with that.

Q. Let's talk about another of the criteria by which the Court has said if you are going to call something science, you need to establish it. That's the known or potential error rate. Are there any known or potential error rates published in the field?

A. Yes. I went through them today.

Q. What type of potential error rates?

A. Published known or potential error rates.

Q. Those images you put side by side. You look at those. I think this is what you did on direct examination. You say, "Look. Those match. Look how close they were. Those match." You remember doing that?

A. Yes.

Q. In fingerprints I think the FBI was saying at one point you had to have a certain number of points that you can point to and say there are seven points here that match. What's the number in ballistics?

A. A couple of things on that. Number one, that's not the way -- when I left the FBI that's not the way they did it. They moved from doing purely objective points of comparison kind of thing to accounting for the quality and quantity of the points of comparison.

They were looking at both because they

01:48PM found they did not have the discriminatory power if they were just using some arbitrary number. For us it's the same thing. You can go to a CMS regime if you want to. I have no objection to that, which is just counting. I don't think it captures the totality of what you are looking at and it's not really it's not really adding any value.

Q. In your opinion that doesn't add any value?

A. In my opinion if there's any value added, it would be very small.

Q. How many points of similarity are necessary? The answer would be?

A. There's no fixed number.

Q. There's no fixed number. When the National Academy of Sciences says in terms of the known or potential error rate and protocol that you were supposed to be using you agree that says we're not able to specify on how many points are necessary for a given level of confidence? Sufficient studies have not been done to understand the reliability and repeatability of methods.

A. We're talking apples and oranges and they're talking about doing it like DNA. You go inside. You count the number of matching striations or something of that degree. We're saying our discipline is not like

that. We're fundamentally different.

How do we test us? We test the actual output, what's coming out of the black box. That's our actual conclusions. Are they right? Are they wrong? That's what we're testing. We get error rates from that. And I disagree. If they say there's nothing done to assess the reliability of the methods, I disagree.

Q. So when the National Academy of Sciences says in the Daubert case when you want to call yourself a science that you have to specify the number of points of similarity, you can't call yourself a science, your reaction is, "They just don't know. We're a science anyway"?

A. I think there's a lot of sciences that don't count things and that are sciences, yes.

Q. Are those the other sciences that are under critique for the National Academy of Sciences because they don't use strictly speaking the scientific method?

A. If the National Academy of Sciences were consistent with their standards there they would disqualify a lot of sciences as science.

Q. We're working on it. Okay. Let's start with toolmarks. I'm trying to get -- you have the Daubert -- the Daubert court has given you five criteria and said you have to do this and that. We now know that you

don't meet, absolutely don't meet the third criteria.

A. Which is?

Q. How many points of similarity? What's the standard?

A. Where does the Daubert criteria say you have to have a certain number of points of similarity? I have never read that. I've read it needs to be testable which we have done. It needs to be controlling standards.

Q. What's the controlling standard? If there's no standard for the similarities under D, what's the standard?

A. There is a standard just as in radiology or dentistry. I had it up there. In your training you have to look at a lot of known matches. You have to look at a lot of not known non-matches.

You have to say before you effect an identification the correspondence is better than any known non-match I have ever seen. That's the written objective standard. But, yes, you're making a decision in a subjective process.

Q. So when you -- when you look at a side by side comparison you say they look the same and you give it to somebody else in your field and they say it looks the same. You both come to the same conclusion, right? But

01:51PM 1 you don't know if you assess the picture the same way?
01:51PM 2 A. Each -- each -- I'm not sure I understand -- if
01:51PM 3 you have assessed it and say, "You're right. It's not
01:51PM 4 the same algorithm of a machine," looking at it and
01:51PM 5 coming to the exact same numerical score, that's true.
01:51PM 6 Q. Apparently that's kind of what the Daubert
01:51PM 7 court and National Academy of Sciences wants you to do,
01:51PM 8 isn't it?
01:51PM 9 A. I didn't see that in the Daubert guidelines.
01:51PM 10 The Daubert guidelines said testability which I agree
01:52PM 11 with. Even though the Daubert guidelines don't conform
01:52PM 12 to what philosophers of science really say a science is,
01:52PM 13 nevertheless, I think it actually works quite well for
01:52PM 14 forensic techniques.
01:52PM 15 Q. Do you agree with the National Research Council
01:52PM 16 Ballistic Imaging that conclusions drawn in firearms
01:52PM 17 identification should not be made to imply the presence
01:52PM 18 of a firm statistical basis when none has been
01:52PM 19 demonstrated?
01:52PM 20 A. When it says "imply the presence of a firm
01:52PM 21 statistical basis when none has been demonstrated," I
01:52PM 22 think if you go on further and read that, it says,
01:52PM 23 "Specifically examiners tend to cast their assessments
01:52PM 24 in bold absolutes."
01:52PM 25 I think that's what they're referring to

and I agree with them. You shouldn't cast them in bold absolutes. We don't give statistical data in our conclusions. That's true.

Q. I think you gave us a conclusion at the end of your PowerPoint that, if I understood the statistics, that you can say with some [illegible] based on the statistics with some degree of certainty that when you say there's a comparison it's a practical certainty?

A. Uh-huh.

Q. And the statistical basis for that is you've had a bunch of other firearm examiners hold the picture side by side and they came to the same conclusions you did.

A. No. They weren't looking at photographs. These come out of hundreds, if not thousands, of proficiency tests and some very good validity tests which had very good performance. That's where we're getting the data from.

Q. Do you agree when the court in the United States versus Glen said one of the problems of your field which makes it difficult for the judiciary to buy it is that the tendency of ballistics experts to make assertions that their matches are certainly beyond all doubt, that the error rate of their methodology is zero and other such pretensions?

01:53PM A. Do I agree that's a bad thing?
01:53PM Q. Do you agree that's by and large the problem
01:54PM the courts have found with the ballistics proffer you're
01:54PM making when you claim to have a zero error rate?
01:54PM A. I'm not claiming to make a zero error rate. If
01:54PM I can interject here --
01:54PM Q. You're going to object?
01:54PM A. Interject. What I think the court was saying,
01:54PM and I agree with them, is it makes no sense to proffer
01:54PM an opinion of absolute certainty. I agree with that.
01:54PM In the past sometimes that was done and I disagree with
01:54PM it. It shouldn't be done. It shouldn't have been done
01:54PM then. It shouldn't be done now. It shouldn't be done
01:54PM in the future.
01:54PM Q. Let's talk about the Daubert standard regarding
01:54PM standards and controls. Would you agree a fundamental
01:54PM problem with toolmark and firearms analysis is the lack
01:54PM of a precisely-defined process? As noted above, AFTE
01:54PM has adopted a theory of identification but it does not
01:54PM provide a specific protocol.
01:54PM A. No, I don't think that's a fundamental problem
01:55PM because, here again, they're looking at that through the
01:55PM lens of a DNA type of specific protocol working with
01:55PM homogeneous materials or discreet materials. I think
01:55PM for things like what we do and for things like

radiology, paleontology, et cetera where there is more subjectivity involved when you are dealing with a high number of variations in what you are looking at you should not be that strict.

And I think had the NAS had some of those type people on there like paleontologists, for example, I have a strong suspicion the outcome would have been different.

