

Idaho State Police Forensic Services

Approval for Quality System Controlled Documents



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Training Manual

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Quality Manager

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Idaho State Police Forensic Services

FIREARMS & TOOL MARK EXAMINER TRAINING Manual

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Section 1.0 ADMINISTRATIVE MATTERS AND PROCEDURES

1.1 Obtain a copy of the Quality Procedure Manual. Familiarize yourself with its contents and indicate you understand the rules and procedures contained therein by your signature below.

Trainee

Date

1.2 Discuss with your Lab Manager the laboratory Quality Assurance Program and the Proficiency Testing Program.

Lab Manager

Date:

1.3 Discuss with your Lab Manager the laboratory policy regarding the reexamination of evidence.

Lab Manager

Date

1.4 Discuss with your Lab Manager the laboratory policies regarding the following:

- (a) Providing telephonic results prior to issuance of a final laboratory report.
- (b) Inquiries from the press and other media.
- (c) Request to give a deposition in a criminal case.
- (d) Request to testify in a civil case.
- (e) Request to testify in a grand jury proceeding or a preliminary hearing.
- (f) Providing a laboratory report to other agencies.

Lab Manager

Date

1.5 Become familiar with the requirements and the facilities available for the secure storage of evidence within the lab. Discuss this with the Lab Manager and an examiner from the lab.

Lab Manager

Date

Discipline Leader/on-site trainer

Date

Section 2 BACKGROUND/HISTORY OF FIREARMS IDENTIFICATION

- 2.1 Define the following terms:
(a) firearms identification
(b) ballistics

Discipline Leader/on-site trainer

Date

- 2.2 Read the applicable sections from the basic references and prepare a report on the history, principles, evolution and scope of firearms identification in its broadest sense. Support your report by data accumulated in your notebook. Discuss this with the Discipline Leader/on-site trainer who will review your report.

Discipline Leader/on-site trainer

Date

- 2.3 Formulate an answer to the following questions:
(a) Is firearms identification an art or science?
(b) What are the types of conclusions that can be reached in firearms identification comparisons?
(c) What is the basis for each of the above conclusions?
(d) Can experts in the field of firearms identification disagree regarding their conclusions? Why?
(e) How does "probability" relate to firearms identification?

Discipline Leader/on-site trainer

Date

- 2.4 Familiarize yourself with the "Association of Firearms and Toolmark Examiners" (AFTE) to include its history, criteria for membership, committees, the AFTE glossary and the AFTE journal and be able to discuss them.

Discipline Leader/on-site trainer

Date

Section 3 FIREARMS & AMMUNITION DEVELOPMENT AND CURRENT TRENDS

3.1 Review the history of early firearms and ammunition development up to the advent of metallic cartridges, with particular emphasis on lock mechanisms, early rifling techniques, percussion systems, priming methods and pre-metallic cartridges. Prepare a chronological outline of this early development and discuss it with the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

3.2 Study the firearms reference collection noting in particular the types of firearms which are representative of commercial and military firearms development since the advent of metallic cartridges.

Discipline Leader/on-site trainer

Date

3.3 Trace the evolution of the rimfire cartridge from the mid-nineteenth century to the current generation of modern .22 caliber rimfire cartridges.

Discipline Leader/on-site trainer

Date

3.4 Study the history of centerfire cartridge development starting with black powder cartridges to the current generation of modern centerfire cartridges. Make notes to show the chronological history of this development and discuss it with the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

3.5 Study the Standard Ammunition File (SAF), in particular cartridges and shotshells which are representative of commercial and military ammunition development during the past three decades.

