



## **Forensic Video Analysis**

# **Test No. 24-5581 Summary Report**

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Participants were provided with evidence data acquired from an iPhone 11 Pro Max. They were asked to examine the evidence utilizing their own tools and methods. Data were returned from 65 participants and are compiled in the following tables:

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This report contains the data received from the participants in this test. Since these participants are located in many countries around the world, and it is their option how the samples are to be used (e.g., training exercise, known or blind proficiency testing, research and development of new techniques, etc.), the results compiled in the Summary Report are not intended to be an overview of the quality of work performed in the profession and cannot be interpreted as such. The Summary Comments are included for the benefit of participants to assist with maintaining or enhancing the quality of their results. These comments are not intended to reflect the general state of the art within the profession.

Participant results are reported using a randomly assigned "WebCode". This code maintains participant's anonymity, provides linking of the various report sections, and will change with every report.

# Manufacturer's Information

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The Forensic Video Analysis test consisted of evidence data acquired from an iPhone 11 Pro Max; iOS 16.6.1. Participants were asked to enhance and clarify the video and produce a derivative that makes it easier to see and understand the incident.

## SAMPLE PREPARATION/VALIDATION

A predetermined staged event involving a vehicle of interest parked outside of a small office building shortly before a fire broke out in the building was executed and video recorded. This event was recorded using a single camera view captured by an iPhone and stored in the cloud.

The .MOV file was zipped and uploaded to the CTS Portal. A MD5 and SHA1 hash value was calculated and provided for the compressed file to validate the integrity of the downloaded file.

## VERIFICATION

Predistribution results were consistent with each other and the manufacturer's preparation information. The combination of internal test validation and the responses received from predistribution testing structured the final questions utilized in this test. The following list of tools were utilized in the validation of this test: Amped FIVE (revisions 33279 and 34212), Jacksum (version 1.7.0), FFmpeg (versions 6.1 and 7.0.1), FFprobe (version 6.1 and 7.0.1), and ExifTool (versions 12.78 and 12.93). CTS does not endorse any particular tools.

## SCENARIO PROVIDED TO PARTICIPANTS

A vehicle of interest was parked outside of a small office building shortly before a fire broke out in the building, which resulted in millions of dollars in damage. Arson is suspected as the cause. A surveillance camera was attached to the exterior wall of the building and captured a portion of the front of the vehicle but at an extreme angle (i.e., the camera sensor is nearly perpendicular to the front plane of the vehicle) just as power was lost to the building due to the fire. The recorded video was stored in the cloud. The surveillance camera was loosely mounted to the wall and a large air handler nearby caused the camera to vibrate during capture.

A video file export of the designated recording was made by investigators in QuickTime MOV format. Investigators request video enhancement of the MOV file to see the license plate of the vehicle more clearly.

## **Manufacturer's Information, continued**

### **Question Manufacturer's Response - Examination Questions**

1-1 What is the SHA-256 hash value of the MOV file?

84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5

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1-2 What is the reported frame rate of the MOV file? (report as a numeric value in fps)

29.97 FPS (MediaInfo reports minimum and maximum frame rates as 28.571 and 30 FPS, respectively)

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1-3 What are the pixel dimensions of the MOV file?

1920 x 1080

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1-4 What is the bit rate of the recorded video in the MOV file?

16015859 bits per second (bps) [MediaInfo], 16016781 bps [FFprobe], 16 or 16.0 Megabits per second (Mbps) [MediaInfo and ExifTool]. Also acceptable are any of these expressed in kilobits per second (kbps): 16000 kbps, 16015.859 kbps, or 16016.781 kbps.

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1-5 How many frames are there in the MOV file?

159

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1-6 Is there an audio track present in the MOV file?

No

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### **Question Manufacturer's Response - Enhanced Video Examination**

2-1 Note methods or tools used and settings for the video enhancement here.

This was a free form question on methods and tools used. No manufacturer's response is provided.

