



National Technical Systems  
1435 Allec Street  
Anaheim, CA 92805

www.nts.com  
Main: 714-999-1616

**Date:** JANUARY 29, 2021

**Customer:**

Perfect Point EDM  
15192 Triton Lane  
Huntington Beach, CA 92649

**Purchase Order Number:** P919-SBIR

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## **MICROGRAPH ANALYSIS & MICROHARDNESS**

**SPECIFICATIONS:**

Drawing – 10960-003 REV 1  
SOW – SOW 61-222 REV A

**TESTS:**

Micrograph Analysis  
Microhardness

**TEST ITEMS:**

Date Received:	11/12/2020
Sample Identification:	HL11-6
Serial Numbers:	Tier 1: AL001.015-1, AL001.015-2, AL001.016-3, AL001.016-4, AL001.017-1, AL001.017-3, AL001.018-2, AL001.018-4, AL001.019-4, AL001.019-5, AL001.020-2, AL001.020-4, AL001.021-1, AL001.021-2, AL001.022-1, AL001.022-3, AL001.023-2, AL001.023-4 Tier 2: AL001.012-1, AL001.012-2, AL001.013-1, AL001.013-2, AL001.014-1, AL001.014-5 Tier 3: Ti001.012-1, Ti001.013-1, Ti001.014-1, Ti001.015-1, Ti001.016-1, Ti001.017-1, Ti001.018-1, Ti001.019-1, Ti001.020-1, Ti001.021-1, Ti001.022-1, Ti001.023-1

This is to certify that fifty two (52) units were subjected to the testing according to the above specifications. See page 2 for summary of test results.

Test data, photographs and equipment list are attached.

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Sarah Loggins  
*Preparer*

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Cesar DeLuna  
*Department Manager  
Technical Reviewer*

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Josephin Mazariegos  
*Quality Representative*

**REVISIONS**

Revision	Reason for Revision	Date
NR	Initial Release	1/29/2021

**SUMMARY OF TEST RESULTS**

Test	Part Number	Results
Micrograph Analysis	HL11-6	For customer evaluation
Microhardness	HL11-6	For customer evaluation

**MICROGRAPH ANALYSIS**

PART IDENTIFICATION:	HL11-6
SERIAL NUMBERS:	Tier 1: AL001.015-1, AL001.015-2, AL001.016-3, AL001.016-4, AL001.017-1, AL001.017-3, AL001.018-2, AL001.018-4, AL001.019-4, AL001.019-5, AL001.020-2, AL001.020-4, AL001.021-1, AL001.021-2, AL001.022-1, AL001.022-3, AL001.023-2, AL001.023-4 Tier 2: AL001.012-1, AL001.012-2, AL001.013-1, AL001.013-2, AL001.014-1, AL001.014-5 Tier 3: Ti002.012-1, Ti002.013-1, Ti002.014-1, Ti002.015-1, Ti002.016-1, Ti002.017-1, Ti002.018-1, Ti002.019-1, Ti002.020-1, Ti002.021-1, Ti002.022-1, Ti002.023-1
TEST PROCEDURES:	SOW 61-222 REV A
TEST METHOD VARIATION(S):	None
TEST SPECIMENS:	Thirty six (36) units were submitted for micrograph analysis.
EQUIPMENT USED:	See Equipment Page
SAMPLE PREP PERFORMED BY:	Alex Villicana
TEST(S) PERFORMED BY:	Alex Villicana
TEST PERFORMED AT:	1435 S. Allec St., Anaheim CA 92805
TEST DATE:	12/15/2020

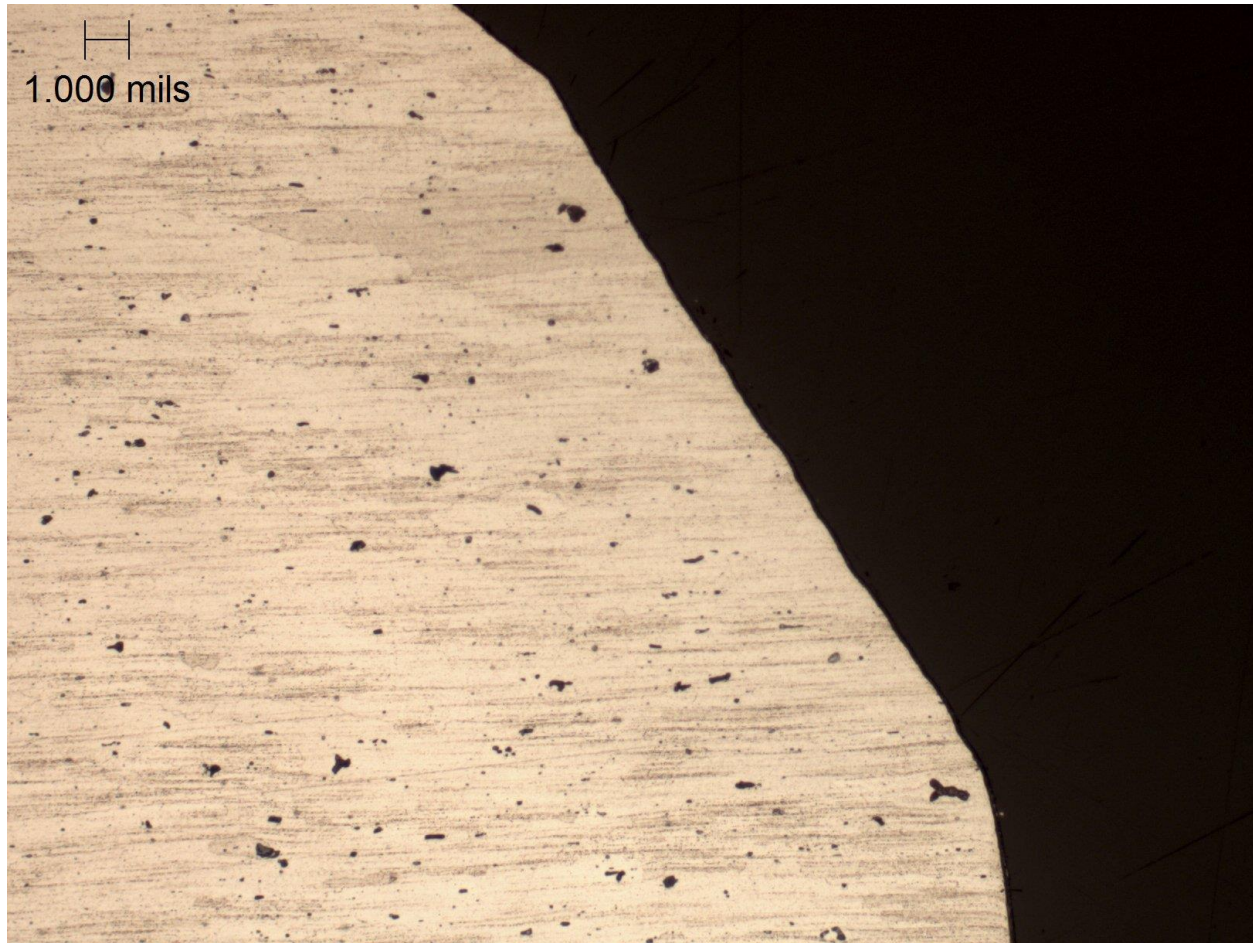
**TEST RESULTS:**

See attached images for final results.

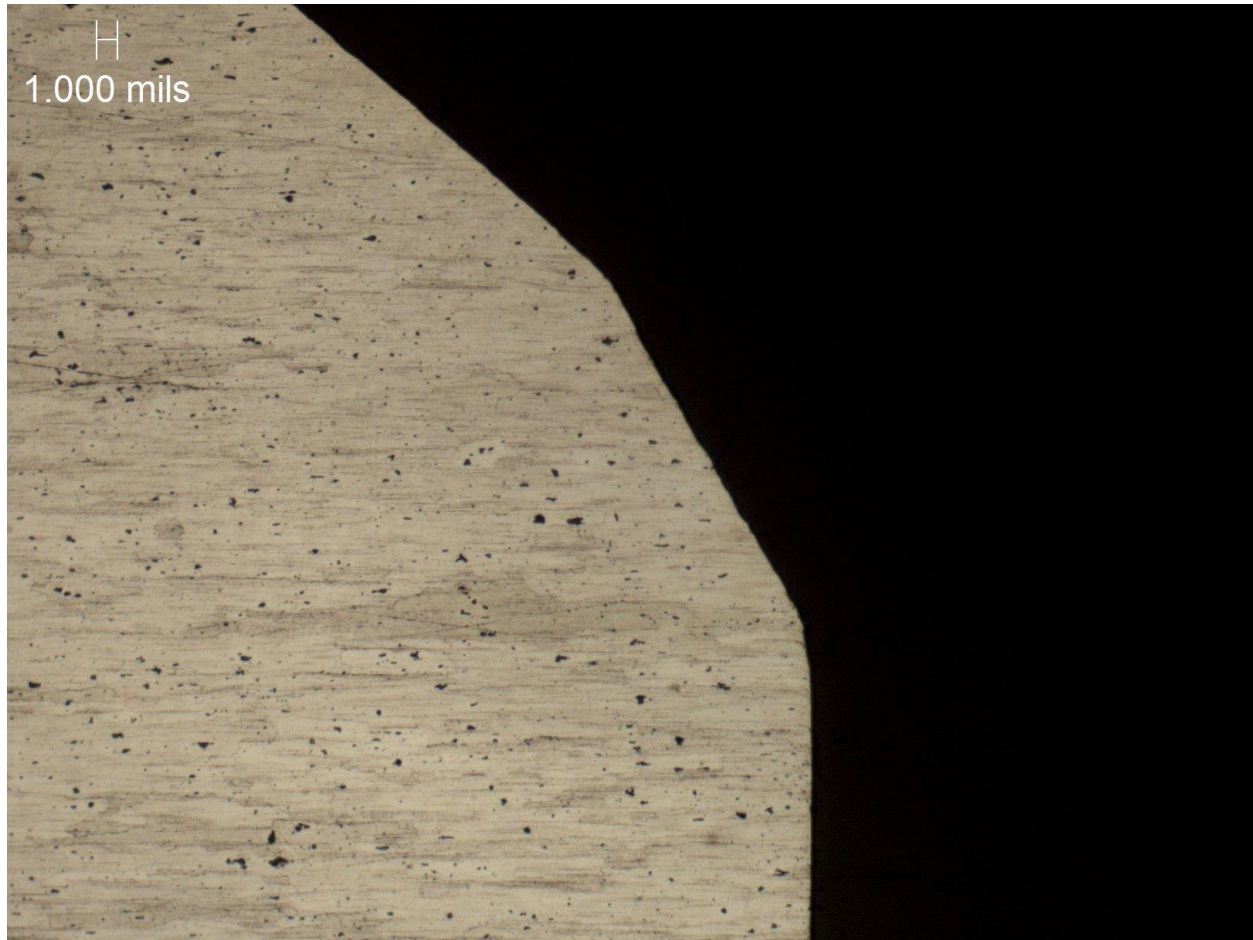


Material: Aluminum  
Offset Position: 0.015  
S/N: AL.001.015-1  
Defects: None Found  
Magnification 100X





Material: Aluminum  
Offset Position: 0.015  
S/N: AL.001.015-1  
Defects: None Found  
Magnification 200X



Material: Aluminum  
Offset Position: 0.015  
S/N: AL.001.015-2  
Defects: None Found  
Magnification 100X





Material: Aluminum  
Offset Position: 0.015  
S/N: AL.001.015-2  
Defects: None Found  
Magnification 200X

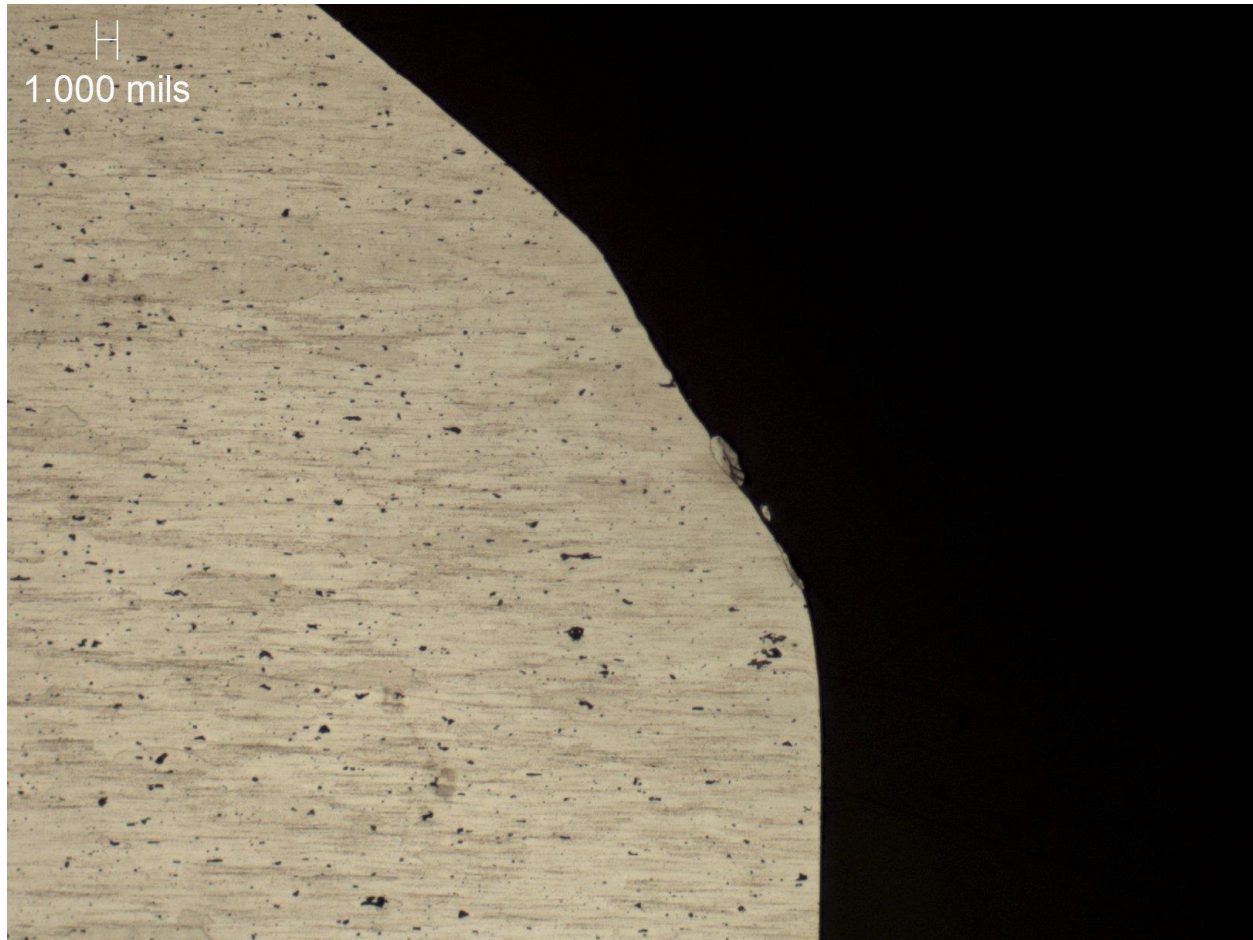


Material: Aluminum  
Offset Position: 0.016  
S/N: AL.001.016-3  
Defects: None Found  
Magnification 100X

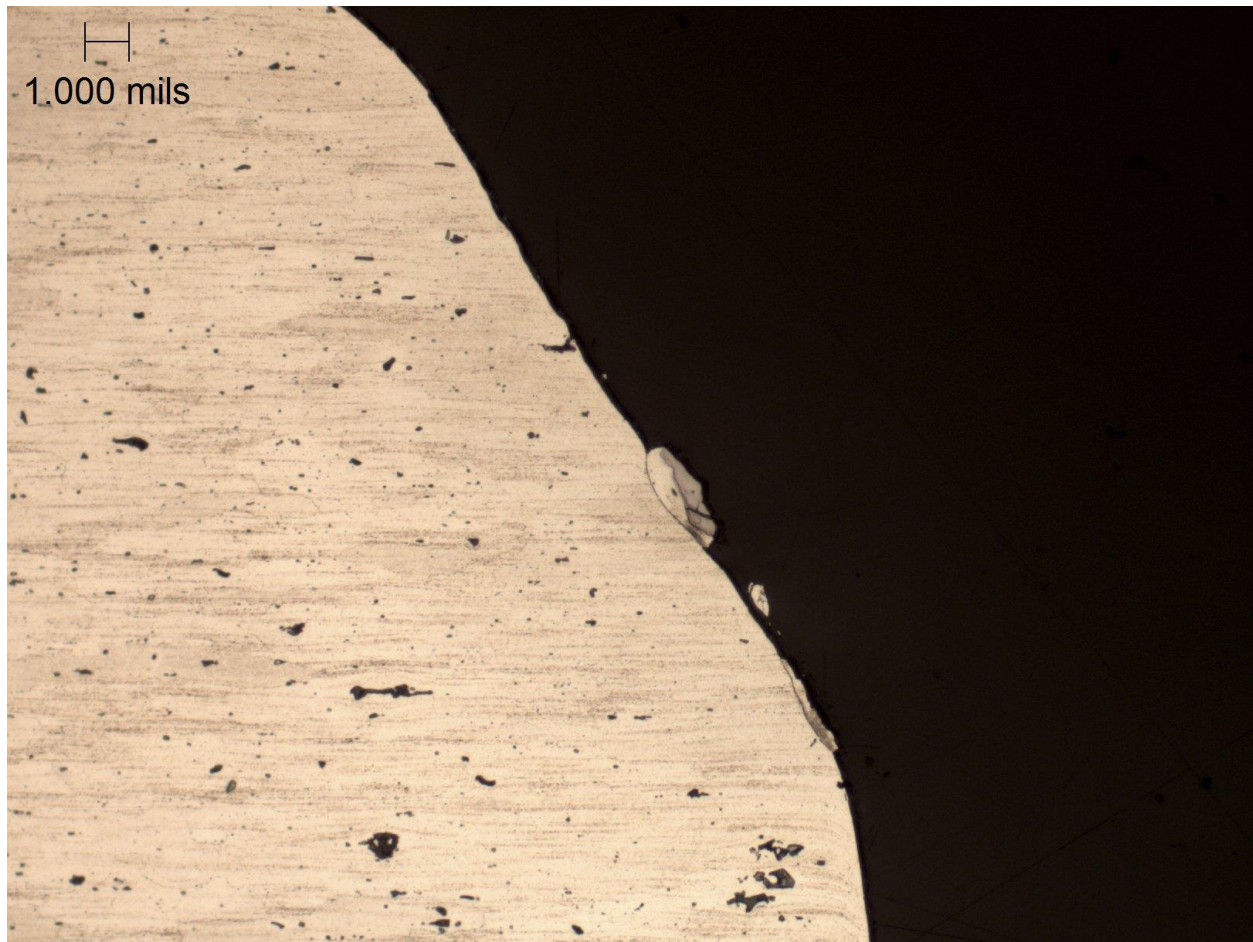


Material: Aluminum  
Offset Position: 0.016  
S/N: AL.001.016-3  
Defects: None Found  
Magnification 200X





Material: Aluminum  
Offset Position: 0.016  
S/N: AL.001.016-4  
Defects: None Found  
Magnification 100X

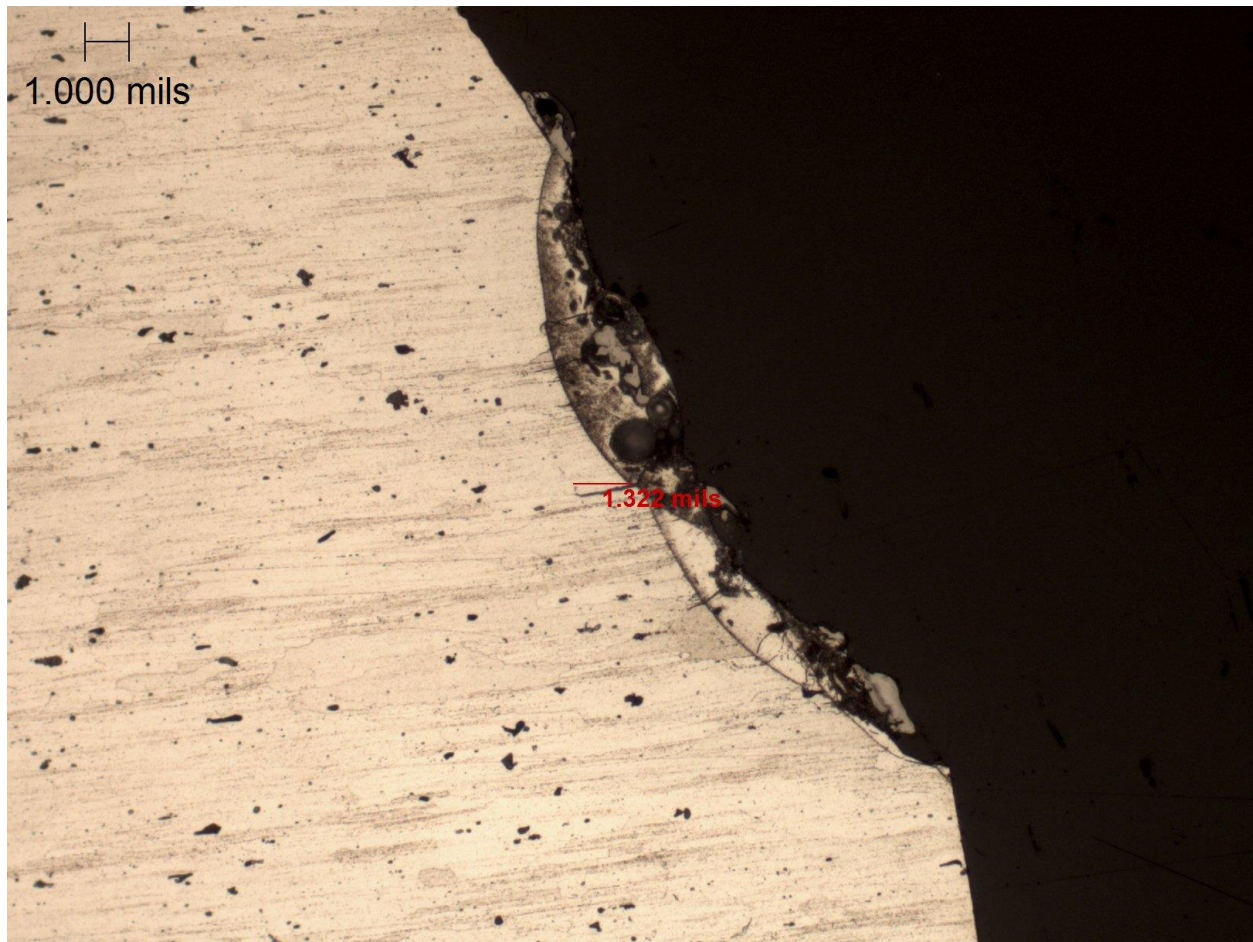


Material: Aluminum  
Offset Position: 0.016  
S/N: AL.001.016-4  
Defects: None Found  
Magnification 200X