Discipline Leader/on-site trainer

Date

Section 4 MANUFACTURE OF MODERN FIREARMS

4.1 Numerous techniques are used in the manufacture of modern firearms. Research in detail these processes and set these out in your notes. Include but do not restrict your study to the following machining methods:

- (a) shaping
- (b) planning
- (c) Drilling
- (d) reaming
- (e) turning
- (f) boring
- (g) milling-include both face milling and peripheral (slab) milling
- (h) broaching
- (i) abrasive machining-include honing, lapping, grinding, sanding, and ultrasonic methods
- (j) sawing
- (k) filing
- (l) swaging
- (m) electrochemical machining (ECM)
- (n) electrodischarge machining (EDM)
- (o) investment casing

Discipline Leader/on-site trainer

Date

4.2 Demonstrate your knowledge of the basic nomenclature of handguns, rifles, and shotguns.

- a. Include, but do not restrict your study, to the following: breechface, breechbolt, bolt, bolt face, extractor, ejector, firing pin, rifling, barrel, lands, grooves, ramp, magazine, clip, ejection port, receiver.
- b. Point out these parts in several handguns, rifles and shotguns as applicable.
- c. Discuss the manufacturing techniques which would have been used to fabricate and finish each of the parts and note the machining marks on each part.
- d. Point out any "mark of abuse" which could contribute to the uniqueness of each part.
- e. Identify areas that machining marks might "carry over" to another firearm.

Discipline Leader/on-site trainer

Date

- 4.7 Visit the manufacturing facilities of at least two firearms and/or barrel manufacturers such as Wilson barrels, Ruger, Smith and Wesson, Mossberg, Marlin and US Repeating Arms. Record notes in your notebook on each visit and produce a written report of your visit for lab files and an oral report for lab members. Particular emphasis should be placed on manufacturing and rifling techniques used by each manufacturer, noting methods and procedures which leave unique manufacturing toolmarks on firearms parts which, in turn, produce individual microscopic marks on bullets, cartridge cases and shotshell casings. Coordinate these visits with the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

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5.3 Discuss the purpose and essential ingredients of priming mixture used in modern cartridges.

Discipline Leader/on-site trainer

Date

5.4 Know and discuss the difference between caliber and caliber type. Illustrate this difference by relating these terms to a discussion of the .22 caliber, .30 caliber and .38 caliber families of cartridges.

Discipline Leader/on-site trainer

Date

5.5 Visit at least two ammunition-manufacturing facility such as Remington, Federal or Winchester to observe the manufacture of rimfire and centerfire cartridges and shotshells. Make detailed notes of the manufacturing processes and generate a written report for lab files. Also prepare an oral presentation for lab members upon your return. Particular emphasis should be placed on pellet and bullet manufacture, shotshell casing and cartridge case manufacture and the steps involved in the loading of cartridges and shotshells. Coordinate this visit with the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

Section 6 INSTRUMENTATION

6.1 Differentiate between the following:

- (a) compound microscope
- (b) stereo microscope
- (c) comparison microscope

Discipline Leader/on-site trainer

Date

Discipline Leader/on-site trainer

Date

6.7 Become familiar with and demonstrate the use of the following equipment:

- (a) speed micrometer
- (b) inertia bullet puller
- (c) steel rule
- (d) reticle in ocular lens of binocular microscope
- (e) balances and scales located in the lab

Discipline Leader/on-site trainer

Date

6.8 Review the maintenance and calibration of the balances in the firearms lab.

Discipline Leader/on-site trainer

Date

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- 7.4. Partially disassemble and reassemble a representative sample of revolvers from the reference collection. Photograph and note the differences in their mechanisms. Identify each part by name.

Discipline Leader/on-site trainer

Date

- 7.5 Field strip and reassemble a representative sample of the semiautomatic firearms in the firearm reference collection. Note the differences in their mechanisms. Be able to identify the parts using the specific manufacturers nomenclature

Discipline Leader/on-site trainer

Date

- 7.6 Field strip and reassemble a representative sample of submachine guns in the firearms reference collection. Note differences in the mechanism and operation of each. Identify the major parts by name.

Discipline Leader/on-site trainer

Date

- 7.7 Familiarize yourself with the operation of a representative sample of military and civilian center fire rifles from the firearms reference collection. Be able to identify the major components and action types of the various samples.

Discipline Leader/on-site trainer

Date

- 7.8. Familiarize yourself with the operation of each of a representative sample of shotguns in the firearms reference collection. Identify the major parts by name and make appropriate notes. Be able to discuss the various action types in the collection.