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## **Summary Comments**

This test was designed to allow participants to assess their proficiency in data verification, media characterization, data analysis and video enhancement using their own tools and methods. The participants were provided with data acquired from an iPhone 11 Pro Max camera and were asked to answer questions as well as make enhancements to the video. Refer to the Manufacturer's Information for preparation details.

A total of 65 participants returned results for this test.

A variety of software tools were used by participants during examination with 74% reporting the tool Amped FIVE.

All six examination questions achieved consensus. In a separate section of this test, participants were asked to perform specific enhancement steps to the video file and submit these enhanced video files and still images to CTS. An expert reviewed the files submitted by participants and those observational notes are presented in Table 3.

CTS recognizes that examiners in different organizations may not perform all the same tasks. In order to allow participants and accrediting bodies to objectively measure enhancement and/or investigative skills, this test may have included questions that are outside the laboratory's normal reporting procedures.

# Forensic Video Examination Responses

TABLE 1

**Question 1- 1 : Examination Questions**

**Question 1-1: What is the SHA-256 hash value of the MOV file?**

Manufacturer's 84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5

Response:

WebCode	Response
2PMJBM	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
2RNRFW	2C8553B7EE8CD7F314CF94498BF4112FBF2E9C35
2XE2PV	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
37NQ4U	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
39RLMW	1. 84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
3QAKUF	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
3QWT2Y	SHA256 84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
4YJ98E	159f333463cd8ab1aba272f1bb34dfc984dc774555f1173ba28699a2a4187069
6XMCVP	Sha-256 - 84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
73WT6D	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
7EQ9RU	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
7NBD2E	84A361708461D90DC418E56BE6B7E0445799564F92108926A97E16903785553F5
8BK3RE	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
8KV6DE	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
8WK66G	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
9Y4FGR	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
A8X93Q	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
A9N7GP	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
ACNHCP	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
AV4RDP	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
B23TTA	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
B3JPKA	BB19EA4CEB46F4FDF0F895D1ADB723D4275D22B224CC3EF3E0D56EC111AA1D14
B7J2GA	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
BJH3TB	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
CACG79	84A36170846D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
CC4FK8	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
CJ33AL	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
CRD6VM	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
DBZD7M	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5

TABLE 1

Question 1- 1 : Examination Questions	
WebCode	Response
DJW977	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
EDKJ6A	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
FKZPEL	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
GJLF2E	The SHA-256 hash value of the MOV file is 84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5m.
GWBEV3	SHA256 hash: 84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
HNZDA2	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
HVA2KE	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
J8J2UD	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
JZNYT2	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
KV8Q63	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
LNKKHF	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
LVHCQA	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
M23ULW	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
MM3TAV	5f4c6b24985ba5cf67b8bf800e9acb433039b6f551dcd68adfd5b21acda89ef1
N48MEA	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
NJMLLV	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
NQHNM8	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
NQZUMX	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
P3V8K9	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
PFWY4R	7fb77dc0763dc4995b7daf772c554f63795c51e00ef971597f3bf6f7e4805102
PXEYWA	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
Q8K8C9	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
QXTL8W	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
REFN4Q	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
RF9GYA	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
RQ6K34	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
RZEPFU	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
T9PB33	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
TWCB7A	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
TXJT46	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
U8M2LQ	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
V2X39M	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
VCGJZT	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5

TABLE 1

Question 1- 1 : Examination Questions	
WebCode	Response
VKRLLU	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
XDJYK6	84A361708461D90DC418E56BE6B7E045799564F9210B926A97E16903785553F5
XGLWVX	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5
XV4PJ4	84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5

Question 1-1: What is the SHA-256 hash value of the MOV file?

