CALIBRATION

Each time a user logs on to the IBIS application, an automatic calibration program checks the microscope motor, light, zoom, and focus mechanisms. For IBIS to perform this calibration, it is important that the light conversion device is in the shroud position. In addition to this automatic calibration, it is also recommended you perform a manual microscope calibration periodically.

The DAS Microscope Calibration program that comes installed on the IBIS machine calibrates the BRASSCATCHER portion of the microscope. This calibration program tests motor switches, lights, and zoom lens magnifications of BRASSCATCHER.

To open the calibration software, double click the Microscope Calibration Icon on the IBIS desktop.

The calibration software activates the microscope and displays the camera's view of the calibration pin. The calibration pin is located towards the rear of the cartridge case holder and is used as a reference point for the calibration.

By using the light and focus scroll bars, verify/adjust the following parameters:

1. Optimal light level: Verify that there is no washout in the image.
2. Focus: Verify that the image is in focus.
3. Magnification: Set magnification so that the calibration ring is within the two red rings. Do not move the red rings!

The manual calibration process, when carried out regularly, ensures better system performance. Adjustments may not be necessary; you need only make adjustments to the light, focus, and magnification when needed. If adjustments are made, click the checkmark button to accept the new settings. IF no adjustments are needed, click the Cancel button to exit and keep the current settings.

Perform a manual calibration on the microscope on a quarterly basis. Record the results of the calibration in the calibration log book.

7.5 CALIBRATION CHECK OF THE LASER RANGEFINDER

The Hilti PD42 Laser Range Meter will have the calibration checked on a quarterly basis using the following procedure:

1. A two-point calibration will be done using the 6th floor hallways outside of the stairwell on the northeast side of the building. The calibration will be done using the walls as the line to begin the measurements. The walls for the alcove area are just north of the stairwell exit onto the 6th floor. The alcove has a window that faces to the west and is located just outside the Forensic Chemistry Laboratory.
2. While standing in the alcove area, face east, and place the back of the rangefinder even with the wall to your south. Hold up the rangefinder and press the On/Off Button, located on the top right-hand corner of the rangefinder. Once the rangefinder is turned on, press the Measure Button just below the Graphic Display. Keeping the rangefinder in line with the wall, aim the red laser light across the hallway until it appears on the far wall. Ensure that the Horizontal Bubble Level on the bottom, right edge of the rangefinder is centered and press the Measure Button again. A reading will appear in the Graphic Display. The measurement of this hallway is 42’10”. All of the resulting readings must be within 1’6” (41”4”-44’4”). Repeat the procedure 2 more times and record all readings in the “Rangefinder Calibration Log.” When all measurements have been taken, press the Delete (clear) Button to the right of the Measure Button to clear the screen.
3. While standing just outside the alcove area, face to the south down the longer hallway. Line up the back edge of the rangefinder with the wall to your west. Repeat the procedure described above, only now you are focusing the rangefinder on the south wall of the long hallway. The measurement of this hallway is 95’8”. All of the resulting readings must be within 1’6” (94’2”-97’2”). Take 3 measurements total and record all readings in the “Rangefinder Calibration Log.”
4. Should any of the measurement readings fall outside of the specified accuracy tolerance, the reading should be marked as a failure in the “Rangefinder Calibration Log.” The rangefinder should not be used until it has been properly adjusted at a Hilti Service Center and the accurate adjustment of the tool has been confirmed by a calibration certificate.

The hallways were measured and the above values have been established.

8.1 TRAINING SCHEDULE

The Firearms Unit provides an in-house, one year training course in the examination of firearms. This course is based on the AFTE Training Manual. The San Diego Police Firearms course is supplemented by firearms classes from the California Department of Justice, California Criminalistics Institute, the FBI Training Academy, Firearms Manufacturers' Armors' Courses, and visits to ammunition component manufacturers and firearms manufacturers.

The training course is composed of classroom lecture blocks and firearms laboratories. Progress of the trainee is judged by performance on written tests, assignment and examination of Collaborative Testing Services unknowns and completion of laboratory projects. Each lecture block is completed by a written and practical exam. There is also a final exam, which covers the salient points of the entire course which is tested by mock evidence examination and direct and cross-examination in a mock trial.

All written and practical tests must be completed with a minimum score of 80%. The caliber identification unknowns, and striation and impression matching unknowns, must be passed with a score of 100%. Any failures must be assessed by the trainer, student, and unit supervisor. A new test will be administered.

A certificate of completion will be given to the trainees who successfully complete the IBIS training. A certificate of completion will also be given when a trainee has completed the bullet and cartridge case comparison portion of the curriculum indicating they have successfully completed the primary portion of the firearms training. Certificates of completion will be given on each individual subject upon successful completion of each unit listed under "Special Topics in Firearms Examination" lectures and tests (where appropriate). These are topics 17-26 on the Firearms Training "Course Schedule."

