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Draft Test Procedures for the Gun Safety Technology Challenge

National Institute of Justice

April 2016

45 **Introduction**

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47 This document has been developed for the National Institute of Justice (NIJ) Gun Safety
48 Technology Challenge. It describes test methods to provide a basis to determine whether
49 the addition of a smart gun technology does or does not significantly reduce the reliability
50 of the firearm system compared to existing firearms. These firearms or firearms
51 accessories can be understood to use integrated components that exclusively permit an
52 authorized user or set of users to operate or fire the gun and automatically deactivate it
53 under a set of specific circumstances, reducing the chances of accidental or purposeful use
54 by an unauthorized user. The integrated gun safety technology may include different
55 authentication technologies, such as radio frequency identification and fingerprint sensors.

56
57 Testing and evaluation is designed to prioritize the collection and use of data that can
58 substantiate conclusions about the relative performance of firearms, so that firearms with
59 and without advanced gun safety technology that are similar with respect to type, form
60 factor, caliber, and other physical characteristics are tested and evaluated using a common
61 methodology and equivalent ammunition. Testing and evaluation is not designed to
62 provide comparison of test results against absolute performance requirements or safety
63 criteria, but rather to provide a meaningful comparison of test results of one firearm
64 against another similar firearm, or a firearm with and without a relevant safety accessory.

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66 Please direct any feedback on this document by email to gunsafetytechnology@usdoj.gov.

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91 **1 Scope**

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93 **1.1** This document describes a testing methodology to provide meaningful comparisons
94 between similar firearms to determine whether the reliability of the tested firearms differs
95 significantly based on performance.

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97 **1.2** Test methods are included to determine whether the addition of a smart gun
98 technology does or does not significantly reduce the reliability of the firearm system
99 compared to existing firearms.

100

101 **1.3** The sample used is designed to detect significant differences between similar
102 firearms with reasonable test economy using a variety of tests.

103

104 **1.4** The sample used is not designed to be a complete engineering test, or to evaluate a
105 firearm at or close to its expected service life, nor is it designed to detect small differences
106 in statistical parameter(s) of interest, marginal performance, or randomly encountered
107 problems that would require a large sample to measure with a high degree of confidence.

108

109 **1.5** Firearms such as pistols, revolvers, rifles, and shotguns, as defined at 27 CFR 478.11,
110 are within the scope of this document.

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112 **1.6** Semi-automatic pistols, rifles, and shotguns, as defined at 27 CFR 478.11, are within
113 the scope of this document.

114

115 **1.7** Accessories with integrated components that modify the firearms in 1.5 and 1.6 for
116 the purpose of augmenting safety are also within the scope of this document.

117

118 **1.8** Fully automatic firearms and machineguns, as defined at 27 CFR 478.11, are not
119 addressed in this document.

120

121 **1.9** This document shall not be understood as addressing all of the safety risks
122 associated with testing firearms. The user of this document is responsible for following
123 appropriate safety practices when handling or operating firearms.

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137 **2 Normative references**

138
139 Test Operations Procedure (TOP) 3-2-045, *Small Arms - Hand and Shoulder Weapons and*
140 *Machineguns*, 17 September 2007.

141
142 NIJ Standard 0109.00, *38/357 Caliber Revolvers*, July 1983.

143
144 NIJ Standard 0112.03 Revision A, *Autoloading Pistols for Police Officers*, July 1999.

145
146 NIJ Standard 0113.00, *12-Gauge Shotguns for Police Use*, March 1989.

147
148 TOP 4-2-500, *Ammunition Characteristics*, 9 November 1981.

149
150 TOP 4-2-016, *Ammunition, Small Arms*, 12 June 1978.

151
152 TOP 3-2-504, *Safety Evaluation of Hand and Shoulder Weapons*, 1 March 1977.

153
154 TOP 3-2-500, *Weapon Characteristics*, 9 November 1981.

155
156 TOP 3-2-807, *Nondestructive Testing of Materials*, 5 December 1985.

157
158 ITOP 4-2-829, *Vertical Target Accuracy and Dispersion*, 7 September 1999.

159
160 AR 70-38, *Research, Development, Test and Evaluation of Materiel for Extreme Climatic*
161 *Conditions*, 15 September 1979.

162
163 MIL-STD-810G w/ Change 1, *Environmental Engineering Considerations and Laboratory*
164 *Tests*, 15 April 2014.

165
166 ITOP 4-2-602, *Rough Handling Tests*, 19 April 2002.

167
168 TOP 1-2-512, *Electromagnetic Compatibility Tests*, 15 May 1995.

169
170 MIL-STD-882D, *Standard Practice for System Safety*, 11 May 2012.

171
172 ATEC Publication No. 1-8, *Technical Document Style Manual*, 1 March 2005.

173
174 ATEC Pamphlet 73-4, *System Test and Evaluation Procedures*, 19 April 2004.

175
176 ISO/IEC 27000:2014(E), *Information technology — Security techniques — Information*
177 *security management systems — Overview and vocabulary*, 15 January 2014.

178
179 Siegmund Halpern, *The Assurance Sciences: An Introduction to Quality Control*
180 *and Reliability* (Englewood Cliffs, NJ: Prentice-Hall), 1978.

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183 **3 Terms and definitions**

184

185 **Accuracy**

186 A measure of the ability of the firearm-ammunition system to center projectile impacts on
187 the point of aim.

188

189 **Authentication**

190 As defined in ISO/IEC 27000:2014(E), provision of assurance that a claimed characteristic
191 of an entity is correct. In practice, it is a process to confirm or verify that a presented value
192 or characteristic, such as a password or biometric, matches a reference value or
193 characteristic.

194

195 **Cartridge**

196 A unit of ammunition consisting of a projectile, a casing that houses the propellant, and
197 primer.

198

199 **Chambering**

200 Actuation that inserts a cartridge or round into the chamber.

201

202 **Dispersion**

203 The extent to which projectile impacts spread about the center of impact because of shot-
204 to-shot variations.

205

206 **Durability**

207 Resistance to wear, damage, or degradation.

208

209 **Ejecting**

210 Actuation that jettisons a spent casing from the firearm.

211

212 **Extracting**

213 Actuation that removes a spent casing from the chamber.

214

215 **Feeding**

216 Actuation that moves ammunition from a housing device, such as a magazine, toward the
217 chamber.

218

219 **Firing**

220 Actuation that activates the primer to cause the propellant to ignite and jettison the
221 projectile through the barrel and out the muzzle.

222

223 **Locking**

224 Actuation that firmly secures a cartridge in the chamber.

225

226 **Malfunction**

227 Deviation from the normal functioning of a firearm or one of its components.

228

229 **Pistol**

230 As defined at 27 CFR 478.11, a weapon originally designed, made, and intended to fire a
231 projectile (bullet) from one or more barrels when held in one hand, and having (a) a
232 chamber(s) as an integral part(s) of, or permanently aligned with, the bore(s); and (b) a
233 short stock designed to be gripped by one hand and at an angle to and extending below the
234 line of the bore(s).

235
236 **Reliability**

237 The probability that a device will perform its intended function for a specified period of
238 time under stated conditions (Halpern).

239
240 **Revolver**

241 As defined at 27 CFR 478.11, a projectile weapon, of the pistol type, having a breechloading
242 chambered cylinder so arranged that the cocking of the hammer or movement of the
243 trigger rotates it and brings the next cartridge in line with the barrel for firing.

244
245 **Round**

246 A unit of ammunition when counted.

247
248 **Rifle**

249 As defined at 27 CFR 478.11, a weapon designed or redesigned, made or remade, and
250 intended to be fired from the shoulder, and designed or redesigned and made or remade to
251 use the energy of the explosive in a fixed metallic cartridge to fire only a single projectile
252 through a rifled bore for each single pull of the trigger.

253
254 **Semiautomatic pistol**

255 As defined at 27 CFR 478.11, any repeating pistol which utilizes a portion of the energy of a
256 firing cartridge to extract the fired cartridge case and chamber the next round, and which
257 requires a separate pull of the trigger to fire each cartridge.

258
259 **Semiautomatic rifle**

260 As defined at 27 CFR 478.11, any repeating rifle which utilizes a portion of the energy of a
261 firing cartridge to extract the fired cartridge case and chamber the next round, and which
262 requires a separate pull of the trigger to fire each cartridge.

263
264 **Semiautomatic shotgun**

265 As defined at 27 CFR 478.11, any repeating shotgun which utilizes a portion of the energy
266 of a firing cartridge to extract the fired cartridge case and chamber the next round, and
267 which requires a separate pull of the trigger to fire each cartridge.

268
269 **Shotgun**

270 As defined at 27 CFR 478.11, a weapon designed or redesigned, made or remade, and
271 intended to be fired from the shoulder, and designed or redesigned and made or remade to
272 use the energy of the explosive in a fixed shotgun shell to fire through a smooth bore either
273 a number of ball shot or a single projectile for each single pull of the trigger.

274

275 **Smart gun**

276 Firearms or firearms accessories that can be understood to utilize integrated components
277 that exclusively permit an authorized user or set of users to operate or fire the gun and
278 automatically deactivate it under a set of specific circumstances, reducing the chances of
279 accidental or purposeful use by an unauthorized user.

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281 **Stoppage**

282 A malfunction that prevents further firing until corrected.

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321 **4 Documentation requirements**

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4.1 All documentation shall be recorded in either print or electronic format, or a combination of the two, at the discretion of test personnel as test facilities or test conditions may favor one format over the other at different times throughout the duration of testing.

4.2 Firearms chosen for comparative analysis shall be declared and the similarities between them shall be described.

4.3 A firearm chosen for comparative analysis with and without a safety accessory shall be declared and the intended effect of the accessory on the functionality of the firearm shall be described.

4.4 The ammunition selected for use in testing shall be declared and described.

4.5 All inspection activities shall be recorded and reported.

4.6 All test results and observations shall be recorded and reported.

4.7 All maintenance activities of test items, such as cleaning and lubrication, shall be recorded and reported.

4.8 All malfunctions, stoppages, or firearm failures shall be recorded, coded in accordance with 6, and reported.

4.9 Test data shall be recorded in a common tabular or spreadsheet format to facilitate analysis and portability of the data.

4.10 Data from inspections should be recorded in tabular or spreadsheet formats where possible to facilitate data comparisons in subsequent inspections throughout the overall testing.

4.11 Photographs, X-rays, etc. shall be preserved in a digital format to assist data handling and transmission.

4.12 Human factors observations related to operation, maintenance, and usability of test firearms shall be recorded throughout testing.

367 **5 Test requirements**

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369 **5.1 General considerations**

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371 **5.1.1** The safety of test personnel shall be the primary consideration in performing
372 any test. Test personnel should perform a thorough safety review before undertaking any
373 firearms testing in accordance with this document.

374
375 **5.1.2** Test personnel shall observe safe handling of firearms and ammunition at all
376 times and should don appropriate personal protective equipment (PPE) during firing.

377
378 **5.1.3** Local standard operating procedures (SOPs) regarding safety should be
379 followed.