Q. They made a mistake putting chemists on there?

A. No. I think they made a mistake in excluding others.

Q. I'm sorry. They excluded them? They didn't offer an invite to anybody in the field from the start?

THE COURT: Let's move on.

Q. (By Mr. Anton) You agree -- I think you referred in one of your PowerPoint slides that you have that the meaning of "exceeds the best agreement" and "consistent with" are not specified. The examiner is expected to draw from his or her own experience.

A. Yes.

Q. This AFTE document which is the best guidance available for the field of toolmark identification does not even consider, let alone address, questions regarding variability, reliability, repeatability or the number of correlations needed to achieve a given degree

of confidence.

A. They're looking at that strictly through the lens of a DNA paradigm.

THE COURT: Let me interrupt. Here's the problem I have. When we look at statistical analysis and breaking it down into numbers we don't know how many guns and what type of manufacturer, how many are still in use, how many are in the bottom of rivers, how many have been destroyed.

We don't have the statistical baseline to move forward with any type of -- assigning any type of value probabilities. Would that be correct?

THE WITNESS: Yes and no. If you are looking at it from the perspective of a DNA paradigm, that's right.

THE COURT: That's what I am looking at.

THE WITNESS: It's difficult to do that. However, it's not impossible to generate statistics off of the data we have. For example, if you come up -- you get a point estimate for an error rate based on the validity and proficiency test you have statistical data on which to go.

THE COURT: You have statistical data on the error rate but you don't have statistical data -- an examiner can't say, "I'm 98 percent certain this is the

same gun," because the examiner doesn't know how many guns of that manufacturer are out there.

THE WITNESS: At the current state of the science that's correct. There's no database that would enable you to say with a high degree of certainty, "I'm 99 percent confident," or something of that nature.

THE COURT: We have that information regarding genes, DNA.

THE WITNESS: Uh-huh.

THE COURT: Let's move on.

Q. (By Mr. Anton) Now then, you agree with the National Academy of Sciences that AFTE standards acknowledge that these decisions involve subjective qualitative judgments by examiners and that the accuracy of examiners' assessments is highly dependent on their skill and training?

A. Yes.

Q. Even with more training and experience using newer techniques, the decision of the toolmark examiner remains a subjective decision based on unarticulated standards and no statistical foundation for estimation of error rates.

A. It is a subjective decision. I do not believe it is based on unarticulated standards. Would you be able to go back to that? Based on unarticulated

standards. We do have an articulated standard. I don't agree with no statistical information for estimation of error rates. I presented those today.

Q. I would like to go back to your Tiger Woods analogy. You get a picture and it's out of focus. The more you fine tune it, bring it in focus, the more people are going to recognize the similarities, correct?

A. The more people -- as you bring into focus you will start having people recognize Tiger Woods.

Q. Wouldn't it stand to reason that using science and using testing materials that help bring the bullets and casings into more focus would be a better thing?

A. Yes, it could be, provided it's been validated.

Q. Provided it's been validated. The problem that you have with using this new technology is that it hasn't been properly validated according to your standards?

A. I think probably according to anybody's standards.

Q. The National Academy of Sciences' problem with your technique is it hasn't been validated according to their standards, right?

A. I suppose if one wants to interpret that that way. I'm not sure I agree with that.

Q. So basically then if we have to go outside the

field and get an expert and he's subject to critique from you because there's not enough literature that demonstrates the validity of his critique, we should exclude it. We shouldn't exclude your opinions even though the National Academy of Sciences says they don't constitute science.

A. I'm not saying anything should be excluded necessarily. If someone wants to use a different technique with different methods, they can. I'm saying that I wouldn't put as much stock in it as I would the standard validated technique. It hasn't been validated to any degree, if it's something way out of the norm.

If you are using a scanning electron microscope at a thousand to 2000 power, that might be wonderful but that has to be validated because we don't use those kinds of magnifications.

Q. What would you have to do to validate it?

A. The same thing we've done. You'd have to give them out to examiners, tightly-controlled tests, see what kind of conclusions. Are they accurate in their conclusions or are they not.

Q. Who in the AFTE is doing that with the new technology?

A. Well, I know there's some research being done on infrared materials, infrared scopes. I know there's

research being done on machine-based systems. Scott Chumbley at the Ames Laboratory at the Iowa State University has done research on that. Ben Bacharach at Intelligent Automation in Maryland has done research using machines and algorithms. And that's all to the good.

Q. What's wrong currently with having somebody -- you stated the art surface metrology equipment such as the white light interferometer. What's wrong with that? Why can't that be done?

A. There's nothing wrong with taking that equipment and looking at specimens. What people have to be careful about is we want this to be trustworthy outcomes. If somebody is going to make decisions based on that, it's not been validated yet. We have to be skeptical about that kind of thing.

Q. Wouldn't you think it's fair that if somebody is going to use that measuring equipment that they use it and they show you their results and their conclusions and you look at it and you have the opportunity to say, "I agree with this," or "I disagree with this"?

A. Well, I can look at what their product is but that doesn't mean it's a valid thing. I can say that looks pretty good but that doesn't mean I'm going to accept it if it hasn't gone through a validation

process.

Q. The validation process that you want those people to use, how is that different from the validation process the National Academy of Sciences wants you to use?

A. What the National Academy of Sciences came up with as their ideal is the DNA paradigm. I'm saying that's not appropriate for what we do. It's also not appropriate for anybody who is coming up with using a different technique. That's the wrong kind of standard.

Q. Basically the bottom line is the reason it's the wrong technique for your field is because your field is so subjective?

A. No, not at all.

THE COURT: Excuse me. I didn't follow the question. Because what's the wrong technique?

Q. (By Mr. Anton) When you talk about, "Don't hold us to the DNA standard. We're not DNA" --

THE COURT: Okay.

Q. (By Mr. Anton) You don't like being held to that standard because unlike the other true sciences, your field is so subjective.

A. If you want to have someone come in and do careful measurements and all that kind of stuff, that's fine. That's being done. I'm not opposed to that.

That's where the future probably lies.

Q. What would be wrong with having that done in this case?

A. Nothing, except it's not a validated procedure. Just like the research that's been done, it also has not been fully validated by any means. The researchers will tell you that.

Q. Are you saying that white light interferometer is not considered a reliable piece of scientific equipment to do measurements?

A. No. I think it's probably a very reliable thing but it doesn't necessarily -- you can't say, "I have this wonderful measuring instrument and I'm going to measure things and come to conclusions."

Q. You have to look at the conclusions drawn after the measurements are done?

A. Of course but you can't --

MR. ANTON: That's all I have, Your Honor.

THE COURT: Do you have any questions?

MS. MOSELEY: I do if I may.

REDIRECT EXAMINATION

BY MS. MOSELEY:

Q. With regard to the white light interferometer and these other measuring devices, Dr. Bunch, have you been presented with any research showing that those

methods are capable of making reliable statements about firearms evidence?

A. No.

Q. And so if I understand you correctly, while you don't object to the white light interferometer as far as it being a measuring technique -- is that fair?

A. That's fair.

Q. You haven't been shown any research that the white light interferometer has any application in the field of firearms comparison?

A. That's correct. Now, if there were research done with a white light interferometer and it was shown to be valid and reliable, I'd be all for it. In fact it could be superior but we don't know that.

Q. All of the validation studies and all of the testing that the firearms field has at this point, the research that is available has been done using the comparison microscope?