COURSE SCHEDULE

1. COURSE OBJECTIVES - The student will be made aware of the course requirements, the course schedule and the test methods. The AFTE Glossary will be handed out to the student. The student will be introduced to the Reference Collections, Library, and the instrumentation.

2. FIREARMS SAFETY PROCEDURES - The student will be introduced to basic and Laboratory firearms safety procedures. This will include written safety rules and a trip to the Range to examine and test fire various firearms.

3. INTRODUCTION TO THE FIREARMS LITERATURE - The student will be given a course reading list. The student will be introduced to the basic firearm manuals that are used on daily casework.

4. FIREARMS HISTORICAL DEVELOPMENT - The student will be introduced to the history of firearms development. The instruction block will start with the very first black powder gun development and will conclude with modern firearms.

5. MODERN FIREARMS MANUFACTURE - This block will cover the manufacturing methods of modern firearms with emphasis on the tool marks that are used for class characteristics and individual characteristics. The student will visit a rifling broach manufacturer and observe the rifling of barrels. The student will also visit a firearms manufacturer.

6. MODERN FIREARMS NOMENCLATURE AND IDENTIFICATION MARKS - The following areas will be covered by the student:

    a. Revolvers
    b. Pistols
    c. Rifles
    d. Shotguns
    e. Zip guns

   The student will be tested by written exam on each topic area. The goal is the specific identification of firearm makes and models. The student will also be introduced to proof marks and serial number locations and styles.

7. BULLET AND SHOT MANUFACTURE - The student will learn the construction of bullets and their subsequent identification in terms of type and use.

8. CARTRIDGE CASE MANUFACTURE - This covers the methods of manufacture of cartridge cases and primers. The student will be able to identify the styles and types of cases and any class characteristic markings on them.

9. HEADSTAMPS AND BUNTERMARKS - The student will be introduced to cartridge case identification by the examination of headstamps. The student will be exposed to the case identification guides. The student will also be exposed to bunter marks as a method of examination of manufacturer

markings. The student will demonstrate their understanding of this concept by practical examination.

10. GUNPOWDER: DEVELOPMENT, NOMENCLATURE, AND MARKINGS - The student will be introduced to the historical development of gunpowder, and the modern manufacture of smokeless gunpowders. The student will be exposed to identification protocols of various gunpowder types.

11. THE ORIGIN OF CLASS AND INDIVIDUAL MARKING ON MISSILES - The student will learn the location and shape of class and individual markings on missiles. The student will be exposed to the origin of these markings.

12. THE ORIGIN OF CLASS AND INDIVIDUAL MARKINGS ON CASES: - The student will be introduced to the location and shape of class and individual markings on cartridge cases. The student will be exposed to the origin of these markings and their forensic use.

13. TOOLMARKS AS A STRIATION/IMPRESSION MATCHING PROBLEM - The student will be exposed to the AFTE identification protocol in terms of the meaning of the terms STRIAE and IMPRESSION. The student will also conduct a series of test fires from two known firearms and attempt to make a "best match" between two different firearms.
The result is to establish the best "sufficient agreement" in a known non-match case. The student will also be presented with test fires from the one firearm and will establish "sufficient agreement" in a known match case. This will provide the student with the basis of Theory of Identification based on the theory of "sufficient agreement".
The student will demonstrate proficiency by written tests and known and unknown practical examinations. The student will also demonstrate the results of the range of conclusions based on instructor-provided test fires to give the results of:
    a. IDENTIFICATION
    b. INCONCLUSIVE
    c. ELIMINATION
    d. UNSUITABLE FOR EXAMINATION

    This section will provide the foundation of the Theory of Identification to make comparisons of evidence ammunition components to test fire standards.

14. BIASOTTI: PROBABILITY AND STATISTICS - The student will be exposed to the Biasotti statistical probability methods of determining "sufficient agreement" between best comparisons of known non-makes to known makes. This is a further refinement of the AFTE Theory of Identification.

15. SAN DIEGO FIREARMS LABORATORY CASE WORK PROTOCOL - The student will be introduced to a case work-up, note package, and its requirements and distribution. The student will be introduced to the concept of peer review of a casework package.

    The student will also be introduced to the concept of a second opinion in matching identifications, and technical review.

16. COURT TESTIMONY AND MOCK TRIAL - The student will be examined and graded in a mock testimony. This is the FINAL test of the student in that the student will "testify" to all elements of the identification of firearms.

SPECIAL TOPICS IN FIREARMS EXAMINATION

The following topics are considered "special topics" and are taught after the student has completed the first 16 sections in firearms examination. These classes can be taught as continuation courses or taught when the need for extra examiners in these topic areas are needed.

17. THE EXAMINATION AND IDENTIFICATION OF ASSAULT FIREARMS - The student will be exposed to the concept of "Assault Firearm" identification as per California Penal Code 12276. The student can meet this requirement by attending the Regional Training Academy Menu Course on the topic.