Discipline Leader/on-site trainer

Date

- 7.9. Familiarize yourself with the operation of a representative sample of the rimfire revolvers, pistols and rifles. Identify the major parts by name and make appropriate notes. Be able to discuss the various action types in the collection.

- (d) broken extractor
- (e) push off
- (f) trigger shoe
- (g) false half-cock
- (k) hairline cracks
- (l) improper timing
- (m) excessive pressure
- (n) dented barrel

Discipline Leader/on-site trainer

Date

7.15. Become familiar with the lab's firearms range including its physical dimensions, construction of walls and backstop, and bullet velocity limitations. Know how to test fire firearms thought to be possibly unsafe. Become familiar with the use of all the equipment on the range. Know the range rules and emergency medical treatment procedures.

Discipline Leader/on-site trainer

Date

7.16. Attend Armorer's training offered by various manufacturers of firearms, at their manufacturing facilities if possible. Coordinate these with the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

7.17. Explore the capabilities in restoring an inoperable evidence firearm to operating condition and also know the limitations and reservations which must be considered. Discuss this with the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

7.18. Review and record the references in the lab library which can be used to identify the manufacturer and/or source of a firearm using the following criteria:

- (a) proof marks
- (b) inspector marks
- (c) factory numbers and markings

Section 8.1 BULLET EXAMINATIONS AND COMPARISONS

8.1.1. Obtain a copy of and familiarize yourself with the lab protocol for the examination of fired bullets.

Discipline Leader/on-site trainer

Date

8.1.2. Define what is meant by or determine the significance of the following terms or phrases as they relate to the examination and comparison of fired bullets. Discuss with the Discipline Leader/on-site trainer.

- (a) slippage
- (b) shaving
- (c) obscuration
- (d) leading edge and trailing edge
- (e) melting
- (f) blow-by
- (g) striation
- (h) individual microscopic marks
- (i) ogive
- (j) bearing surface
- (k) class characteristics
- (l) general rifling characteristics
- (m) "insufficient individual microscopic marks"
- (n) corrosion
- (o) leading
- (p) "limited individual microscopic marks"
- (q) "single-action" firing
- (r) "double-action" firing

Discipline Leader/on-site trainer

Date

8.1.3. As they relate to the examination and comparison of fired bullets or bullet fragments, know the

characteristics of these fired bullets. Also prepare a list of firearms which could have been used to fire these bullets provided to you. As necessary, use the KSF, SAF, and GRC files in conducting these examinations.

Discipline Leader/on-site trainer

Date

8.1.8. Using test bullets fired from polygonal rifled barrels, demonstrate your proficiency in accurately determining the rifling characteristics of these fired bullets. Compile a list of firearms which could have been used to fire these bullets using the GRC file.

Discipline Leader/on-site trainer

Date

8.1.9. Become knowledgeable about the facilities in the lab for the recovery of fired test bullets. Know when and how to use the horizontal recovery tank and fiber box and their limitations. Observe and assist the Discipline Leader/on-site trainer from the lab in the recovery of fired bullets using each of these methods. Know and observe all safety rules.

Discipline Leader/on-site trainer

Date

8.1.10. Familiarize yourself with the ammunition storage areas in the lab. Know how to locate test ammunition after correctly selecting test ammunition using the SAF. Discuss with the Discipline Leader/on-site trainer the reasons for using substitute ammunition or down-loading ammunition for test firing. Know the proper procedure for down-loading ammunition for test firing. Under supervision of the Discipline Leader/on-site trainer prepare and fire down-loaded test ammunition.

Discipline Leader/on-site trainer

Date

8.1.11. Test fire "consecutively-made" barrels and/or microscopically compare test bullets from "consecutively-made" barrels. Observe the differences and similarities in the striations and discuss with the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

Discipline Leader/on-site trainer

Date

8.1.17. Using a .32 S & W caliber revolver, test fire two each of the following cartridges and compare the test bullets with each other. Conduct this test with the Discipline Leader/on-site trainer.

