

(Numerical Designation)

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Standard for Barrel and Overall Length Measurements for Firearms



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Standard for Barrel and Overall Length Measurements for Firearms

Keywords: *barrel, bore, firearm, integral chamber, length, measurand, revolver, rifle, shotgun, uncertainty*

This standard describes procedures for measuring the barrel length and overall length of firearms and for estimating the uncertainty of those measurements. Estimation of uncertainty is achieved through repeated measurements by all lab personnel responsible for barrel length and overall length measurements. Annex A provides an example illustrating measurement results and describes several other sources of measurement uncertainty.

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Foreword

Barrel lengths and overall lengths are dimensional specifications of firearms commonly mandated by criminal law. Procedures are outlined here for measuring these quantities on three different types of firearms to determine their conformance to the specifications. Methods for determining the uncertainty of barrel length and overall length measurements are also described and illustrated here.

This standard was proposed by the Subcommittee on Firearms and Toolmarks (SCFT) of the Organization of Scientific Area Committees (OSAC) by submitting a request to the American Academy of Forensic Sciences (AAFS) Academy Standards Board (ASB). It is based on a guideline describing the measurement procedures originally developed by the Scientific Working Group for Firearms and Toolmarks (SWGgun). SCFT has added procedures for the estimation of uncertainty, a crucial component for establishing measurement traceability.

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1 Scope

This standard is intended for firearm examiners conducting barrel and overall length measurements for firearms. The calculation of uncertainty for these types of measurements is required and is illustrated with examples.

2 Normative References

ATF National Firearms Act Handbook. U.S. Department of Justice Bureau of Alcohol, Tobacco, Firearms and Explosives Office of Enforcement Programs and Services [Internet]: ATFE-Publication 5320.8 [Revised April 2009], Chapter 2; available at: <https://www.atf.gov/sites/default/files/assets/pdf-files/atf-p-5320-8.pdf>, _____ and <https://www.atf.gov/firearms/national-firearms-act-handbook> (reviewed Sept. 22, 2016) referenced below as ATF-NFA.

JCGM 200:2012, *International Vocabulary of Metrology — Basic and General Concepts and Associated Terms* (VIM 3rd edition); <http://www.bipm.org/en/publications/guides/#gum>.

JCGM 100:2008, *Evaluation of measurement data — Guide to the expression of uncertainty in measurement* (GUM); <http://www.bipm.org/en/publications/guides/#gum>.

Association of Firearm and Tool Mark Examiners, *Glossary, 6th Edition*, Version 6.030317 (2013), referenced below as AFTE Glossary.

3 Terms and Definitions

For the purposes of this document, the following definition applies.

3.1

Measurand

quantity intended to be measured
(VIM, Sec. 2.3)

3.2

Terms Specific to Firearms

Terms specific to firearms, such as muzzle, bore, forcing cone, breech face, action, chamber, barrel, firing pin, and bolt are described in the AFTE Glossary.

4 Requirements

4.1 Background

United States federal laws, state laws, and international laws contain requirements for the minimum barrel lengths and minimum overall lengths of both rifles and shotguns. These requirements may vary for different jurisdictions. Examples of minimum length requirements in federal law [ATF-NFA] include: 16 inch barrel length for rifles, 18 inch barrel length for shotguns, and 26 inch overall length for both rifles and shotguns. The procedures, measurements, and calculations for assessing barrel and overall lengths against the applicable specifications follow.

4.2 General

4.2.1 When handling any firearm, even for the purposes of measuring, safety is the first concern. Make sure the firearm is unloaded before conducting measurements. If there is any doubt about the operation of a firearm, consult with a qualified firearms instructor (if available), protocols, or manufacturers' literature before handling a firearm for measuring.

4.2.2 When measuring barrel or overall length, ensure that the firearm is free from movement and stable for measuring and is located in an area with proper lighting and that the measuring devices have current calibration certificates that provide traceability to the international unit of length through accredited calibration laboratories.

4.2.3 Common devices used to measure barrel and overall lengths (BL-OL) are measuring tapes, steel rulers, measuring rods, and caliper devices. The unique identifier(s) for the device(s) used shall be recorded in the examination record.

4.2.4 Measurements for altered or uneven barrels should include the longest portion.

4.2.5 Measurands: The quantities to be measured for BL-OL are described in ATF-NFA. Briefly, "The ATF procedure for measuring barrel length is to measure from the closed bolt (or breech-face) to the furthest end of the barrel", and "The overall length of a firearm is the distance between the muzzle of the barrel and the rearmost portion of the weapon measured on a line parallel to the axis of the bore."

