

Firearms/Toolmarks Discipline Standard Operating Procedure for Class Characteristic Database Entries and Searches

1 Introduction

The General Rifling Characteristics (GRC) database is comprised of observed and measured class characteristics collected from known test-fired bullets and cartridge cases. Test-fired bullets and cartridge cases used for the GRC database are received from forensic laboratories and cooperating law enforcement agencies both within and outside the United States. The purpose of the GRC database is to provide investigative information to law enforcement agencies on the make and model of a firearm that could have fired a questioned bullet or cartridge case based on observed and measured class characteristics.

2 Scope

These procedures are for collecting GRC information for entry into and performing database searches of the FBI Laboratory GRC database produced by Firearms/Toolmarks Unit (FTU) personnel.

3 Equipment/Materials/Reagents

- Alicona InfiniteFocus SL with rotational bullet mount, movable stage, and appropriate lighting and magnification lenses.
- Computer with Windows Office Professional[®] operating system running Microsoft Access[®].
- Measurement equipment
- Microscope (stereozoom/comparison)

4 Standards and Controls

- National Institute of Standards and Technology Standard Reference Material bullet (NIST SRM 2460)
- Alicona IF-Verification Tool G2
- Alicona 6mm Calibration Pin

5 Performance Checks

5.1 Performance checks of the measurement equipment and Alicona will be performed and recorded as outlined in the *FTD SOP Measurement, Calibration, Performance Check and Maintenance of Equipment*.

6 Sampling

Not Applicable.

7 Procedures

7.1 GRC Measurements of Bullets and Observable Class Characteristics on Cartridge Case for Entry into the GRC Database

7.1.1 Each entry into the GRC database will be assigned a unique identifier.

7.1.2 For specimens generated internally for entry into the GRC database, the GRC Program Manager (PM) will record the observable class features and conduct the necessary measurements for specimen(s) being entered into the GRC database. At a minimum, the GRC unique identifier, number of lands and grooves (L/G), direction of twist, L/G widths, and observable class characteristics on the cartridge cases will be recorded on the container for the specimen being entered into the database.

7.1.3 For specimens submitted from forensic laboratories and cooperating law enforcement agencies, the GRC PM will determine if the necessary materials have been submitted: a minimum of two test-fired bullets and/or cartridge cases or suitable casting material from barrel, and completed GRC Test-fire Entry Sheet (located on the GRC database CD).

7.1.4 Specimens for entry into the GRC database must be in suitable condition for accurate measurements - no fragments or interference from expansion and land and groove edges are acceptable.

7.1.5 The primary method for obtaining measurements will be analysis of three dimensional (3D) scan data acquired from the 3D Toolmark Topographical Instrument, the Alicona InfiniteFocus (AIF) SL. When using AIF SL, only one measurement is necessary for each specimen entered into the GRC database.

7.1.5.1 If the Alicona instrument is not available or not functioning properly, measurements can be obtained using methods described in Section 6.1.7 and two sets of measurements are necessary if using these methods.

7.1.6 3D Toolmark Topographical Instrument Measured GRCs

7.1.6.1 The instrument instructions on how to obtain scans and perform measurements, using a 3D Toolmark Topographical Instrument, are located with the instrument and labeled FTU Control Document 020.

7.1.6.2 Appropriately trained personnel will use the AIF SL to scan the surface of the test-fired bullet, and save the scans for future measurements.

7.1.6.3 The GRC PM will perform the measurements on the acquired scans. The high and low values of the range of measurements will be recorded on the specimen container.

7.1.7 Microscope Measured GRCs

The GRC PM will use the appropriate *FTD SOP Bullet Examinations* and/or *FTD SOP Cartridge Case Examinations* to determine the GRC information for the specimen(s).

7.1.8 The GRC PM will measure the chord (width) of each land impression (LIMP) and groove impression (GIMP) for all the submitted test-fired bullets. The high and low values of the range of measurements will be recorded on the specimen container.

7.1.9 The maximum and minimum measurement from both sets of measurements will be used to establish the LIMP and GIMP boundaries for the GRC database.

7.2 GRC Database Entry and Management

7.2.1 The data acquired from steps 7.1.1 through 7.1.9 will be entered into the database by the GRC PM and saved for use by the FTU and for future distribution.

7.2.2 After entries have been put into the GRC database, a confirmation will be performed to ensure the correct information has been recorded for each specimen by qualified FTU personnel. The initials of the confirmer on the specimen container will indicate the information has been correctly recorded into the database. If the information has been incorrectly entered, the confirmer will make the necessary correction(s) and note the correction on the specimen container.

7.2.3 The information collected from the specimens entered into the GRC database will be maintained by the GRC PM.

7.2.4 Screen shots demonstrating the step-by-step method for specimen entry into the GRC database will be maintained on the FTU shared drive for future users (see FTU Controlled Document FTU_010).