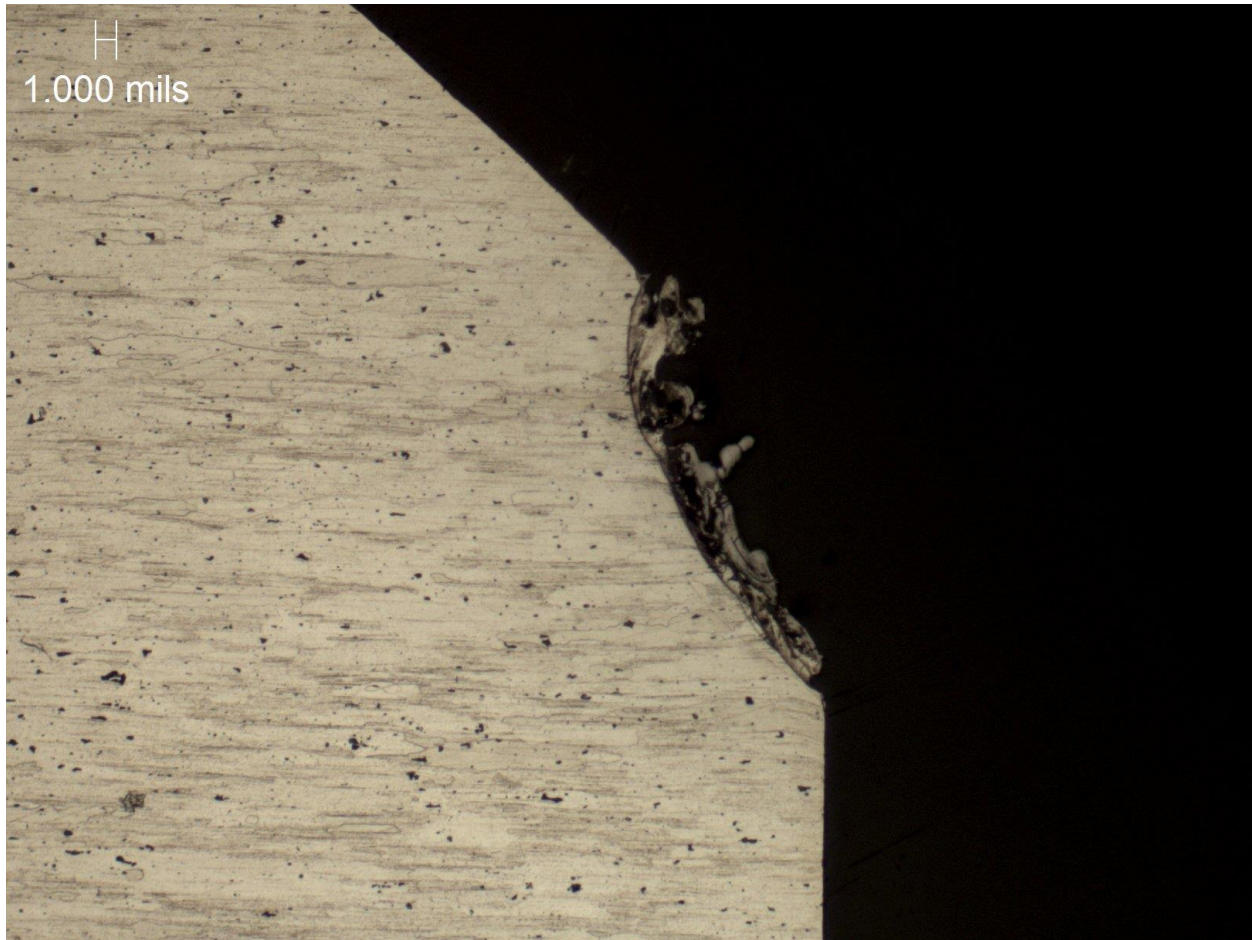


Material: Aluminum  
Offset Position: 0.017  
S/N: AL.001.017-1  
Defects: None Found  
Magnification 200X



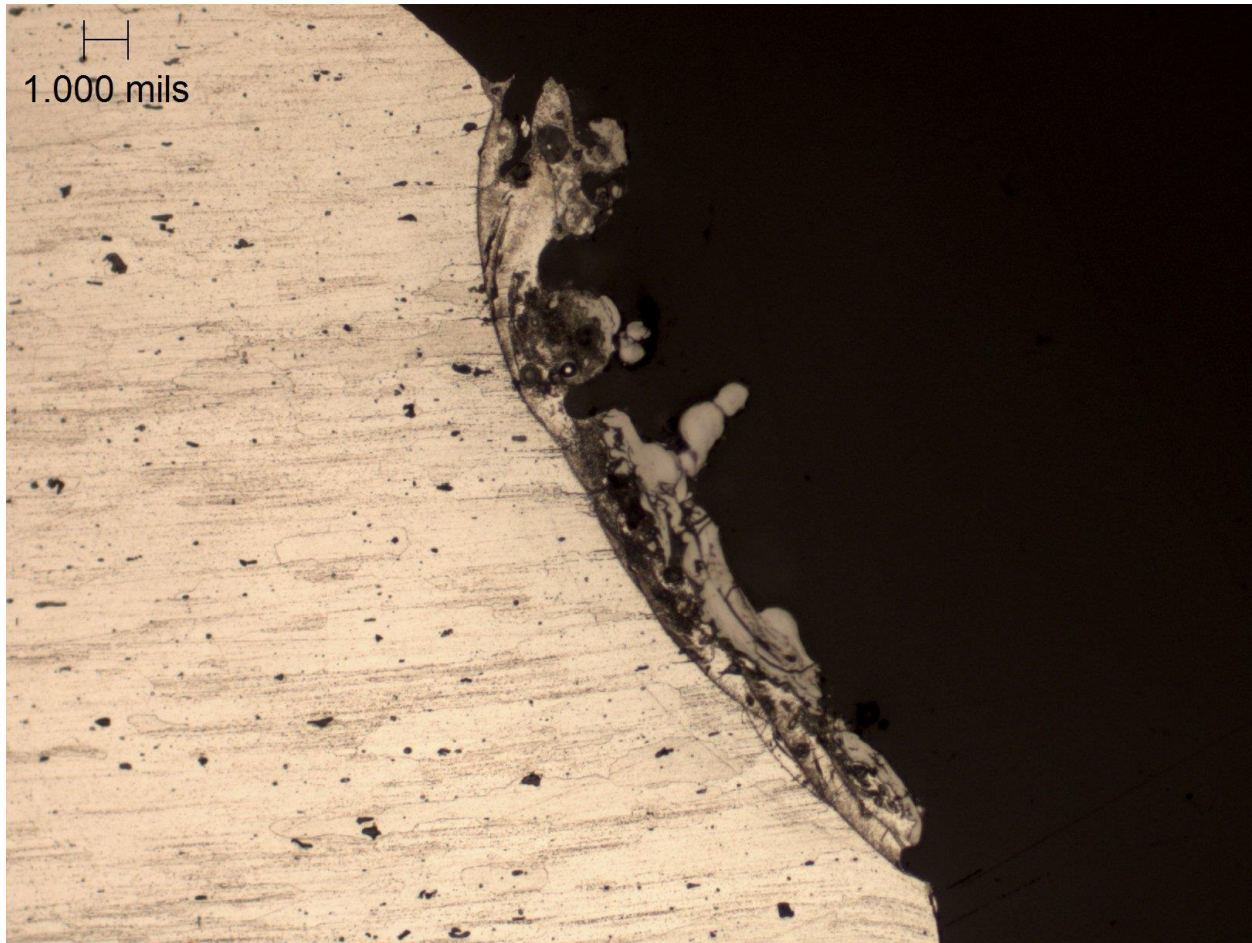


Material: Aluminum  
Offset Position: 0.017  
S/N: AL.001.017-1  
Defects: None Found  
Magnification 200X

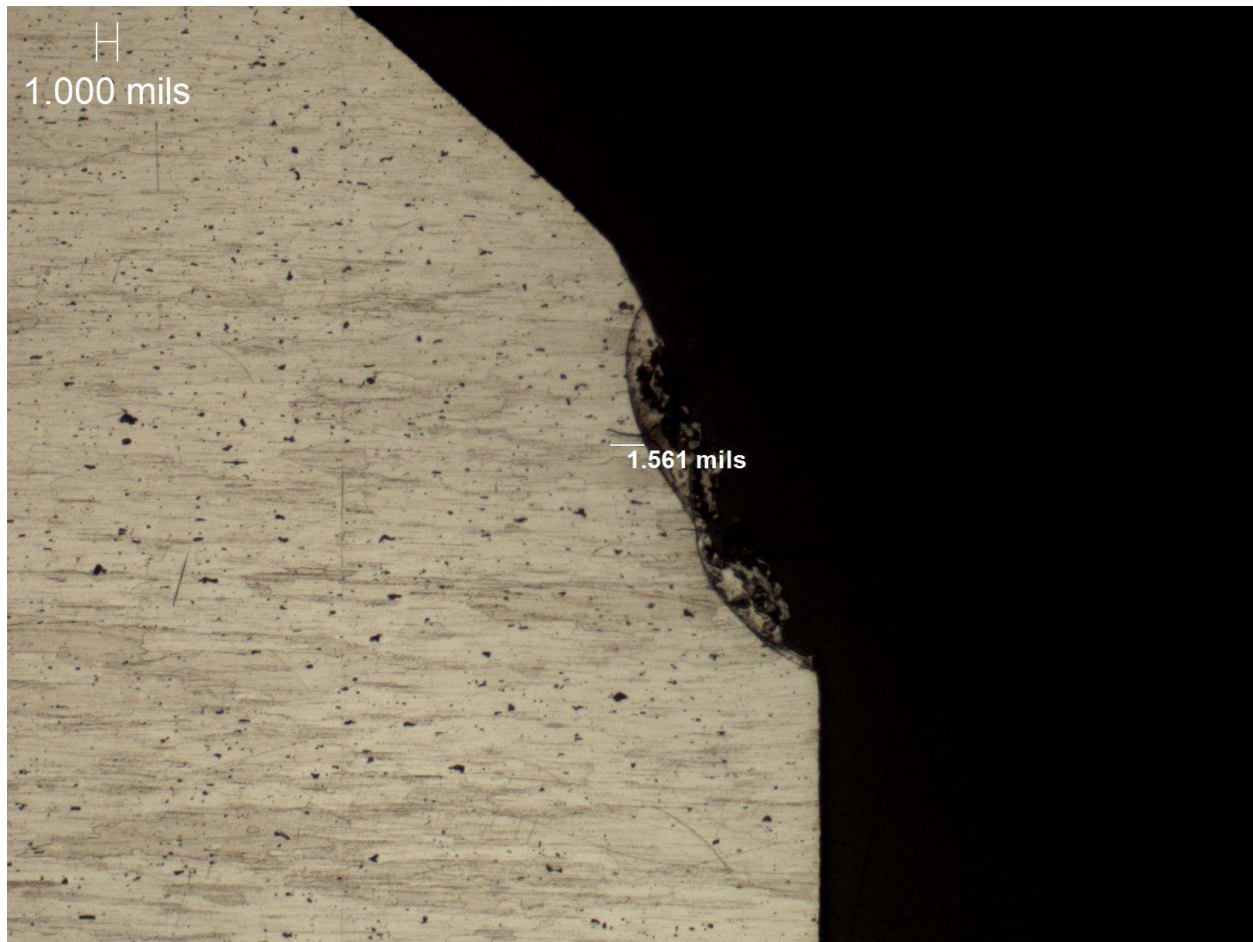


Material: Aluminum  
Offset Position: 0.017  
S/N: AL.001.017-3  
Defects: None Found  
Magnification 100X



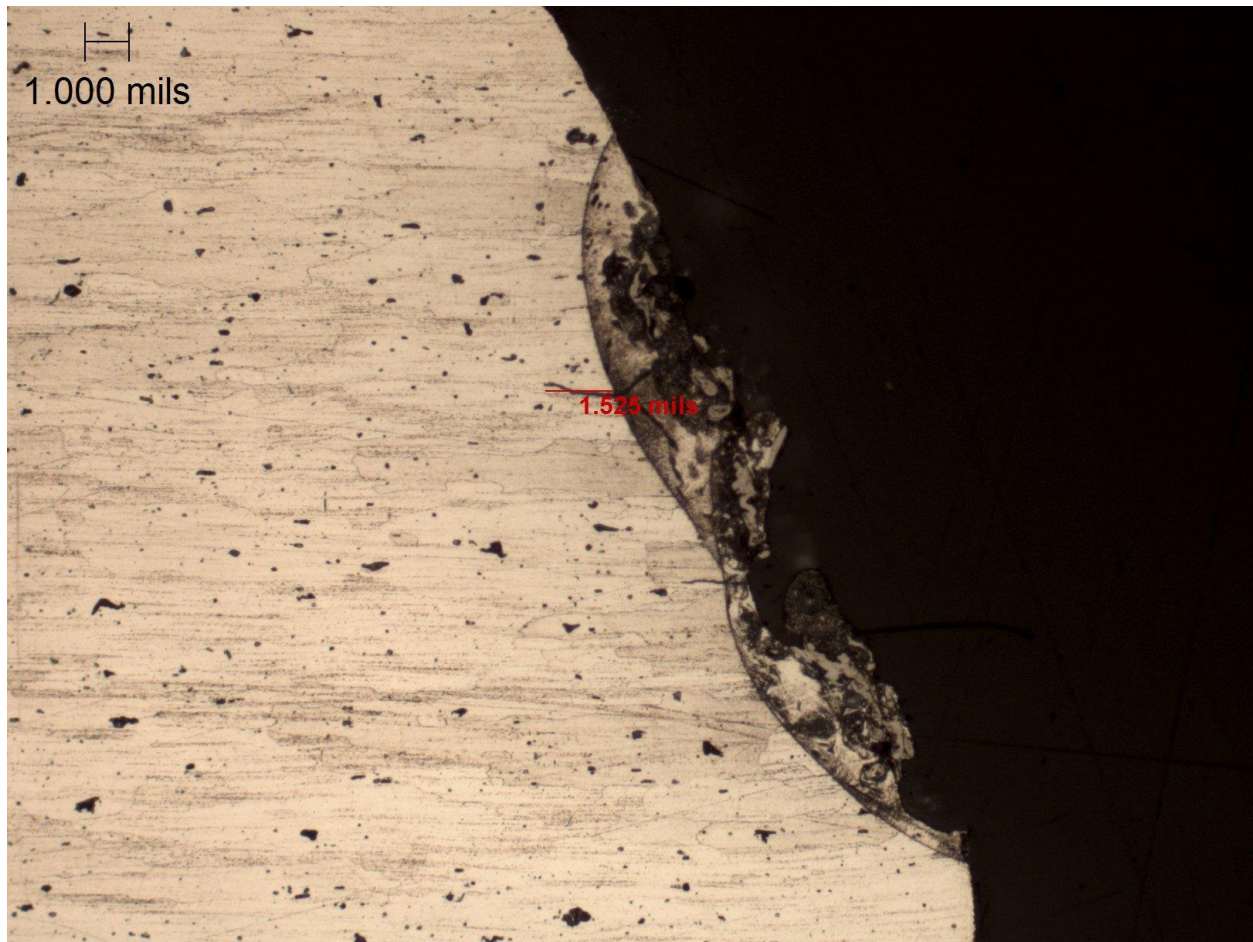


Material: Aluminum  
Offset Position: 0.017  
S/N: AL.001.017-3  
Defects: None Found  
Magnification 200X



Material: Aluminum  
Offset Position: 0.018  
S/N: AL.001.018-2  
Defects: None Found  
Magnification 100X



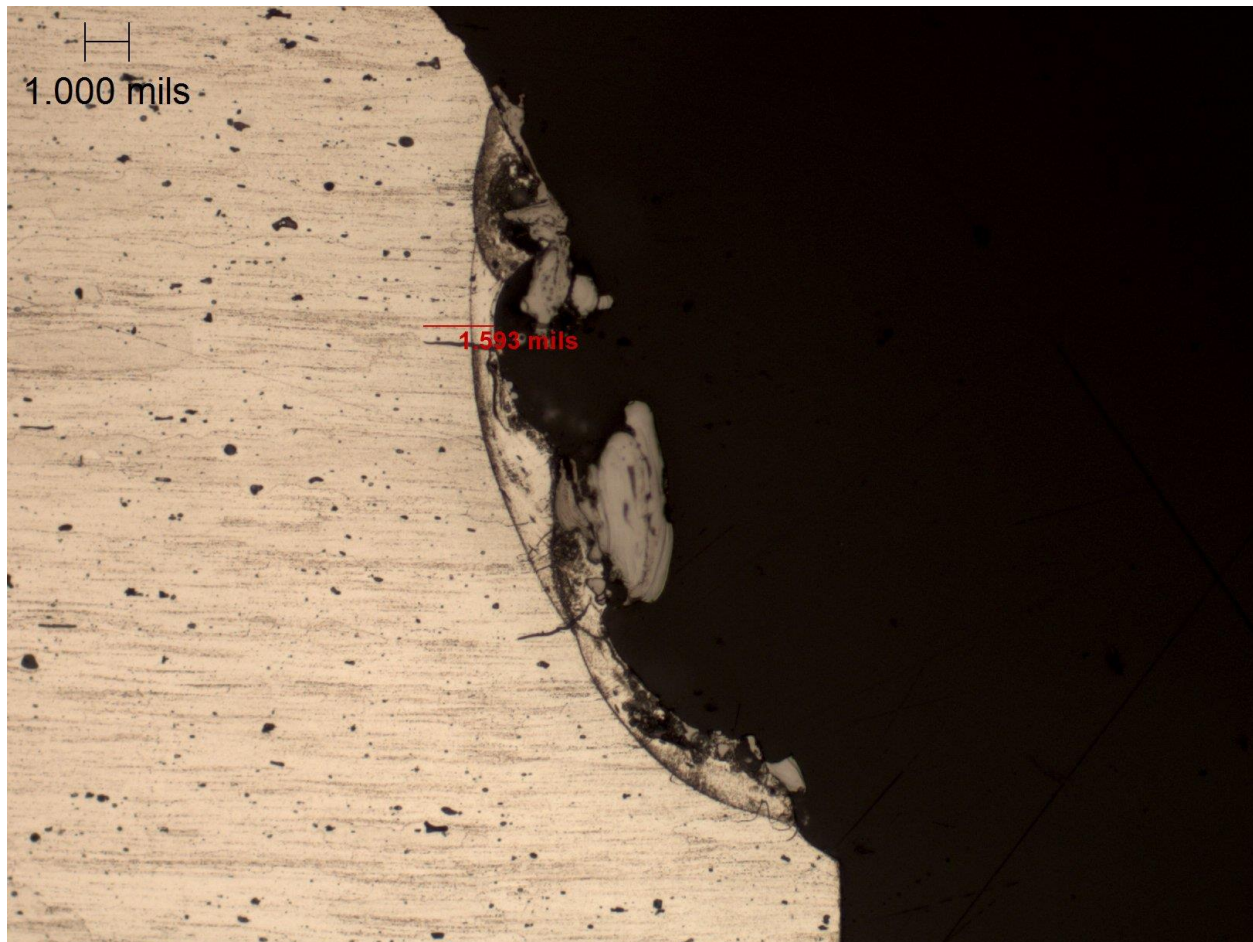


Material: Aluminum  
Offset Position: 0.018  
S/N: AL.001.018-2  
Defects: None Found  
Magnification 200X