A. Correct.

Q. Perhaps in the future some of these other techniques may be shown to be reliable but they haven't been yet?

A. Exactly.

Q. Would you reach the same conclusion -- we have discussed specifically the white light interferometer --

but also with the scanning electron microscope and some of the other newer techniques?

A. There's some very promising ideas and technology out there that theoretically could be wonderful. The problem is the scanning microscope is extremely expensive. White light interferometry, however you say that, profilometry, shadow profilometry that the Ames Laboratory uses, the method that Ben Bacharach uses at Intelligent Automation, all of those things hold promise but they have to be, A, perfected and they have to be, B, validated.

I think the researchers themselves would agree with that. In fact one of the researchers, Scott Chumbley, did a head-to-head test of human examiners versus his machine method not to validate the examiners but to validate the machine. It turns out the examiners were more accurate which is not an indictment of the machine. Conceivably, you could have some day a machine do better but you need to test it and see.

Q. Have you been provided with any studies in the course of your research -- and it sounds like you've been doing a lot of research and studies of other research materials. Have you ever run across any research that shows that the comparison microscope and/or the human examiner is not capable of doing what

02:08PM firearms examiners claim they can do and that is match one cartridge case to a weapon?

A. No, absolutely not. Everything I have seen indicates there's enormous value added from the examiners' conclusions and that they certainly can, do very reliably draw those conclusions.

Q. While there may be research out there making assertions about what we in the firearms field, what examiners should be doing or what equipment should be being used, there hasn't been any empirical research to validate?

A. Let me put it to you this way: we had an examiner trainee in our unit at one time who was a former NASA engineer. NASA has a saying. One test is worth a thousand expert opinions. There's lots of tests showing what we can do and they're all positive. I don't know of any test saying that we can't do what we're doing.

Q. Thank you.

MS. MOSELEY: Pass the witness.

RECROSS EXAMINATION

BY MR. ANTON:

Q. So I'm clear, when you talk about -- your testimony, the rigor of the DNA protocol, what do you mean? That they're strictly applying the Daubert

02:09PM 1 standard?
02:09PM 2 A. I don't -- I'm not making any judgments about
02:09PM 3 whether they're applying the Daubert standard or not. I
02:09PM 4 know they have -- in their protocols because of the
02:09PM 5 nature of their business they can come up with very,
02:09PM 6 very precise affixed protocols like a recipe, a cookbook
02:09PM 7 which everybody is going to follow.
02:09PM 8 One of the advantages is, which any
02:09PM 9 statistician will tell you, you're going to get higher
02:09PM 10 precision, all other things being equal, higher
02:09PM 11 consistency. That doesn't say anything about the
02:09PM 12 accuracy. You can have very precise but very inaccurate
02:09PM 13 tests. That's possible.
02:09PM 14 Q. What percentage do you think of the people in
02:10PM 15 the AFTE hold any kind of degree in science?
02:10PM 16 A. I honestly don't know. I think these days
02:10PM 17 probably would be fairly high.
02:10PM 18 Q. What's fairly high?
02:10PM 19 A. I'm guessing 80 percent. I don't know.
02:10PM 20 Q. You would agree in other fields of science such
02:10PM 21 as DNA, those people, 100 percent of them are
02:10PM 22 scientists, aren't they?
02:10PM 23 A. I don't know that for sure but I suspect -- if
02:10PM 24 your point is it would be a higher percentage, I'm not
02:10PM 25 going to disagree.

THE COURT: When you say a person is a scientists do you mean that they hold some type of degree, some kind of higher degree in science?

MR. ANTON: Some kind of higher degree in science in the field in which they're studying, yes.

A. Well, I would never be one to say, "Well, we're a science just like physics is a science." That would be silly. I'm not trying to make that kind of claim. The question is is what we're doing scientific? Is it trustworthy? And I think the answer clearly is yes.

Q. (By Mr. Anton) Even though it doesn't meet several of the Daubert standards?

A. I think in my opinion it does meet them.

MR. ANTON: That's all I have.

MS. MOSELEY: Nothing.

THE COURT: You may step down.

(The witness left the stand.)

MS. MOSELEY: I would proffer -- perhaps this is after the fact that I would proffer Dr. Bunch as an expert in the field of firearms examination. And based on his testimony I would ask the Court to find the science of firearms examination reliable and admissible under Daubert, as well as under 702 and 705.

And at this time I would -- well, I guess I should get a ruling if the Court is prepared to make

one.

THE COURT: Response.

MR. ANTON: Your Honor, they're doing eyeball comparisons essentially that any juror can do. Their explanation of how these toolmarks --

THE COURT: Excuse me. I'm going to ask members of the audience not to respond or try to communicate in response to the attorneys.

MR. ANTON: Their eyeball comparisons might be helpful to the jury. I think as the testimony demonstrates whatever this field is, it's not science. They can call themselves experts but they're not a science.

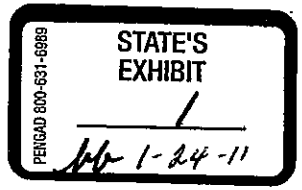
THE COURT: The State's motion is granted and your motion to suppress the evidence is denied.

(End of Excerpt)

State's Exhibit No. 1

(PowerPoint presentation, attached hereto)

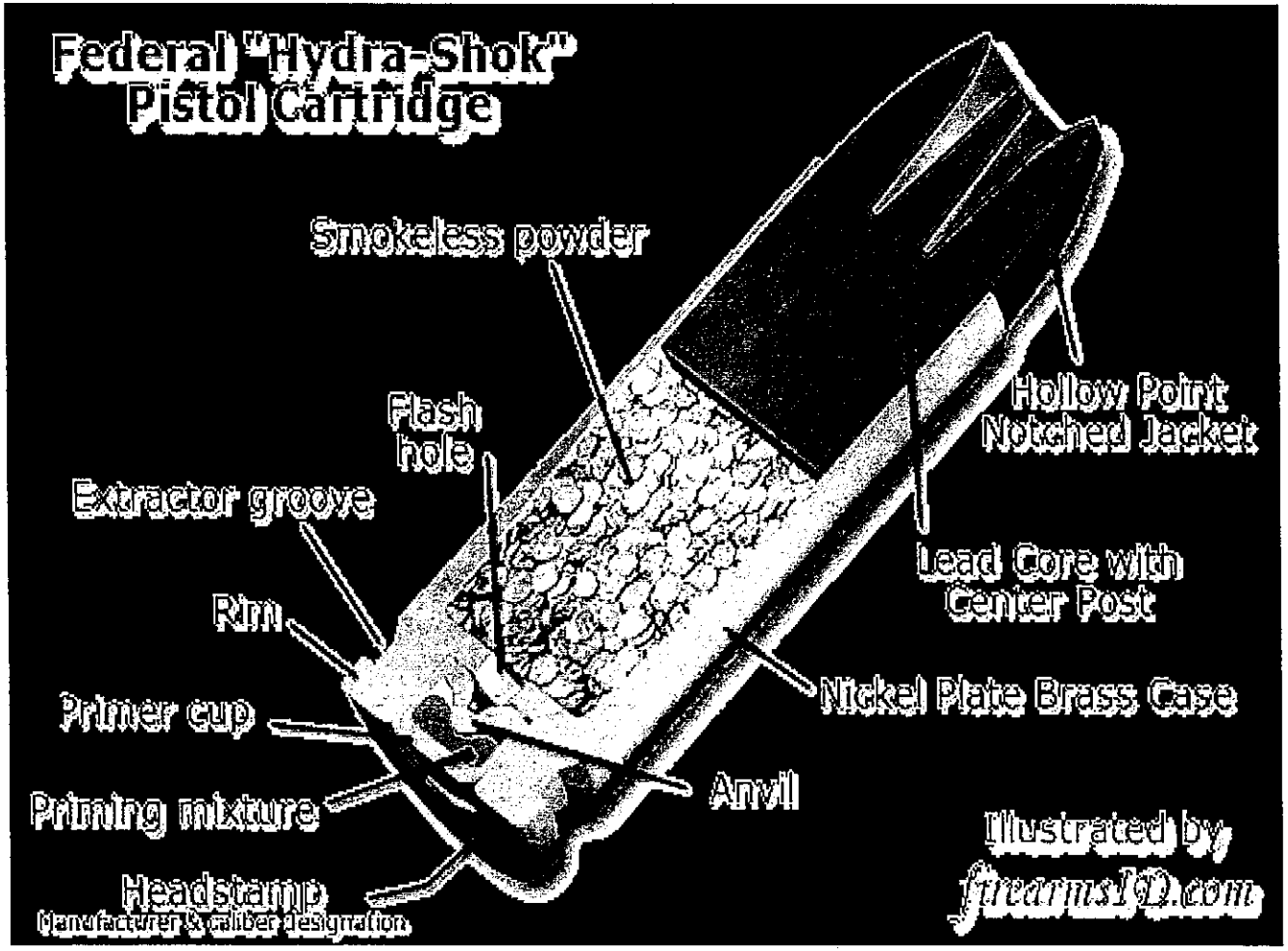
Firearm & Toolmark Identification: Evaluation of Validity