7.3 Distribution of the FBI GRC Database

7.3.1 Approximately every two years, an updated version of FBI GRC database will be distributed to forensic laboratories and cooperating law enforcement agencies.

7.3.2 The GRC PM will facilitate the production and distribution of the GRC database. The list of participating and recipient agencies will be maintained by the GRC PM.

7.3.3 Prior to distribution to forensic laboratories and cooperating law enforcement agencies, the GRC PM will conduct a performance check on the GRC database using *Appendix A*, GRC Database Performance Check Form. This performance check will determine if the information contained in the database is present and retrievable. The total number of hits for each search field will be recorded; this record will be maintained by the GRC PM.

7.3.4 If the performance check fails, a second attempt will be made. If the second performance check fails, the GRC PM will contact the FBI Laboratory Database Programmer for assistance. The updated GRC database will not be distributed until a successful performance check has been completed.

7.3.5 Each distributed updated version of the GRC database will include operating instructions, a GRC Test-fire Entry Sheet, a copy of the completed GRC Database Performance Check Form, and instructions on how to perform a performance check with instructions on how to proceed if the performance check fails.

7.4 GRC Database Search

7.4.1 The examiner/technician will use the appropriate FBI LOM and FTD SOP(s) to determine the GRC information for the specimen(s).

7.4.2 The examiner/technician will conduct a search through the GRC database using a range of land and groove widths.

- a. At the discretion of the examiner or condition of the evidence, the range for the widths can be adjusted to expand or narrow the search results.
- b. Additional search criteria, such as cartridge case information, may be added to further narrow the search results.

7.4.3 The examiner will review the search results to ensure the GRC information is complete and that no obvious errors are present.

8 Calculations

To convert measurements of large lands and grooves from chord (L_c) length to arc (L_a) length the following equation can be used (D : bullet diameter):

$$L_a = \pi D \left(\frac{2 \sin^{-1} \left(\frac{L_c}{D} \right)}{360^\circ} \right)$$

9 Measurement Uncertainty

Not Applicable.

10 Limitations

The GRC database does not include every firearm produced by each manufacturer. Variations in manufacturing methods, use, neglect, and/or environmental effects may cause the GRCs to vary within a single firearm. The GRCs for a specific make/model of a firearm from a single manufacturer may vary slightly from one firearm to the next due to acceptable manufacturing tolerances. Different manufacturers may produce firearms of a specific caliber with similar GRCs and a specific make/model of a firearm could be chambered in more than one caliber. The addition of aftermarket components to a firearm can have varying GRCs from the original manufacturer's design. Furthermore, some data entry errors may exist in the database.

11 Safety

When handling firearms the FTU *Safety Protocol for Handling of Firearms and Ammunition* will be followed. Protective gloves must be worn when handling bullets that have been possibly exposed to blood, tissue, or other body fluids.

12 References

Mathews, J.H., Firearms Identification, Vols. I-III, Charles C. Thomas, Springfield, IL (1977).

Gunther, J.D., and Gunther, C.O., The Identification of Firearms, John Wiley, New York (1935).

Hatcher, J.S., Jury, F.J., and Weller, J., Firearms Investigation, Identification and Evidence, The Stackpole Co., Harrisburg, PA (1957).

FBI Laboratory Quality Assurance Manual

FBI Laboratory Operations Manual

"FTU Safety Protocols for Handling of Firearms and Ammunition", Appendix A, *FTD SOP
Firearm Examinations*.

Firearms/Toolmarks Unit, S drive/FTU QA Folder/ GRC Screen Shots (FTU, Controlled Document FTU010).

Rev. #	Issue Date	History
1	03/02/18	Issuing unit name changed to Firearms/Toolmarks Discipline in title and on header on all pages. New hardware added to Section 3 and measureable standards added to Section 4. Procedural changes made to Section 6 due to the use of the 3D Measurement system. Minor changes to the distribution and use within the unit added to Section 6. Additional limitations added to Section 9 for clarification. Added safety protocol footnote to Section 10. Added Appendix B.
2	03/02/20	Updated title, which was formerly General Rifling Characteristics (GRC). Reformatted Section 3. Added Section 5 and renumbered. Indicated location of instrument instructions in Section 7.1.6.1. Updated SOP titles in Sections 7.1.7 and 12. Updated Appendix A. Removed Appendix B.

Approval

Redacted - Signatures on File

Firearms/Toolmarks
 Unit Chief

Date: 02/28/2020

Firearms/Toolmarks
 Technical Leader

Date: 02/28/2020

Appendix A: *FTU GRC Database Performance Check Form*

Redacted - Form on File