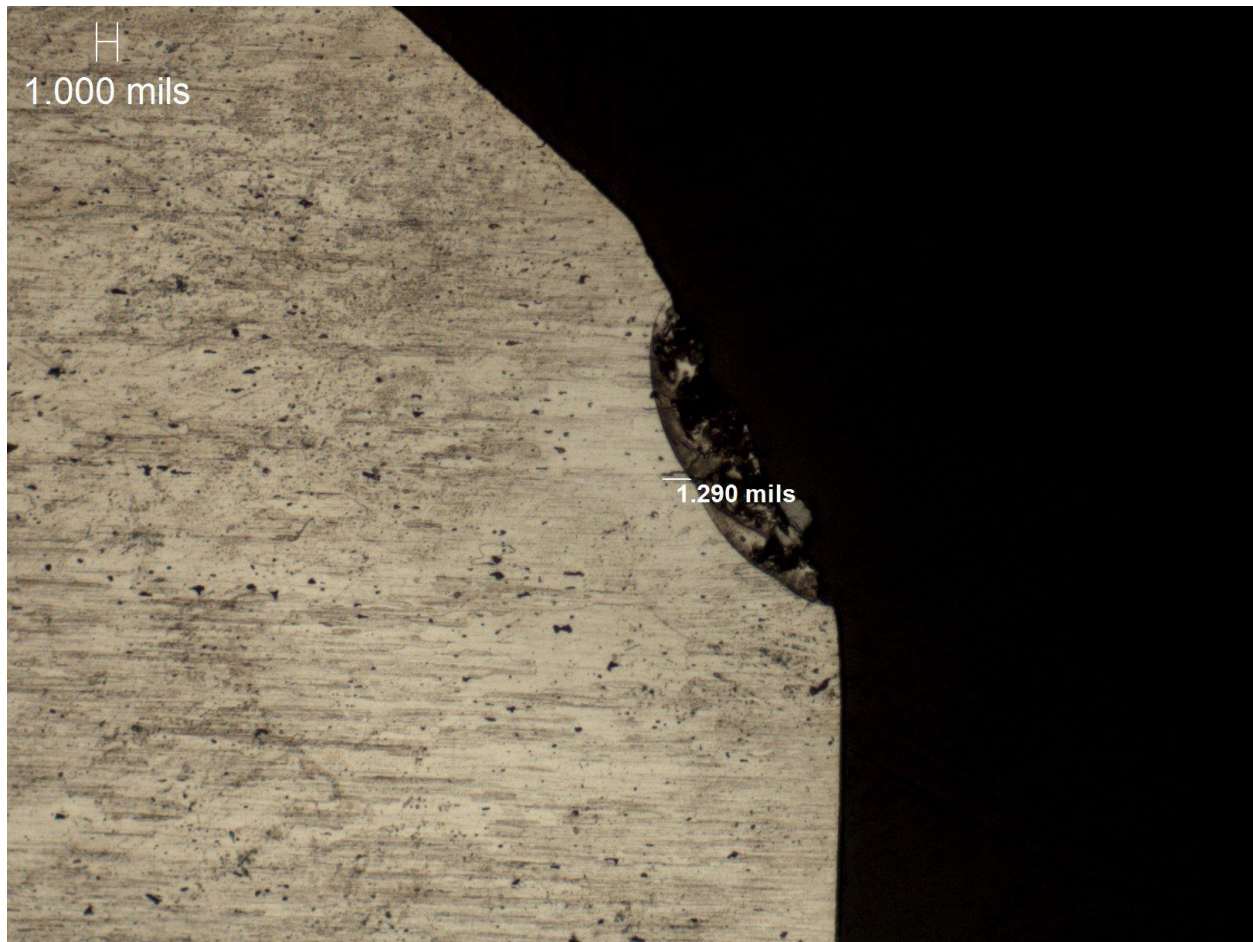


Material: Aluminum  
Offset Position: 0.018  
S/N: AL.001.018-4  
Defects: None Found  
Magnification 100X





Material: Aluminum  
Offset Position: 0.018  
S/N: AL.001.018-4  
Defects: None Found  
Magnification 200X



Material: Aluminum  
Offset Position: 0.019  
S/N: AL.001.019-4  
Defects: None Found  
Magnification 100X





Material: Aluminum  
Offset Position: 0.019  
S/N: AL.001.019-4  
Defects: None Found  
Magnification 200X

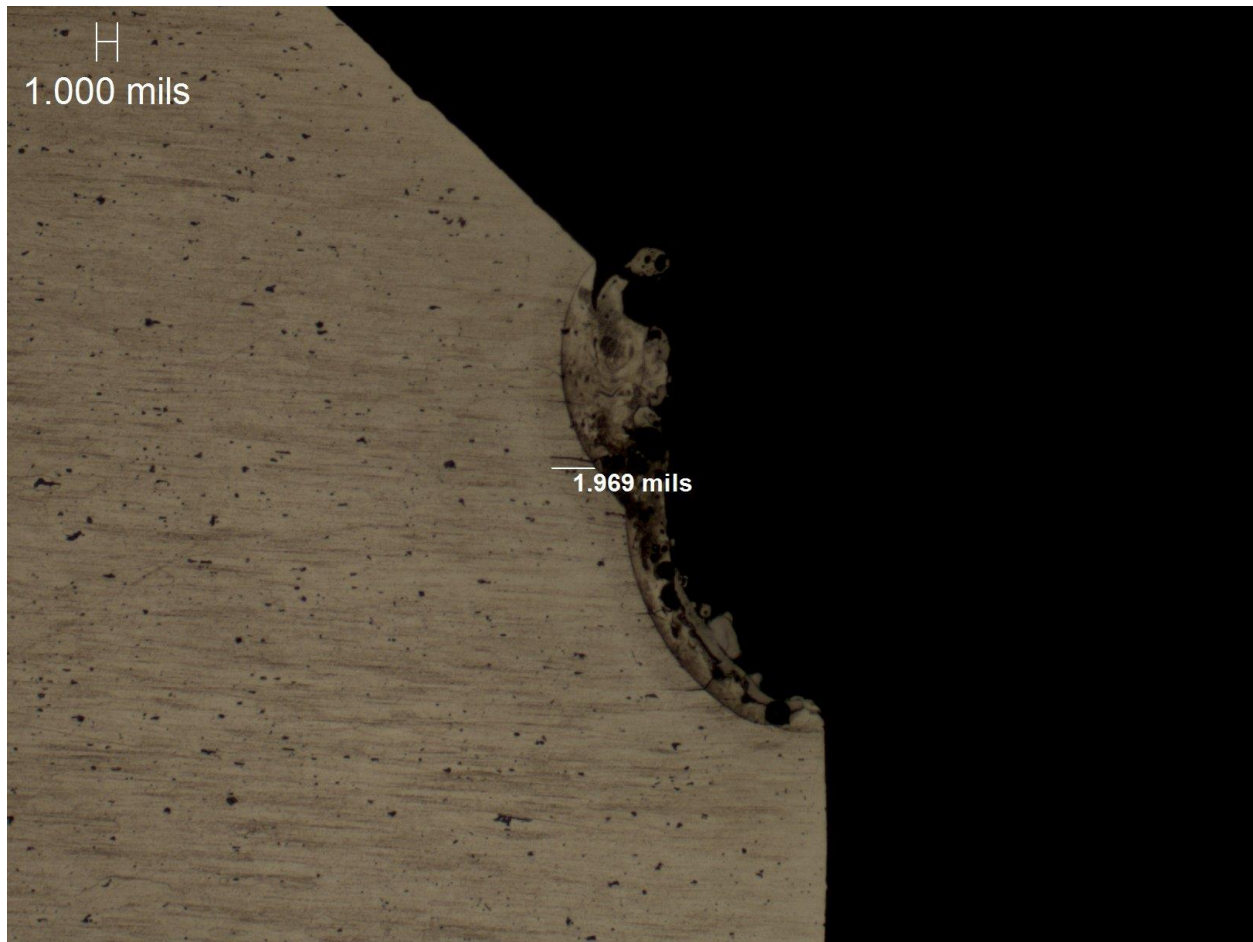


Material: Aluminum  
Offset Position: 0.019  
S/N: AL.001.019-5  
Defects: None Found  
Magnification 100X

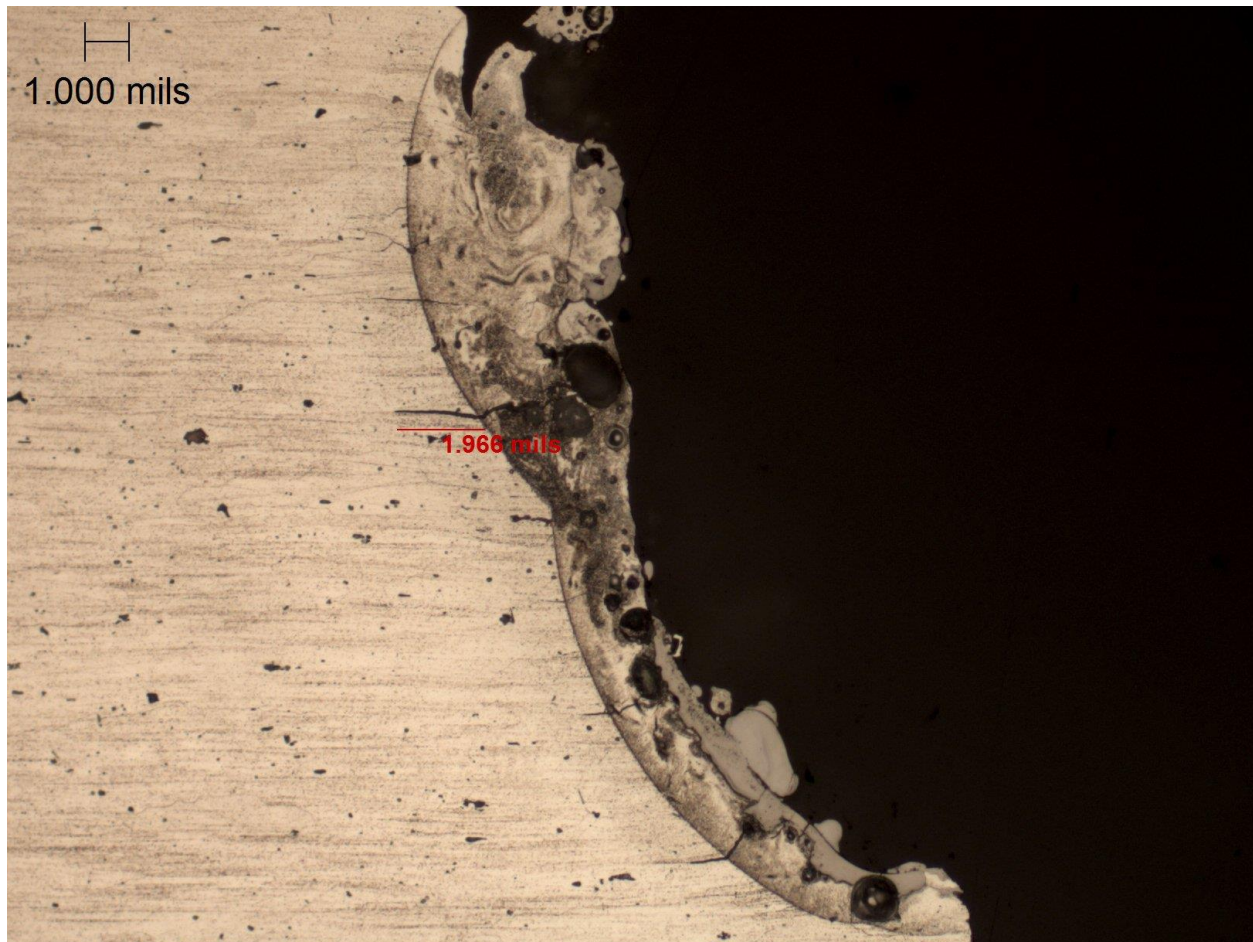


Material: Aluminum  
Offset Position: 0.019  
S/N: AL.001.019-5  
Defects: None Found  
Magnification 200X

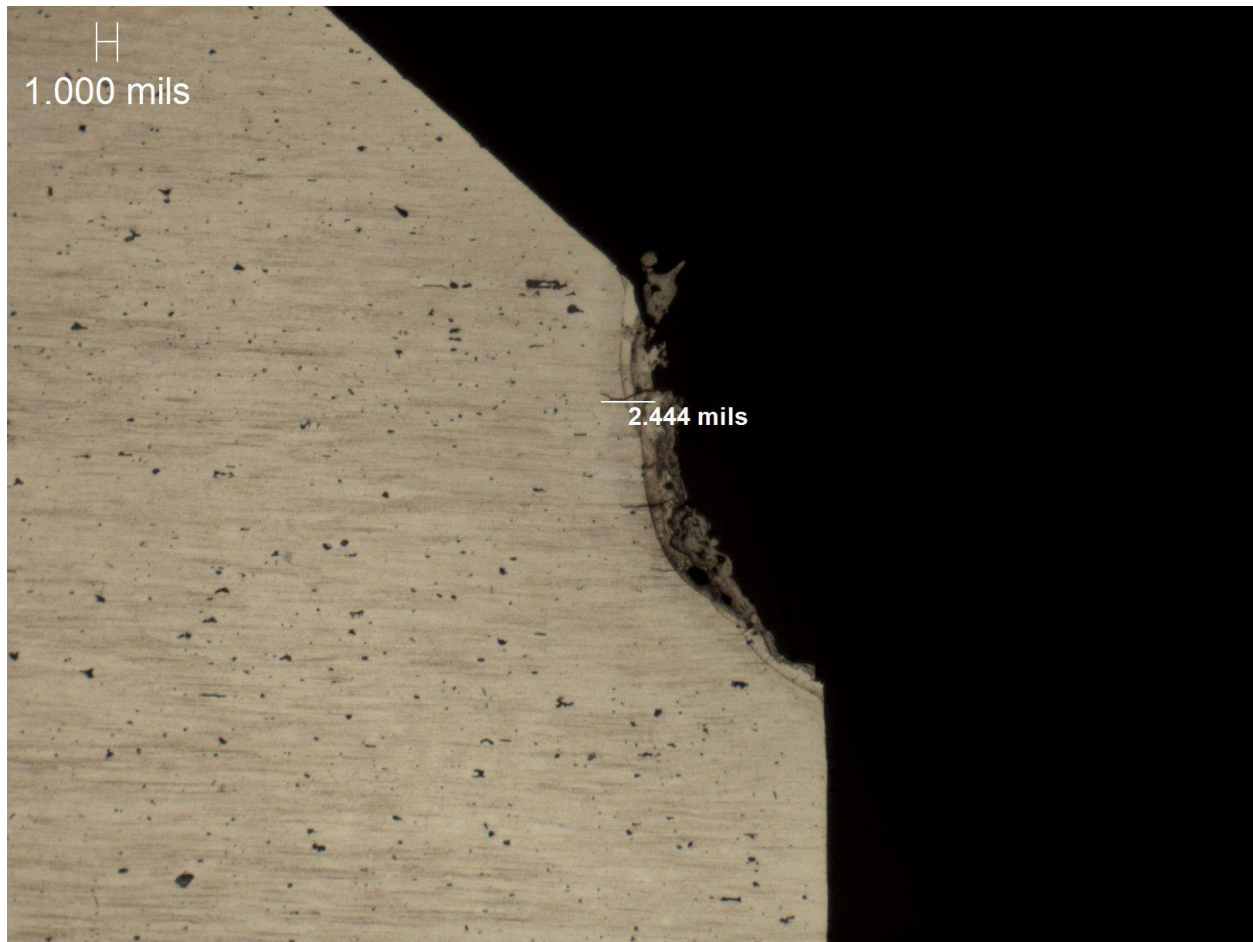




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Offset Position: 0.020  
S/N: AL.001.020-2  
Defects: None Found  
Magnification 100X

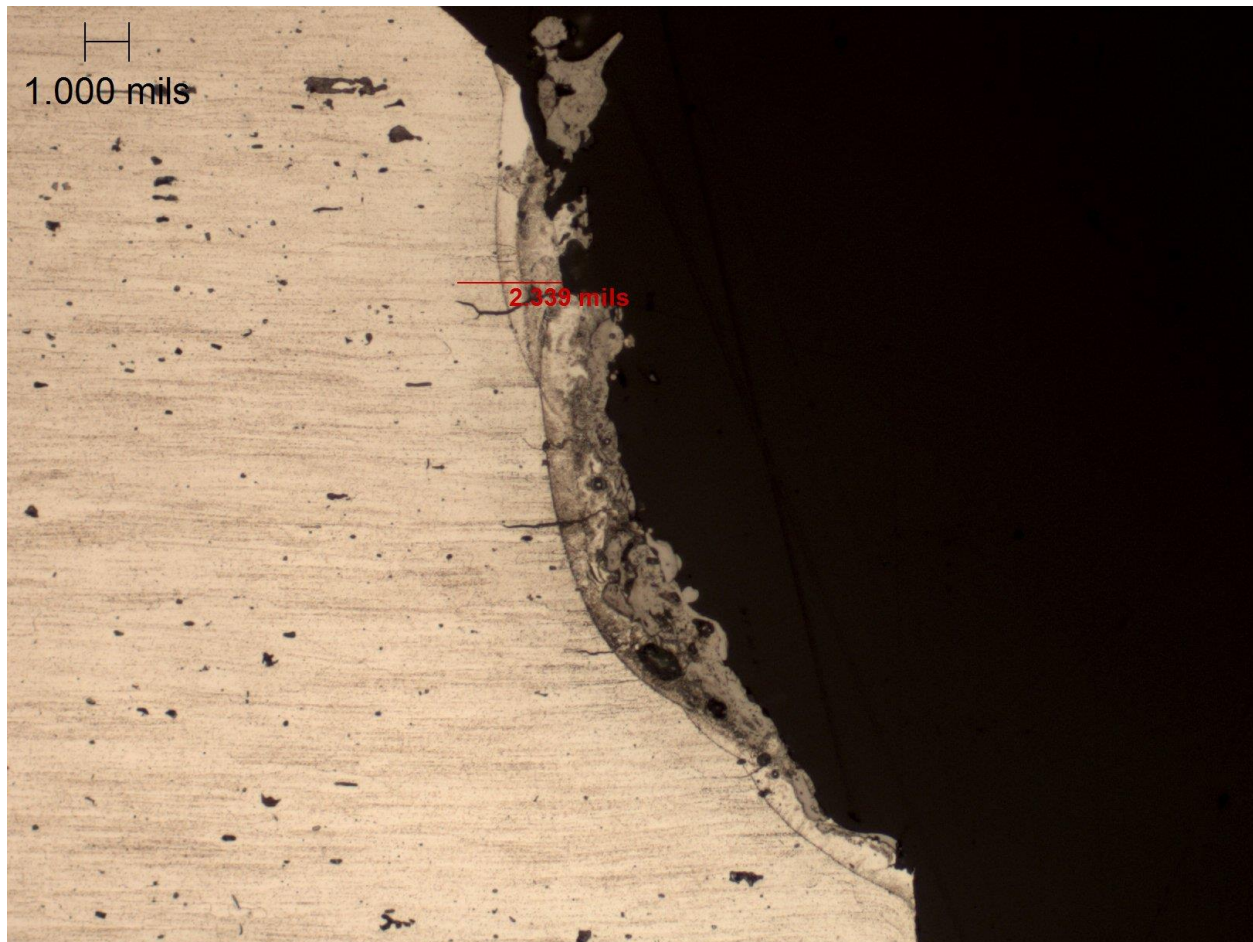


Material: Aluminum  
Offset Position: 0.020  
S/N: AL.001.020-2  
Defects: None Found  
Magnification 200X

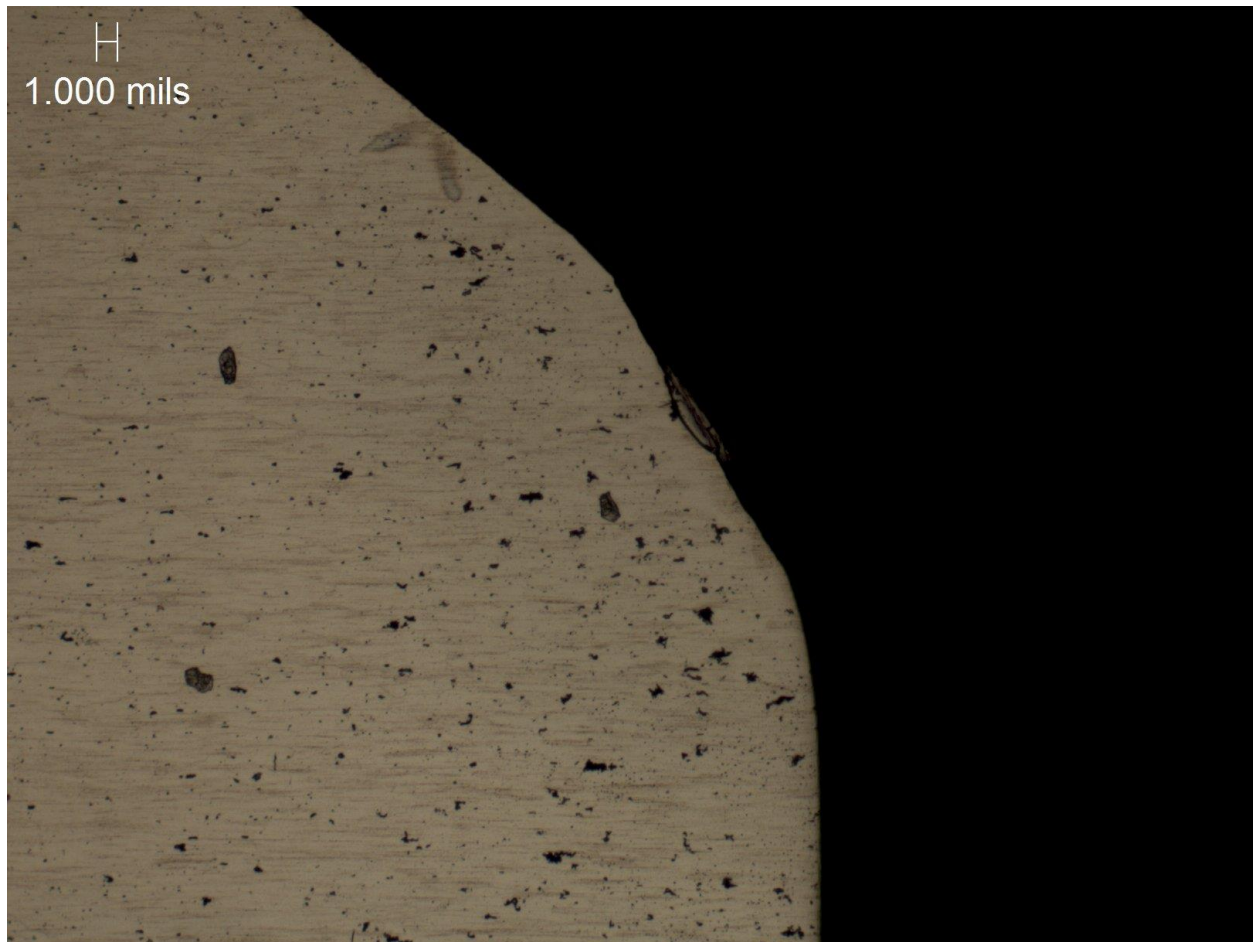


Material: Aluminum  
Offset Position: 0.020  
S/N: AL.001.020-4  
Defects: None Found  
Magnification 100X