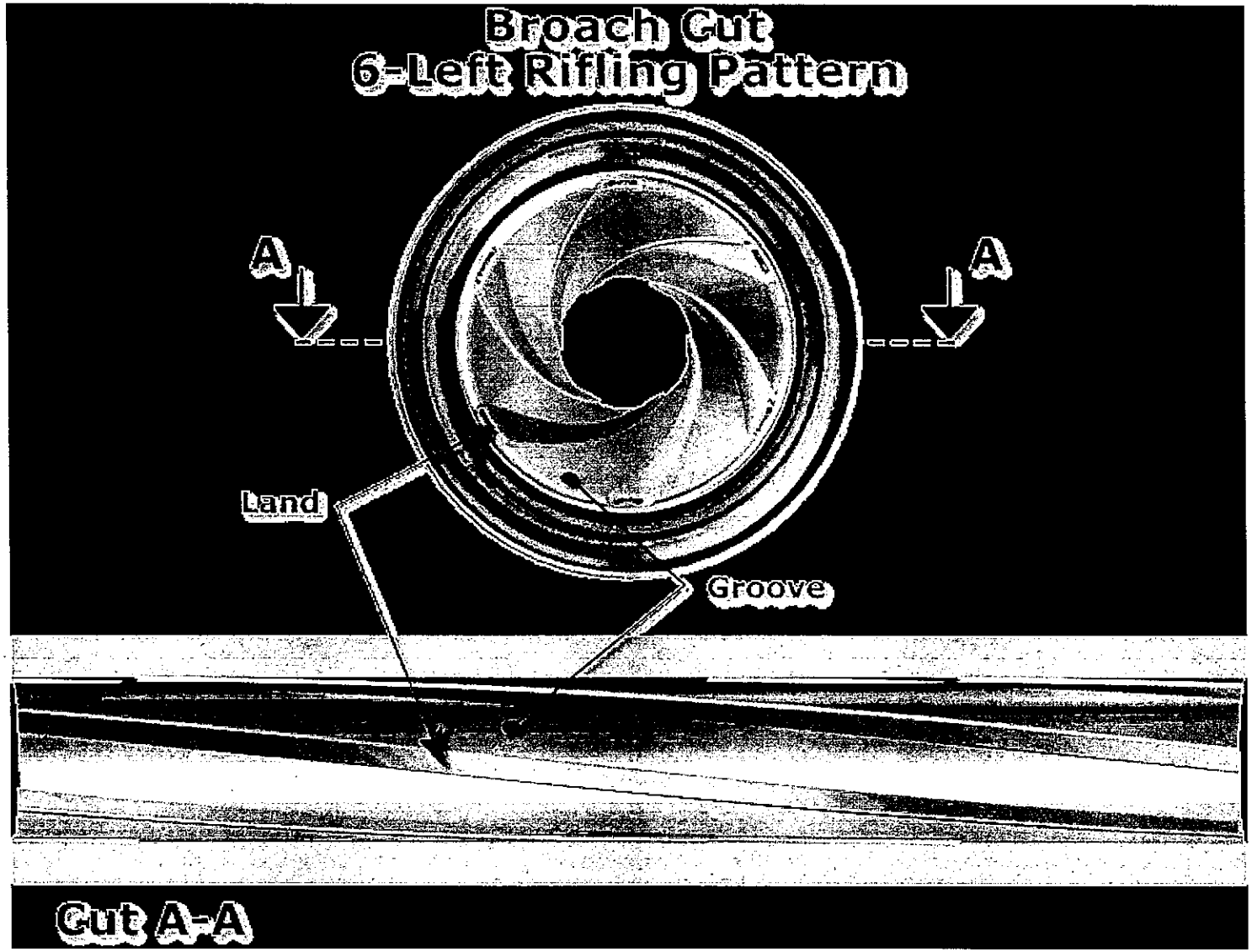


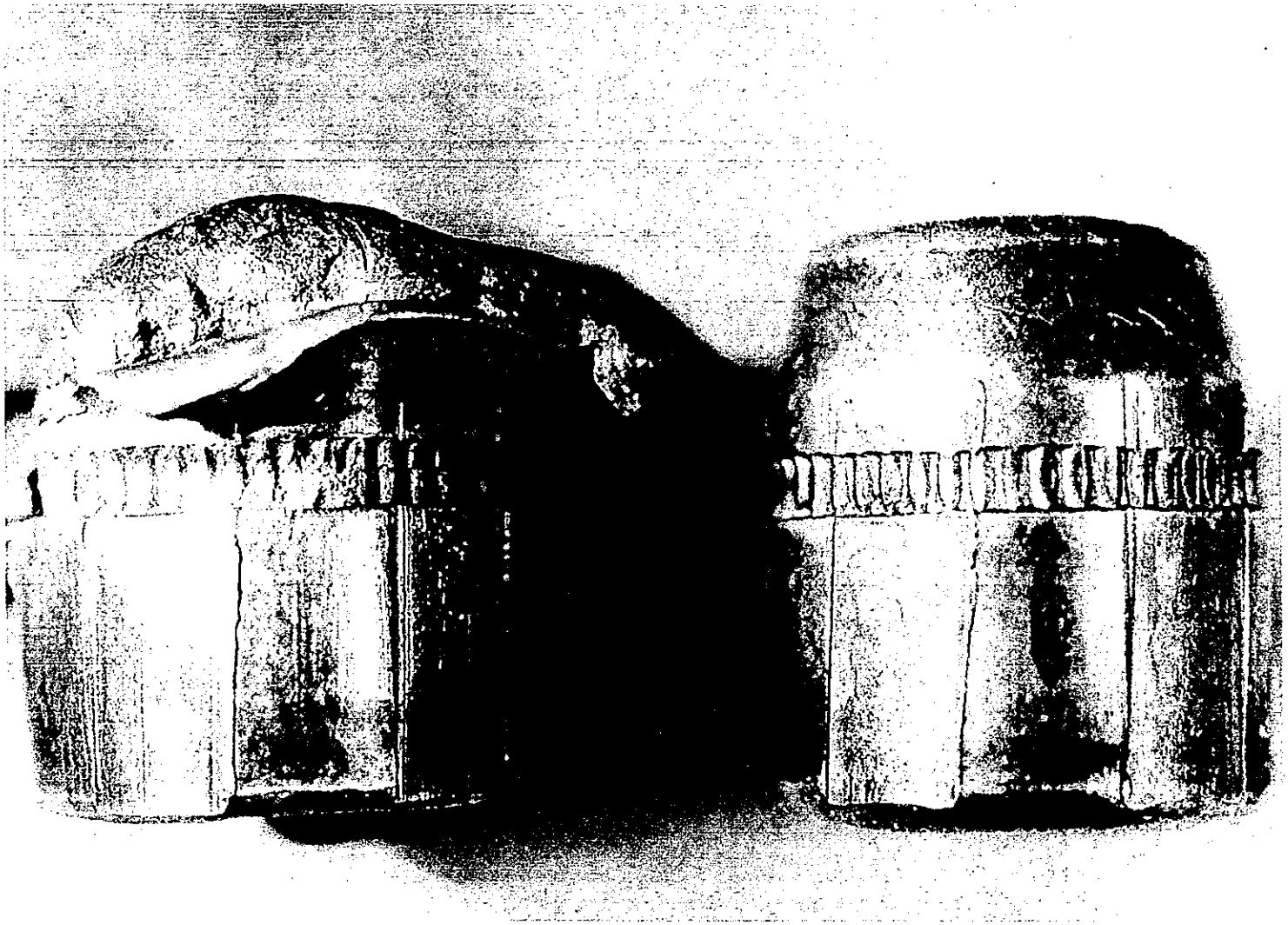
Central question: How strong are "Match" and Exclusion conclusions? What claims and report language are warranted by existing evidence?

1. Absolute certainty?
2. Practical certainty?
3. Reasonable degree of scientific certainty?
4. Expression of high confidence?
5. Association/consistent with?
6. More likely than not?
7. Of no probative value (useless)
8. Of negative probative value (more likely wrong than right)

But before answering, some background information…


Federal "Hydra-Shok"
Pistol Cartridge
Smokeless powder
Flash hole
Hollow Point Notched Jacket
Extractor groove
Lead Core with Center Post
Rim
Nickel Plate Brass Case
Primer cup
Anvil
Priming mixture
Illustrated by
firearms101.com
Headstamp
Manufacturer & caliber designation