380
381 **5.1.4** Prior to conducting any test firings, the initial inspection results in 7.1 shall be
382 reviewed to determine if special warnings, new SOPs, or test revisions are needed to assure
383 safe operations.

384
385 **5.1.5** Test personnel shall consider whether safety tests should be conducted in
386 accordance with TOP 3-2-504, Safety Evaluation of Hand and Shoulder Weapons, prior to
387 conducting the tests in 7.

388
389 **5.1.6** For comparative analysis between different firearms, at least two models of
390 firearms should be tested.

391
392 — The different models tested should be highly similar to permit a meaningful comparison
393 of performance.

394
395 — The similarities between the models shall be documented.

396
397 **5.1.7** For a comparative analysis of a firearm with and without a safety accessory, at
398 least one model of firearm should be tested with and without the safety accessory.

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400 **5.1.8** The test firearms should adequately represent the populations from which the
401 samples have been drawn.

402
403 **5.1.9** Simple identification numbers should be assigned to the test firearms prior to
404 initial inspection. A list should be maintained of the assigned number versus the firearm
405 serial number or other information that uniquely identifies the firearm.

406
407 **5.1.10** The operation of firearms is interrelated with ammunition. Care must be taken
408 during testing to assure that the distinction is made between inherent firearm functioning
409 and ammunition induced problems.

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411 **5.1.11** Trained and experienced firers should be used. Care must be taken to not
412 fatigue the person firing the firearm.

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5.1.12 The arbitrary replacement of critical weapon parts with new parts before the next test is conducted would permit a precise evaluation of the influence of the particular test environment on firearm functioning. However, this practice would negate the accumulation of data on long-term parts durability and firearm life. Care should be taken, therefore, to replace parts only when they are at the end of their serviceable life or present a safety hazard.

5.1.13 All firearms and firearms accessories shall be exposed to adverse conditions as specified in the test methods, except where explicitly excluded. Unless specifically excluded, such as in 7.7.7 and 7.8.16, all devices and artifacts associated with the firearm systems shall be exposed as stated to adverse conditions, such as high or low temperatures, humidity, sand and dust, and water immersion.

459 **5.2 Informational review**

460

461 **5.2.1** All instructional materials that are issued with the test items by the developer or
462 manufacturer, such as manuals, safety assessments, and reports of previous tests
463 conducted on the same model or closely related items, shall be reviewed by test personnel.

464

465 **5.2.2** Information shall be assembled on the physical characteristics of the test firearm
466 as described in TOP 3-2-500, including its method of operation and maintenance
467 requirements.

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469 **5.2.3** All informational materials shall be kept in an organized electronic file or an
470 organized paper file, or both, depending on what is furnished with the test firearms for
471 future reference.

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505 **5.3 Facilities and instrumentation**

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507 **5.3.1** Adequate PPE shall be available for test personnel.

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509 **5.3.2** Firing ranges shall safely accommodate firing to the required distances.

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511 **5.3.3** Test stands shall safely restrain the firearm, allow remote firing, and assure
512 reproducible results.

513

514 **5.3.4** Any control firearm used to permit checking test setups, instrumentation, or
515 other aspects of a test protocol should be similar to the test firearm.

516

517 **5.3.5** Targets shall be physical or electronic with the capability of recording the X and
518 Y coordinates of each projectile passing through the plane of the target.

519

520 — Electronic targets are preferred as they allow multiple targets along the line-of-fire so
521 that each shot is recorded at multiple ranges.

522

523 — Care must be taken to establish a reproducible aim point.

524

525 — Physical targets such as paper, cloth, or plywood require careful manual measurement
526 of each bullet hole.

527

528 **5.3.6** Velocimeters shall have a maximum permissible error of measurement of 0.1%
529 or 0.5 m/s, whichever is highest.

530

531 **5.3.7** Antisurge springs shall be long enough to permit gradual load application.

532

533 **5.3.8** Stargages and airgages shall have a maximum permissible error of measurement
534 of ± 0.025 mm.

535

536 **5.3.9** MIL-STD-810G, *Environmental Engineering Considerations and Laboratory Tests*,
537 shall be used as the default reference regarding environmental conditions for conditioning
538 test items and tests under adverse conditions.

539

540 **5.3.10** All tests shall be conducted at “standard ambient” as defined in 5.1.a in MIL-STD-
541 810G unless specified otherwise. “Standard ambient” is defined as a temperature of $25^{\circ} \pm$
542 10°C ($77 \pm 18^{\circ}\text{F}$); a relative humidity of 20 to 80 percent; and an atmospheric pressure
543 equal to the site pressure.

544

545 **5.3.11** Test facilities shall be capable of conducting high temperature conditioning as
546 described in MIL-STD-810G, Method 501.6.

547

548 **5.3.12** Test facilities shall be capable of conducting low temperature conditioning as
549 described in MIL-STD-810G, Method 502.6.

550

551 **5.3.13** Test facilities shall be capable of conducting humidity conditioning as described
 552 in MIL-STD-810G, Method 507.6.

553
 554 **5.3.14** Test facilities shall be capable of conducting sand and dust conditioning as
 555 described in MIL-STD-810G, Method 510.6.

556
 557 **5.3.15** Test facilities shall be capable of conducting water immersion conditioning as
 558 described in MIL-STD-810G, Method 512.6.

559
 560 **5.3.16** Climatic chambers shall be capable of providing temperatures between -51°C
 561 (-60°F) and 71°C (160°F).

562
 563 **5.3.17** Test items shall be kept within ±2°C (±3.6°F) of the required conditioning
 564 temperatures and test temperatures during temperature conditioning.

565
 566 **5.3.18** The air temperature gradient across the test item during temperature
 567 conditioning shall not exceed 1°C (2°F) per meter or a maximum of 2.2°C (4°F) total when
 568 not operating.

569
 570 **5.3.19** Thermographs and thermocouples shall have a maximum permissible error of
 571 measurement of ±0.6°C (±1°F).

572
 573 **5.3.20** Pressure shall be kept at ±5% of the standard ambient value or ±200 Pa (±0.029
 574 psi), whichever is greater.

575
 576 **5.3.21** Climatic chambers shall be capable of providing a relative humidity of at least
 577 95%.

578
 579 **5.3.22** The relative humidity at the chamber control sensor shall be kept within ±5%
 580 RH of the specified value.

581
 582 **5.3.23** Sand and dust chamber shall be able to dispense a mixture at a rate of 100±25
 583 g/min·m².

584
 585 **5.3.24** The sand and dust compounds that should be used are those identified in TOP 3-
 586 2-045 Test Procedure 4.5.4.b(1).

587
 588 — The compound for the blowing sand and dust test is a mixture, by weight, of the
 589 following three products: 50% SIL-CO-SIL 125, 42% No. 1 Dry Underground Silica, and 8%
 590 No. 3 Q-ROK Underground Silica. The resulting mixture is approximately 99.5% silicon
 591 dioxide and will have the particle distribution as shown in the following table.

592

Size, Microns	Less than 45	45	53	75	106	150	212	300	425	600	850	1180
Percent, by weight	28.0	10.5	7.5	3.4	2.7	5.5	15.1	17.6	2.1	1.2	6.1	0.3

593

594 — The SIL-CO-SIL 125 compound is 99.5% silicon dioxide with the particle size
 595 distribution show in the following table.
 596

Size, Microns	Less than 45	45 to 53	53 to 75	75 to 106	106 to 150
Percent, by weight	79	6	9	4.4	1.4

597
 598 — Supply sources are available from the manufacturer, U.S. Silica, P.O. Box 187, Berkeley
 599 Springs, WV 25411-0187, or www.u-s-silica.com.
 600

601 **5.3.25** Firearms subjected to unattended environmental conditioning prior to testing
 602 should not be conditioned loaded as there is no continuous hands-on control.
 603

604 **5.3.26** Should a compelling technical reason exist to condition a loaded firearm prior to
 605 testing, a safety review shall be conducted prior to environmental conditioning to
 606 determine the safety hazards.
 607

608 **5.3.27** Specified lubricants shall be used in each adverse condition test as determined
 609 by reference to appropriate manuals or other authority.
 610

611 **5.3.28** Test firearms shall not be cleaned or relubricated prior to the completion of a
 612 test procedure unless stated in the test method.
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638 **5.4 Ammunition**

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640 **5.4.1** Ammunition shall be sourced based on need and availability in the following
641 order:

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643 — Option 1: US Government ammunition that has been lot tested to meet relevant U.S.
644 military standards shall be used.

645

646 — Option 2: Commercial ammunition from an established manufacturer that meets
647 relevant standards shall be used.

648

649 — Option 3: Test item manufacturer or developer shall supply ammunition that meets
650 relevant standards. Documentation shall be provided to demonstrate that the
651 ammunition meets the standards.

652

653 **5.4.2** Relevant standards may include ANSI/SAAMI standards, U.S. military standards,
654 or other recognized technical standards.

655

656 **5.4.3** If Option 1 is used, the ammunition shall be fully identified with the full
657 nomenclature, Department of Defense Identification Code (DODIC), condition code (CC),
658 and lot number. Only CC “A” and CC “B” should be used.

659

660 **5.4.4** The ammunition used should be described in accordance with TOP 4-2-500,
661 Ammunition Characteristics.

662

663 **5.4.5** If standard ammunition is used, a single lot of ammunition should be used for
664 the entire series of tests.

665

666 **5.4.6** If a single lot cannot be obtained for the entire series of tests, every effort should
667 be made to complete each separate test procedure with a single lot.

668

669 **5.4.7** Ammunition that has a small and consistent dispersion should be used. The
670 inherent ammunition dispersion from lot acceptance or test firings should be provided if
671 available.

672

673 **5.4.8** Candidate ammunition lots can be fired to determine their inherent dispersion,
674 however this process requires special test barrels (Mann type barrels) and rigid test
675 mounts. Dispersion can be demonstrated through prior test results, however test
676 personnel can determine whether inherent dispersion of the ammunition should be
677 measured.

678

679 **5.4.9** Proprietary, nonstandard, prototype, or experimental ammunition should not be
680 used unless it is an essential component to the gun safety technology and can be
681 demonstrated that it is safe to use.

682

683 **5.4.10** If other than standard ammunition is used, test personnel shall consider
684 whether should be evaluated for safety in accordance with TOP 4-2-016, Ammunition,
685 Small Arms.

686
687 **5.4.11** Testing personnel may refuse any ammunition it deems unsafe to use.
688

689 **5.4.12** Ammunition should be kept in its original shipping and storage containers until
690 use.

691
692 **5.4.13** A general visual examination of the ammunition should be made after it is
693 removed from its packaging and any discrepancies or irregularities, such as shipping
694 damage or evidence of improper storage, should be recorded.
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729 **5.5 Test sequence**

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731 **5.5.1** Test sequences should generally conduct the most abusive test last for each test
732 item.

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734 **5.5.2** For comparative analysis between different firearms, at least two models of
735 firearms selected in accordance with 5.1.6 should complete the test sequence.

736

737 **5.5.3** For a comparative analysis of a firearm with and without a safety accessory, at
738 least one model of firearm selected in accordance with 5.1.7 should complete the test
739 sequence with and without the safety accessory.