Material: Aluminum  
Offset Position: 0.020  
S/N: AL.001.020-4  
Defects: None Found  
Magnification 200X

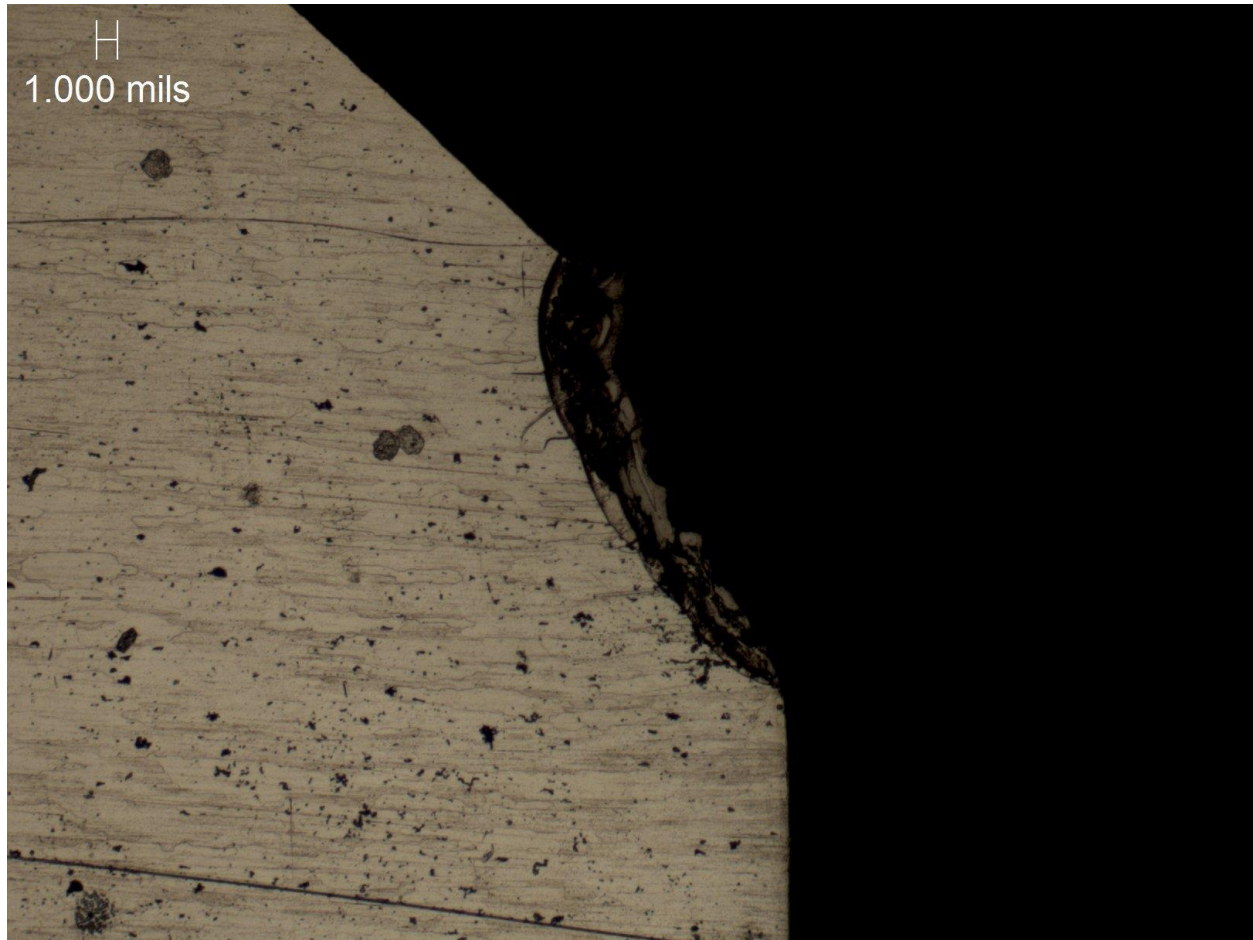


Material: Aluminum  
Offset Position: 0.021  
S/N: AL.001.021-1  
Defects: None Found  
Magnification 100X

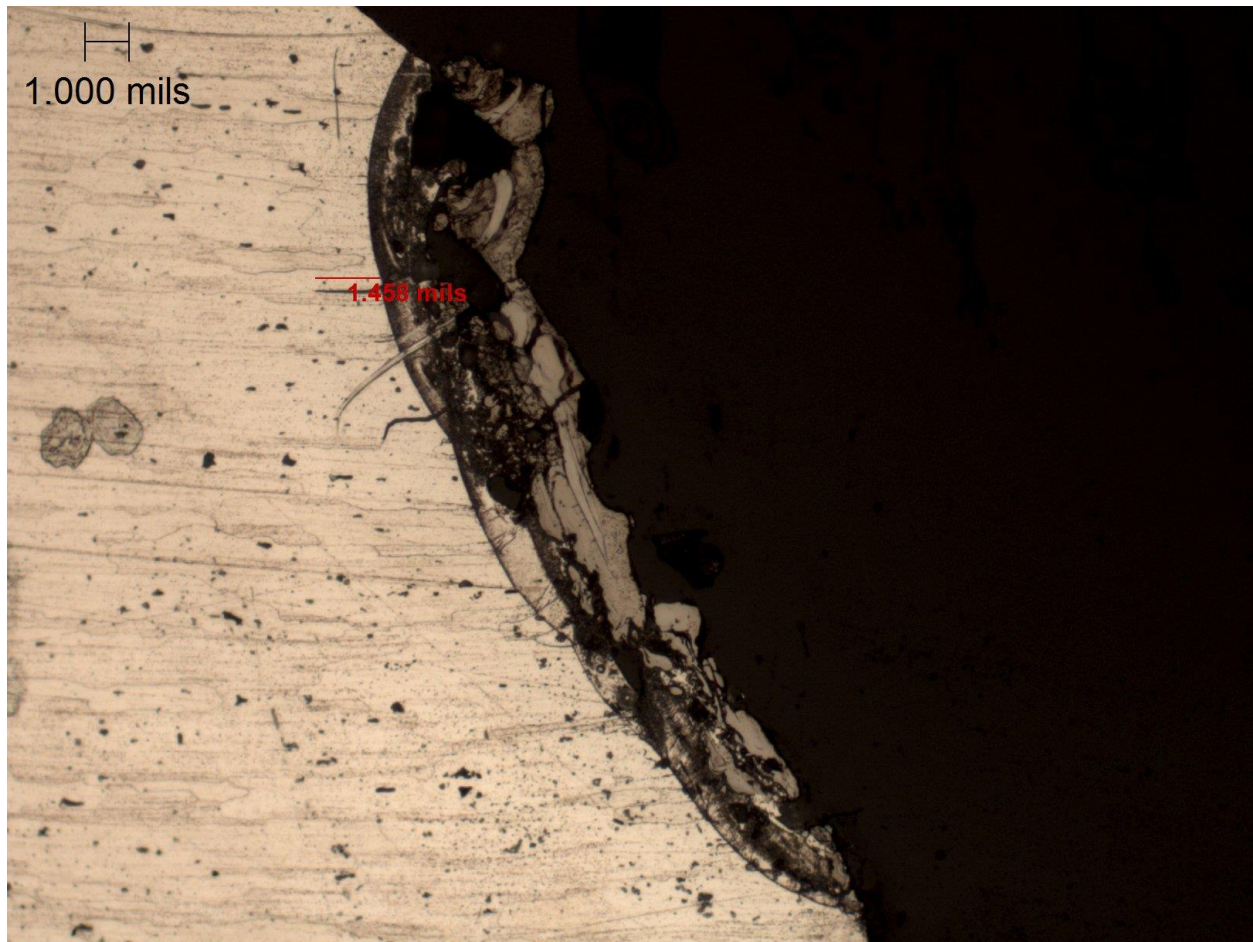




Material: Aluminum  
Offset Position: 0.021  
S/N: AL.001.021-1  
Defects: None Found  
Magnification 200X

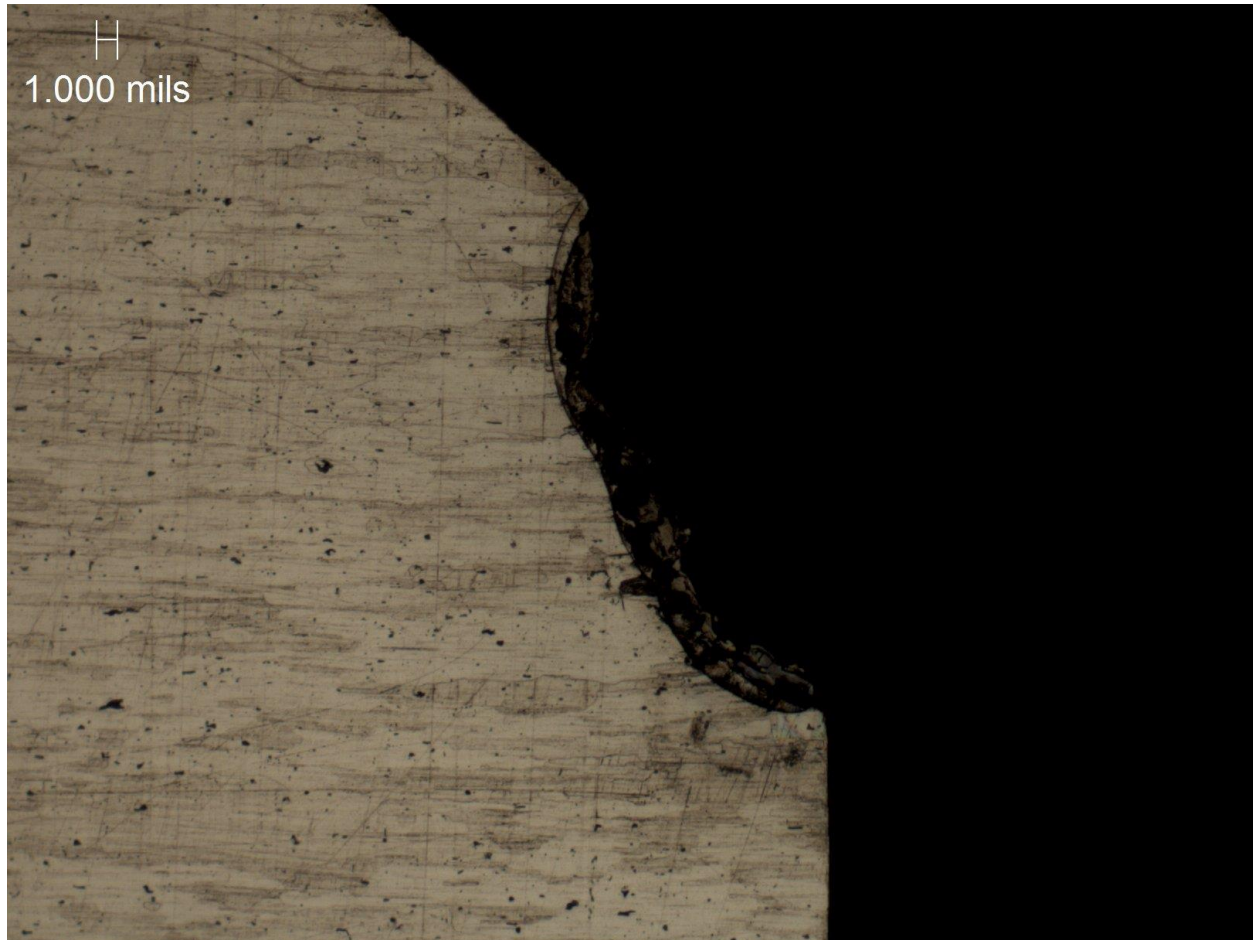


Material: Aluminum  
Offset Position: 0.021  
S/N: AL.001.021-2  
Defects: None Found  
Magnification 100X

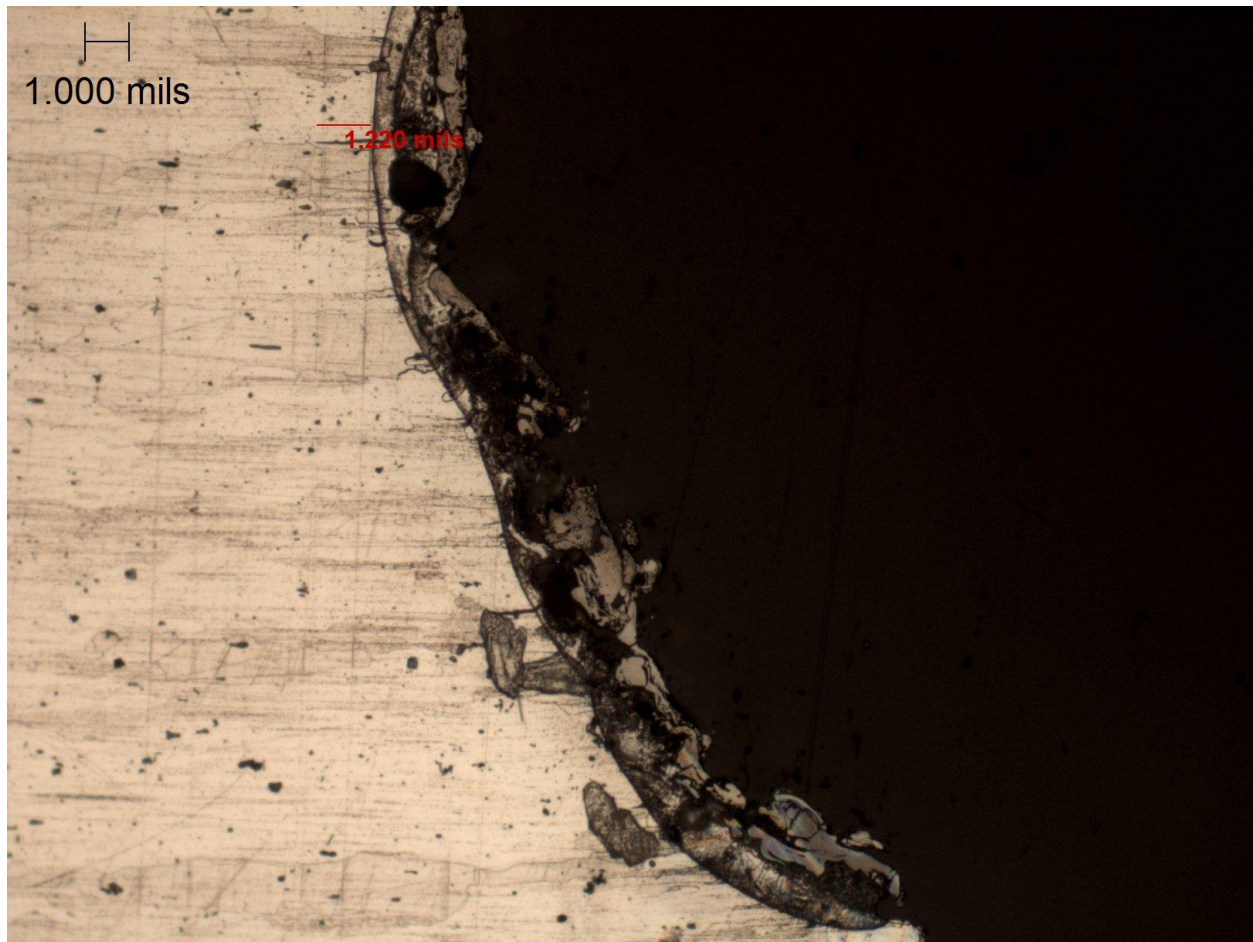


Material: Aluminum  
Offset Position: 0.021  
S/N: AL.001.021-2  
Defects: None Found  
Magnification 200X

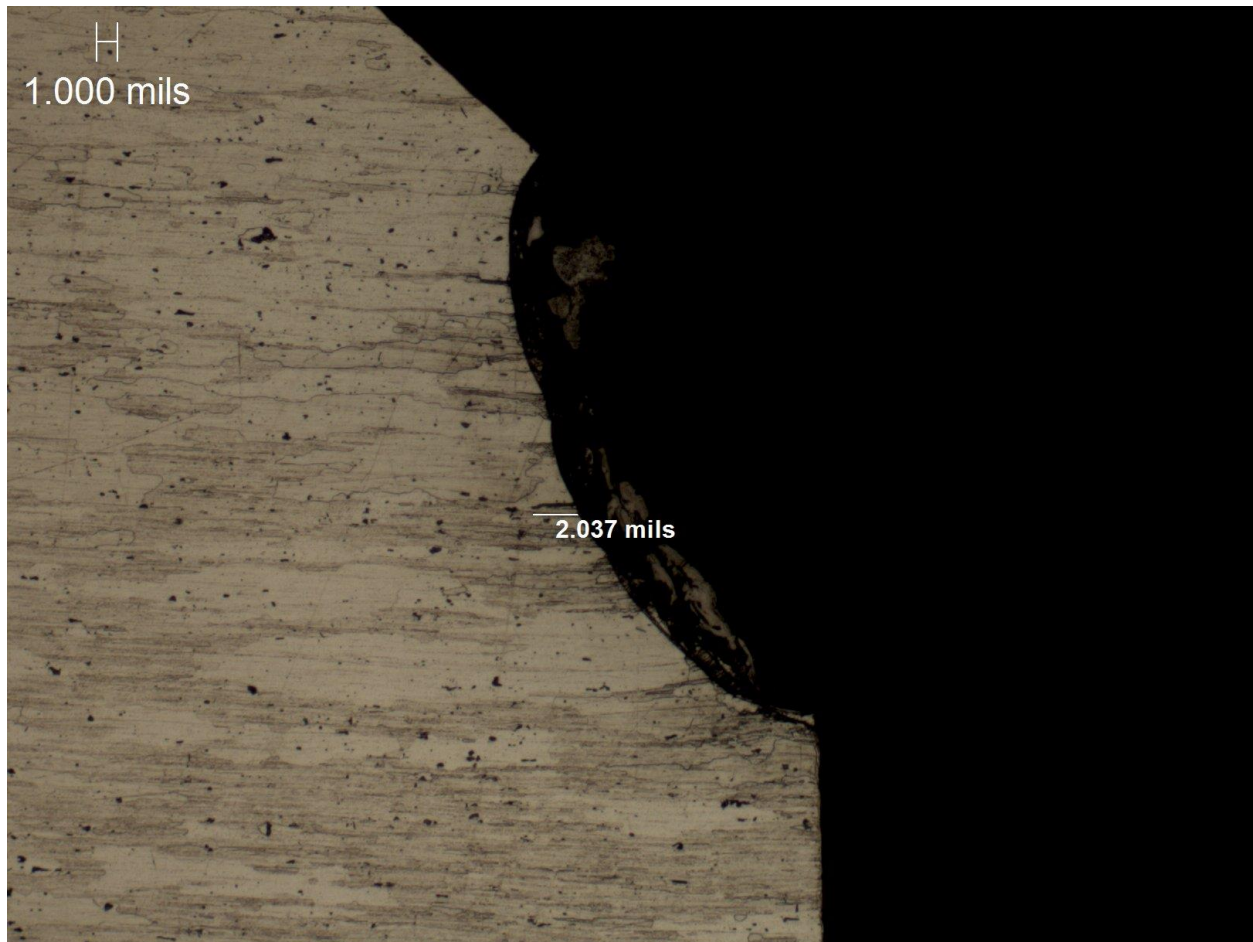




Material: Aluminum  
Offset Position: 0.022  
S/N: AL.001.022-1  
Defects: None Found  
Magnification 100X