Broach Cut
6-Left Rifling Pattern
A
A
Land
Groove
Cut A-A

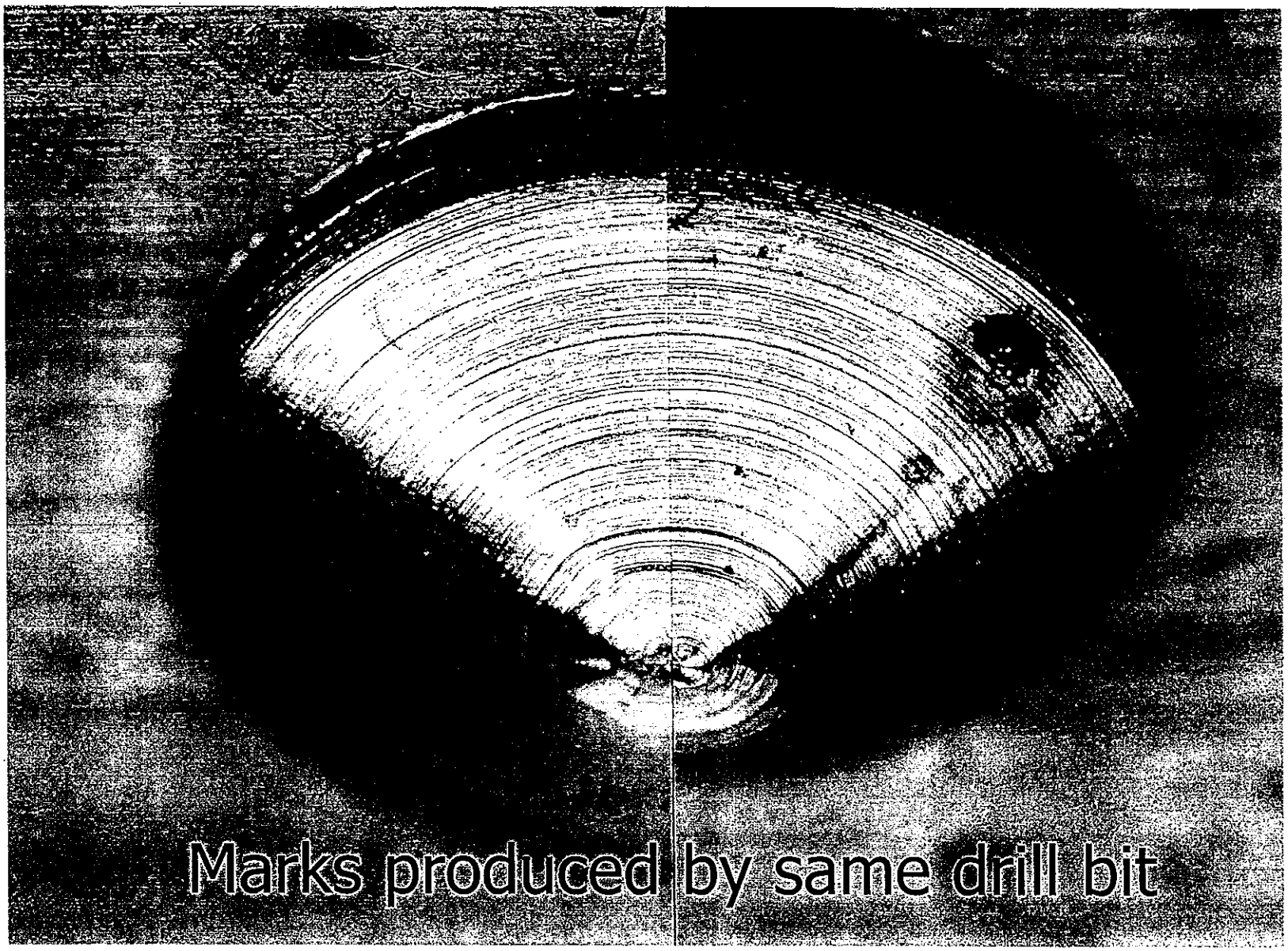


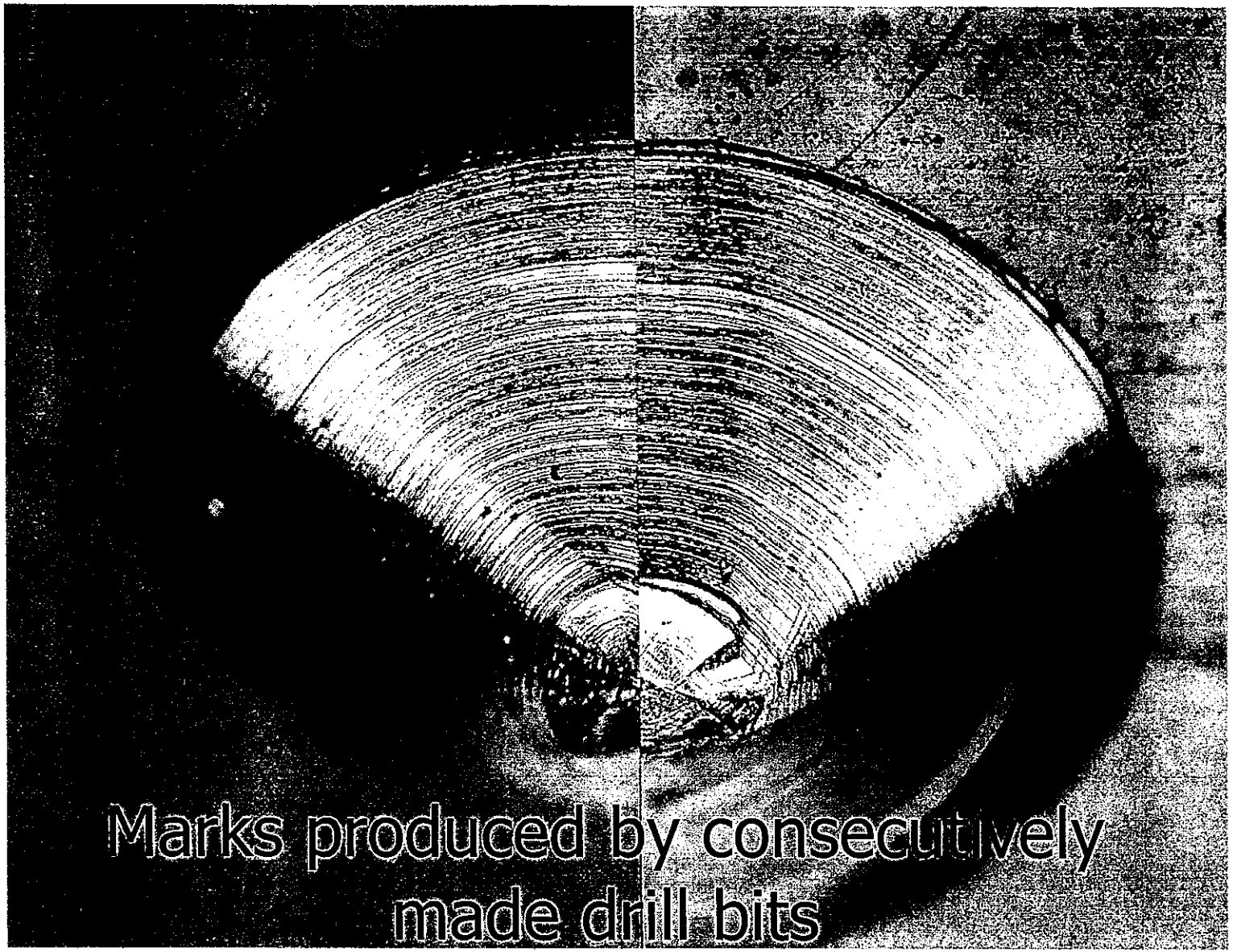

Bullets fired from same barrel


Bullets fired from different barrels


ases fired in same firearm


Cartridge cases fired in
Commercially made firearms


Marks produced by same drill bit


Marks produced by consecutively
made drill bits

Firearm & Toolmark Identification rests on two fundamental propositions (and their corollaries).

Proposition #1 (The principal claim):

Macroscopic and microscopic marks imparted to objects by different tools will rarely if ever display agreement sufficient to lead a qualified examiner to conclude the objects were marked by the same tool. That is, a qualified examiner will rarely if ever commit a false positive error (misidentification).