740

741 **5.5.4** Two predefined test sequences have been designed: “light duty” and “heavy
742 duty.”

743

744 **5.5.5** For “light duty” testing, the test sequence based on a two-firearm sample shall be
745 followed as shown below, with the predefined round count in the test methods indicated in
746 parentheses. The total round count for Test Firearms 1 and 2 is $750 + 750 = 1,500$.

747

Test Firearm No. 1	Test Firearm No. 2
Accuracy and dispersion (30)	Accuracy and dispersion (30)
Reliability and durability (600)	Unauthorized user false positive (120)
1.5 m drop (120)	Quick draw scenario (240)
	Electromagnetic interference (120)
	High temperature (120)
	Low temperature (120)

748

749 **5.5.6** For “heavy duty” testing, the test sequence based on a six-firearm sample shall
750 be followed as shown below, with the predefined round count in the test methods indicated
751 in parentheses. The total round count for Test Firearms 1 through 6 is $6,150 + 6,150 +$
752 $6,150 + 3,270 + 2,190 + 270 = 24,180$.

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Test Firearms No. 1, 2, 3	Test Firearm No. 4	Test Firearm No. 5	Test Firearm No. 6
Accuracy and dispersion (30)	Accuracy and dispersion (30)	Accuracy and dispersion (30)	Accuracy and dispersion (30)
Reliability and durability (6,000)	Unauthorized user false positive (360)	Electromagnetic interference (960)	1.5 m drop (120)
1.5 m drop (120)	Quick draw scenario (720)	Humidity (960)	Mechanical jostling (120)
	High temperature (960)	Water immersion (120)	
	Low temperature (960)	1.5 m drop (120)	
	Sand and dust (120)		
	1.5 m drop (120)		

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5.5.7 A unique test sequence may be designed.

5.5.8 The test sequence used shall be documented.

791 **5.6 Firearm maintenance**

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793 **5.6.1** All maintenance actions shall be recorded.

794

795 **5.6.2** Firearms shall be maintained in accordance with technical manuals or
796 instructional materials.

797

798 **5.6.3** Part replacement intervals should be complied with as prescribed in technical
799 publications.

800

801 **5.6.4** Firearms shall always be cleaned, inspected, and lubricated (CIL) at the end of
802 each test procedure and before the start of another test procedure.

803

804 **5.6.5** The CIL shall be conducted at the operator level, often referred to as “field strip
805 and clean.”

806

807 **5.6.6** More detailed maintenance shall be performed as needed following completion
808 of each test procedure and only unserviceable components shall be replaced before the test
809 firearm is used in the next test procedure.

810

811 **5.6.7** Parts that are determined to be in a condition to adversely affect safety should
812 be replaced immediately whenever they are identified, regardless of whether a test
813 procedure has been completed.

814

815 **5.6.8** The CIL at the end of a test procedure may serve as the CIL for the start of a
816 subsequent test procedure, based on the judgment of test personnel.

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818 **5.6.9** The life history of any part that is replaced shall be recorded and the part shall
819 be retained for possible further detailed examination.

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837 **6 Data requirements**

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839 **6.1 General considerations**

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841 **6.1.1** Firearm functioning data shall be recorded to establish an accurate, complete
842 historic profile of the test firearm under evaluation.

843

844 **6.1.2** Standardized terminology from TOP 3-2-045 plus additional new codes related
845 to authentication technologies unique to smart guns, such as radio frequency identification
846 and fingerprint sensors, listed shall be used to characterize malfunctions and stoppages to
847 document and analyze these events. These codes describe the condition of the firearm as
848 determined primarily by visual observation.

849

850 **6.1.3** Malfunctions and stoppages shall be characterized by the terms in organized in
851 standardized groups in the following categories:

852

853 — Malfunction and performance codes (6.2)

854

855 — Attribution codes (6.3)

856

857 — Significance to the operator (6.4)

858

859 — Guidance concerning keeping track of incidents by round count (6.5)

860

861 — Miscellaneous codes and abbreviations (6.6)

862

863 **6.1.4** The cycle of operation of firearms within the scope of this document can be
864 broken down into six distinct actions in order: feeding, chambering, locking, firing,
865 extracting, and ejecting.

866

867 **6.1.5** Malfunctions may occur which can adversely affect firearm performance while
868 still permitting continuation of firing.

869

870 **6.1.6** Malfunctions may occur which immediately prevent further firing until
871 corrected, referred to as stoppages.

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873 **6.1.7** All malfunctions and stoppages may be reviewed by test personnel for safety
874 implications in accordance with MIL-STD-882E.

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883 **6.2 Malfunction and performance codes**

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885 **6.2.1** The following codes shall be used to characterize malfunctions and performance
886 issues:

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888 — BFM: Bolt failed to move. Used for weapons firing from an open bolt to indicate that the
889 bolt made no forward movement when the bolt sear was released by pulling the trigger.
890 Also used for those cases where the bolt is held rearward by a manually operated bolt
891 latch and fails to move forward when the latch is released.

892

893 — FSR: Failure to strip round. The bolt properly engaged the cartridge but stalled or failed
894 to push the round out of the magazine.

895

896 — FFD: Failure to feed. A cartridge was not fed into the proper position in front of the
897 bolt.

898

899 — BFC: Bolt failed to close. The bolt properly stripped the cartridge but stopped short of
900 the forward most position.

901

902 — BFL: Bolt failed to lock. The bolt locking surfaces or locking mechanism are not
903 engaged even though the bolt is in the forward most position.

904

905 — BCE: Bolt closed on an empty chamber. There is no cartridge in the chamber even
906 though the bolt is forward and locked.

907

908 — FFR: Failure to fire. The firearm failed to fire when the trigger was pulled.

909

910 — FUL: Failure to unlock. The weapon fired but the bolt is still in the locked position.

911

912 — FXT: Failure to extract. The fired cartridge case is still in the chamber or the bolt has
913 not moved back far enough to activate the ejector.

914

915 — FEJ: Failure to eject. The bolt moved to, or through, the proper position for ejection but
916 the case did not eject.

917

918 — TFN: Trigger false negative. Trigger failed to pull with designated operator handling
919 firearm. Smart gun specific.

920

921 — TFP: Trigger false positive. Trigger pulled with undesigned operator handling
922 firearm. Smart gun specific.

923

924 **6.2.2** These more specific codes may be used to describe a malfunction or
925 performance issue:

926

927 — BFM FDS: Failure of safety to disengage.

928

- 929 — BFM FTF: Failure of trigger to function.
- 930
- 931 — BFC STB: Stubbed round.
- 932
- 933 — BFC BUR: Bolt under rode cartridge.
- 934
- 935 — BFC BOR: Bolt overrode cartridge.
- 936
- 937 — FFD DFD: Double feed.
- 938
- 939 — FFD FFU: Failure of round to feed up from the magazine.
- 940
- 941 — FFD FBC: Failure of the bolt to cycle back far enough to pick up the next cartridge.
- 942
- 943 — FFR FSO: Failure to sear off, firing pin did not strike properly positioned cartridge.
- 944
- 945 — FFR FCP: Failure of cartridge primer, the primer has a proper indent but did not fire.
- 946
- 947 — FXT FEX: Failure of extractor to engage or stay engaged with the cartridge.
- 948
- 949 — FXT FES: Case stuck in chamber such that bolt/extractor cannot extract it.
- 950
- 951 — FEJCSB: Case spin back (fired case exited but bounced back into the weapon).
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975 **6.3 Attribution codes**

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977 **6.3.1** The following attributions codes shall be used to designate the source or underlying
978 cause of the malfunction.

979

980 — AMO: Ammunition. Problems clearly caused by deficiency of the ammunition.

981

982 — GUN: Malfunction that is induced by the weapon itself despite proper maintenance and
983 proper operator performance.

984

985 — MAG: Malfunctions identifiable as induced by the magazine.

986

987 — PER: Personnel. Problems induced by operator error (repetitive PER may identify a
988 human factors problem or a deficiency in operator training procedures.)

989

990 — REP: Repetitive malfunctions. The special category termed "repetitive" is used when
991 repeated stoppages due to a faulty component occur, and corrective action is not
992 immediately determined or incorrect action is taken.

993

994 — SYS: System. Problems that cannot be attributable to a single cause, but are caused by
995 the interaction of more than two components.

996

997 — TST: Test. Malfunctions induced by the test set up, such as an improper weapon mount,
998 wrong part installed, etc.

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1000 — AUT: Authentication system malfunction. Smart gun specific.

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1021 **6.4 Classification of the significance of a malfunction to the operator**

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1023 **6.4.1** Incidents shall be characterized by one of four classes in accordance with the
1024 following definitions:

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1026 — Class 1: The operator is able to return the firearm to an operational condition within 10
1027 seconds using only tools and equipment carried in an operational scenario. This class is
1028 often referred to as “correctable by immediate action”.

1029

1030 — Class 2: More than 10 seconds are required using only tools and equipment carried in
1031 an operational scenario. This class is often referred to as “operator correctable
1032 failures”.

1033

1034 — Class 3: A failure not correctable by the operator because it requires a higher level of
1035 maintenance or the use of tools and parts that the operator is not authorized to carry on
1036 his person. It is correctable, however, at the lowest level organizational maintenance.

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1038 — Class 4: A failure that is not correctable in the field. The firearm must be escalated to
1039 higher-level maintenance or is unrepairable and must be scrapped.

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1067 **6.5 Round counts**

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1069 **6.5.1** Round counts shall be the primary method of reporting where an incident
1070 occurs.

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1072 **6.5.2** The round count at each event, such as a malfunction, magazine change, change
1073 of firing cycle, or maintenance action, shall be recorded.

1074

1075 **6.5.3** The cumulative round count shall be used to correlate firing data throughout
1076 testing.

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1078 **6.5.4** The final record shall be used to identify the exact conditions and sequence of
1079 each round fired.

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1113 **6.6 Miscellaneous codes**

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1115 **6.6.1** The following miscellaneous codes shall be used:

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1117 — CIL: Clean, inspect, and lubricate.

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1119 — FRA: Failure to remain assembled.

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1121 — GFE: Government-furnished equipment.

1122

1123 — NT: No test, data is not reportable as test data.

1124

1125 — SA: Semiautomatic.

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1127 — SPM: Shots per minute (do not use rounds per minute as rpm can cause confusion).

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1129 — SS: Single shot.

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1131 — UNK: Unknown.

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1159 **6.7 Data presentation**

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1161 **6.7.1** Data shall be presented in formats that are factual, comprehensive, and easy to
1162 understand.

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1164 **6.7.2** U.S. Army Test and Evaluation Command (ATEC) Publication Number 1-8,
1165 Technical Document Style Manual may be followed regarding both printed and electronic
1166 presentations of data in reports.

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1168 **6.7.3** ATEC Pamphlet 73-4, System Test and Evaluation Procedures, Chapter 4 may be
1169 followed regarding data level definitions.

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1205 **7 Test methods**

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1207 The test methods in 7 shall apply to a single test item. For multiple test items, the test
1208 method shall be repeated for each test item.