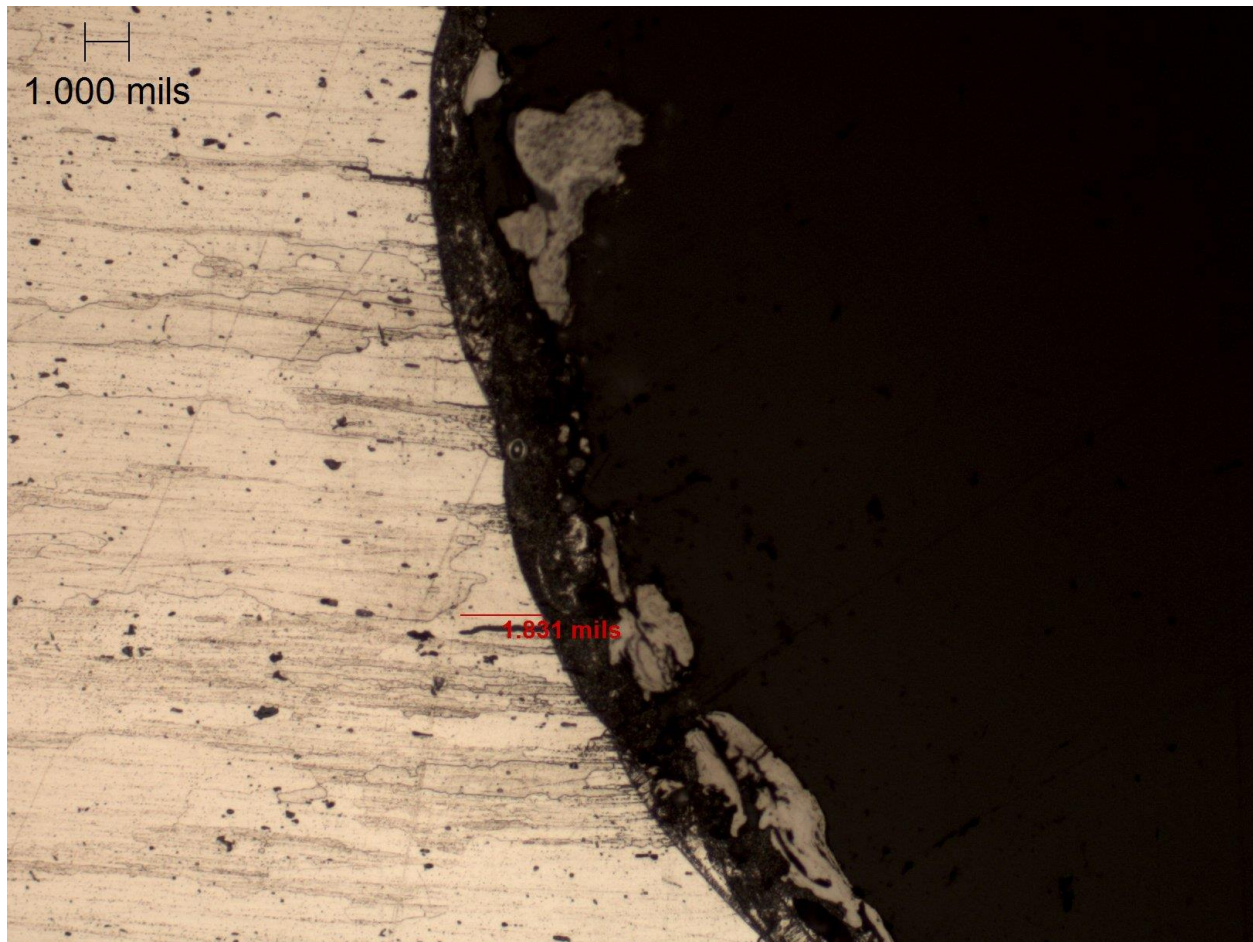


Material: Aluminum  
Offset Position: 0.022  
S/N: AL.001.022-1  
Defects: None Found  
Magnification 200X

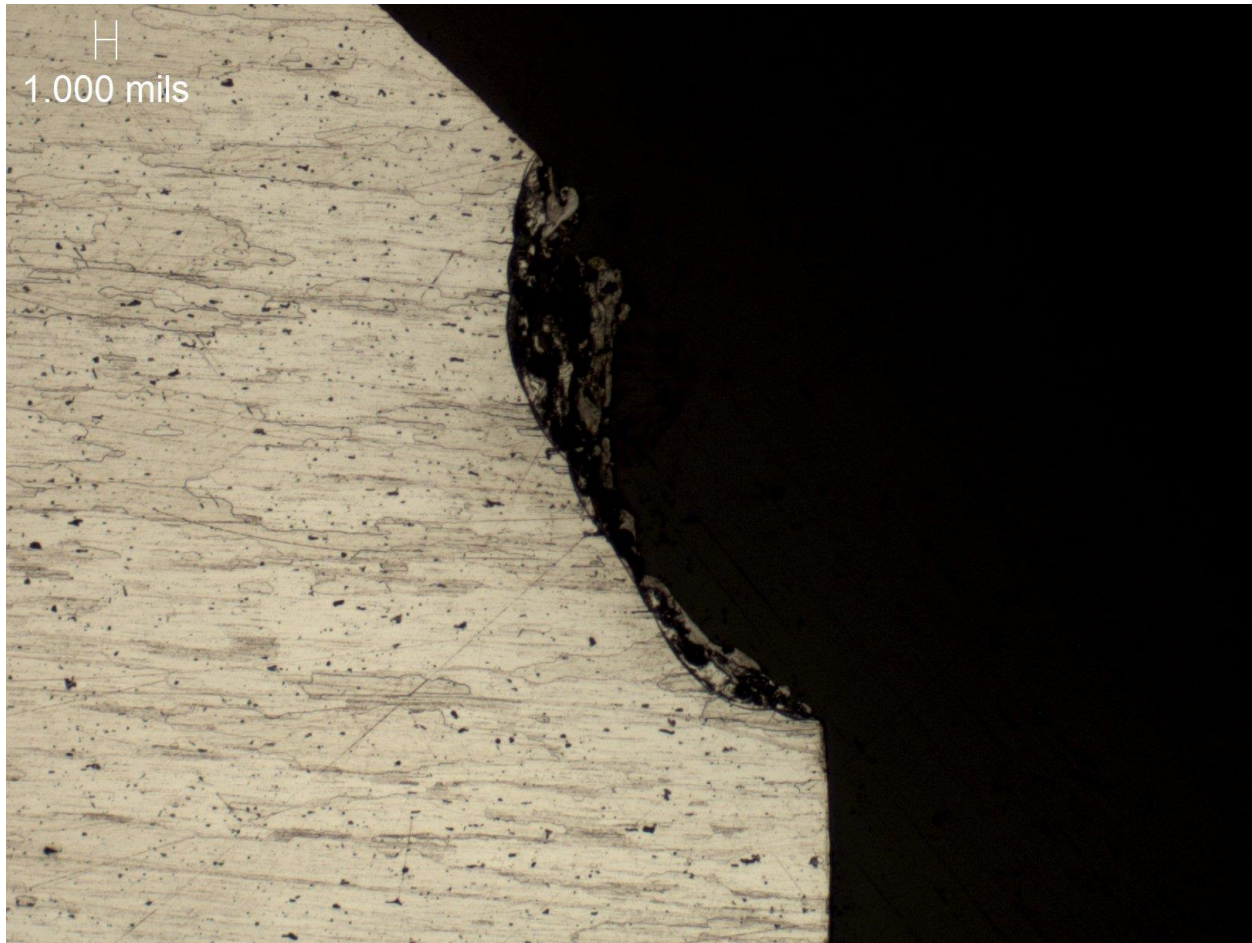


Material: Aluminum  
Offset Position: 0.022  
S/N: AL.001.022-3  
Defects: None Found  
Magnification 100X



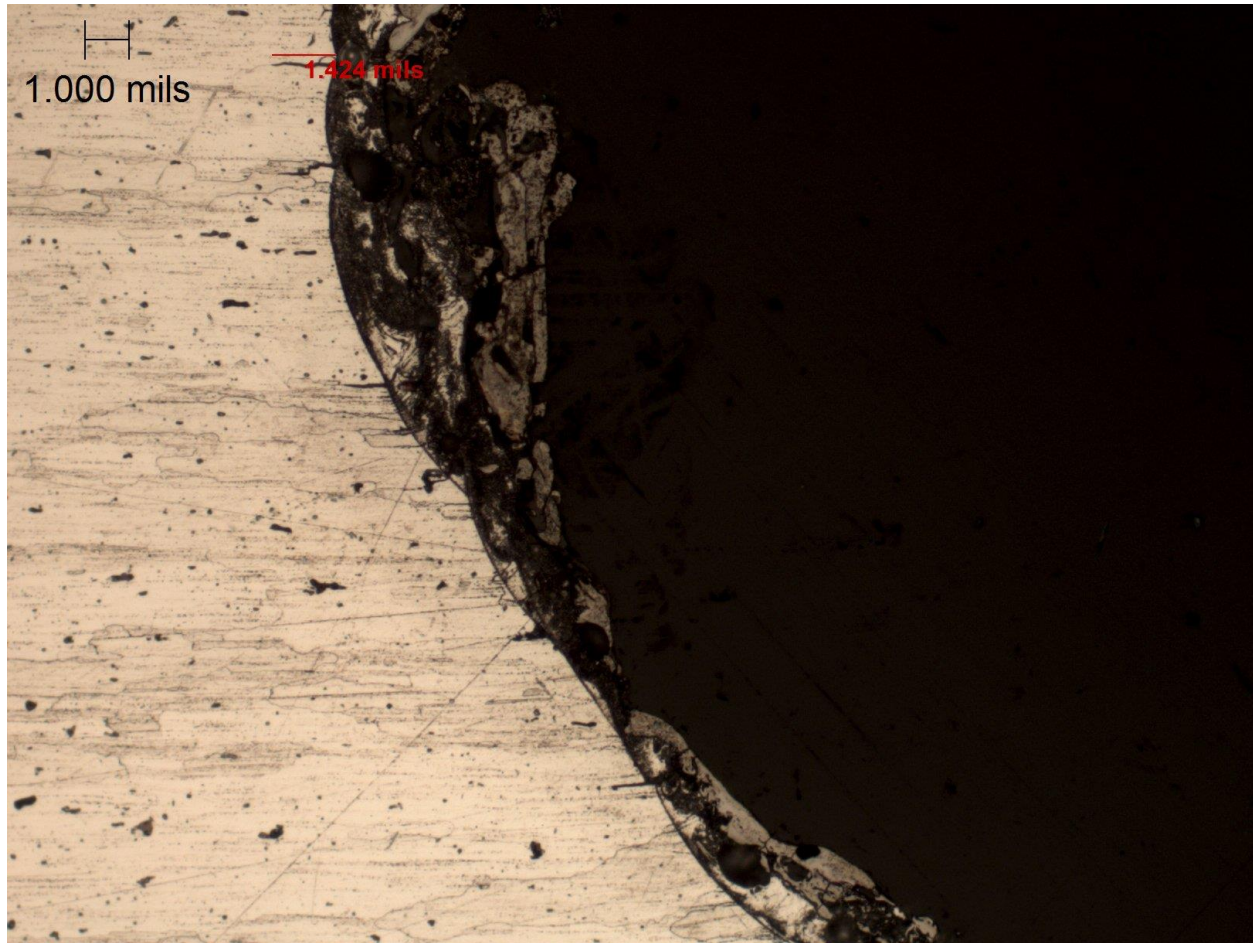


Material: Aluminum  
Offset Position: 0.022  
S/N: AL.001.022-3  
Defects: None Found  
Magnification 200X



Material: Aluminum  
Offset Position: 0.023  
S/N: AL.001.023-2  
Defects: None Found  
Magnification 100X

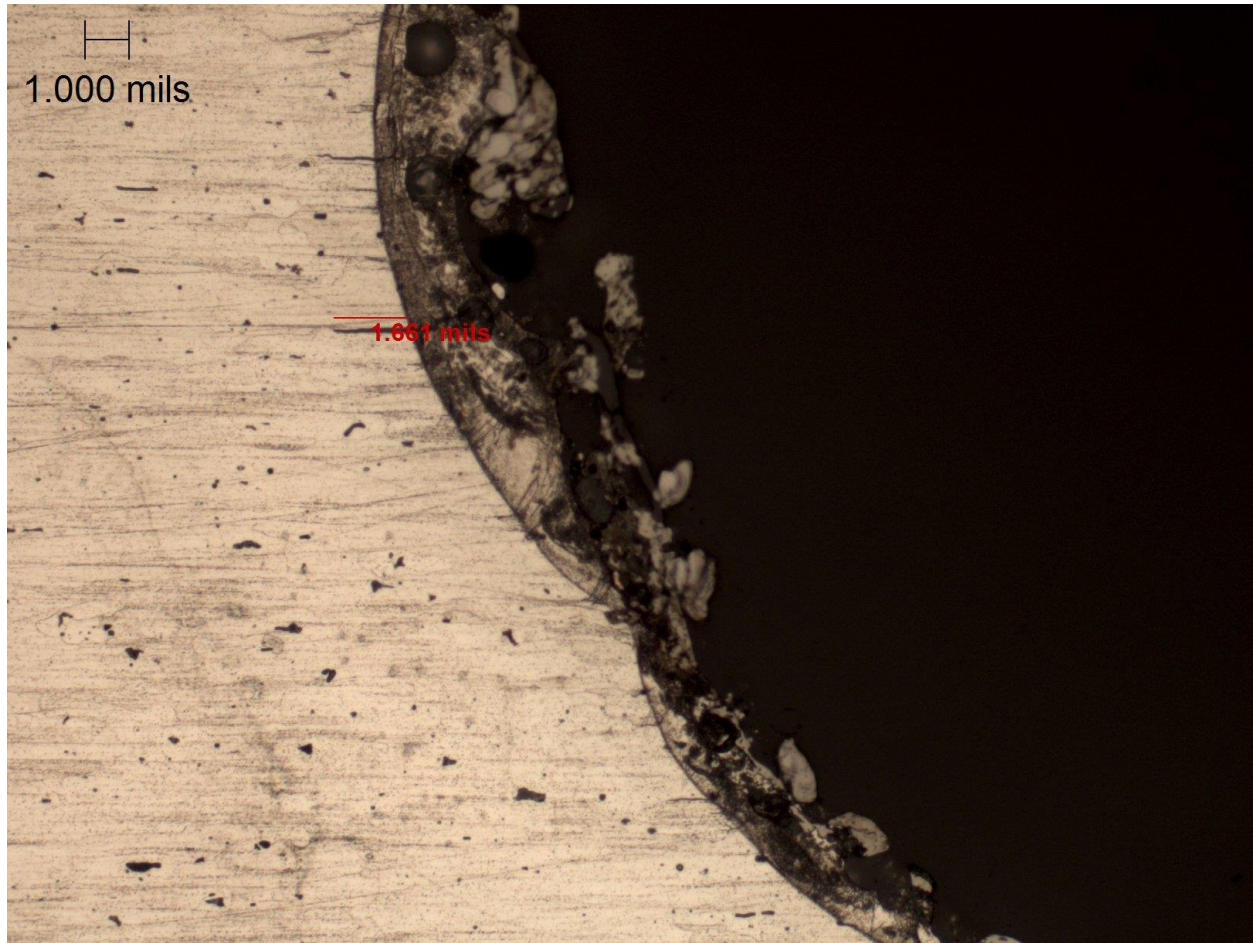




Material: Aluminum  
Offset Position: 0.023  
S/N: AL.001.023-2  
Defects: None Found  
Magnification 200X

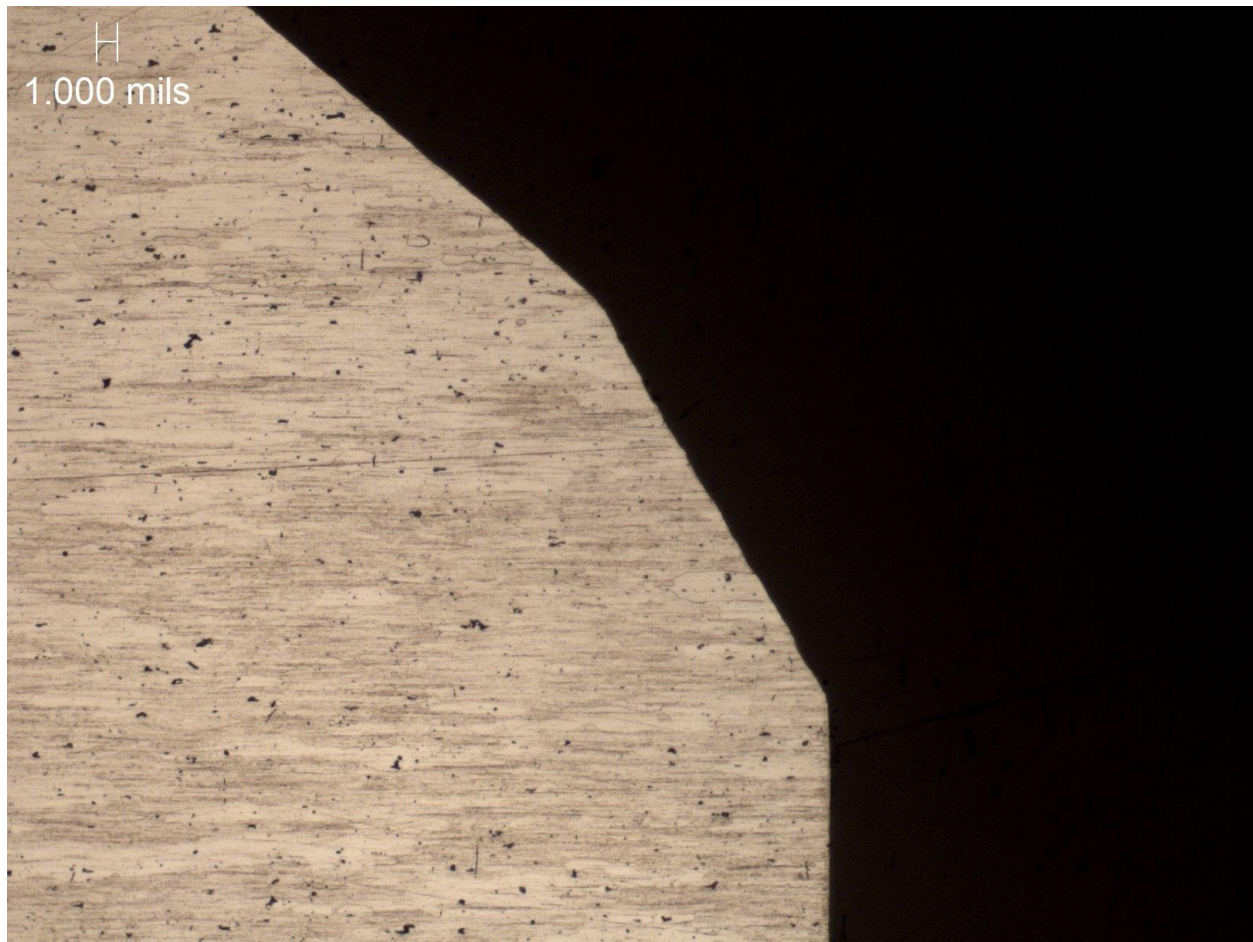


Material: Aluminum  
Offset Position: 0.023  
S/N: AL.001.023-4  
Defects: None Found  
Magnification 100X



Material: Aluminum  
Offset Position: 0.023  
S/N: AL.001.023-4  
Defects: None Found  
Magnification 200X





Material: Aluminum  
Offset Position: 0.012  
S/N: AL.001.012-1  
Defects: None Found  
Magnification 100X



Material: Aluminum  
Offset Position: 0.012  
S/N: AL.001.012-2  
Defects: None Found  
Magnification 100X



Material: Aluminum  
Offset Position: 0.013  
S/N: AL.001.013-1  
Defects: None Found  
Magnification 100X





Material: Aluminum  
Offset Position: 0.013  
S/N: AL.001.013-2  
Defects: None Found  
Magnification 100X