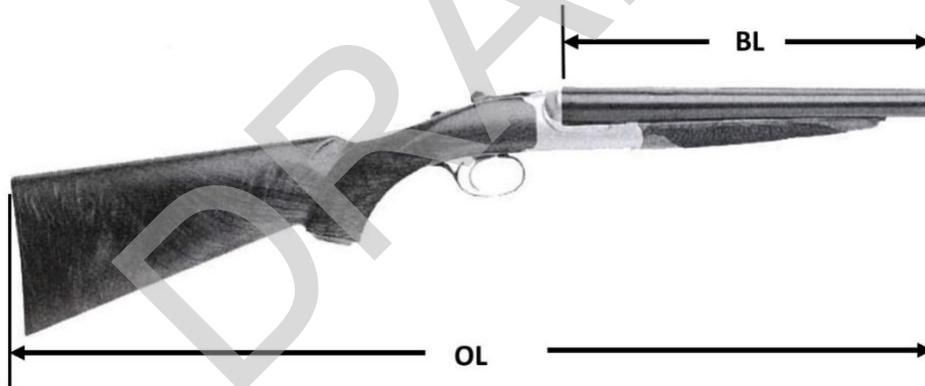


Figure 1. Illustration of barrel length (BL) and overall length (OL) measurands (adapted from ATF-NFA)

Additional provisions and highlights are described in Sections 4.3, 4.4, and 4.5.

4.3 Barrel Length Measurements

4.3.1 Revolvers

4.3.1.1 When measuring a revolver barrel, the distance parallel to the bore axis from the rear of the forcing cone to the farthest end of the muzzle represents the length of the barrel.

4.3.1.2 Ruler/Measuring Tape: A revolver barrel may be measured by placing a steel ruler/measuring tape on the exterior of the barrel, parallel to the axis of the bore to determine the barrel length. The ruling marks shall then be perpendicular to the muzzle bore.

4.3.1.3 Measuring Rod: A measuring rod may be used to measure barrel length; however, it may be difficult to determine the starting point for the measuring rod. Consideration must be taken to determine how the starting point can be accurately achieved. A block at the muzzle or forcing cone end of the firearm, which is perpendicular to the axis of the bore, may be used to represent the starting point for the measuring rod to determine barrel length. The material of the measuring rod shall be sufficiently soft that it does not scratch the barrel.

4.3.1.4 Caliper: A revolver barrel may be measured by placing a caliper on the exterior of the barrel, parallel to the axis of the bore to determine the barrel length.

4.3.2 Integral Chamber Barrels

4.3.2.1 When measuring the barrel of a firearm that has an integral chamber, the distance parallel to the bore axis from the muzzle end to the breech face (with the action closed) represents the length of a barrel. All measurements are made perpendicular to the bore axis at the farthest point of the barrel.

4.3.2.2 Ruler/Measuring Tape: An integral chamber barrel can be measured by placing a steel ruler/measuring tape on the exterior of the barrel, parallel to the axis of the bore.

4.3.2.3 Measuring rod: Before measuring an integral chamber barrel, ensure that the firing pin is not impeding the measuring rod from making contact with the breech face. It may be necessary to cock the firearm in order to withdraw a protruding firing pin. In the case of a fixed firing pin, be certain it is not reducing the barrel length measurement. Ensure that the measuring rod, when inserted in the barrel, is parallel to the bore axis.

4.4 Overall Length Measurements

4.4.1 When measuring the overall length of a firearm, the measurement shall be taken along a line which is parallel to the axis of the bore from a perpendicular tangential line which touches the rearmost point of the firearm to a perpendicular tangential line that touches the furthest point of the muzzle.

4.4.2 The overall firearm length shall be determined using a measuring platform or fixture that can provide indications of length increments parallel to the bore axis illustrated in Fig. 1.

4.5 Uncertainty for Barrel and Overall Length Measurements

4.5.1 Estimating the uncertainty of length measurements is essential to achieving traceability of the measurements to the international unit of length. This section provides essential steps for laboratory studies to estimate the uncertainty of those BL-OL measurements that are reported by the laboratory to external parties.

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4.5.2 The uncertainty of a laboratory's BL-OL measurements shall be estimated with data from a study of repeated measurements of several firearms by all those in the laboratory responsible for measuring and reporting BL-OL. The same type of measuring device shall be used for all measurements for a given uncertainty study.