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1210 **7.1 Initial inspection**

1211
1212 This test is adapted from TOP 3-2-045 Test Procedures 4.1 and 4.18 to inspect test firearms
1213 for their physical characteristics, safety, and identification to serve as a baseline for
1214 subsequent inspections later in the sequence of tests.

1215
1216 **7.1.1** Documentation requirements in 4 shall be observed at all times.

1217
1218 **7.1.2** The firearm shall be disassembled and all major components shall be visually
1219 examined for conformance with specifications and design drawings. Any deviations from
1220 specifications shall be recorded.

1221
1222 **7.1.3** If a firearm has been chosen for comparative analysis with and without a safety
1223 accessory, a visual examination of the safety accessory shall be conducted.

1224
1225 **7.1.4** The firearm shall be photographed in various stages of disassembly.

1226
1227 **7.1.5** If a firearm has been chosen for comparative analysis with and without a safety
1228 accessory, the firearm shall be photographed with and with and without the safety
1229 accessory.

1230
1231 **7.1.6** Nondestructive testing (NDT) of components subjected to stress during firing
1232 shall be conducted in accordance with TOP 3-2-807.

1233
1234 — Magnetic particle inspection shall be the default NDT.

1235
1236 — If different or additional NDT should be required, the rationale shall be documented.

1237
1238 **7.1.7** The following for the test item shall be recorded, as applicable:

1239
1240 — Test item nomenclature, serial number(s), manufacturer's name, and the corresponding
1241 locally assigned identification;

1242
1243 — Type and adequacy of packaging and preservatives;

1244
1245 — Completeness of logistic support;

1246
1247 — Number and names for all parts;

1248
1249 — Defective parts; and

1250

1251 — Free length or force-displacement curves for all springs, as appropriate, within the
1252 designed operating range.

1253

1254 **7.1.8** The following firearm characteristics shall be recorded, as applicable:

1255

1256 — Firing pin protrusion;

1257

1258 — Firing pin energy or indent;

1259

1260 — Trigger pull;

1261

1262 — Headspace;

1263

1264 — Barrel length;

1265

1266 — Method of barrel attachment;

1267

1268 — Length of rifled bore;

1269

1270 — Direction and twist of rifling;

1271

1272 — Number of lands and grooves;

1273

1274 — Diameter across lands and grooves;

1275

1276 — Chamber dimensions;

1277

1278 — Charging force;

1279

1280 — Receiver length;

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1282 — Magazine capacity;

1283

1284 — Type of feed extraction, ejection, and cocking;

1285

1286 — Fire control selector, type, and method of operation; and

1287

1288 — Type of mechanism (closed or open bolt).

1289

1290 **7.1.9** If a firearm has been chosen for comparative analysis with and without a safety
1291 accessory, the following characteristics of the safety accessory shall be recorded, as
1292 applicable:

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1294 — Method of attachment;

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1296 — Mode of operation;

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- Power requirements;
- Battery type.

7.1.10 The weights of the following shall be recorded:

- Firearm without magazine;
- Empty magazine;
- Single round of ammunition;
- Fully loaded magazine; and
- Firearm with fully loaded magazine.

7.1.11 If a firearm has been chosen for comparative analysis with and without a safety accessory, the weights of the following shall additionally be recorded:

- Safety accessory; and
- Firearm with attached safety accessory and fully loaded magazine.

7.1.12 The dimensions of the firearm shall be recorded.

7.1.13 If a firearm has been chosen for comparative analysis with and without a safety accessory, the dimensions of the firearm with and without a safety accessory shall be recorded.

7.1.14 If a firearm has been chosen for comparative analysis with and without a safety accessory, the accessory shall be:

- Attached to the test firearm and checked to ensure that it remains secure;
- Inspected for possible interference with normal firearm functions, such as loading and fired case ejection; and
- Actuated for its intended purpose and observed whether it operates successfully.

7.1.15 The observations from 7.1.14 shall be recorded.

7.1.16 Sight characteristics shall be recorded as applicable to complete accuracy and dispersion tests in accordance with 7.3.

1342 **7.1.17** The time and tools necessary to accomplish complete disassembly and assembly
1343 of the test firearm shall be recorded two times by one test personnel.
1344

1345 **7.1.18** A characteristics data sheet shall be prepared consisting of a general view
1346 photograph of the firearm along with a listing of all principal physical and performance
1347 characteristics in accordance with TOP 3-2-500.
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1388 **7.2 Post-firing inspection**
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1390 This test is adapted from TOP 3-2-045 Test Procedure 4.20 to inspect test firearms after
1391 each test to determine if any damage or degradation has occurred and to verify that they
1392 are suitable for the next scheduled test. The complexity of the inspection will depend on
1393 the severity of the test just completed.
1394

1395 **7.2.1** Documentation requirements in 4 shall be observed at all times.
1396

1397 **7.2.2** Test firearms shall be inspected at the completion of each test.
1398

1399 **7.2.3** The minimum inspection is the CIL, as follows:
1400

1401 — The CIL is done at the operator’s level; and
1402

1403 — Specialized tools and cleaning equipment may be used to expedite the effort.
1404

1405 **7.2.4** The test firearm shall be disassembled to the “field strip” level and the following
1406 inspections shall be performed:
1407

1408 — Inspect the bore and chamber for residue and deposits, and preserve samples of any
1409 unusual deposits for analysis;
1410

1411 — Clean and visually inspect the bore and chamber;
1412

1413 — Inspect sliding and mating surfaces for wear, chipping, galling, etc.;
1414

1415 — Check springs for breakage and manually exercise them as a check on proper function;
1416

1417 — Visually inspect exposed parts of the firing pin, extractor, ejector, etc.;
1418

1419 — Examine load bearing components such as locking lugs and bolts;
1420

1421 — Clean, lubricate, and reassemble the weapon;
1422

1423 — Hand cycle a dummy cartridge to check for proper chambering, sear action, extraction,
1424 and ejection;
1425

1426 — Check that safety switches, etc. perform as intended;
1427

1428 — Check the security of safety accessory attachment, if appropriate; and
1429

1430 — Check the function of safety accessories, if appropriate
1431

1432 **7.2.5** A comprehensive inspection is done at the conclusion of the test sequence of the
1433 test firearm, or at any point in the test program at the determination of test personnel

1434 based on the performance or condition of the test firearm, which includes the CIL and may
1435 include the following as determined:

- 1436 — Bore and chamber measurements;
- 1438 — Magnetic particle or dye penetrant inspection of components subjected to stress during
1439 firing ;
- 1441 — Free length or force-displacement curves for all springs, as appropriate;
- 1443 — Firing pin protrusion and indent;
- 1445 — Trigger pull force; and
- 1447 — Radiographs.

1449 **7.2.6** The following data shall be recorded as obtained above:

- 1450 — Results of manual and visual inspections, including photographs as required;
- 1452 — Analysis of unusual residue;
- 1454 — Bore and chamber measurements;
- 1456 — Force-displacement spring data;
- 1458 — Trigger pull force;
- 1460 — Radiographs; and
- 1462 — Results of magnetic particle and dye penetrant inspections.

1480 **7.3 Accuracy and dispersion**

1481
1482 This test is adapted from TOP 3-2-045 Test Procedure 4.4 to determine the accuracy and
1483 dispersion characteristics of the test firearm and ammunition at a relevant tactical range
1484 when fired handheld from a supported position or fired from a mechanical mount secured
1485 to a rigid base.

1486
1487 The results of this test will be used to determine how accuracy and dispersion compare
1488 between firearms, as well as if the accuracy and dispersion of a specific test firearm are
1489 changing over the course of testing.

1490
1491 **7.3.1** Documentation requirements in 4 shall be observed at all times.

1492
1493 **7.3.2** Targets shall be positioned perpendicular to the line of fire.

1494
1495 **7.3.3** Electronic targets that do not physically interfere with the bullet trajectory
1496 should be used.

1497
1498 **7.3.4** Physical targets, such as paper, cloth, or plywood may also be used.

1499
1500 **7.3.5** Firearms may be fired manually from a supported position and can be
1501 accomplished by seating the person firing the firearm in a comfortable position with the
1502 firearm supported by sandbags or a height adjustable rest, or a “bench rest” position.

1503
1504 **7.3.6** The weapon should be supported such that the firer needs only to adjust the
1505 final aim of the weapon.

1506
1507 **7.3.7** Gun mounts may be used and shall be compatible with the specific firearm being
1508 tested.

1509
1510 **7.3.8** If a gun mount is used, the specific procedures for assembling the firearm to the
1511 mount and adjusting the aiming of the system shall be documented.

1512
1513 **7.3.9** Velocity of the transverse wind shall not exceed 16 km/hr (10 mph) and shall
1514 not vary by more than 8 km/hr (5 mph);

1515
1516 **7.3.10** Velocity of the wind parallel to the line of fire shall not exceed 24 km/hr (15
1517 mph) and shall not vary by more than 12 km/hr (7.5 mph).

1518
1519 **7.3.11** Should a compelling technical reason exist to use lower maximum transverse
1520 and parallel wind velocities, records of previous tests of the same or closely related firearm
1521 should be consulted before establishing the maximum permitted wind velocities for the
1522 test and the rationale shall be documented.

1523
1524 **7.3.12** Firing should be done with the firearm and ammunition at standard ambient
1525 conditions as specified in 5.3.10.

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7.3.13 The ambient air temperature along the trajectory of the bullet may fall outside standard ambient conditions.

7.3.14 Targets for pistols, revolvers, and shotguns shall be positioned at a range of 25 and 50 meters.

7.3.15 Targets for rifles shall be positioned at a range of 50, 100, and 200 meters.

7.3.16 The test firearm shall be disassembled, cleaned, lubricated, and reassembled.

7.3.17 The firearm shall be zeroed in accordance with the product manuals or product information.

7.3.18 The firearm shall be zeroed for 100 meters if product manuals are not available or do not specify the value.

7.3.19 Necessary rounds to assure that the firearm is sighted on target shall be fired, often referred to as “sighting rounds.”

7.3.20 If sighting rounds are not required, three rounds shall be fired to condition the barrel, often referred to as “warmer rounds.”

7.3.21 Three targets shall be fired.

7.3.22 Ten rounds shall be fired from the test firearm at each target from a bench rest or mechanical mount.

7.3.23 Sight alignment shall be checked before each shot is fired.

7.3.24 An optical or laser boresight may be used as necessary to check alignment to the target aiming point if the firearm is not equipped with sights.

7.3.25 The velocity as corrected to muzzle shall be recorded using appropriate instrumentation for each shot of the accuracy and dispersion test.

7.3.26 The same instrumentation shall be used for the duration of the test.

7.3.27 Accuracy and dispersion measurements shall be calculated in accordance with the methods in ITOP 4-2-829.

7.3.28 The following data shall be measured and recorded:

- X and Y coordinates of each impact relative to the aim point;
- The velocity of each shot;

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- Target data reduced in accordance with ITOP 4-2-829;
- Target ranges and type(s) of target(s);
- Photographs of test mounts and bench rest firing facility;
- Procedures used to mount and fire weapons; and
- Meteorological conditions, including transverse and parallel wind velocities.