- (a) .32 S & W caliber Remington with lead bullet
- (b) .32 Auto caliber Remington with full metal case jacketed bullet

Discipline Leader/on-site trainer

Date

8.1.18. Test fire a representative sample of Polygonal or Hexagonal rifling profile pistols. Using two test bullets from each pistol, make microscopic comparisons of the test bullets. Conduct this test with the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

8.1.19. Compile a list of reasons as to why bullet identifications cannot be made in some cases, and why some barrels and bullets can preclude or tend to preclude identifications. This list should include, but not be limited to, the results of the above testing.

Discipline Leader/on-site trainer

Date

8.1.20. Discuss the significance of identifying manufacturing toolmarks on a fired bullet from a victim with those on unfired bullets loaded into cartridges from the suspect. Read the article in the April, 1985 issue of the Crime laboratory Digest concerning "Manufacturing Toolmark Identification on the Base of Jacketed Bullets".

Discipline Leader/on-site trainer

Date

8.1.21. Discuss the feasibility of determining caliber and/or the rifling characteristics of a fired bullet from an examination of a bullet hole in metal.

Discipline Leader/on-site trainer

Date

results of your comparisons.

Discipline Leader/on-site trainer

Date

8.2.5. Test fire the following firearms using comparable CCI, Remington, Federal, and Winchester ammunition of the appropriate caliber type for each firearm. Select ammunition with both nickel and brass primers. Test fire each firearm at least twice using each brand of ammunition. Microscopically intercompare and photograph the markings as in paragraph 3, above.

- (a) .38 Special caliber Smith & Wesson revolver
- (b) .357 Magnum caliber Smith & Wesson revolver
- (c) 9mm Smith & Wesson, , pistol
- (d) .22 long Rifle caliber Ruger pistol

Discipline Leader/on-site trainer

Date

8.2.6. Test fire a .22 Long Rifle caliber Smith and Wesson revolver, fire six .22 Long Rifle caliber cartridges, six .22 Long caliber cartridges, and six .22 Short caliber cartridges of the same manufacturer. Mark each cartridge to note the chamber in which it is fired. Intercompare and photograph the markings imparted to the fired cartridge cases.

Discipline Leader/on-site trainer

Date

8.2.7. Discuss the possibility of comparing and identifying reloading-type marks on cartridges/cartridge cases. Identify the various types of marks which may be indicative of reloaded ammunition. Become familiar with the reloading equipment in the lab and the procedures used in reloading cartridges. Reload several cartridges and compare reloading-type marks on these cartridges with each other.

Discipline Leader/on-site trainer

Date

8.2.8. Discuss the feasibility of comparing and identifying manufacturing toolmarks on a fired cartridge case from the scene of a crime with cartridges which can be associated with the suspect. Identify the various types of manufacturing toolmarks which may be present on cartridges or cartridge cases.

(g) shot collar and shot cup

Discipline Leader/on-site trainer

Date

8.3.2. Familiarize yourself with the use of the SAF in regard to the determination of gauge and manufacturer of fired shotshell components. Know the limitations in regard to making such determinations. Demonstrate your proficiency in using the SAF to conduct this type of search to the Discipline Leader/on-site trainer.

Discipline Leader/on-site trainer

Date

8.3.3. Using a shotgun, saw off a portion of the barrel. Test fire this shotgun using a Remington shotshell with a power piston wad. Recover the test shotshell wads and make microscopic comparisons of marks imparted to the test wads.

Discipline Leader/on-site trainer

Date

8.3.4. Test fire 4 shotguns using at least two test shotshell casings from each shotgun and microscopically compare the marks imparted to these shotshell casings. Include in your comparisons the following types of marks: firing pin impression, breechface marks (primer, battery cup, and head), extractor marks, ejector marks, chamber marks, and any other mechanism marks. Photograph these marks and discuss the significance of identifying any of these types of marks.

