

**TENNESSEE BUREAU OF INVESTIGATION**  
*Forensic Services Division*

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Firearms/Toolmarks Standard Operating Procedures Manual  
Caliber Determination Procedure

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**13.0 CALIBER DETERMINATION PROCEDURE**

**13.1 Scope:** Caliber, or the base diameter of a bullet, is one of the class characteristics of a fired bullet. Determination of caliber can aid the firearm examiner during the identification or elimination of a suspect firearm. If no firearm is submitted, the bullet's caliber may be used in determining the General Rifling Characteristics of the firearm involved.

**13.2 Precautions/Limitations:** The firearm examiner shall recognize that the measurements taken are estimates and shall use the best available method to obtain these measurements. If the base is mutilated, the examiner may only be able to determine that the evidence is consistent within a range of calibers or that the caliber cannot be determined. Lastly, when utilizing available General Rifling Characteristics file(s), the firearm examiner shall recognize that the data available is not all inclusive.

**13.3 Related Information:**

**13.3.1** Range of Conclusions Appendix 4

**13.3.2** Ammunition Reference Collection Appendix 6

**13.3.3** Performance Checks and Maintenance Appendix 7

**13.3.4** Ammunition Component Classification and Examination Procedure 12

**13.4 Instruments:**

**13.4.1** Dial Calipers

**13.4.2** Digital Calipers

**13.4.3** Unitron Measuring Projector

**13.4.4** Stereo Microscope

**13.4.5** Comparison Microscope and Leica Administrative Suite (LAS) software

**13.4.6** Balance

**13.5 Reagents/Materials:** None

**13.6 Hazards/Safety:**

**13.6.1** It is the responsibility of the firearm examiner to employ appropriate safety and health practices. Safe firearm handling procedures shall be strictly followed at all times.

**13.7 Reference Materials/Controls/Calibration Checks:**

**13.7.1** All performance checks and calibration checks on the equipment and instruments used in these procedures shall be performed in strict accordance to those listed in the Performance Checks and Maintenance Appendix 7.



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**13.7.2** Ammunition Reference Collection (See Appendix 6)

**13.7.3** General Rifling Characteristics Database(s)

#### **13.8 Procedures/Instructions:**

**13.8.1** Caliber determination from base measurement and comparison to reference bullets:

**13.8.1.1** The following may be utilized to determine the caliber of a fired bullet. The condition of the bullet shall determine which steps to be used.

- Check the calibration of the dial caliper, digital caliper, or Leica Administrative Suite (LAS) software and balance according to the procedures detailed in the Performance Checks and Maintenance Appendix 7. This will be known as the performance check. All results of performance checks shall be recorded in the case notes.
- Compare the base diameter of the evidence bullet directly with known standards contained in the ammunition reference collection.
- Measure the approximate base diameter of the evidence bullet using calipers, the LAS software, or the Unitron Measuring Projector, and compare this measurement with known measurements published in reference literature.
- Weigh the bullet on a checked balance.
- Physical characteristics of the evidence bullet, such as weight, bullet shape, composition, nose configuration, and number and placement of cannelures, may aid in caliber determination.

**13.8.2** Caliber determination from land and groove measurements utilizing the stereo microscope and caliper method:

**13.8.2.1** In measuring a fired bullet to determine the width of the land and groove impressions, it is paramount that the points used for beginning and ending a measurement comply with the discipline-wide practice. This practice utilizes the anchor points shown below.

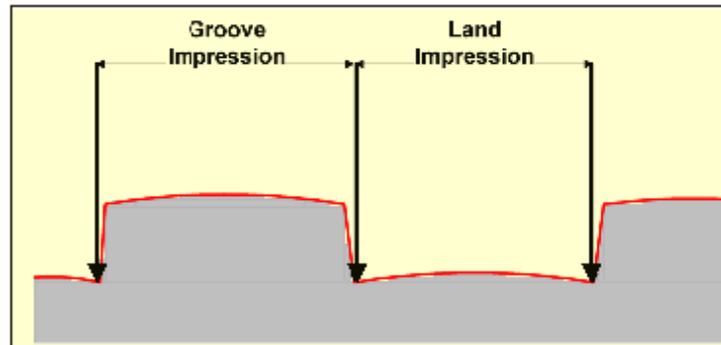


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**13.8.2.2** Check the calibration of the caliper according to the method detailed in the Performance Checks and Maintenance Appendix 7. All results of performance checks shall be recorded in the case notes.

**13.8.2.3** The fired bullet in question is either held or mounted on a steady surface beneath the stereo microscope.

**13.8.2.4** The land impression of the fired bullet is placed in a horizontal position and measured with calipers.

**13.8.2.5** The measurement is then recorded to the nearest thousandth of an inch.

**13.8.2.6** Repeat the above for the groove impression.

**13.8.2.7** When multiple land and groove impressions are present on the bullet, it is good practice to measure multiple land and groove impressions and take an average of these measurements.

**13.8.2.8** For bullets with damaged bases, the caliber or base diameter can be calculated using the number of land and groove impressions (#LAG) and their measurements, and utilizing the following formula:

$$\text{Diameter} = \frac{\# \text{ LAG} \times (\text{width of one land impression} + \text{width of one groove impression})}{\pi}$$

**13.8.3** Caliber determination from land and groove measurements utilizing the digital caliper on the Leica FSC-M Comparison Microscope:

**13.8.3.1** Check the calibration of the digital caliper according to the method detailed in the Performance Checks and Maintenance Appendix 7. All results of performance checks shall be recorded in the case notes.

**13.8.3.2** Position the bullet on the left stage of the Comparison Microscope. The bullet should be oriented so that the axis of the bullet is parallel to the center line visible through the



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Comparison Microscope.