1618 **7.4 Reliability and durability**
1619

1620 This test is adapted from TOP 3-2-045 Test Procedure 4.3 to determine the performance of
1621 the test firearm and its component parts over a substantial number of rounds fired.
1622

1623 **Always be alert for indications of imminent barrel failure!**
1624

- 1625 — These indications may include an increase in muzzle flash, erratic flight of bullets, an
1626 increase in the malfunction rate, and any other significant change in firearm
1627 performance.
1628
- 1629 — Since firearms barrels are often fired to, or past, the limits of serviceability, the
1630 possibility exists for erratic bullet flight and deviations from the established line-of-fire.
1631
- 1632 — The nature of this test also requires firing an unusually large number of rounds per day
1633 which may also increase toxic fumes to levels above those more typically encountered.
1634

1635 **7.4.1** Documentation requirements in 4 shall be observed at all times.
1636

1637 **7.4.2** Suitable personal protective equipment shall be donned during firing such as
1638 gloves, pads, and other appropriate attire for protection from hot gun barrels and
1639 expended cartridge cases.
1640

1641 **7.4.3** All firing shall be done with the firearm firmly handheld or held in an
1642 appropriate mount.
1643

1644 **7.4.4** The firing range shall have adequate ventilation to reduce the exposure to toxic
1645 fumes.
1646

1647 **7.4.5** The test firearm shall be disassembled, cleaned, inspected, lubricated, and
1648 reassembled.
1649

1650 **7.4.6** Headspace and barrel bore measurements shall be recorded.
1651

1652 **7.4.7** The basic firing cycle shall constitute firing approximately 120 rounds, given in
1653 7.4.8 through 7.4.11 for the particular type of firearm being tested.
1654

1655 **7.4.8** Pistols shall have a basic firing cycle that is a multiple of the number of rounds in
1656 the magazine totaling approximately 120 rounds.
1657

1658 — Example 1: If the magazine holds 12 rounds, the basic firing cycle would include 10 full
1659 magazines for a total of 120 rounds.
1660

1661 — Example 2: If the magazine holds 11 rounds, the basic firing cycle would include 11 full
1662 magazines for a total of 121 rounds.
1663

1664 **7.4.9** Revolvers shall have a basic firing cycle that is a multiple of the number of
1665 rounds in the cylinder totaling approximately 120 rounds.

1666
1667 — Example 1: If the cylinder holds 6 rounds, the basic firing cycle would include 20 full
1668 cylinders for a total of 120 rounds.

1669
1670 — Example 2: If the cylinder holds 5 rounds, the basic firing cycle would include 24 full
1671 cylinders for a total of 120 rounds.

1672
1673 **7.4.10** Shotguns shall have a basic firing cycle of 120 shells.

1674
1675 **7.4.11** Rifles shall have a basic firing cycle that is a multiple of the number of rounds in
1676 the magazine totaling approximately 120 rounds.

1677
1678 — Example 1: If the magazine holds 17 rounds, the basic firing cycle would include 7 full
1679 magazines for a total of 119 rounds.

1680
1681 — Example 2: If the magazine holds 20 rounds, the basic firing cycle would include 6 full
1682 magazines for a total of 120 rounds.

1683
1684 **7.4.12** The firing procedure for “light-duty” testing shall include 5 basic firing cycles for
1685 a total round count of approximately 600 rounds.

1686
1687 — Example: The firing procedure for a pistol with a magazine that holds 12 rounds would
1688 include 5 basic firing cycles of 120 rounds per basic firing cycle.

1689
1690 **7.4.13** The firing procedure for “heavy-duty” testing shall include 50 basic firing cycles
1691 for a total round count of approximately 6,000 rounds.

1692
1693 — Example: The firing procedure for a pistol with a magazine that holds 12 rounds would
1694 include 50 basic firing cycles of 120 rounds per basic firing cycle.

1695
1696 **7.4.14** If the firing procedure should differ from 7.4.12 or 7.4.13, the firing procedure
1697 shall be specified.

1698
1699 **7.4.15** Firing shall be done at a regular cadence of approximately one shot per second
1700 for semiautomatic or one shot per five seconds for single-shot firearms.

1701
1702 **7.4.16** Reloading and magazine changes should be done at a pace that can be
1703 comfortably maintained throughout the firings.

1704
1705 **7.4.17** Gun safety technology features shall be deactivated and reactivated periodically
1706 to ensure for proper functioning in accordance with the following:

1707
1708 — Pistols: Between reloading magazines.

1709

- 1710 — Revolver: Between reloading the cylinder.
1711
1712 — Shotguns: Ten times per basic firing cycle at regularly spaced intervals.
1713
1714 — Revolvers: Between reloading magazines or ten times per basic firing cycle at regularly
1715 spaced intervals if the rifle does not use a magazine.
1716
1717 **7.4.18** The firing procedure shall include appropriate breaks for cooling, cleaning,
1718 lubrication, and other maintenance activities.
1719
1720 **7.4.19** Parts shall be replaced only when they become unserviceable or present a safety
1721 hazard.
1722
1723 **7.4.20** The first rounds of the first cycle shall include testing accuracy and dispersion in
1724 accordance with 7.3.
1725
1726 **7.4.21** The firearm shall be allowed to cool for a minimum of 10 minutes after each
1727 basic firing cycle, or approximately every 120 rounds.
1728
1729 **7.4.22** The firearm shall be cooled to the point that the barrel can be held indefinitely in
1730 a bare hand every two basic firing cycles, or approximately every 240 rounds.
1731
1732 **7.4.23** The firearm shall be wiped and lubricated without disassembly after every five
1733 basic firing cycles, or approximately every 600 rounds.
1734
1735 **7.4.24** The firearm shall be disassembled, cleaned, inspected, lubricated, and
1736 reassembled every 10 basic firing cycles, or approximately every 1,200 rounds.
1737
1738 **7.4.25** Accuracy and dispersion measurements shall be repeated every 10 basic firing
1739 cycles, or approximately every 1,200 rounds.
1740
1741 **7.4.26** NDT shall be added to the CIL every 20 basic firing cycles, or approximately
1742 every 2,400 rounds.
1743
1744 **7.4.27** The following data shall be recorded:
1745
1746 — Bore and headspace measurements;
1747
1748 — NDT results;
1749
1750 — Temperature and exposure times;
1751
1752 — Malfunctions in accordance with 6;
1753
1754 — All maintenance actions performed;
1755

1756 — All difficulties in loading or operating the firearms; and

1757

1758 — Meteorological conditions.

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1812 **7.5 High temperature**

1813
1814 This test is adapted from TOP 3-2-045 Test Procedure 4.5.1.a to determine the effect of
1815 high temperatures on the performance of firearms.

1816
1817 **Personnel are required to load, fire, and service the firearm in a high temperature**
1818 **environment!**

1819
1820 — Precautions must be taken to prevent possible heat injuries.

1821
1822 — Local SOPs must be followed to prevent possible heat injuries.

1823
1824 **7.5.1** Documentation requirements in 4 shall be observed at all times.

1825
1826 **7.5.2** Conditioning test items in a hot test environment shall be done in accordance
1827 with MIL-STD-810G, Method 501.6.

1828
1829 **7.5.3** Conditioning shall follow the Basic Hot (A2) profile as described in MIL-STD-
1830 810G, Method 501.6 based on climatic data found in AR 70-38.

1831
1832 **7.5.4** Prior to conditioning, the test firearm shall be cleaned and lubricated with a
1833 lubricant specified for high temperatures.

1834
1835 **7.5.5** Prior to firing, the test firearm and ammunition shall be conditioned in a climatic
1836 chamber for at least 6 hours at 63°C (145°F), which corresponds to the upper bound of the
1837 induced air temperature for Basic Hot (A2).

1838
1839 **7.5.6** The basic firing cycle for the particular type of firearm being tested described in
1840 7.4.8 through 7.4.11 shall be used.

1841
1842 **7.5.7** The firing procedure for “light-duty” testing shall include one basic firing cycle
1843 for a total round count of approximately 120 rounds.

1844
1845 **7.5.8** The firing procedure for “heavy-duty” testing shall include eight basic firing
1846 cycles for a total round count of approximately 960 rounds.

1847
1848 **7.5.8.1** Two basic firing cycles, or approximately 240 rounds, shall be fired from the
1849 test firearm.

1850
1851 **7.5.8.2** The test firearm shall be reconditioned in the climatic chamber for at least
1852 two hours at 63°C (145°F).

1853
1854 **7.5.8.3** 7.5.8.1 and 7.5.8.2 shall be repeated until eight basic firing cycles, or
1855 approximately 960 rounds, have been fired.

1856
1857 **7.5.9** Firing shall be done in accordance with 7.4.15 through 7.4.17.

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7.5.10 Maintenance should not be performed prior to all rounds being fired.

7.5.11 If maintenance is required before the end of the firing procedure, as indicated by increased malfunction rate, difficulty in loading or operating the firearm, etc., the firearm shall be removed from the climatic chamber and maintenance shall be performed as required.

7.5.12 After all rounds have been fired, the test firearm shall be removed from the conditioning chamber and allowed to cool.

7.5.13 The test firearm shall be immediately disassembled, thoroughly inspected, cleaned, and lubricated in accordance with 7.2.

7.5.14 Any changes observed shall be recorded.

7.5.15 The following data shall be recorded:

- Temperature and exposure times;
- Malfunctions in accordance with 6;
- Any damage noted during inspection;
- All maintenance actions performed; and
- All difficulties in loading or operating the firearms.

1904 **7.6 Low temperature**
1905

1906 This test is adapted from TOP 3-2-045 Test Procedure 4.5.1.b to determine the effect of low
1907 temperatures on the performance of firearms.

1908
1909 **Personnel are required to load, fire, and service the firearm in a low temperature**
1910 **environment!**

1911
1912 — Precautions must be taken to prevent possible injuries due to the cold environment.

1913
1914 — Local SOPs must be followed to prevent possible injuries due to the cold environment.

1915
1916 — Particular attention must be given to avoid the contact of bare skin with the firearm,
1917 ammunition, or any cold surface.

1918
1919 **7.6.1** Documentation requirements in 4 shall be observed at all times.

1920
1921 **7.6.2** Conditioning test items in a hot test environment shall be done in accordance
1922 with MIL-STD-810G, Method 502.6.

1923
1924 **7.6.3** Conditioning shall follow the Basic Cold (C1) profile as described in MIL-STD-
1925 810G, Method 501.6 based on climatic data found in AR 70-38.

1926
1927 **7.6.4** Prior to conditioning, the test firearm shall be cleaned and lubricated with a
1928 lubricant specified for high temperatures.

1929
1930 **7.6.5** Prior to firing, the test firearm and ammunition shall be conditioned in a climatic
1931 chamber for at least 6 hours at -33°C (-28°F), which corresponds to the lower bound of the
1932 induced air temperature for the Basic Cold (C1) profile.

1933
1934 **7.6.6** The basic firing cycle for the particular type of firearm being tested described in
1935 7.4.8 through 7.4.11 shall be used.