Discipline Leader/on-site trainer

Date

8.3.5. Using a 12 gauge semiautomatic shotgun, obtain at least two test shotshell casings with a representative sample of 12 gauge shotshell ammunition. Use small size shot, medium size shot, buckshot and slugs for this test. Also recover a representative number of the fired pellets and fired wadding from each test firing. Compare markings on these test shotshell casings with each other. Examine the fired components which were recovered and compare them to unfired components of the same type. Discuss the significance of your findings.

Discipline Leader/on-site trainer

Date

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Discipline Leader/on-site trainer

Date

9.6 Successfully complete a mock court dealing with distance testing.

Discipline Leader/on-site trainer

Date

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10.6. Define the following terms as they relate to toolmark identification and give three examples of tools or methods which could produce each category:

- (a) shearing
- (b) pinching
- (c) fracture
- (d) scrape mark
- (e) impression
- (f) slicing

Discipline Leader/on-site trainer

Date

10.7. Define the term "class characteristics" as it applies to toolmark identification. Using the tools of methods selected as examples in the paragraph above, describe their respective class characteristics in detail.

Select at least two tools representative of each category in paragraph 5 above from the lab. Produce toolmarks with each tool and observe the class characteristics of the toolmark. Vary the angle and force with which each tool is used.

Discipline Leader/on-site trainer

Date

10.8. Using soft copper wire of approximately 1/4-inch diameter, make cuts through it with the tools which employ a shearing, pinching and slicing action. Make test cuts in lead using the same tools. Attempt to identify the cuts in the copper wire as having been made by the same tool as that which cut the test lead. Support your results with photographs and note any lighting considerations made necessary by the color difference between copper and lead.

Discipline Leader/on-site trainer

Date

10.9. Select a flat-bladed tool such as a screwdriver, and a pry bar and make marks in a piece of copper or brass sheeting. Make the same type of marks in lead with both tools. Microscopically compare those in the brass or copper sheeting with the test marks in the lead. Attempt to identify the appropriate marks with the appropriate tool. Photograph your results and comment on the difference in the quality of marks made by each tool.

Discipline Leader/on-site trainer

Date

10.10. Using a drive pin punch, produce an impression in a piece of brass sheeting. Produce a set of

10.15. Discuss the fact that generally saws, files, and abrasive tools are not identifiable with the marks they produce. Cite any exceptions to this rule.

Discipline Leader/on-site trainer

Date

10.16. Obtain a used tire and make cuts and stabs into the sidewall with a fixed blade knife. Attempt to make comparisons of the toolmarks produced by the knife. Support your results with photographs and notes. Discuss how the results of your examinations might be altered if the knife had been sharpened after making the questioned cuts, or if the knife had been used for an extended period of time after making the initial questioned cuts.

Discipline Leader/on-site trainer

Date

10.17. Investigate pressure/contact examinations in regard to objects which may have been in contact with each other for an extended time. Research several cases of this type and set these out in your notes.

Discipline Leader/on-site trainer

Date

10.18. Discuss and demonstrate the making of casts of toolmarks. Also discuss the potential of such casts and of photographs alone in making toolmarks identifications.

Discipline Leader/on-site trainer

Date

10.19 Successfully perform a toolmark competency test.

Discipline Leader/on-site trainer

Date

10.20 Successfully complete a mock court dealing with toolmark examination.

Discipline Leader/on-site trainer

Date

Section 11. SERIAL NUMBER RESTORATION

11.1 Read the Handbook of Methods for the Restoration of Obliterated Serial Numbers by Tretow. Be prepared to discuss the theory of number restoration.

on-site trainer

Date

11.2 Sketch the entire stressed area above and below the indentation of a stamped item and depict what remains when the indented area is removed.

on-site trainer

Date

11.3 Make a list of the various methods used to mark items by private industry. This list should include but not be restricted to: casting, stamping, dot matrix, laser and electrical discharge machining.

(a) Discuss with the Discipline Leader/on-site trainer the effect each of these marking techniques has on the subsurface of the marked area.