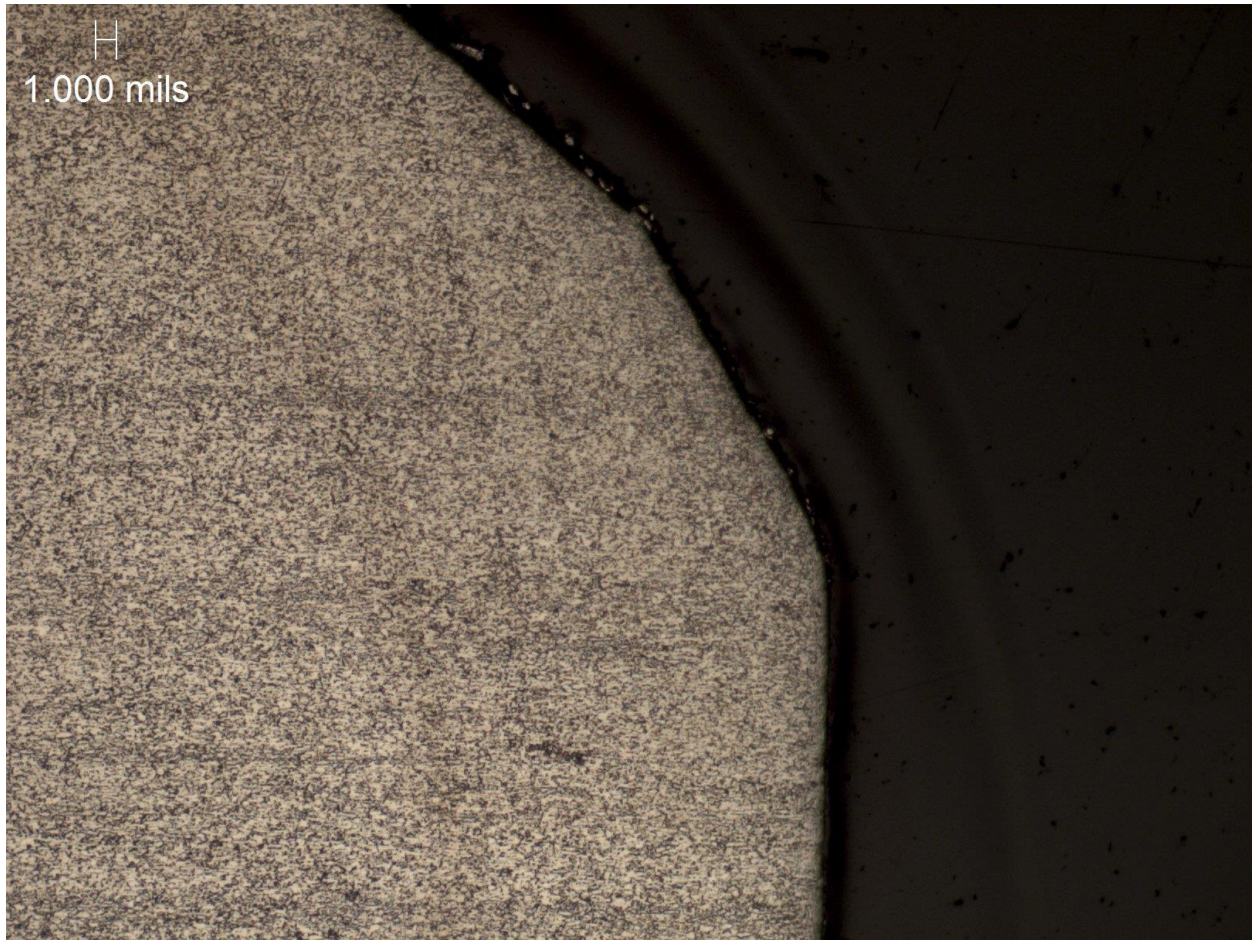


Material: Aluminum  
Offset Position: 0.014  
S/N: AL.001.014-1  
Defects: None Found  
Magnification 100X

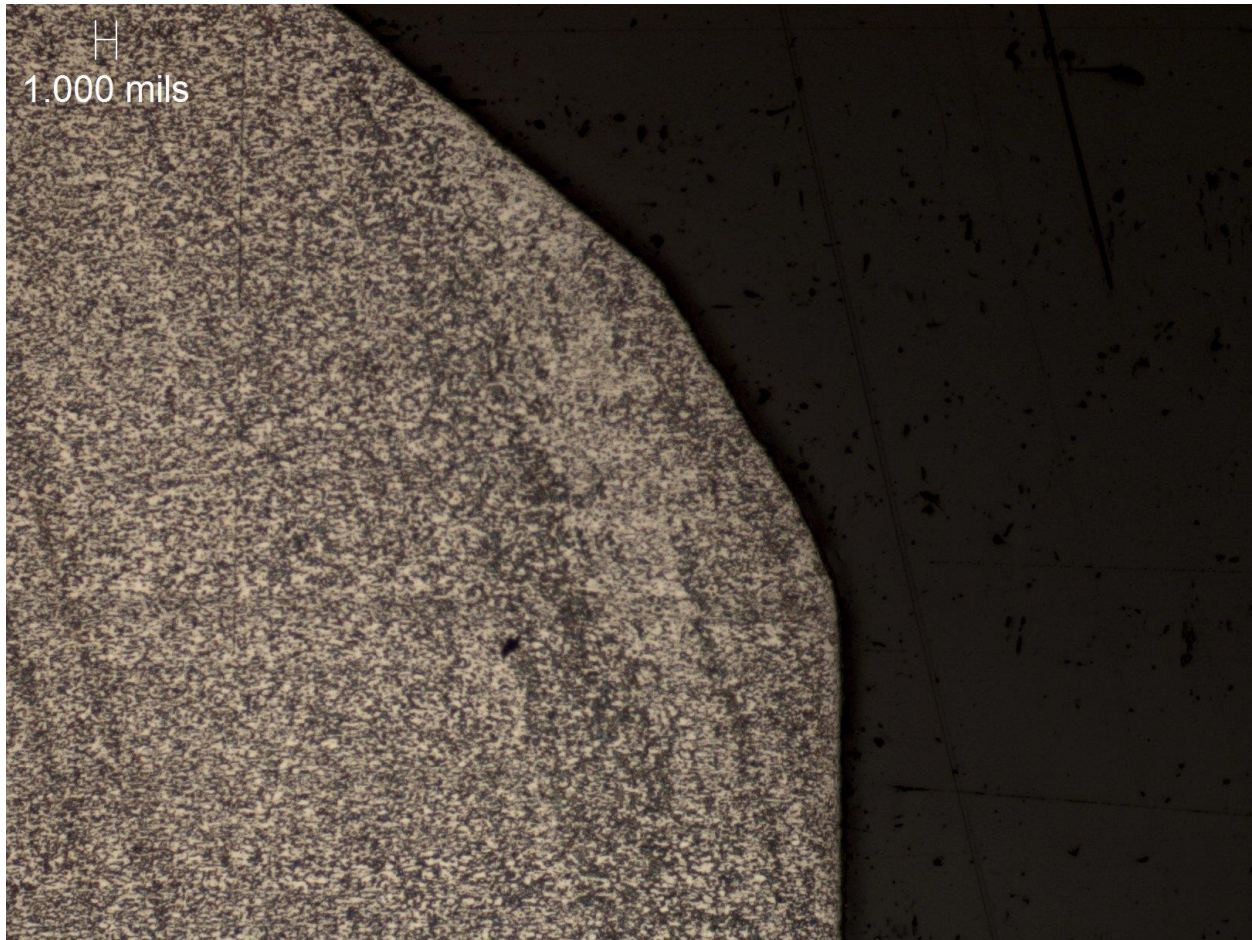


Material: Aluminum  
Offset Position: 0.014  
S/N: AL.001.014-5  
Defects: None Found  
Magnification 100X



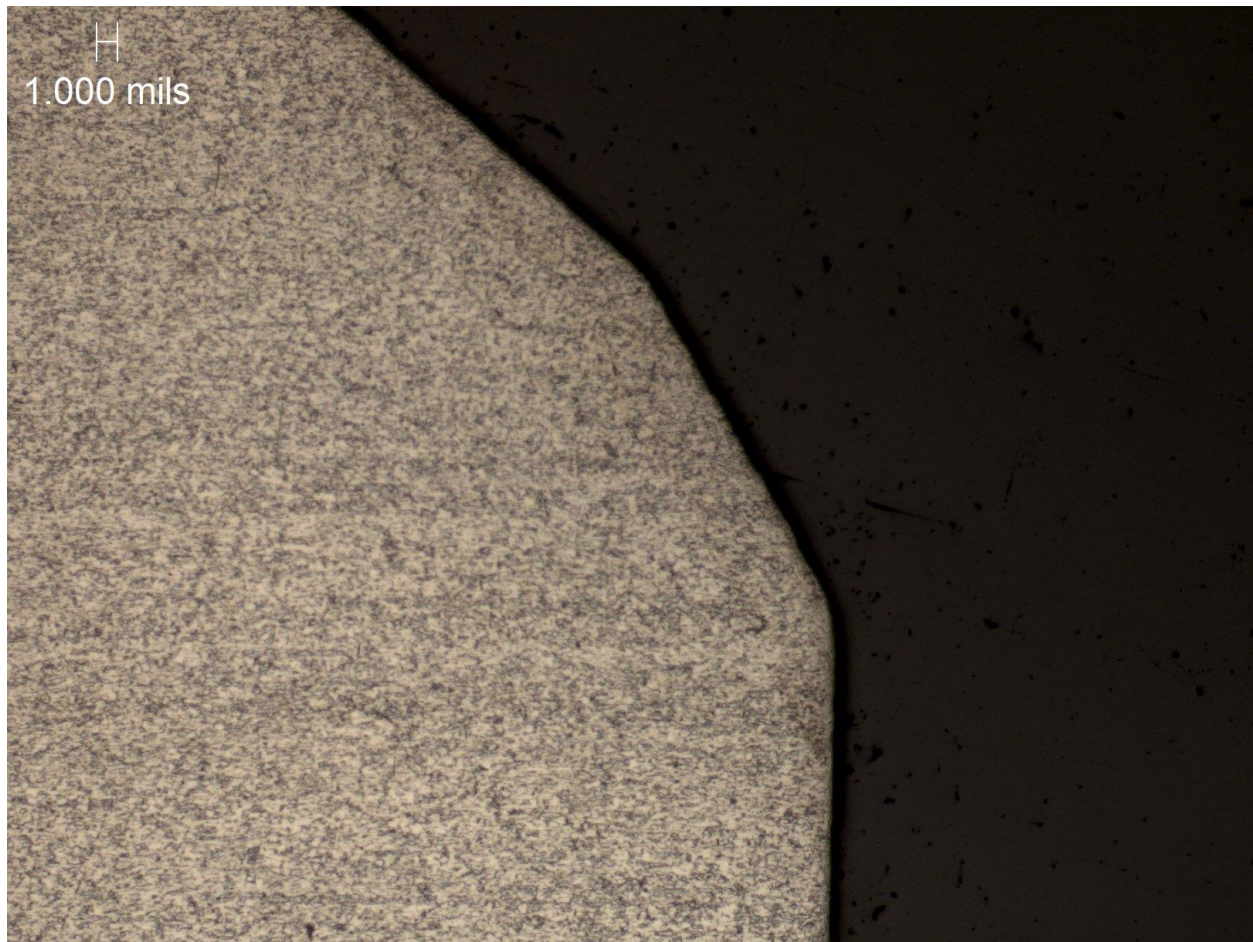


Material: Titanium  
Offset Position: 0.012  
S/N: Ti001.012-1  
Defects: None Found  
Magnification 100X



Material: Titanium  
Offset Position: 0.013  
S/N: Ti001.013-1  
Defects: None Found  
Magnification 100X



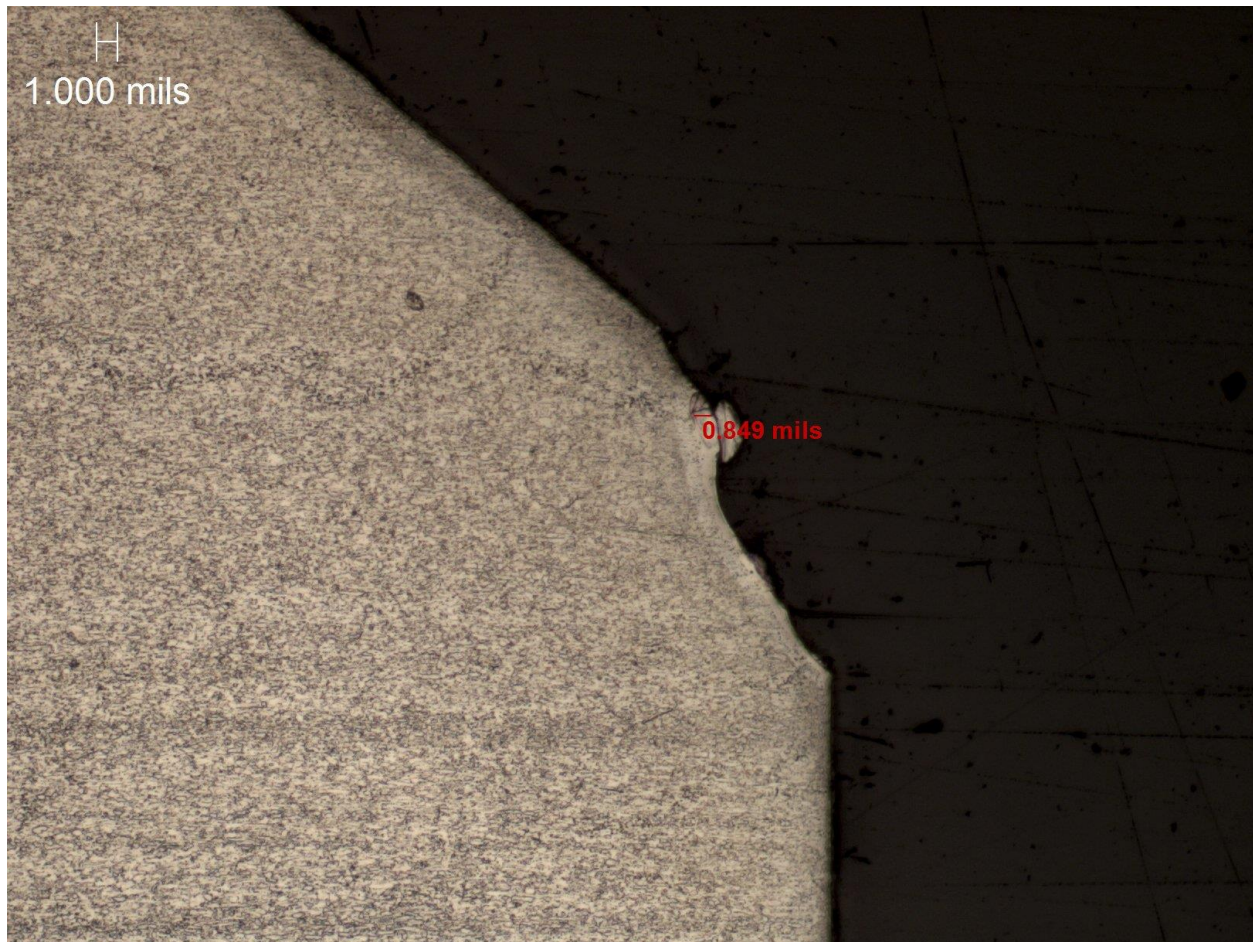


Material: Titanium  
Offset Position: 0.014  
S/N: Ti001.014-1  
Defects: None Found  
Magnification 100X



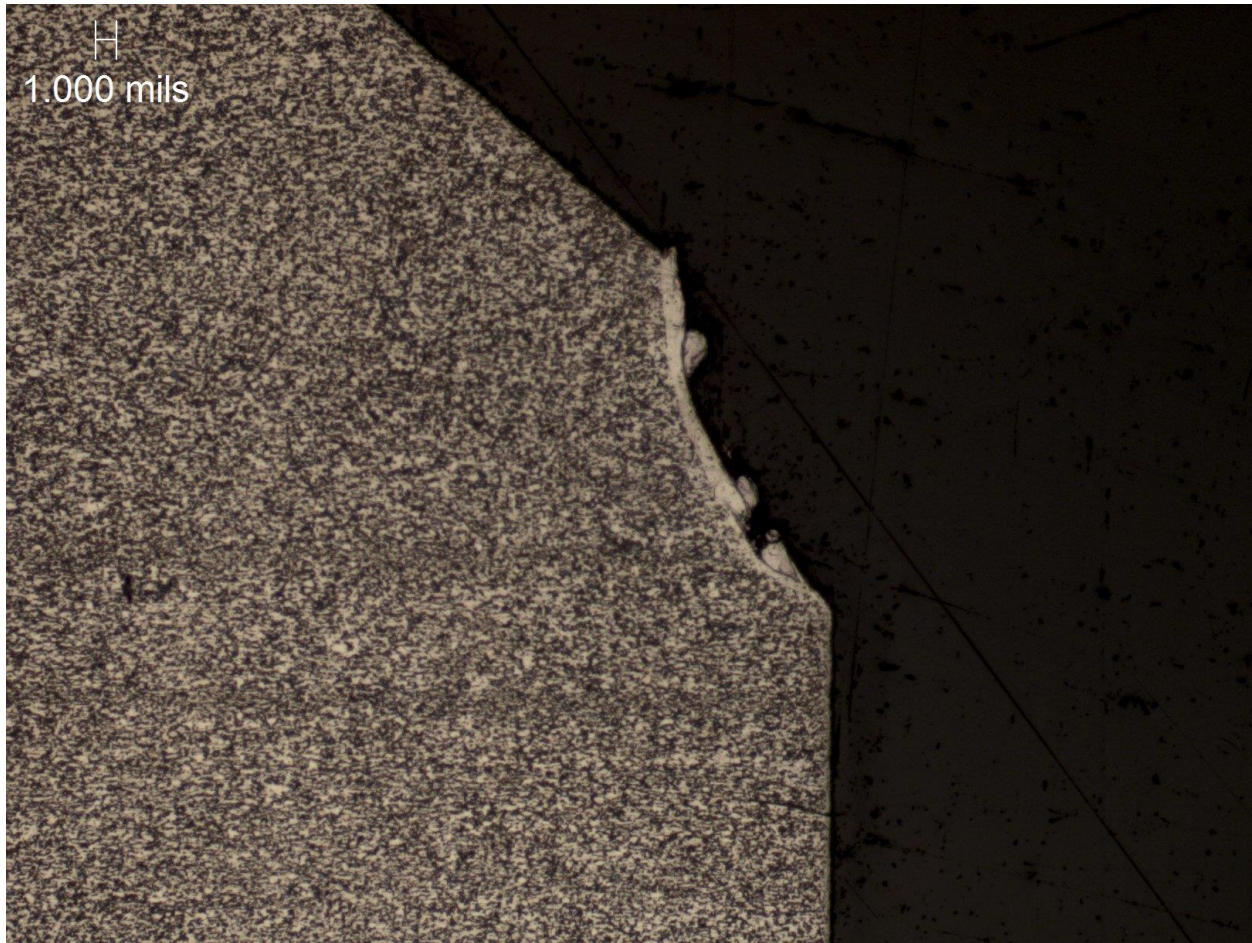


Material: Titanium  
Offset Position: 0.015  
S/N: Ti001.015-1  
Defects: None Found  
Magnification 100X



Material: Titanium  
Offset Position: 0.016  
S/N: Ti001.016-1  
Defects: None Found  
Magnification 100X



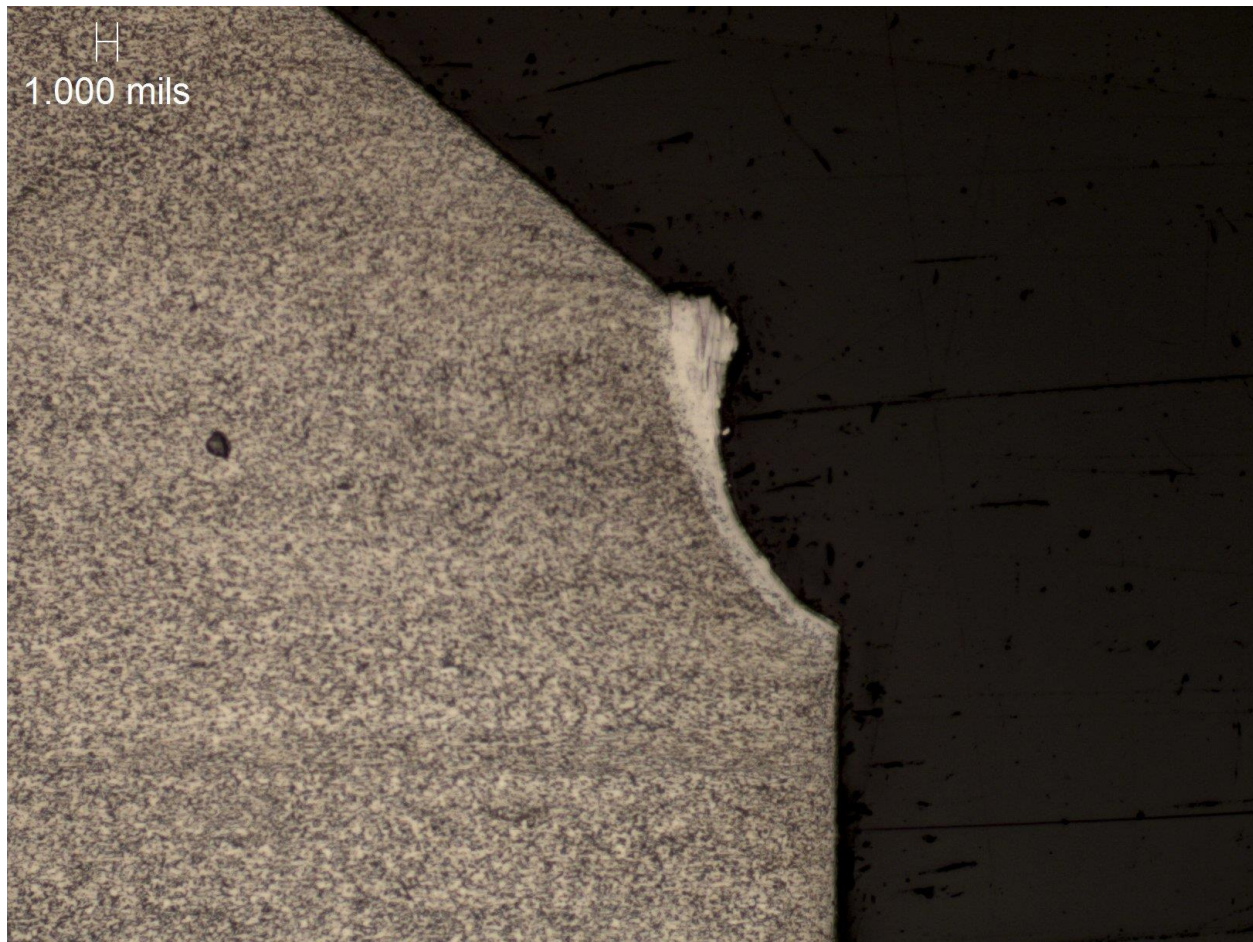


Material: Titanium  
Offset Position: 0.017  
S/N: Ti001.017-1  
Defects: None Found  
Magnification 100X