1936
1937 **7.6.7** The firing procedure for “light-duty” testing shall include one basic firing cycle
1938 for a total round count of approximately 120 rounds.

1939
1940 **7.6.8** The firing procedure for “heavy-duty” testing shall include eight basic firing
1941 cycles for a total round count of approximately 960 rounds.

1942
1943 **7.6.8.1** Two basic firing cycles, or approximately 240 rounds, shall be fired from the
1944 test firearm.

1945
1946 **7.6.8.2** The test firearm shall be reconditioned in the climatic chamber for at least
1947 two hours at -33°C (-28°F).

1948

1949 **7.6.8.3** 7.6.8.1 and 7.6.8.2 shall be repeated until eight basic firing cycles, or
1950 approximately 960 rounds, have been fired.

1951
1952 **7.6.9** Firing shall be done in accordance with 7.4.15 through 7.4.17.

1953
1954 **7.6.10** Maintenance should not be performed prior to all rounds being fired.

1955
1956 **7.6.11** If maintenance is required before the end of the firing procedure, as indicated by
1957 increased malfunction rate, difficulty in loading or operating the firearm, etc., the firearm
1958 shall be removed from the climatic chamber and maintenance shall be performed as
1959 required.

1960
1961 **7.6.12** After all rounds have been fired, the test firearm shall be removed from the
1962 conditioning chamber and allowed to warm up.

1963
1964 **7.6.13** The test firearm shall be immediately disassembled, cleaned, inspected, and
1965 lubricated in accordance with 7.2.

1966
1967 **7.6.14** Any changes observed shall be recorded.

1968
1969 **7.6.15** The following data shall be recorded:

- 1970
1971 — Temperature and exposure times;
1972
1973 — Malfunctions in accordance with 6;
1974
1975 — Any damage noted during inspection;
1976
1977 — All maintenance actions performed;
1978
1979 — Any difficulties in loading or operating the firearms peculiar to operation at low
1980 temperature, including any difficulties when using cold weather gear; and
1981
1982 — Evidence of bullet instability.

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1995 **7.7 Humidity**

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This test is adapted from TOP 3-2-045 Test Procedure 4.5.2 to determine the effect of high humidity on the performance of firearms.

7.7.1 Documentation requirements in 4 shall be observed at all times.

7.7.2 Conditioning test items in a humid test environment shall be done in accordance with MIL-STD-810G, Method 507.6.

7.7.3 Conditioning shall follow the Aggravated Cycle outlined in 4.4.2.2 and shown in Table 507.6-7 in MIL-STD-801G.

— Maintain the relative humidity at $95\pm 4\%$ at all times except that during the descending temperature periods the relative humidity may drop to as low as 85%.

— A cycle is 24 hours.

— The temperature profile is as follows:

Time	T (°C)	T (°F)
00:00	30	86
02:00	60	140
08:00	60	140
16:00	30	86
24:00	30	86

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7.7.4 Prior to conditioning, the test firearm shall be cleaned and lubricated with a lubricant specified for high temperatures.

7.7.5 Prior to firing, the test firearm and ammunition shall be conditioned in the climatic chamber for at least 24 hours at $-27\pm 2^{\circ}\text{C}$ ($73\pm 3.6^{\circ}\text{F}$) and $50\pm 5\%$ RH.

7.7.6 The test firearm shall be exposed to the temperatures and humidity in 7.7.3 for ten consecutive 24-hour cycles in the climatic chamber.

7.7.7 The ammunition required for this test shall not be exposed to the environmental conditions.

7.7.8 The test firearm shall be removed from the climatic chamber between hour 20 and hour 24 of the exposure cycle for test firings.

2032 **7.7.9** The basic firing cycle for the particular type of firearm being tested described in
2033 7.4.8 through 7.4.11 shall be used.

2034
2035 **7.7.10** Two basic firing cycles, or approximately 240 rounds, shall be fired from the test
2036 firearm during the third, fifth, eighth, and tenth cycles.

2037
2038 **7.7.11** Firing shall be done in accordance with 7.4.15 through 7.4.17.

2039
2040 **7.7.12** The test firearm shall be placed back into the climatic chamber without cleaning,
2041 lubrication, or maintenance after each pair of two basic firing cycles.

2042
2043 **7.7.13** Maintenance should not be performed prior to all rounds being fired.

2044
2045 **7.7.14** If maintenance is required before the end of the firing procedure, as indicated by
2046 increased malfunction rate, difficulty in loading or operating the firearm, etc., maintenance
2047 shall be performed as required.

2048
2049 **7.7.15** If an unscheduled interruption occurs that causes the exposure conditions to fall
2050 below allowable limits, the test shall be restarted from the end of the last successfully
2051 completed 24-hour cycle.

2052
2053 **7.7.16** After 960 rounds have been fired through the test firearm, the test firearm shall
2054 be immediately disassembled, cleaned, inspected, and lubricated in accordance with 7.2.

2055
2056 **7.7.17** Any changes observed shall be recorded.

2057
2058 **7.7.18** The following data shall be recorded:

- 2059
2060 — Records to substantiate proper exposure chamber operation;
2061
2062 — Malfunctions in accordance with 6;
2063
2064 — Any damage noted during inspection; and
2065
2066 — All maintenance actions performed.

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2078 **7.8 Sand and dust**

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2080 This test is adapted from TOP 3-2-045 Test Procedure 4.5.4.b(4) to determine the effects of
2081 blowing sand and dust on firearm performance.

2082
2083 **Caution should be exercised when handling the sand and dust compounds!**

2084
2085 — These compounds are largely composed of silica which is considered hazardous under
2086 Occupational Safety and Health Administration standards.

2087
2088 — Obtain the manufacture’s Material Safety Data Sheet for additional information.

2089
2090 — Consult local safety specialists with questions on proper handling procedures.

2091
2092 **7.8.1** Documentation requirements in 4 shall be observed at all times.

2093
2094 **7.8.2** Conditioning test items in a sandy and dusty conditioning environment shall be
2095 done in accordance with MIL-STD-810G, Method 510.6.

2096
2097 **7.8.3** Sand and dust exposure shall be conducted in a static chamber.

2098
2099 **7.8.4** The chamber is a box of any size that allows free circulation of the sand and dust
2100 laden air around the test firearm.

2101
2102 **7.8.5** A volumetric dry feeder and electric blower should be attached to the back end
2103 of the chamber.

2104
2105 **7.8.6** The feeder shall deliver a constant but adjustable flow of dust mixture to the air
2106 delivery duct of the blower.

2107
2108 **7.8.7** Vents should be provided to relieve any buildup of air pressure and aid air
2109 circulation.

2110
2111 **7.8.8** Access doors, windows, and cable ports may be incorporated as needed, but they
2112 shall fit tightly enough to contain the circulating atmosphere.

2113
2114 **7.8.9** The chamber may be bottomless so that it can be lowered over the test firearm
2115 and mount.

2116
2117 **7.8.10** The chamber does not need to accommodate firings, but it should be located as
2118 closely as possible to a firing position.

2119
2120 **7.8.11** The sand and dust compounds that should be used are those identified in 5.3.24.

2121
2122 **7.8.12** Should these compounds not be available, similar compounds can be substituted.

2123

- 2124 **7.8.13** The test firearm shall be cleaned and lubricated prior to conditioning.
2125
- 2126 **7.8.14** One basic firing cycle for the particular type of firearm being tested described in
2127 7.4.8 through 7.4.11 shall be used.
2128
- 2129 **7.8.15** The test firearm shall be conditioned fully loaded in a “safe” state.
2130
- 2131 **7.8.16** The remaining ammunition to permit one basic firing cycle of rounds shall not be
2132 conditioned.
2133
- 2134 **7.8.17** The test firearm shall be positioned vertically in in a normal firing position
2135 inside the chamber.
2136
- 2137 **7.8.18** The volumetric feeder and electric blower of the static test chamber shall be
2138 adjusted to dispense the mixture at a rate of 100 ± 25 g/min·m² as specified in 5.3.23 over
2139 the area of concern.
2140
- 2141 **7.8.19** The actual rate can be determined prior to exposure of the test firearm by
2142 placing a flat collection plate of known size in the position to be occupied by the test
2143 firearm, operating the chamber for one minute, and weighing the mixture that has been
2144 deposited on the plate.
2145
- 2146 **7.8.20** The dust dispenser shall be turned on and operated for 5 minutes.
2147
- 2148 **7.8.21** After 5 minutes, the dispenser shall be turned off and the dust shall be allowed
2149 to settle before entering the chamber.
2150
- 2151 **7.8.22** The exposed test firearm and ammunition shall be transported to the firing
2152 position while disturbing any sand and dust deposits as little as possible.
2153
- 2154 **7.8.23** Firing shall be done in accordance with 7.4.15 through 7.4.17.
2155
- 2156 **7.8.24** Maintenance should not be performed prior to all rounds being fired.
2157
- 2158 **7.8.25** If firearm performance is unsatisfactory, the congested parts shall be cleaned as
2159 much as possible by blowing sharply or by jarring the firearm.
2160
- 2161 **7.8.26** If performance is still unsatisfactory, any remaining exposed ammunition shall
2162 be replaced with clean ammunition.
2163
- 2164 **7.8.27** If repeated malfunctions make it impossible to fire all of the ammunition, the test
2165 firearm shall be cleaned, inspected, and lubricated prior to firing the remaining
2166 ammunition.
2167

2168 **7.8.28** If repeated malfunctions make it impractical to fire the remaining ammunition,
2169 the test firearm shall be completely disassembled to determine the exact source of dust-
2170 induced malfunction.

2171
2172 **7.8.29** The test firearm shall be reassembled and several rounds shall be fired to verify
2173 serviceability.

2174
2175 **7.8.30** At the end of the test, the test firearm shall be immediately disassembled,
2176 cleaned, inspected, and lubricated in accordance with 7.2.

2177
2178 **7.8.31** Any changes observed shall be recorded.

2179
2180 **7.8.32** The following data shall be recorded:

- 2181 — Full specification of the sand and dust compounds used;
- 2182 — Actual sand and dust dispensing rate;
- 2183 — Chamber dimensions;
- 2184 — Position of the test firearm and ammunition while in the chamber;
- 2185 — Any difficulties encountered during operation of the test firearm;
- 2186 — Actual number of rounds fired;
- 2187 — Malfunctions in accordance with 6;
- 2188 — Any damage noted during inspection; and
- 2189 — All maintenance actions performed.

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2214 **7.9 Water immersion**
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2216 This test is adapted from TOP 3-2-045 Test Procedure 4.5.6 and MIL-STD-810G Method
2217 512.6 to determine firearm performance following water immersion.