(b) Discuss with the Discipline Leader/on-site trainer how the marking methods used can directly affect the ability of the examiner to restore any obliterated markings and why.

on-site trainer

Date

11.4 Define in your notebook the term "plastic deformation" of metal.

on-site trainer

Date

11.5 Briefly discuss in your notebook and the Discipline Leader/on-site trainer the difference between cold rolled steel and cast iron metal.

on-site trainer

Date

11.11 Determine whether the reaction rate for the stressed area is faster or slower than the etching rate of the rest of the surface and why.

on-site trainer

Date

11.12 Determine the specialized equipment that might be used in number restoration and discuss these with the Discipline Leader/on-site trainer.

on-site trainer

Date

11.13 Determine the various ways photography can be utilized to document the process of serial number restoration. Also discuss its limitations.

on-site trainer

Date

11.14 Research the various kinds of magnifying and enhancing equipment used for number restoration and explain when and why each would be used.

on-site trainer

Date

11.15 Become familiar with the following chemicals:

- (a) CuNH_4Cl
- (b) CuCl_2
- (c) NaOH
- (d) HCl
- (e) HNO_3
- (f) KCN
- (g) K_2SO_4
- (h) Aqua Regia
- (i) H_2SO_4

- (e) chrome/nickel 25 caliber auto-loading pistol
- (f) shotgun alloy receiver
- (g) shotgun case hardened receiver
- (h) Winchester rifle

on-site trainer

Date

11.20 Obtain several sample serial numbers from the Discipline Leader/on-site trainer; alter the serial numbers using different methods and then attempt to restore them. Prepare notes and photographs to substantiate your conclusions and results.

on-site trainer

Date

11.21 Be prepared to discuss with the Discipline Leader/on-site trainer the methods used and lessons learned during the restoration process.

on-site trainer

Date

11.2. Obtain several pieces of aluminum that have had stamped numbers removed. Attempt to restore these numbers using various techniques. Prepare notes and photographs to substantiate your conclusions and results.

on-site trainer

Date

11.23 Discuss with the Discipline Leader/on-site trainer how the combination of brief application of CuNH_4C_12 followed by normal NaOH application can shorten the processing time on aluminum.

on-site trainer

Date

11.24 Discuss with the Discipline Leader/on-site trainer why alternating HNO_3 and HCl can work so well on chrome or nickel-plated firearms.

on-site trainer

Date

Section 13 Supervised cases

13.1 Upon successful completion of competency testing and the Quality Manager having reviewed and approved the training documentation, the Trainee will be responsible for the analysis of casework under close supervision. Analysis notes for supervised casework will be signed by the trainer. The onsite trainer will determine when the need for close supervision is completed based on the analysts ability to work independently and the types of cases completed. Upon completion of this required the trainee can begin unsupervised casework.

Discipline Leader/on-site trainer

Date

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Section 15 Training in Other Forensic Science Disciplines

- 15.1 The trainee shall have a general understanding of the other disciplines offered by the Idaho State Police Forensic Services. This understanding can be gained from school course work, reading about each discipline in a General Forensic Science book, reviewing the methods of each discipline and/or talking with or observing other Forensic Scientists working in those areas.

on-site trainer

Date

Basic References:

- Policies and procedure manuals for the laboratory
- Manufacturers procedure and operation manuals
- "AFTE Glossary" AFTE Standardization Committee
- "Basic Firearms/Toolmarks Course" California Department of Justice
- "Cartridges of the World" BARNES
- "Encyclopedia of Modern Firearms, Parts and Assembly, Vol I." BROWNELL
- "Firearms and Ammunition Fact Book" NRA STAFF
- "Firearms Identification" Vol. I, MATHEWS
- "Firearms Investigation, Identification and Evidence" HATCHER, JURY, and WELLER
- "Gun Digest Book of Exploded Firearms Drawings" MUNTZ
- "Gunshot Wounds" DiMAIO
- "Handbook of Firearms and Ballistics" HEARD
- "Handbook of Forensic Science" FBI
- "Handbook of Methods for the Restoration of Obliterated Serial Numbers" TREPTOW
- "Handgun and Shoulder Arms Assembly" NRA
- "Hatcher's Notebook" HATCHER
- "History and Development of Small Arms Ammunition, Vol. 1-3, HOYEM

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