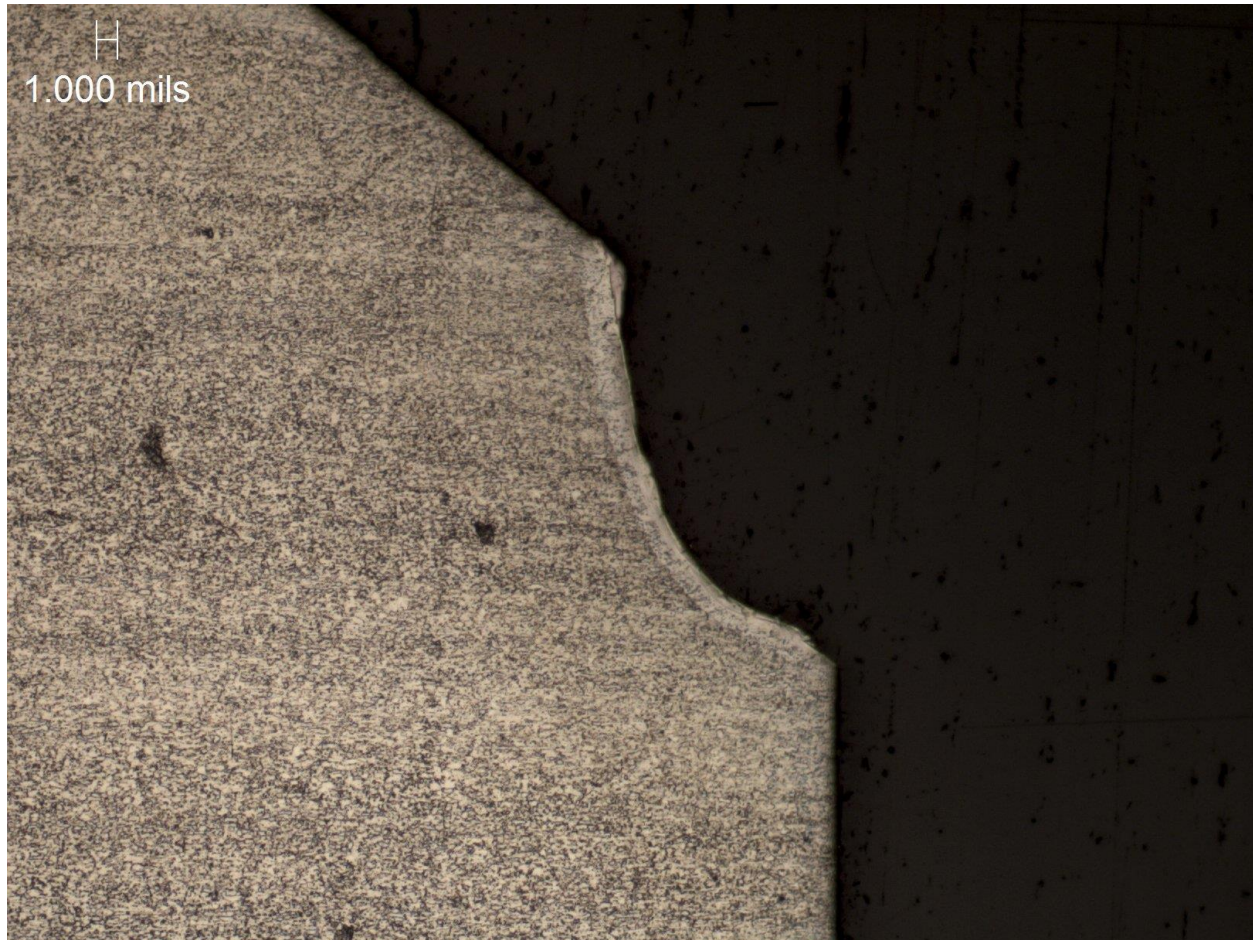


Material: Titanium  
Offset Position: 0.018  
S/N: Ti001.018-1  
Defects: None Found  
Magnification 100X



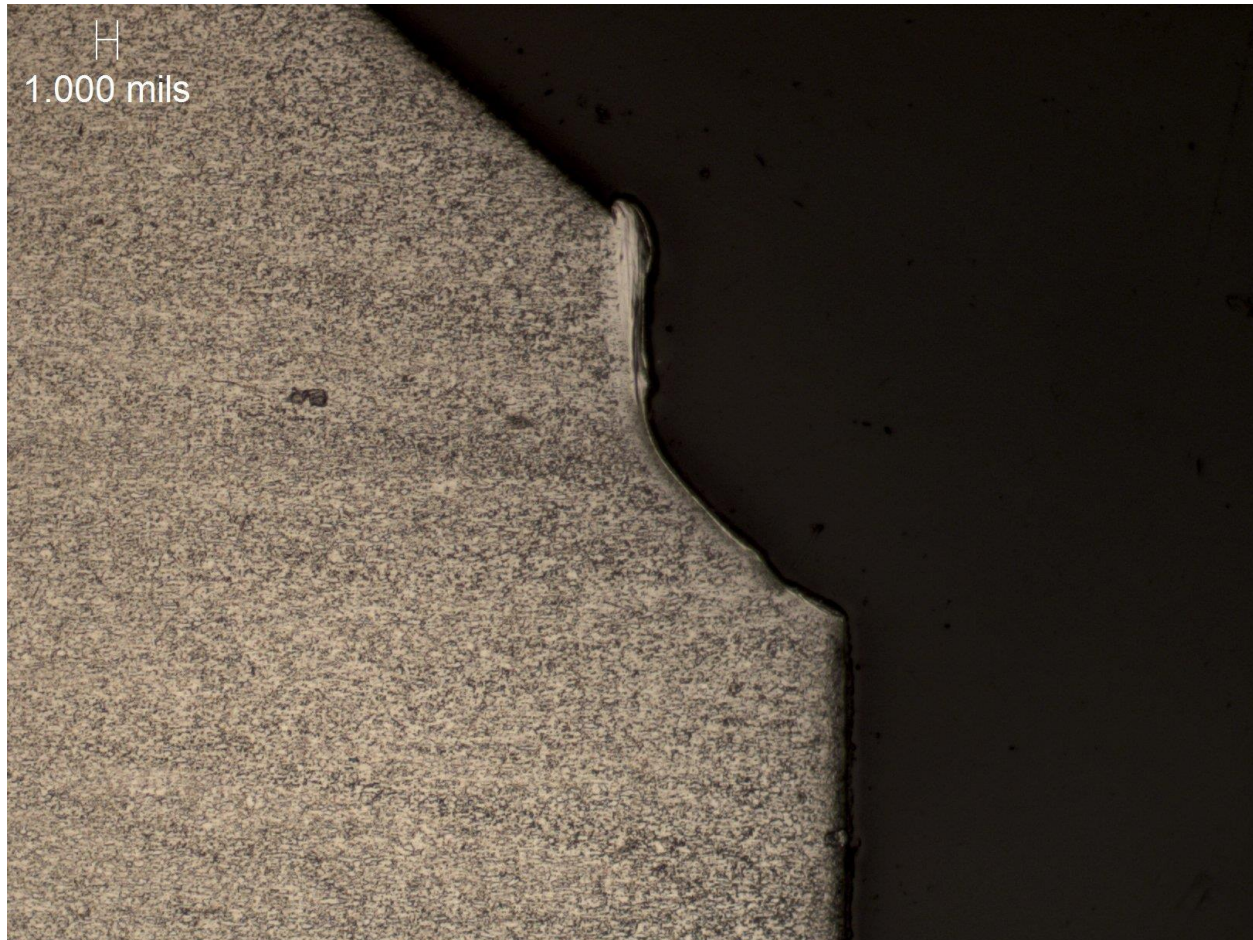
Material: Titanium  
Offset Position: 0.019  
S/N: Ti001.019-1  
Defects: None Found  
Magnification 100X



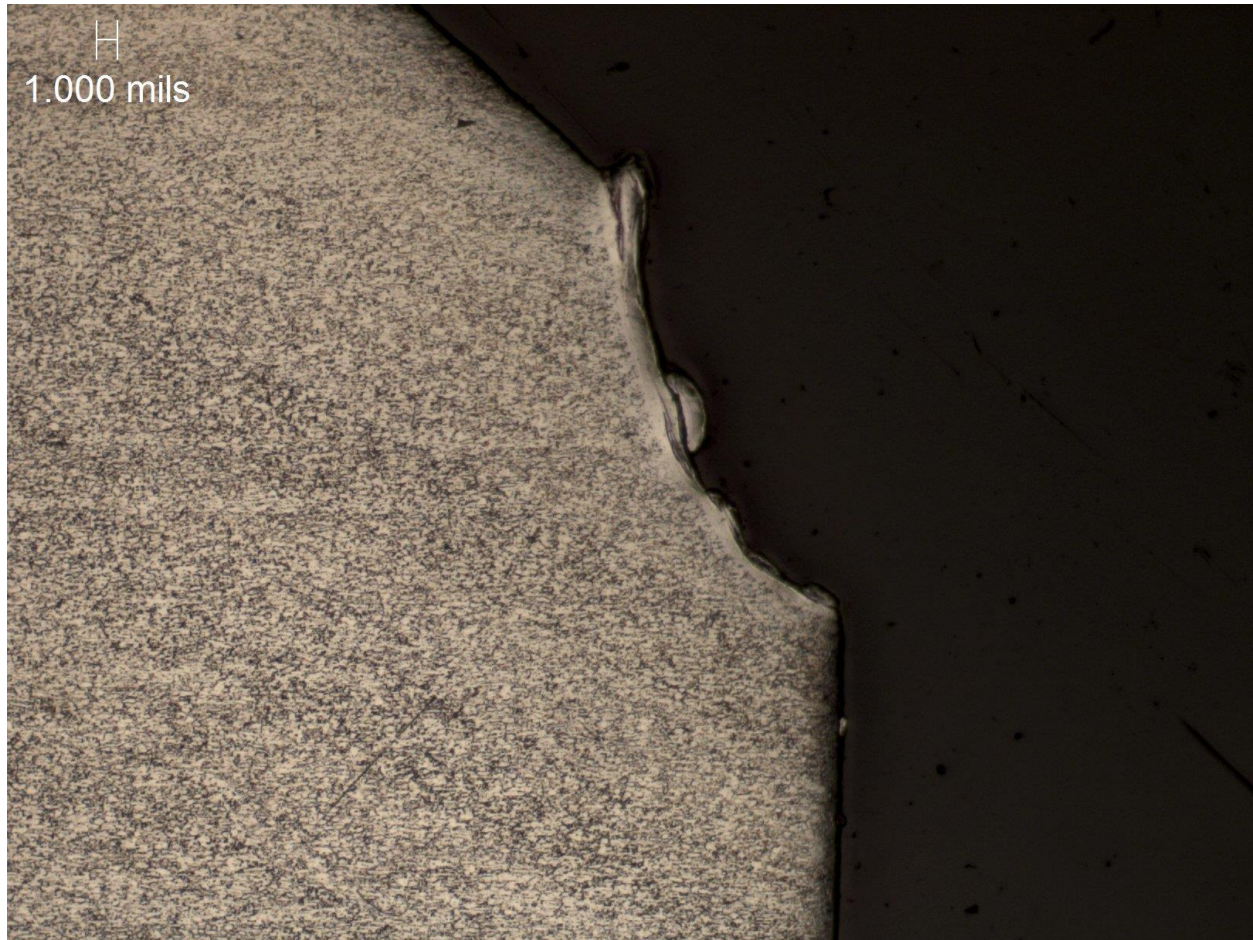


Material: Titanium  
Offset Position: 0.020  
S/N: Ti001.020-1  
Defects: None Found  
Magnification 100X





Material: Titanium  
Offset Position: 0.021  
S/N: Ti001.021-1  
Defects: None Found  
Magnification 100X



Material: Titanium  
Offset Position: 0.022  
S/N: Ti001.022-1  
Defects: None Found  
Magnification 100X





Material: Titanium  
Offset Position: 0.023  
S/N: Ti001.023-1  
Defects: None Found  
Magnification 100X

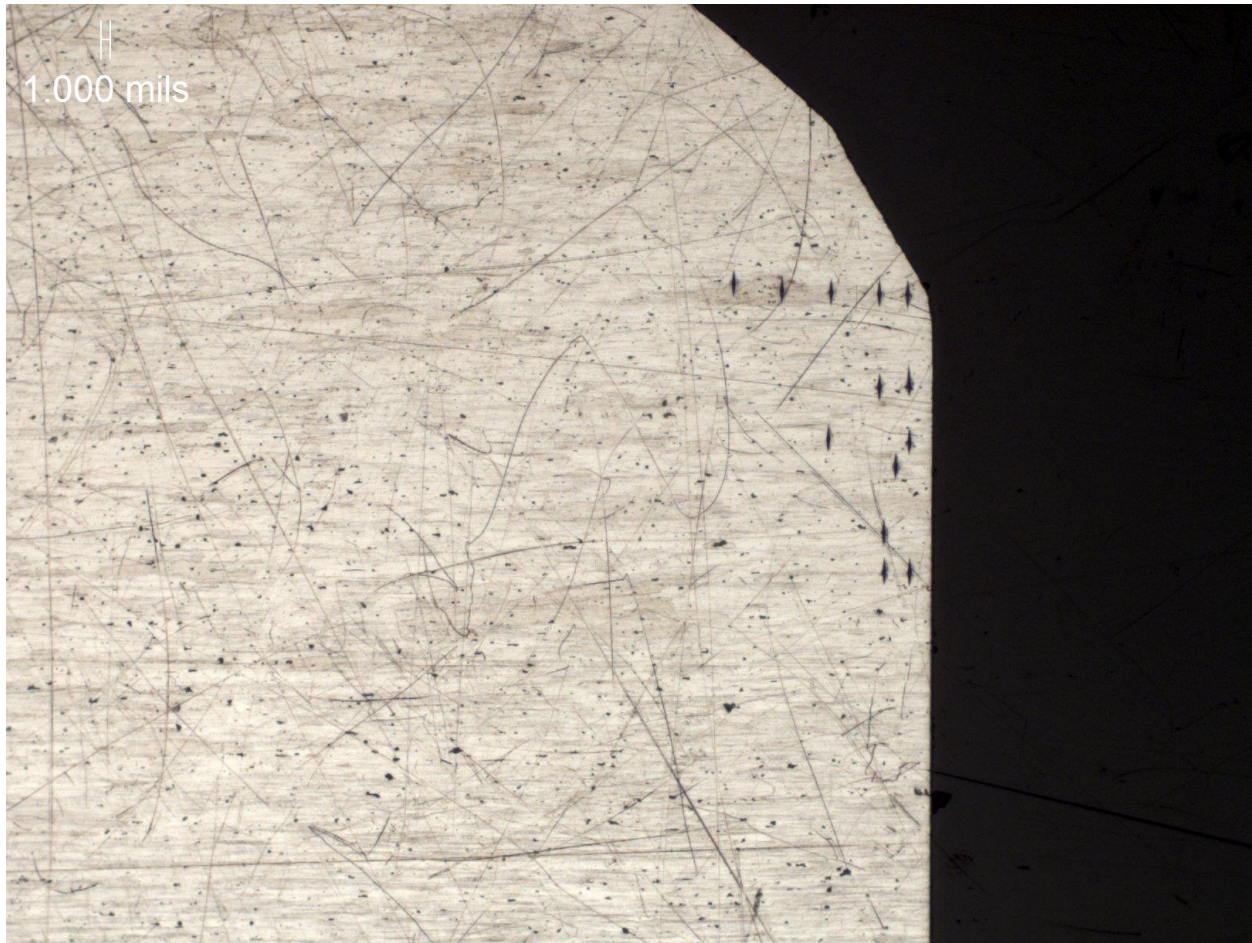


**MICROHARDNESS**

PART IDENTIFICATION:	HL11-6
SERIAL NUMBERS:	AL001.015-2, AL001-.016-3, AL001.017-1, AL001.018-4, AL001.019-4, AL001.020-4, AL001.021-1, AL001.022-1, AL001.023-2, Ti001.012-1, Ti001.013-1, Ti001.014-1, Ti001.015-1, Ti001.016-1, Ti001.017-1, Ti001.018-1, Ti001.019-1, Ti001.020-1, Ti001.021-1, Ti001.022-1, Ti001.023-1
TEST PROCEDURES:	SOW 61-222 REV A
TEST METHOD VARIATION(S):	None
EQUIPMENT USED:	See Equipment Page
TEST(S) PERFORMED BY:	Shakilur Rahman
TEST PERFORMED AT:	NTS Baltimore, 5 North Park Drive, Hunt Valley, MD 21030
TEST DATE:	01/18/2021

**TEST RESULTS:**

See attached addendum at end of report for results. Images below are post Microhardness testing taken at NTS Anaheim.