2218

2219 **7.9.1** Documentation requirements in 4 shall be observed at all times.
2220

2221 **7.9.2** Immersing test items in water shall be done in accordance with MIL-STD-810G,
2222 Method 512.6.
2223

2224 **7.9.3** A water container that can achieve a covering depth of 1 m of water over the
2225 uppermost point of the test item and maintain the test item at that depth shall be used.
2226

2227 **7.9.4** The temperature of the water shall be 18°C ±10°C (64°F ±18°F).
2228

2229 **7.9.5** The immersion water temperature shall be measured and recorded.
2230

2231 **7.9.6** The test firearm shall be cleaned and lubricated prior to immersion.
2232

2233 **7.9.7** A complete visual examination of the test firearm shall be conducted prior to
2234 immersion with special attention to sealed areas, gaskets, seals, and structural integrity,
2235 and the results shall be documented.
2236

2237 **7.9.8** Additional sealing, taping, caulking, or other means to resist water leakage shall
2238 not be used on the test firearm.
2239

2240 **7.9.9** One basic firing cycle for the particular type of firearm being tested described in
2241 7.4.8 through 7.4.11 shall be used.
2242

2243 **7.9.10** The test firearm shall be immersed fully loaded in a “safe” state.
2244

2245 **7.9.11** The remaining ammunition to permit one basic firing cycle of rounds shall not be
2246 immersed.
2247

2248 **7.9.12** The fully loaded test firearm shall be weighed prior to immersion.
2249

2250 **7.9.13** The test firearm shall be stabilized at standard ambient conditions prior to
2251 immersion.
2252

2253 **7.9.14** The test firearm shall be positioned vertically in in a normal firing position
2254 inside the immersion container.
2255

2256 **7.9.15** The test firearm shall be secured in a manner that will allow it to be maintained
2257 at the immersion depth in 7.9.3.
2258

2259 **7.9.16** The test firearm shall be immersed so that the uppermost point of the test item
2260 is 1.0±0.1 m below the surface of the water.

2261
2262 **7.9.17** The test firearm shall be immersed for 5 minutes.

2263
2264 **7.9.18** After 5 minutes, the test firearm shall be removed from the water and the
2265 exterior shall be wiped dry.

2266
2267 **7.9.19** The test item shall be weighed immediately after immersion and exterior wiping.

2268
2269 **7.9.20** The exposed test firearm shall be transported to the firing position.

2270
2271 **7.9.21** Firing shall be done in accordance with 7.4.15 through 7.4.17.

2272
2273 **7.9.22** Maintenance should not be performed prior to all rounds being fired.

2274
2275 **7.9.23** If firearm performance is unsatisfactory, the test firearm shall be item and
2276 examined evidence of water leakage. Any water found and probable points of entry shall
2277 be documented and blotted away.

2278
2279 **7.9.24** If performance is still unsatisfactory, any remaining exposed ammunition shall
2280 be replaced with clean ammunition.

2281
2282 **7.9.25** If repeated malfunctions make it impossible to fire all of the ammunition, the test
2283 firearm shall be cleaned, inspected, and lubricated prior to firing the remaining
2284 ammunition.

2285
2286 **7.9.26** If repeated malfunctions make it impractical to fire the remaining ammunition,
2287 the test firearm shall be completely disassembled to determine the exact source of water-
2288 induced malfunction.

2289
2290 **7.9.27** The test firearm shall be reassembled and several rounds shall be fired to verify
2291 serviceability.

2292
2293 **7.9.28** At the end of the test, the test firearm shall be immediately disassembled,
2294 cleaned, inspected, and lubricated in accordance with 7.2.

2295
2296 **7.9.29** Any changes observed shall be recorded.

2297
2298 **7.9.30** The following data shall be recorded:

- 2299
2300 — Immersion container dimensions;
2301
2302 — Position of the test firearm and ammunition while in the immersion container;
2303
2304 — Any difficulties encountered during operation of the test firearm;

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- Actual number of rounds fired;
- Malfunctions in accordance with 6;
- Any damage noted during inspection; and
- All maintenance actions performed.

2351 **7.10 1.5 m drop**

2352

2353 This test is adapted from TOP 3-2-045 Test Procedure 4.10, NIJ Standard 0112.03 Revision
2354 A Test 5.7, NIJ Standard 0109.00, and NIJ Standard 0113.00 to assess the possibility of
2355 accidental firing by dropping the firearm from a height of 1.5 m (approximately 5 ft).

2356

2357 **This test may damage the test item and therefore should be done near the end of the**
2358 **overall test sequence!**

2359

2360 **7.10.1** Documentation requirements in 4 shall be observed at all times.

2361

2362 **7.10.2** The test firearm shall be chambered with a primed but otherwise empty
2363 cartridge.

2364

2365 **7.10.3** The firearm shall be loaded to capacity with dummy ammunition, which shall
2366 consist of rounds for the firearm being tested with a projectile in place but no primer and
2367 no propellant.

2368

2369 **7.10.4** The test firearm shall be dropped onto a clean, level concrete surface.

2370

2371 **7.10.5** The test firearm shall be dropped from a height of 1.5 m.

2372

2373 **7.10.6** The drop height shall be measured from the surface of the concrete to the lower
2374 most point of the firearm.

2375

2376 **7.10.7** The test firearm shall be dropped one time in each of the following orientations:

2377

2378 — Normal firing orientation, barrel horizontal;

2379

2380 — Upside down, barrel horizontal;

2381

2382 — On grip or butt, barrel vertical;

2383

2384 — On muzzle, barrel vertical;

2385

2386 — On left side, barrel horizontal;

2387

2388 — On right side, barrel horizontal; and

2389

2390 — On grip or butt, barrel 45° from vertical;

2391

2392 — On muzzle, barrel 45° from vertical;

2393

2394 **7.10.8** If the test firearm has an exposed hammer or striker, the firearm shall be
2395 dropped on the rearmost point of that device. Otherwise, it shall be dropped on the
2396 rearmost point of the test firearm.

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- 7.10.9** A video shall be recorded to verify the proper impact orientation.
- 7.10.10** The test firearm should be dropped by mechanical means, such as a fixture, but can be manually released in the required orientation.
 - For example, a firearm or firearm accessory that uses RFID with a body-worn token can be dropped from a fixture with the token attached to the fixture.
 - For example, a firearm or firearm accessory with an integrated fingerprint sensor will likely need a human operator to drop the device.
- 7.10.11** The firearm shall be dropped in the condition that it would be in if it were dropped when in hand and ready to fire.
- 7.10.12** Any additional gun safety technology shall be activated to permit firing prior to the drop tests and remain active for all drops.
- 7.10.13** The test firearm shall be cycled and returned to the specified testing condition after each drop.
- 7.10.14** The drop tests in 7.10.7 shall be repeated ten times with the manual safety off.
- 7.10.15** The drop tests in 7.10.7 shall be repeated ten times with the manual safety in the “safe” mode.
- 7.10.16** The firearm shall be inspected after each drop with following information recorded:
 - The position of the manual safety;
 - The state of the gun safety technology;
 - The condition of the primed cartridge; and
 - Any damage to the test firearm.
- 7.10.17** If the primed cartridge case has fired or if indentations are present, a fresh primed case shall be used for the next drop.
- 7.10.18** After all drops have been made, one basic firing cycle shall be fired through the test firearm.
- 7.10.19** The basic firing cycle for the particular type of firearm being tested described in 7.4.8 through 7.4.11 shall be used.

2443 **7.10.20** Firing shall be done in accordance with 7.4.15 through 7.4.17.

2444

2445 **7.10.21** Maintenance should not be performed prior to all rounds being fired.

2446

2447 **7.10.22** If firearm performance is unsatisfactory, the test firearm shall be item and
2448 examined evidence of damage. Any damage found and shall be documented.

2449

2450 **7.10.23** If repeated malfunctions make it impractical to fire the remaining ammunition,
2451 the test firearm shall be completely disassembled and serviced to bring it to a state of
2452 normal operation.

2453

2454 **7.10.24** The test firearm shall be reassembled and several rounds shall be fired to verify
2455 serviceability.

2456

2457 **7.10.25** At the end of the test, the test firearm shall be immediately disassembled,
2458 cleaned, inspected, and lubricated in accordance with 7.2.

2459

2460 **7.10.26** Any changes observed shall be recorded.

2461

2462 **7.10.27** The following data shall be recorded:

2463

2464 — Video recording of each drop;

2465

2466 — The position of the manual safety after each drop;

2467

2468 — The state of the gun safety technology after each drop;

2469

2470 — The condition of the primed cartridge after each drop;

2471

2472 — Any damage to the test firearm.

2473

2474 — Any difficulties encountered during operation of the test firearm;

2475

2476 — Actual number of rounds fired;

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2478 — Malfunctions in accordance with 6;

2479

2480 — Any damage noted during inspection; and

2481

2482 — All maintenance actions performed.

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2489 **7.11 Mechanical jostling**

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2491 This test is adapted from TOP 3-2-045 Test Procedure 4.10 to assess the possibility of
2492 accidental firing and to determine any impact on performance due to mechanical jostling.

2493
2494 **This test may damage the test item and therefore should be done near the end of the**
2495 **overall test sequence!**

2496
2497 **7.11.1** Documentation requirements in 4 shall be observed at all times.

2498
2499 **7.11.2** Exposure of test items to mechanical jostling shall be done in accordance with
2500 with ITOP 4-2-602 Loose Cargo Test.

2501
2502 **7.11.3** The test firearm shall be chambered with a primed but otherwise empty
2503 cartridge.

2504
2505 **7.11.4** The firearm shall be loaded to capacity with dummy ammunition, which shall
2506 consist of rounds for the firearm being tested with a projectile in place but no primer and
2507 no propellant.

2508
2509 **7.11.5** The firearm shall be exposed to mechanical jostling in the condition that it would
2510 be in if it were in hand and ready to fire.

2511
2512 **7.11.6** Any additional gun safety technology shall be deactivated to prevent firing prior
2513 to mechanical jostling and remain active throughout exposure.

2514
2515 **7.11.7** The test machine shall be operated at a 25 mm peak circular motion at a
2516 frequency of 5 Hz.

2517
2518 **7.11.8** The test firearm shall be placed in the test machine left side down.

2519
2520 **7.11.9** The test machine shall be operated for 5 minutes.

2521
2522 **7.11.10** The test firearm shall be placed in the test machine right side down.

2523
2524 **7.11.11** The test machine shall be operated for 5 minutes.

2525
2526 **7.11.12** The test firearm shall be cycled and returned to the specified testing condition
2527 after each 5-minute exposure.

2528
2529 **7.11.13** The exposure in 7.11.9 shall be repeated ten times with the manual safety in the
2530 "safe" mode.

2531
2532 **7.11.14** The exposure in 7.11.11 shall be repeated ten times with the manual safety off.

2533

2534 **7.11.15** The firearm shall be inspected after each 5-minute exposure with following
2535 information recorded:

- 2536 — The position of the manual safety;
- 2538 — The condition of the primed cartridge; and
- 2540 — Any damage to the test firearm.

2542 **7.11.16** If the primed cartridge case has fired or if indentations are present, a fresh
2543 primed case shall be used for the next drop.

2545 **7.11.17** After all exposures have been completed, one basic firing cycle shall be fired
2546 through the test firearm.

2548 **7.11.18** The basic firing cycle for the particular type of firearm being tested described in
2549 7.4.8 through 7.4.11 shall be used.

2551 **7.11.19** Firing shall be done in accordance with 7.4.15 through 7.4.17.