18. THE METHODS OF CONVERSION OF FIREARMS TO MACHINE GUNS - The student will be introduced to the methods and materials used in the conversion of semiautomatic firearms to full automatic machine guns.

19. THE IDENTIFICATION AND CONSTRUCTION OF SILENCERS - The student will be exposed to the concept of firearms silencers. The student will identify the construction concepts and the methods of manufacture.

20. DISTANCE DETERMINATIONS AND GUNSHOT RESIDUE EXAMS - The student will be introduced to the methods of the identification of gunpowder residues and the methods of range determination. The student will demonstrate proficiency by written exam and practical testing. This course will cover both gunshot residue and shotgun pattern testing and evaluation.

21. SHOOTING SCENE TRAJECTORY RECONSTRUCTIONS - The student will learn the basics of ballistics, that is the trajectory of missiles and the determination of those trajectories. The student will be introduced to the use of the chronograph, the use of computer ballistic programs, and the concepts of terminal ballistics. The student will be tasked to determine a trajectory and documenting it by the use of the LASER. The student will determine the

probable point of origin of the gunshot. The student will also be exposed to the identification and determination of ricochet angles and firearm origin.

22. THE FORENSIC INVESTIGATION OF OFFICER INVOLVED SHOOTINGS - The student will be introduced to the method of investigating an Officer Involved Shooting scene. The student will process a crime scene, determine significant firearms and trajectory evidence, and construct a reconstruction of the shooting event. The student will conduct 10 scenes with a qualified Criminalist/Examiner before soloing on their own crime scene.

23. WOUND BALLISTICS - The student will be exposed to the concepts of terminal ballistics and wound ballistics. The student will study the behavior of missiles in living tissues and common materials. The student will demonstrate the basic concepts of penetration mechanics and wound generation. The student will also demonstrate competence in the identification of entry and exit wounds and entry and exit missile holes in non-tissue materials.

24. TACTICAL AND OPERATIONAL USE OF FIREARMS - The student will be exposed to the practical and tactical use of firearms. This section has forensic applications in "how firearms are used" in a given shooting situation. The student will demonstrate proper loading, chambering, and functional use of all classes of firearms. The student will examine the concepts of practical range, rates of fire, loading sequences, and methods of tactical use of firearms.

25. SERIAL NUMBER RESTORATION TECHNIQUES - The student will be introduced to the methods of obliterated serial number restoration. The student will demonstrate proficiency by known and unknown restorations and a written test.

26. FORENSIC CONCEPTS AND PRACTICAL APPLICATIONS OF MANUFACTURING AND HANDLOADING AMMUNITION - The student will be introduced to the methods of bullet casting and handloading ammunition. The student will be exposed to the identification markings that are generated on ammunition components during the handloading and bullet casting process. This training will cover the concepts of headspace, chamber casts for casting identification, and proper bullet feeding.

This concludes the topics that cover standardized training blocks. Specific training in highly specialized areas will be done on an as-needed basis.

The student, as a part of their training and on-going education, is encouraged to attend study groups and training seminars of various firearms related professional associations.

8.2 LABORATORY TECHNICIAN TRAINING

1. ORIENTATION
   a. City provided checklist.
   b. Location of fire exits, parking, restroom locations.
   c. Driving rules and regulations, City and Department Regulations.
   d. Performance Plan/supervisor's expectations.
   e. City orientation class for new city employees.
   f. How to check out evidence and other casework policies and procedures.
   g. Note taking policies and expectations.
   h. How to write a report.

2. FIREARMS SAFETY COURSE
   a. In-house training of safe handling of firearms. Laboratory policy regarding the handling of firearms.
   b. Participation with an experienced examiner in test firing firearms in the water tank.
   c. CCI course on Firearms Safety. Application for the class is to be filled out within the first month of employment.
   d. Both classes are required, though the in-house class is required to begin test firing of firearms. The CCI course is dependent on availability and acceptance into the class.

LABORATORY TECHNICIAN CHECKLIST

		DATE COMPLETED	INITIALS
A. New Employee Orientation			
	1. City Checklist		
	2. Location of:		
	a. Fire Exits		
	b. Parking		
	c. Restrooms		
	3. Driving Rules and Regulations		
	a. City Admin. Regs.		
	b. Dept. Procedures		
	4. Performance Plan		
	5. Supervisory Expectations		
	6. City Orientation Class		
	7. Casework Policies/ Procedures		
	a. Property Room Tour		
	b. Evidence Storage		
	c. Contamination Avoidance		
	d. Marking Evidence		
	e. Evidence Disposition		
	8. Note Taking Policies/Expectations		
	9. Report Writing		

B. Firearms Safety Course			
	1. In-house Training Course		
	a. Includes Safe Handling		
	b. Test firing with an experienced examiner		
	2. CCI Firearms Safety Course		
	1. In-house Training on Policy and Procedure		
	a. How to Pull a Bullet		
	b. Short Form Reports		

		DATE COMPLETED	INITIALS
F. Optional Training			