**13.8.3.3** Using the center line as the starting point, line up the edge of the land impression.

**13.8.3.4** Zero the digital caliper by pressing the “zero” button.

**13.8.3.5** Move the stage to the right until the opposite edge of the land impression is in line with the center line.

**13.8.3.6** Record the value to the nearest thousandths of an inch.

**13.8.3.7** Repeat this process to measure the groove impression of the bullet.

**13.8.3.8** When multiple land and groove impressions are present on the bullet, it is good practice to measure multiple land and groove impressions and take an average of these measurements.

**13.8.3.9** For bullets with damaged bases, the caliber or base diameter can be calculated using the number of land and groove impressions (#LAG) and their measurements, and utilizing the following formula:

$$\text{Diameter} = \frac{\# \text{ LAG} \times (\text{width of one land impression} + \text{width of one groove impression})}{\pi}$$

**13.8.4** Caliber determination from land and groove measurements utilizing the Unitron Measuring Projector:

**13.8.4.1** Check the calibration of the measuring projector according to the method detailed in the Performance Checks and Maintenance Appendix 7. All results of performance checks shall be recorded in the case notes.

**13.8.4.2** Position the bullet on the mount of the measuring projector. The bullet should be oriented so that the axis of the bullet is parallel to the X-axis visible on the projection screen.

**13.8.4.3** Using the X-axis as the starting point, line up the edge of the land impression.

**13.8.4.4** Zero the measuring projector by pressing the “zero” button.

**13.8.4.5** Move the stage up or down until the opposite edge of the land impression is in line with the X-axis.

**13.8.4.6** Record the value to the nearest thousandths of an inch.

**13.8.4.7** Repeat this process to measure the groove impression of the bullet.

**13.8.4.8** When multiple land and groove impressions are present on the bullet, it is good



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practice to measure multiple land and groove impressions and take an average of these measurements.

**13.8.4.9** For bullets with damaged bases, the caliber or base diameter can be calculated using the number of land and groove impressions (#LAG) and their measurements, and utilizing the following formula:

$$\text{Diameter} = \frac{\# \text{ LAG} \times (\text{width of one land impression} + \text{width of one groove impression})}{\pi}$$

**13.8.5** Caliber determination from land and groove measurements utilizing the LAS measurement software on the Leica FSC Comparison Microscope.

**13.8.5.1** Check the calibration of the Leica Application Suite measuring feature according to the method detailed in the Performance Checks and Maintenance Appendix 7. All results of performance checks shall be recorded in the case notes.

**13.8.5.2** Position the bullet on the left stage of the Comparison Microscope. The bullet should be oriented so that the axis of the bullet is perpendicular to the center line visible through the Comparison Microscope.

**13.8.5.3** Open the LAS software. While on the acquire screen, go to the Camera tab. In Extended Annotation, select the distance line.

**13.8.5.4** The land impression is then measured and recorded to the nearest thousandth of an inch.

**13.8.5.5** Repeat the above for the groove impression.

**13.8.5.6** Record the value to the nearest thousandths of an inch.

**13.8.5.7** When multiple land and groove impressions are present on the bullet, it is good practice to measure multiple land and groove impressions and take an average of these measurements.

**13.8.5.8** For bullets with damaged bases, the caliber or base diameter can be calculated using the number of land and groove impressions (#LAG) and their measurements, and utilizing the following formula:

$$\text{Diameter} = \# \text{ LAG} \times \frac{(\text{width of one land impression} + \text{width of one groove impression})}{\pi}$$

**13.8.6** Using the General Rifling Characteristics Database to Provide a List of Firearms:

Once caliber and rifling characteristics are determined, the examiner may be able to provide the investigating agency with a list of suspect firearms that may have been used.

**13.8.6.1** Using the computerized General Rifling Characteristics database provided by the



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Federal Bureau of Investigation (FBI), Association of Firearm and Tool Mark Examiners (AFTE) or from FirearmsID.com, complete the required fields with the information observed or obtained from the evidence bullet(s). Run the computerized search of the database files. Retain these results in the case file.

**13.8.6.2** An off-line search of the FBI General Rifling Characteristics database may be performed using the printed copy of the database files located in the FTIU.

**13.9 Records:** The firearm examiner shall document their findings in the form of handwritten or computer generated notes.

**13.10 Interpretations of Results:** Caliber is written as a numerical term and may be depicted with or without the decimal point. Determination of the number and widths of the land and groove impressions and/or caliber may be acquired by comparing available measurements to Appendix G, Table 6, of the AFTE Glossary. The firearm examiner may also utilize the FBI General Rifling Characteristics Database File, the AFTE General Rifling Characteristics Database File, or the General Rifling Characteristics File provided by FirearmsID.com.

**13.11 Report Writing:** Most bullet caliber determination report writing can be found in the Range of Conclusions Appendix 4.

**13.12 References:**

Association of Firearms and Toolmark Examiners Training Manual, March 3, 2001

Association of Firearms and Toolmark Examiners Procedures Manual, July 9, 2001

Association of Firearms and Toolmark Examiners Glossary, 5<sup>th</sup> Edition, 2007

Haag, Lucien, "Class Characteristics of Rifled Barrels," AFTE Journal, June 1978, Vol. 10, No. 2, pgs. 11-16.

Felix, Kyle, "Using Bullet Weights and Type to Determine Caliber and Brand", AFTE Journal, Winter 2008, Vol. 4, No. 1, pgs. 64-80.

Mathews, J. Howard, Firearms Identification Vol. I, 1973.

Barnes, Frank C., Cartridges of the World, 12th Edition, 2009.

FBI General Rifling Characteristics Database.

AFTE General Rifling Characteristics Database.

[www.firearmsid.com](http://www.firearmsid.com)