2553 **7.11.20** Maintenance should not be performed prior to all rounds being fired.

2555 **7.11.21** If firearm performance is unsatisfactory, the test firearm shall be item and
2556 examined evidence of damage. Any damage found and shall be documented.

2558 **7.11.22** If repeated malfunctions make it impractical to fire the remaining ammunition,
2559 the test firearm shall be completely disassembled and serviced to bring it to a state of
2560 normal operation.

2562 **7.11.23** The test firearm shall be reassembled and several rounds shall be fired to verify
2563 serviceability.

2565 **7.11.24** At the end of the test, the test firearm shall be immediately disassembled,
2566 cleaned, inspected, and lubricated in accordance with 7.2.

2568 **7.11.25** Any changes observed shall be recorded.

2570 **7.11.26** The following data shall be recorded:

- 2572 — The position of the manual safety after each 5-minute exposure;
- 2574 — The condition of the primed cartridge after each 5-minute exposure;
- 2576 — Any damage to the test firearm;
- 2578 — Any difficulties encountered during operation of the test firearm;

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- Actual number of rounds fired;
- Malfunctions in accordance with 6;
- Any damage noted during inspection; and
- All maintenance actions performed.

2626 **7.12 Electromagnetic interference (EMI)**
2627

2628 This test is adapted from TOP 3-2-045 Test Procedure 4.22.2(e) to ensure that the test
2629 firearm is able to function in its intended electromagnetic environment without its own
2630 performance being degraded. Gun safety technology can contain electronic components
2631 that may be susceptible to EMI.
2632

2633 **7.12.1** Documentation requirements in 4 shall be observed at all times.
2634

2635 **7.12.2** Exposure of test items to EMI shall be done in accordance with TOP 1-2-512
2636 Electromagnetic Compatibility Tests.
2637

2638 **7.12.3** The firearm shall be fired in the presence of electromagnetic radiation that could
2639 cause interference with the functioning of any integrated gun safety technology. If the test
2640 facility cannot accommodate live firing, the weapon may be dry fired to verify proper
2641 function of the safety technology.
2642

2643 **7.12.4** The specific frequencies that will need to be assessed will depend on the specific
2644 test item, however the appropriate tests in TOP 1-2-512 should be followed. If possible,
2645 one major frequency at a realistic signal strength should be identified for testing.
2646

2647 **7.12.5** Prior to exposure, the test firearm shall be cleaned and lubricated.
2648

2649 **7.12.6** The basic firing cycle for the particular type of firearm being tested described in
2650 7.4.8 through 7.4.11 shall be used.
2651

2652 **7.12.7** The firing procedure for “light-duty” testing shall include one basic firing cycle
2653 for a total round count of approximately 120 rounds.
2654

2655 **7.12.8** The firing procedure for “heavy-duty” testing shall include eight basic firing
2656 cycles for a total round count of approximately 960 rounds.
2657

2658 **7.12.9** The transmitter shall be turned on five minutes prior to firing.
2659

2660 **7.12.10** Firing shall be done in accordance with 7.4.15 through 7.4.17.
2661

2662 **7.12.11** Maintenance should not be performed prior to all rounds being fired.
2663

2664 **7.12.12** After all rounds have been fired, the transmitter shall be turned off.
2665

2666 **7.12.13** If firearm performance is unsatisfactory, the signal strength shall be reduced.
2667

2668 **7.12.14** If repeated malfunctions make it impractical to continue firing, the signal
2669 strength shall be reduced until the malfunctions are not having a substantial impact on
2670 firing.
2671

2672 **7.12.15** At the end of the test, the test firearm shall be immediately disassembled,
2673 cleaned, inspected, and lubricated in accordance with 7.2.

2674
2675 **7.12.16** Any changes observed shall be recorded.

2676
2677 **7.12.17** The following data shall be recorded:

- 2678
2679 — The frequency broadcast;
2680
2681 — The signal strength of the broadcast;
2682
2683 — Any reductions made to the signal strength;
2684
2685 — Any difficulties encountered during operation of the test firearm;
2686
2687 — Actual number of rounds fired;
2688
2689 — Malfunctions in accordance with 6;
2690
2691 — Any damage noted during inspection; and
2692
2693 — All maintenance actions performed.

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2718 **7.13 Quick draw scenario**
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2720 This test is designed to determine how a firearm performs when grabbed by the operator
2721 from a tabletop and a holster and immediately fired.

2722

2723 **7.13.1** Documentation requirements in 4 shall be observed at all times.

2724

2725 **7.13.2** Targets shall be positioned perpendicular to the line of fire.

2726

2727 **7.13.3** Electronic targets that do not physically interfere with the bullet trajectory
2728 should be used.

2729

2730 **7.13.4** Physical targets, such as paper, cloth, or plywood may also be used.

2731

2732 **7.13.5** Targets for shall be positioned at a range of 10 meters.

2733

2734 **7.13.6** Timing devices shall be used to measure the time from a signal to fire to the
2735 discharge by the test operator.

2736

2737 **7.13.7** One signal shall be audible, such as a beep, chime, or buzz.

2738

2739 **7.13.8** One signal shall be visual, such as a light that turns on.

2740

2741 **7.13.9** The choice of audible or visual signal in each trial shall be random such that the
2742 test operator cannot expect the signal to be the same time each trial.

2743

2744 **7.13.10** The time that the signal is activated shall be random such that the test operator
2745 cannot expect the signal at the same time each trial.

2746

2747 **7.13.11** Timing shall be measured in one of two ways:

2748

2749 — The time from the signal to firearm discharge; or

2750

2751 — The time from the signal to a round hitting or passing the target.

2752

2753 **7.13.12** Two setups shall be used, a tabletop setup and a holster setup.

2754

2755 **7.13.13** For the tabletop setup, a fully loaded test firearm shall be placed on a table 1.0
2756 meters high in front of the test operator.

2757

2758 **7.13.14** If the operator is right-handed, the test firearm shall be placed on its left side. If
2759 the operator is left-handed, the test firearm shall be placed on its right side.

2760

2761 **7.13.15** Starting from a comfortable standing position, the firing personnel shall pick up
2762 the test firearm from the tabletop upon hearing or seeing the signal and fire one shot as
2763 quickly as possible at the target.

2764
2765 **7.13.16** The firing personnel shall return the test firearm to the table in the same
2766 position.

2767
2768 **7.13.17** The following data shall be recorded after each trial:

- 2769 — The type of signal used, either audible or visual;
2770
2771 — Timing in accordance with 7.13.11;
2772
2773 — Malfunctions in accordance with 6; and
2774
2775 — Any difficulties encountered during operation of the test firearm;
2776

2777
2778 **7.13.18** For the holster setup, a fully loaded test firearm shall be placed in an appropriate
2779 holster on the test operator.

2780
2781 **7.13.19** The holster shall be worn on the waist on the same side of the body as the firing
2782 hand.

2783
2784 **7.13.20** Starting from a comfortable standing position, the firing personnel shall draw
2785 the test firearm from the holster upon hearing or seeing the signal and fire one shot as
2786 quickly as possible at the target.

2787
2788 **7.13.21** The firing personnel shall return the test firearm to the holster.

2789
2790 **7.13.22** The following data shall be recorded after each trial:

- 2791 — The type of signal used, either audible or visual;
2792
2793 — Timing in accordance with 7.13.11;
2794
2795 — Malfunctions in accordance with 6; and
2796
2797 — Any difficulties encountered during operation of the test firearm;
2798

2799
2800 **7.13.23** The basic firing cycle for the particular type of firearm being tested described in
2801 7.4.8 through 7.4.11 shall be used.

2802
2803 **7.13.24** For “light-duty” testing, one test operator shall fire one basic firing cycle using
2804 the tabletop setup and one basic firing cycle using the holster setup.

2805
2806 **7.13.25** For “heavy-duty” testing, three test operators shall each fire one basic firing
2807 cycle using the tabletop setup and one basic firing cycle using the holster setup.
2808

2809 **7.13.26** At the end of the test, the test firearm shall be immediately disassembled,
2810 cleaned, inspected, and lubricated in accordance with 7.2.

2811
2812 **7.13.27** Any changes observed shall be recorded.

2813
2814 **7.11.28** The following data shall be recorded:

- 2815
- 2816 — The type of signal used, either audible or visual;
- 2817
- 2818 — Timing in accordance with 7.13.11;
- 2819
- 2820 — Any difficulties encountered during operation of the test firearm;
- 2821
- 2822 — Actual number of rounds fired;
- 2823
- 2824 — Malfunctions in accordance with 6;
- 2825
- 2826 — Any damage noted during inspection; and
- 2827
- 2828 — All maintenance actions performed.

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2855 **7.14 Unauthorized user false positive**
2856

2857 This test is designed to determine how a gun safety technology performs when an
2858 unauthorized operator attempts to fire a smart gun.

2859
2860 **7.14.1** Documentation requirements in 4 shall be observed at all times.
2861

2862 **7.14.2** The test operator should not be authorized to use the firearm, depending on the
2863 modality of the gun safety technology employed.
2864

2865 — For example, if the smart gun uses RFID and a body-worn token, the operator should
2866 not wear the token and it should be kept well out of range from the test firearm.
2867

2868 — For example, if the smart gun uses a fingerprint sensor, the operator should not have
2869 fingerprint data loaded on the onboard memory.
2870

2871 **7.14.3** A fully loaded test firearm shall be placed on a table 1.0 meters high in front of
2872 the test operator.
2873

2874 **7.14.4** If the operator is right-handed, the test firearm shall be placed on its left side. If
2875 the operator is left-handed, the test firearm shall be placed on its right side.
2876

2877 **7.14.5** Starting from a comfortable standing position, the firing personnel shall pick up
2878 the test firearm and attempt to fire one shot at the target.
2879

2880 **7.14.6** The firing personnel shall return the test firearm to the table in the same
2881 position.
2882

2883 **7.14.7** The following data shall be recorded after each trial:
2884

2885 — The result of each trial;
2886

2887 — Malfunctions in accordance with 6; and
2888

2889 — Any difficulties encountered during operation of the test firearm;
2890

2891 **7.14.8** The basic firing cycle for the particular type of firearm being tested described in
2892 7.4.8 through 7.4.11 shall be used.
2893

2894 **7.14.9** For “light-duty” testing, one test operator shall attempt to fire one basic firing
2895 cycle.
2896

2897 **7.14.10** For “heavy-duty” testing, three test operators shall each attempt to fire one basic
2898 firing cycle.
2899

2900 **7.14.11** At the end of the test, the test firearm shall be immediately disassembled,
2901 cleaned, inspected, and lubricated in accordance with 7.2.

2902
2903 **7.14.12** Any changes observed shall be recorded.

2904
2905 **7.14.13** The following data shall be recorded:

- 2906
2907 — The result of each trial;
2908
2909 — Any difficulties encountered during operation of the test firearm;
2910
2911 — Actual number of rounds fired;
2912
2913 — Malfunctions in accordance with 6;
2914
2915 — Any damage noted during inspection; and
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2917 — All maintenance actions performed.
2918