4.5.3 Measurements of BL-OL shall be performed in accordance with the procedures outlined in Sections 4.2, 4.3, and 4.4.

4.5.4 Key factors, which may potentially be sources of uncertainty, are:

- Different lengths to be measured (for example 16 inch, 18 inch, and 26 inch, Sec. 4.1).
- Different models of firearms, which may need to be handled or fixtured differently.
- Different observers performing the measurements.
- Inherent uncertainty associated with the measurement device. A different uncertainty budget shall be developed for each type of device used for these measurements.
- Uncertainty in any physical standards used to calibrate the device.
- Misreading the fractions on a length scale during a manual measurement. Observers responsible for manual measurements shall be trained to avoid this error. In addition, the laboratory shall have a clear policy for identifying and dealing with outlier data points, which result from this type of error.

The first two items relate to the measurand and the last four relate to the measurement.

4.5.5 For each type of measurement, barrel and overall length, at least 70 measurements should be obtained in the study, with at least two measurements of each barrel length and overall length by each observer, extending over more than one day. The firearms measured should have slightly different lengths close to the defined values.

4.5.6 For example, if there are five observers in the laboratory, the number of measurements taken to estimate the BL or OL measurement uncertainty might be

$(4 \text{ models of firearm}) \times (5 \text{ observers}) \times (4 \text{ repeated measurements}) = 80 \text{ measurements.}$

4.5.7 For laboratories with fewer observers, the number of models or the number of repeated measurements should be increased so that at least 70 measurements are taken altogether.

4.5.8 The data obtained by any extra observers shall be identifiable in the data analysis.

4.5.9 To complete the analysis, the measured results shall be recorded, their statistical variations shall be calculated, and uncertainty components from all sources shall be estimated and integrated together. The "Blank Measurement Uncertainty Estimation Template" [1], a spreadsheet available from ASCLD/LAB, may be used for this purpose.

4.5.10 An example spreadsheet of simulated data and analysis results for a laboratory study to establish measurement uncertainty is available via Annex A.

4.5.11 Once uncertainties for BL-OL measurements are established, at least two measurements shall be obtained in case work for each quantity to be measured. Any difference between them shall be consistent with the uncertainty as assessed above.

4.5.12 The stability of the measurement process shall be maintained by control chart(s) [5] of measurements of the laboratory's physical check standard(s) guided by its quality procedures.

4.5.13 The process described in Sections 4.5.2 to 4.5.9 or an equivalent process shall be repeated when a change occurs in the laboratory procedure for measurement of barrel length or overall length, such as the acquisition of a measuring device or the addition of new observers.

5. Conformance

The laboratory shall maintain:

- An uncertainty budget,
- Control charts,
- A data log,
- Records of calibration of physical standards used for these measurements,
- Records of calibration and maintenance of measurement devices used for these measurements.

Annex A
(informative)

**Example Spreadsheet for Calculating Uncertainty for Measurement of
Overall Length and Barrel Length**

The spreadsheet, located at [BL-OL Sample Spreadsheet 14nov17.xlsx](#), provides example data, calculations, and component estimates for a laboratory study to estimate uncertainty of barrel length and overall length measurements. It is adapted with one minor correction from a previously developed template [1]. Because errors can find their way into such documents when data are added or substituted, users must verify for themselves that the numerical formulas do not contain omissions or errors and that the calculated results are accurate.

Annex B
(informative)

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Bibliography

1. The Blank Measurement Uncertainty Estimation Template and the references 2, 3, 4, and 6 are all available at <http://www.anab.org/ascl-d-lab-forensic-iso-iec-17025-docs>.
2. *ASCLD/LAB Policy on Measurement Uncertainty*, AL-PD-3060 Ver 1.1 (May 22, 2013).
3. *ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty– Overview*, AL-PD-3061 Ver 1.0 (May 22, 2013)
4. *ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – ANNEX C, Firearms/Toolmarks Discipline, Firearms Category of Testing, Example – Overall Length of a Firearm*, AL-PD-3064 Ver 1.0 (May 22, 2013)
5. American Society for Quality, Control Chart, available at <http://asq.org/learn-about-quality/data-collection-analysis-tools/overview/control-chart.html>
6. *ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – ANNEX A, Details on the NIST 8-Step Process* AL-PD-3062 Ver 1.0 (May 22, 2013).
7. American Association for Laboratory Accreditation, G104 Guide for Estimation of Measuring Uncertainty in Testing (Dec. 2014) https://portal.a2la.org/guidance/est_mu_testing.pdf.
8. American Association for Laboratory Accreditation, G103 A2LA Guide for Estimation of Uncertainty of Dimensional Calibration and Testing Results (February 2016); https://portal.a2la.org/guidance/est_mu_dimen.pdf.