Proposition #2

Most manufacturing processes involve the transfer of rapidly changing or random microscopic marks onto work pieces such as barrel bores, breechfaces, firing pins, screwdriver blades, and the working surfaces of other common tools. This is caused principally by tool wear and abrasive chip formation, or by electrical/chemical erosion. Microscopic marks on both tools and objects then continue to change from further wear, corrosion, or abuse.

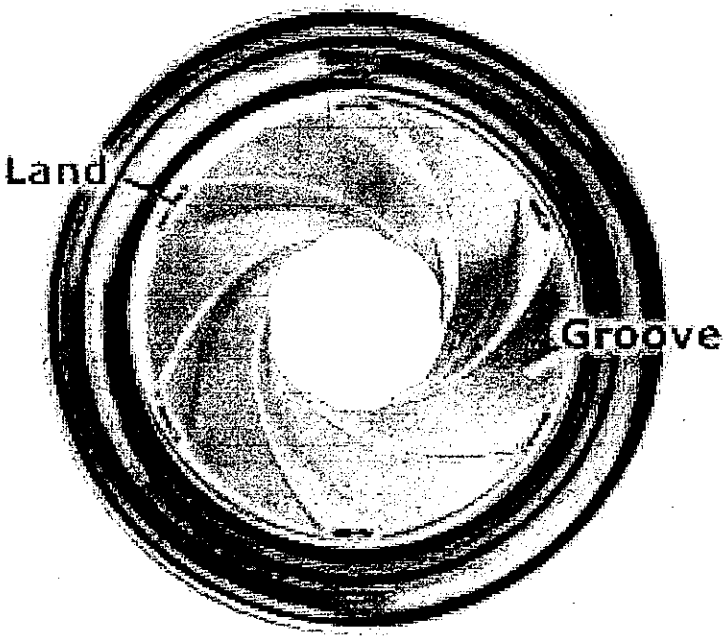
Definition: *Class Characteristics*

General and/or measurable features of a specimen which indicate a restricted group source. They result from design factors, and are therefore determined prior to manufacture.

Examples of Class Characteristics

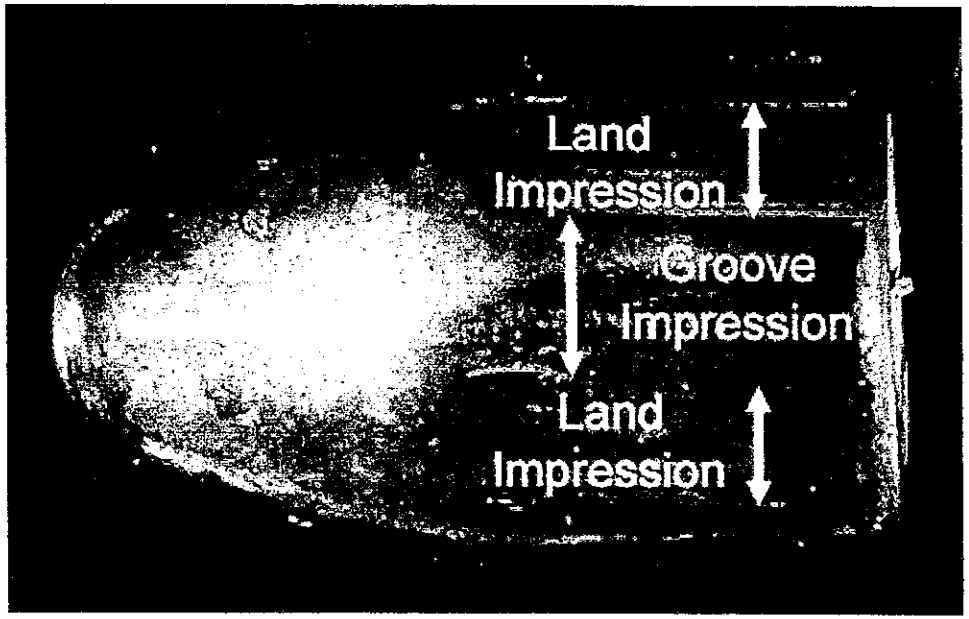
Known Source:

Rifling



Questioned Item:

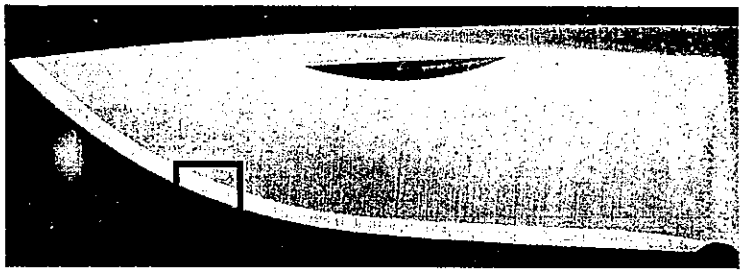
Bullet

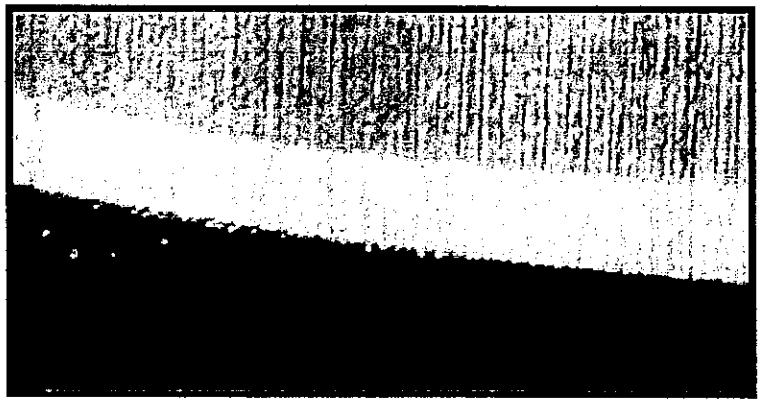


Definition: *Individual Characteristics*

Observed microscopic marks that are restricted to objects marked by the same tool (i.e., individual to the source tool). These characteristics can be used to definitively link a tool to a toolmark, and result from manufacturing processes, wear, corrosion, or abuse.

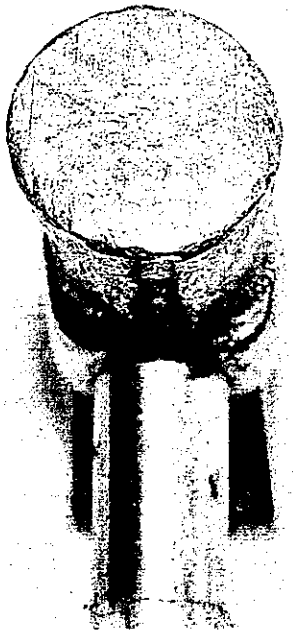
Example of Individual Characteristics from Manufacture



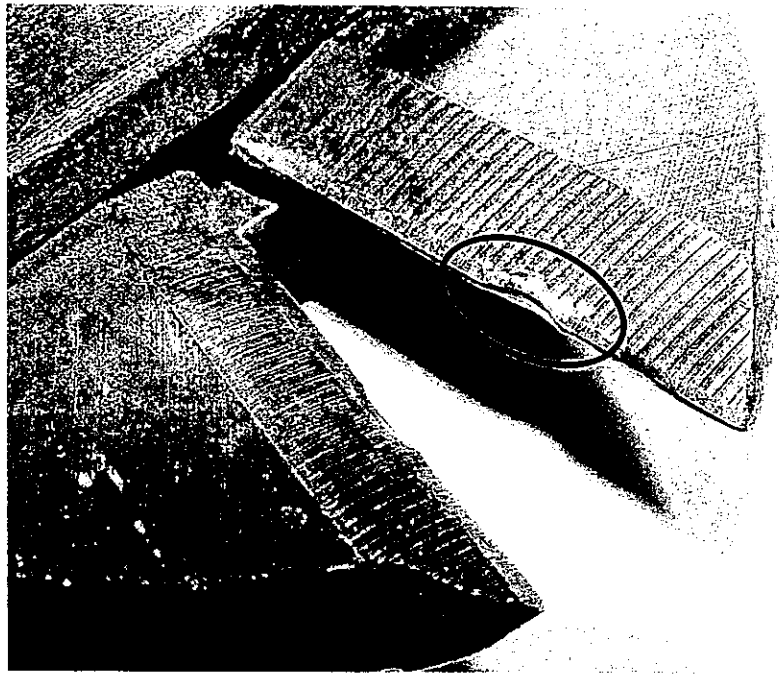


Example of Individual Characteristics from Wear

Use



Abuse



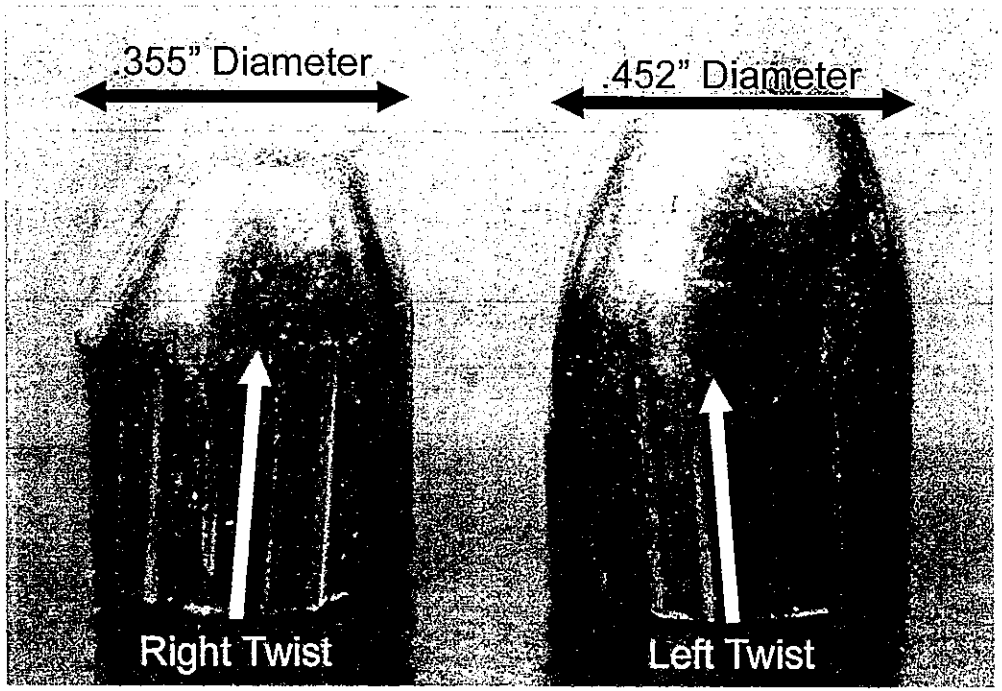
Definition: *Subclass Characteristics*

These lie between class and individual characteristics. They are microscopic features produced during manufacture that are consistent among some items fabricated by the same tool. These are not determined prior to manufacture and are more restrictive than class characteristics.