S/N: AL001.015-2  
Magnification 50X



S/N: AL001.016-3  
Magnification 50X



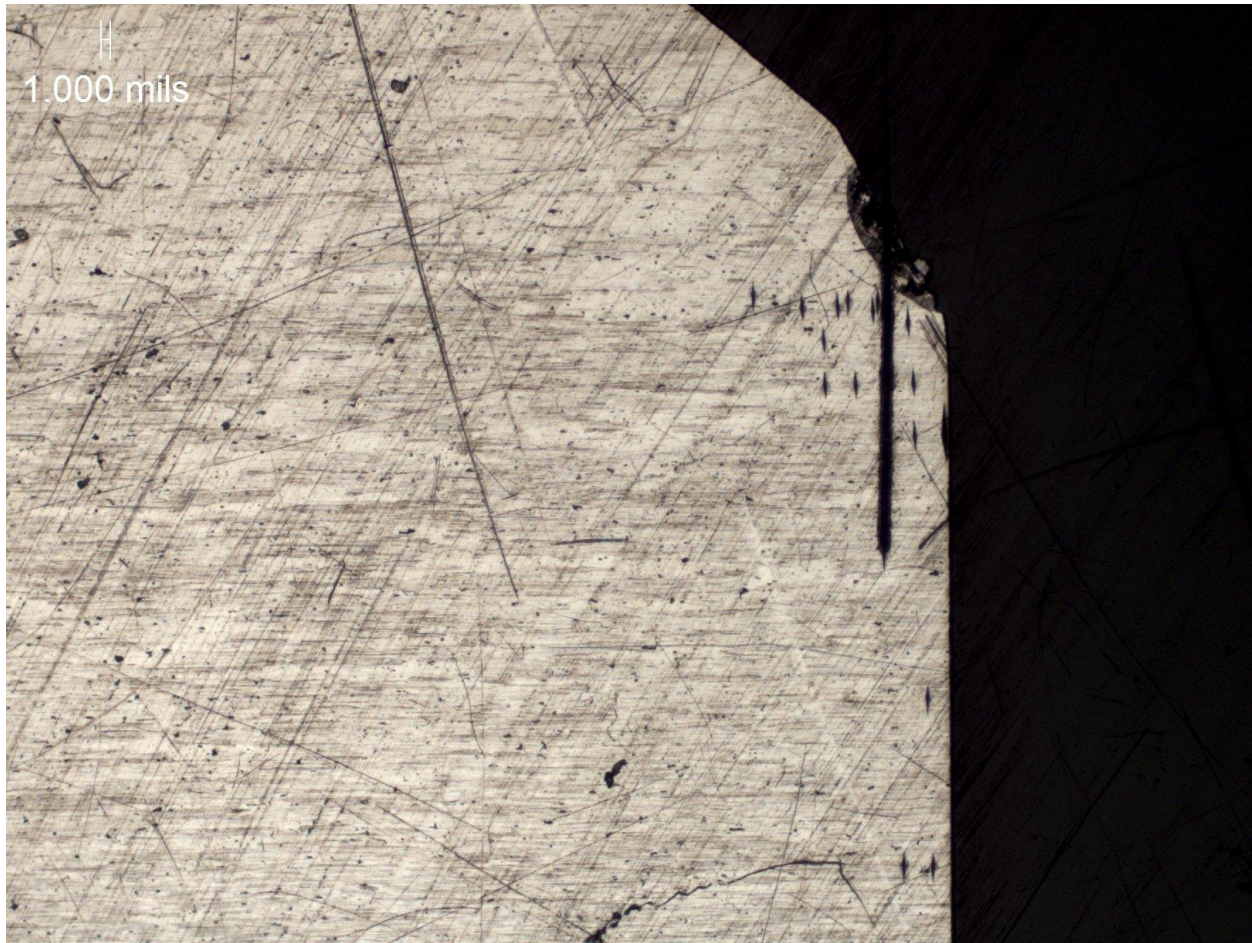


S/N: AL001.017-1  
Magnification 50X



S/N: AL001.018-4  
Magnification 50X





S/N: AL001.019-4  
Magnification 50X





S/N: AL001.020-4  
Magnification 50X

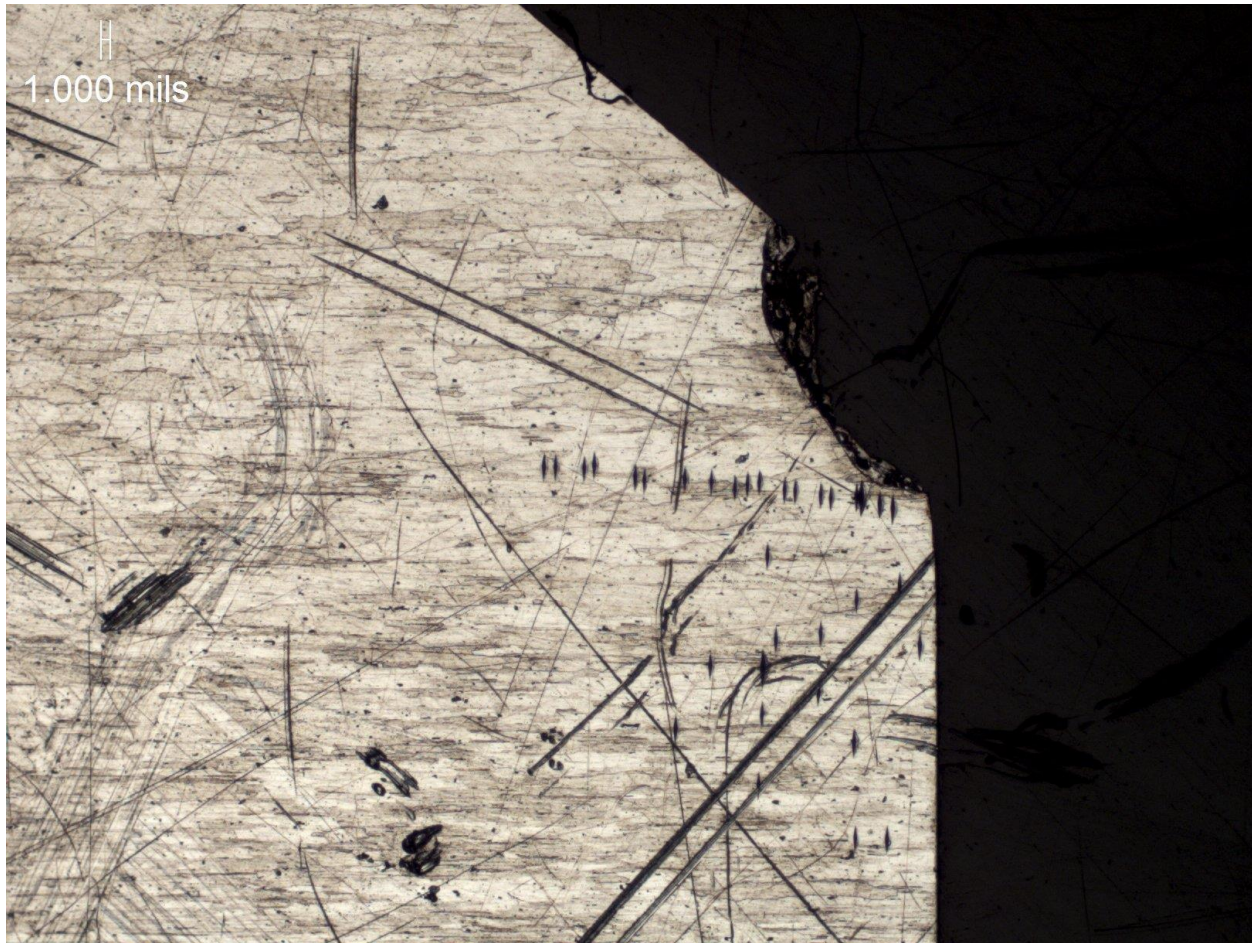


S/N: AL001.021-1  
Magnification 50X





S/N: AL001.022-1  
Magnification 50X



S/N: AL001.023-2  
Magnification 50X





S/N: Ti001.015-1  
Magnification 50X



S/N: Ti001.016-1  
Magnification 50X





S/N: Ti001.017-1  
Magnification 50X



S/N: Ti001.018-1  
Magnification 50X





S/N: Ti001.019-1  
Magnification 50X



S/N: Ti001.020-1  
Magnification 50X





S/N: Ti001.021-1  
Magnification 50X

### EQUIPMENT LIST

Asset Number	Manufacturer	Description	M/N	S/N	Range	Cal Due
WC058994	Zeiss	Inverted Microscope	Axiovert 40MAT	3829000572	50x, 100x, 200x, 500x; +/- 5%	05/31/2021
WC059057	AWS (American Weigh Scales)	Triple Beam balance	TB-2610	N/A		NCR
WC059061	Bausch & Lomb	Stereo Microscope	Stereo Zoom 4	n/a	Per metallurgic scope software	NCR
WC059097	PAXcam	microscope camera	PX-CM 2+	13080186		NCR
WC062714	Struers	Grinder/Polisher	Tegramin-30	60312058 Type: 06036127	50-150 rpm, dual direction	NCR
WC062715	Struers	Grinder/Polisher	Tegramin-30	60312059 Type: 06036127	50-150 rpm, dual direction	NCR





**END OF REPORT**



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National Technical Systems - Baltimore  
5 North Park Drive  
Hunt Valley, MD 21030

Main: 410-584-9099  
Fax: 410-584-9117

**Date In:** December 21, 2020

**Customer:**

Perfect Point EDM  
15192 Titon Lane  
Huntington Beach, CA 92649

**Purchase Order Number:** P919-SBIR

- 
1. TEST OBJECTIVE:  
Determine Knoop Microhardness per CSOW of the Materials Provided
  2. TEST ITEM(S):  
Nine (9) samples
  3. SPECIFICATIONS / METHODS / TECHNIQUES:  
1. Customer Statement of Work (CSOW): Prelim E-Drill Knoop Hardness
  4. RESULTS:  
See results within the report body

TESTING PERFORMED BY:

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Shakilur Rahman  
Engineer II

TECHNICAL/QUALITY APPROVALS:

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Daniel D. Phillips  
Department Manager – FA/Analytical

*This report and the information contained herein represents the results of testing of only those articles/products identified in this document and selected by the client. The tests were performed to specifications and/or procedures approved by the client. National Technical Systems ("NTS") makes no representations expressed or implied that such testing fully demonstrates efficiency, performance, reliability, or any other characteristic of the articles being tested, or similar products. This report should not be relied upon as an endorsement or certification by NTS of the equipment tested, nor does it present any statement whatsoever as to the merchantability or fitness of the test article or similar products for a particular purpose. This document shall not be reproduced except in full without written approval from NTS.*



### TEST ITEM IDENTIFICATION

SAMPLE TYPE	Encapsulated microsections
NUMBER OF SAMPLES SUBMITTED	AL001.015-2, AL001.016-3, AL001.017-1, AL001.018-4, AL001.019-4, AL001.020-4, AL001.021-1*, AL001.022-1, AL001.023-2
SAMPLE IDENTIFICATION	See Below
SAMPLE DISPOSITION	Samples to be returned to NTS Anaheim

\* - Sample “AL001.021-1” was not identified in the provided CSOW. An alternate sample, “AL001.021-2”, was identified.

The photograph below displays an overview of the submitted samples.



**Overview of Submitted Samples, As Received**



### KNOOP MICROHARDNESS

REFERENCE	CSOW – “Prelim E-drill Knoop Hardness”
TEST SPECIMENS	Nine (9)
REQUIREMENT	N/A
SUMMARY	<b>See full results below</b>
SAMPLE PREPARATION DETAILS	N/A
SAMPLE PREPARATION PERFORMED BY	N/A
PREPARATION DATE	N/A
TEST MODIFICATIONS	N/A
TEST CONDITIONS	See datasheet
TEST PERFORMED BY	SR
TEST DATE	January 12-14, 2021
EQUIPMENT USED	WC051578, WC059264

### RESULTS:

A load of 50 grams was used for the indentation test force.

Indentations were made at ~0.0015” from edge, ~0.002” apart. The indentations made were based on instructions from the provided document “Prelim E-drill Knoop Hardness”.

The following table summarizes the test results.

**MICROHARDNESS DATA (HK<sub>50</sub>)**

<b>Sample ID</b>	<b>0.002" (HK)</b>	<b>0.004" (HK)</b>	<b>0.006" (HK)</b>	<b>0.008" (HK)</b>	<b>0.010" (HK)</b>	<b>0.012" (HK)</b>	<b>0.016" (HK)</b>	<b>0.024" (HK)</b>	<b>0.031" (HK)</b>
AL001.015-2	177	182	-	185	-	188	188	-	-
AL001.016-3	-	171	-	177	-	182	188	-	-
AL001.017-1	-	179	-	204	-	198	194	-	-
AL001.018-4	-	-	194	201	-	188	198	-	-
AL001.019-4	-	-	185	198	-	191	191	-	-
AL001.020-4	-	-	-	198	-	204	194	-	-
AL001.021-1*	-	-	-	185	-	201	198	-	-
AL001.022-1	-	-	-	179	-	185	201	198	194
AL001.023-2	-	-	-		179	191	194	188	191

\* Sample AL001.021-1 has a different identification in the CSOW.





## DATASHEET:

Form 06

Revision 1

Page 1 of 1

CUSTOMER NAME: Perfect Point EDM

PROJECT #: PR128708-00

EQUIPMENT USED: WC051578

WC059264

### MICROHARDNESS DATASHEET - KNOOP

#### SAMPLE IDENTIFICATION:

AL001.015-2, AL001.016-3, AL001.017-1, AL001.018-4, AL001.019-4

#### QUALITY CHECK INFORMATION:

Date Performed:

Performed By:

Trace ID	Load (g)	Stated HK	Long Diagonal (μm)	Calculated HK	Check (Y/N) (± 8.2 HK)
CAL15	100	204.80	81.9	212.1	Y

#### SAMPLE ANALYSIS INFORMATION:

Date Performed: 1/12/21

Performed By: SR

#### ANALYSIS RESULTS:

Sample ID	Load (g)	Long Diagonal (μm) / Calculated HK					Average Calculated HK
		Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	
AL001.015-2	50	63.5	62.5	62.0	61.5	61.5	184.0
		176.5	182.1	185.1	188.1	188.1	
AL001.016-3	50		64.5	63.5	62.5	61.5	179.4
			171.0	176.5	182.1	188.1	
AL001.017-1	50		63.0	59.0	60.0	60.5	193.9
			179.3	204.4	197.6	194.4	
AL001.018-4	50		60.5	59.5	61.5	60.0	195.3
			194.4	201.0	188.1	197.6	
AL001.019-4	50		62.0	60.0	61.0	60.5	192.1
			185.1	197.6	191.2	194.4	

#### NOTES:

Sample were encapsulated in epoxy



Form 06

Revision 1

Page 1 of 1

CUSTOMER NAME:

Perfect Point EDM

PROJECT #:

PR128708-00

EQUIPMENT USED:

WC051578

WC059264

### MICROHARDNESS DATASHEET - KNOOP

#### SAMPLE IDENTIFICATION:

AL001.020-4, AL001.021-1, AL001.022-1, AL001.023-2

#### QUALITY CHECK INFORMATION:

Date Performed:

Performed By:

Trace ID	Load (g)	Stated HK	Long Diagonal (μm)	Calculated HK	Check (Y/N) (± 8.2 HK)
CAL15	100	204.80	81.9	212.1	Y

#### SAMPLE ANALYSIS INFORMATION:

Date Performed:

1/14/21

Performed By:

SR

#### ANALYSIS RESULTS:

Sample ID	Load (g)	Long Diagonal (μm) / Calculated HK					Average Calculated HK
		Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	
AL001.020-4	50			60.0	59.0	60.5	198.8
				197.6	204.4	194.4	
AL001.021-1	50			62.0	59.5	60.0	194.6
				185.1	201.0	197.6	
AL001.022-1	50	63.0	62.0	59.5	60.0	60.5	191.5
		179.3	185.1	201.0	197.6	194.4	
AL001.023-2	50	63.0	61.0	60.5	61.5	61.0	188.8
		179.3	191.2	194.4	188.1	191.2	

#### NOTES:

Sample were encapsulated in epoxy. Sample AL001.022-1 has a different Sample ID, AL001.022-2 is noted in the CSOW.



**EQUIPMENT LIST**

<b>Asset Number</b>	<b>Manufacturer</b>	<b>Description</b>	<b>M/N</b>	<b>S/N</b>	<b>Last Calibration</b>	<b>Cal Due</b>
WC051578	Buehler	MICRO-HARDNESS TESTER	1600-9000B	M-83282	06/25/2020	06/25/2021
WC059264	Sun-Tec Corp	MICROINDENTATION HARDNESS STANDARD	N/A	019159	05/08/2018	05/08/2023





END OF REPORT



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National Technical Systems - Baltimore  
5 North Park Drive  
Hunt Valley, MD 21030

Main: 410-584-9099  
Fax: 410-584-9117

**Date In:** December 21, 2020

**Customer:**

Perfect Point EDM  
15192 Titon Lane  
Huntington Beach, CA 92649

**Purchase Order Number:** P919-SBIR

- 
1. TEST OBJECTIVE:  
Determine Knoop Microhardness per CSOW of the Materials Provided
  2. TEST ITEM(S):  
Seven (7) samples
  3. SPECIFICATIONS / METHODS / TECHNIQUES:  
1. Customer Statement of Work (CSOW): Prelim E-Drill Knoop Hardness
  4. RESULTS:  
See results within the report body

TESTING PERFORMED BY:

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Shakilur Rahman  
Engineer II

TECHNICAL/QUALITY APPROVALS:

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Daniel D. Phillips  
Department Manager – FA/Analytical

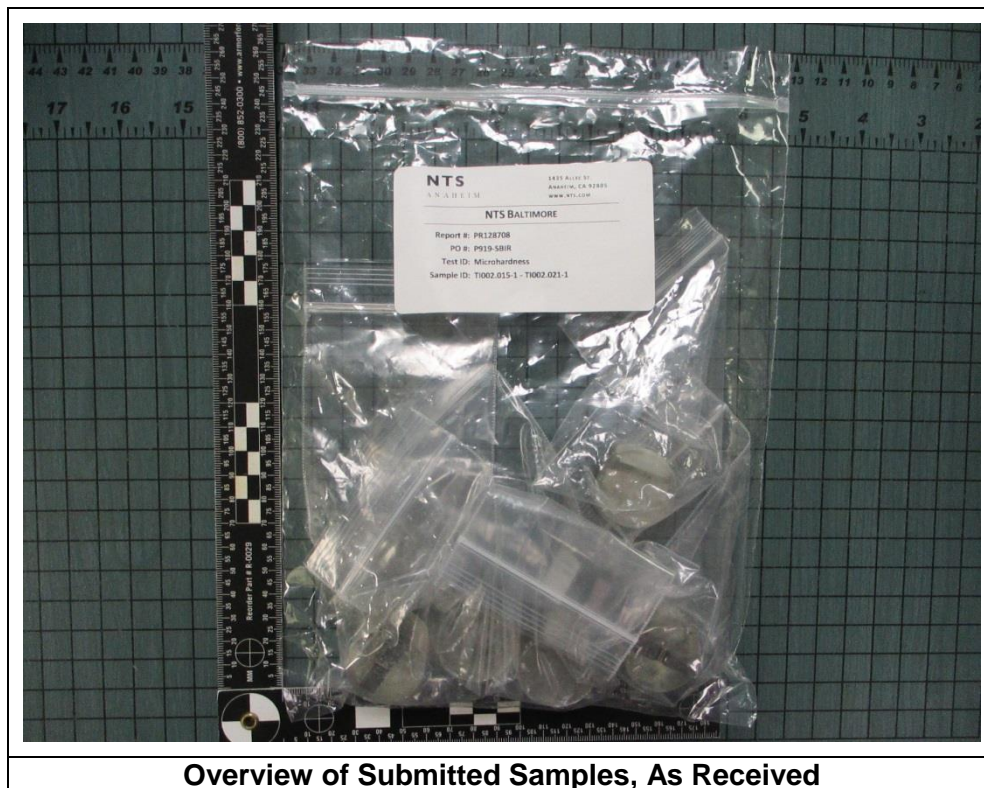
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### TEST ITEM IDENTIFICATION

SAMPLE TYPE	Encapsulated microsections
NUMBER OF SAMPLES SUBMITTED	TI001.015-1, TI001.016-1, TI001.017-1, TI001.018-1, TI001.019-1, TI001.020-1, TI001.021-1*
SAMPLE IDENTIFICATION	See Below
SAMPLE DISPOSITION	Samples to be returned to NTS Anaheim

\* - Sample "TI001.021-1" was not identified in the provided CSOW.

The photograph below displays an overview of the submitted samples.







### KNOOP MICROHARDNESS

REFERENCE	CSOW – “Prelim E-drill Knoop Hardness”
TEST SPECIMENS	Seven (7)
REQUIREMENT	N/A
SUMMARY	<b>See full results below</b>
SAMPLE PREPARATION DETAILS	Samples were lightly polished with an alumina polish to better prepare the surface for indentation.
SAMPLE PREPARATION PERFORMED BY	SR
PREPARATION DATE	January 18, 2021
TEST MODIFICATIONS	N/A
TEST CONDITIONS	See datasheet
TEST PERFORMED BY	SR
TEST DATE	January 18, 2021
EQUIPMENT USED	WC051578, WC059264

### RESULTS:

A load of 50 grams was used for the indentation test force.

Indentations were made at ~0.0015” from edge, ~0.002” apart. The indentations made were based on instructions from the provided document “Prelim E-drill Knoop Hardness”.

The following table summarizes the test results.



**MICROHARDNESS DATA (HK<sub>50</sub>)**

<b>Sample ID</b>	<b>0.002" (HK)</b>	<b>0.004" (HK)</b>	<b>0.006" (HK)</b>	<b>0.008" (HK)</b>	<b>0.012" (HK)</b>	<b>0.016" (HK)</b>
TI001.015-1	336	315	-	274	240	274
TI001.016-1	-	385	-	376	351	344
TI001.017-1	-	368	-	315	322	321
TI001.018-1	-	-	368	339	336	303
TI001.019-1	-	-	351	336	336	329
TI001.020-1	-	-	-	351	344	329
TI001.021-1*	-	-	-	336	268	303

\* Sample TI001.021-1 was not in the CSOW.

**DATASHEET:**

Form 06  
Revision 1  
Page 1 of 1

CUSTOMER NAME:	Perfect Point EDM
PROJECT #:	PR128708-00
EQUIPMENT USED:	WC051578
	WC059264

**MICROHARDNESS DATASHEET - KNOOP****SAMPLE IDENTIFICATION:**

TI001.015-1, TI001.016-1, TI001.017-1, TI001.018-1, TI001.019-1

**QUALITY CHECK INFORMATION:**

Date Performed: 1/18/21

Performed By: SR

Trace ID	Load (g)	Stated HK	Long Diagonal (μm)	Calculated HK	Check (Y/N) (± 8.2 HK)
CAL15	100	204.80	82.0	211.6	Y

**SAMPLE ANALYSIS INFORMATION:**

Date Performed: 1/18/21

Performed By: SR

**ANALYSIS RESULTS:**

Sample ID	Load (g)	Long Diagonal (μm) / Calculated HK					Average Calculated HK
		Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	
TI001.015-1	50	46.0	47.5	51.0	54.5	51.0	287.6
		336.2	315.3	273.5	239.5	273.5	
TI001.016-1	50		43.0	43.5	45.0	45.5	364.0
			384.8	376.0	351.4	343.7	
TI001.017-1	50		44.0	47.5	47.0	47.1	331.4
			367.5	315.3	322.1	320.7	
TI001.018-1	50		44.0	45.8	46.0	48.5	336.4
			367.5	339.2	336.2	302.5	
TI001.019-1	50		45.0	46.0	46.0	46.5	338.2
			351.4	336.2	336.2	329.1	

**NOTES:**

Sample were encapsulated in epoxy





Form 06

Revision 1

Page 1 of 1

CUSTOMER NAME: Perfect Point EDM

PROJECT #: PR128708-00

EQUIPMENT USED: WC051578

WC059264

## MICROHARDNESS DATASHEET - KNOOP

## SAMPLE IDENTIFICATION:

TI001.020-1, TI001.021-1\*

## QUALITY CHECK INFORMATION:

Date Performed: 1/18/21

Performed By: SR

Trace ID	Load (g)	Stated HK	Long Diagonal (μm)	Calculated HK	Check (Y/N) (± 8.2 HK)
CAL15	100	204.80	82.0	211.6	Y

## SAMPLE ANALYSIS INFORMATION:

Date Performed: 1/18/21

Performed By: SR

## ANALYSIS RESULTS:

Sample ID	Load (g)	Long Diagonal (μm) / Calculated HK					Average Calculated HK
		Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	
TI001.020-1	50			45.0	45.5	46.5	341.4
				351.4	343.7	329.1	
TI001.021-1	50			46.0	51.5	48.5	302.3
				336.2	268.3	302.5	

## NOTES:

Sample were encapsulated in epoxy. Sample TI001.022-1 is not noted in the CSOW.



**EQUIPMENT LIST**

Asset Number	Manufacturer	Description	M/N	S/N	Last Calibration	Cal Due
WC051578	Buehler	MICRO-HARDNESS TESTER	1600-9000B	M-83282	06/25/2020	06/25/2021
WC059264	Sun-Tec Corp	MICROINDENTATION HARDNESS STANDARD	N/A	019159	05/08/2018	05/08/2023



**REVISION HISTORY**

Rev.	Revision Date	Description
1	29-Jan-2021	<ul style="list-style-type: none"><li>Corrected various sample IDs at the request of NTS-ANA</li></ul>





END OF REPORT