Examination Process

Level 1 analysis - *Class Characteristics*

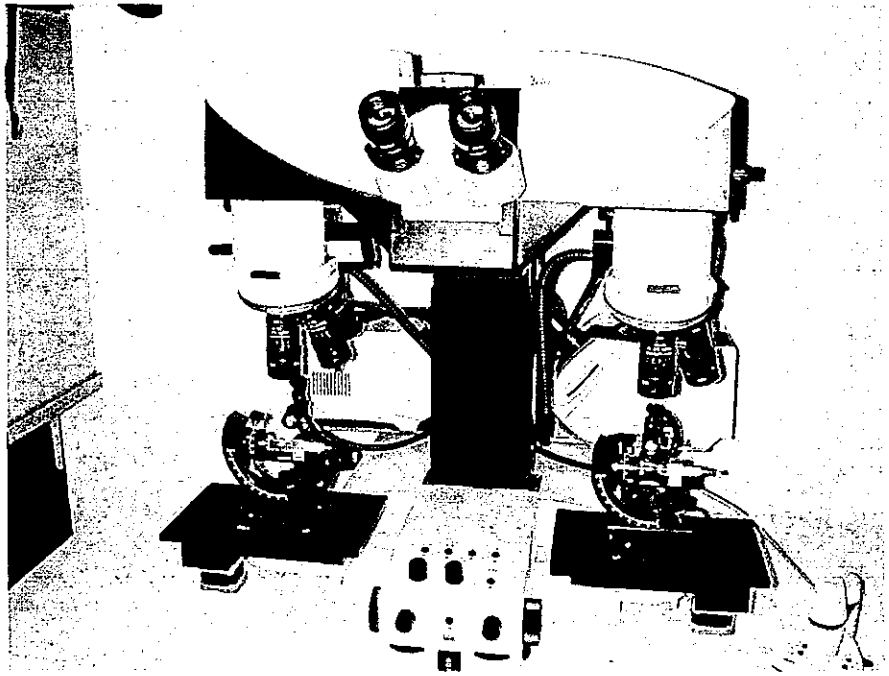
- Elimination, but not individualization, can occur here



Examination Process

Level 2 analysis - *Comparison Microscopy*

- Individualization occurs only here

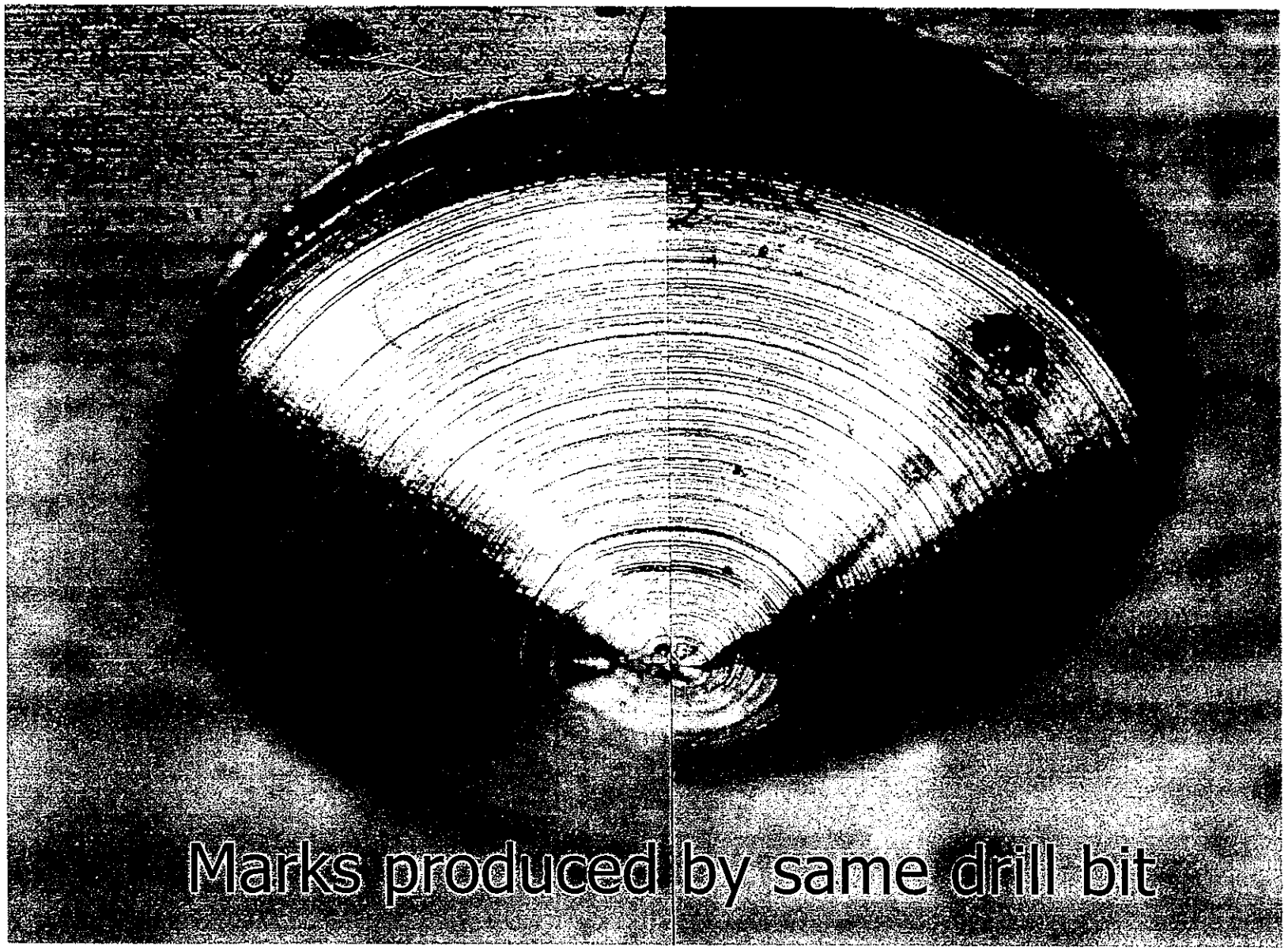


Range of Conclusions

- Identification (Definitive match)
- Inconclusive
- Elimination (Definitive exclusion)

Range of Conclusions - *Identification*

If the class characteristics present are the same, and if the quality, quantity, and character of two toolmarks display sufficient microscopic agreement and compatibility, then an ***identification*** conclusion is often warranted.


Marks produced by same drill bit

Range of Conclusions - *Inconclusive*

Assuming similarity of class characteristics, if two toolmarks are insufficient in their microscopic agreement, or incompatible in their character, then an examiner may be unable to conclude either identity or exclusion (elimination). In this event an ***inconclusive*** result is appropriate.