**Consensus Result:** 84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5

TABLE 1

**Question 1-2 : Examination Questions**

**Question 1-2: What is the reported frame rate of the MOV file? (report as a numeric value in fps)**

**Manufacturer's Response:** 29.97 FPS (MediaInfo reports minimum and maximum frame rates as 28.571 and 30 FPS, respectively)

WebCode	Response
2PMJBM	29.970
2RNRFW	29.97
2XE2PV	29.97
37NQ4U	29.97
39RLMW	29.9717
3QAKUF	29.97
3QWT2Y	29.970
4YJ98E	30
6XMCVP	29.97
73WT6D	29.97
7EQ9RU	29.97
7NBD2E	29970
8BK3RE	29.9700
8KV6DE	29.9700
8WK66G	29.97
9Y4FGR	29.970
A8X93Q	29.97
A9N7GP	29.9717
ACNHCP	29.97
AV4RDP	29.970
B23TTA	29.97
B3JPKA	29.9717
B7J2GA	29.970
BJH3TB	29.970
CACG79	29.970
CC4FK8	29.972
CJ33AL	29.97
CRD6VM	29.97
DBZD7M	29.97
DJW977	29.97
EDKJ6A	29.970

TABLE 1

Question 1- 2 : Examination Questions	
WebCode	Response
FKZPEL	29.97
GJLF2E	29.970
GWBEV3	29.97
HNZDA2	29.9
HVA2KE	29.97
J8J2UD	29.97
JZNYT2	29.97
KV8Q63	29.97
LNKKHF	29.97
LVHCQA	29.970
M23ULW	29.97
MM3TAV	30
N48MEA	29.97
NJMLLV	29.97
NQHNM8	29.97
NQZUMX	29.97
P3V8K9	29.97
PFWY4R	29.970030
PXEYWA	29.9700
Q8K8C9	29.970
QXTL8W	29.97
REFN4Q	29.97
RF9GYA	29.9717
RQ6K34	29.97
RZEPFU	29.97
T9PB33	29.970
TWCB7A	29.97
TXJT46	29.970
U8M2LQ	29.97
V2X39M	29.97
VCGJZT	29.970030
VKRLLU	29.97
XDJYK6	29.97

TABLE 1

Question 1- 2 : Examination Questions	
WebCode	Response
XGLWVX	29.970
XV4PJ4	29.97

Question 1-2: What is the reported frame rate of the MOV file? (report as a numeric value in fps)

Consensus Result: 29.97 FPS

TABLE 1

## Question 1- 3 : Examination Questions

Question 1-3: What are the pixel dimensions of the MOV file?

Manufacturer's 1920 x 1080

Response:

WebCode	Response
2PMJBM	1920 x 1080
2RNRFW	1920 x 1080
2XE2PV	1920 x 1080
37NQ4U	1920 x 1080
39RLMW	3. 1920/1080 (1.778:1)
3QAKUF	1920 × 1080
3QWT2Y	1920 X 1080 (16:9 - 1.778:1)
4YJ98E	1920 x 1080
6XMCVP	1920 x 1080
73WT6D	1920 x 1080
7EQ9RU	1920 x 1080
7NBD2E	1920 X 1080
8BK3RE	1920 x 1080
8KV6DE	1920 x 1080
8WK66G	1920 x 1080
9Y4FGR	1920 x 1080 (around 2,1 megapixels)
A8X93Q	1920 x 1080
A9N7GP	1920/1080 (1.778:1)
ACNHCP	1920 x 1080
AV4RDP	1920/1080 (1.778:1)
B23TTA	1920 x 1080 pxls
B3JPKA	1920/1080
B7J2GA	1920 x 1080
BJH3TB	1920 x 1080
CACG79	1920 x 1080
CC4FK8	1920*1080
CJ33AL	1920 x 1080
CRD6VM	1920 x 1080
DBZD7M	1920 x 1080
DJW977	Width: 1920 pixels Height: 1080 pixels
EDKJ6A	1920 x 1080

TABLE 1

Question 1- 3 : Examination Questions	
WebCode	Response
FKZPEL	1920 x 1080
GJLF2E	The pixel dimensions of the MOV file are 1920 x 1080.
GWBEV3	1920 x 1080
HNZDA2	1920 pixels x 1080 pixels
HVA2KE	1920 X 1080
J8J2UD	1920 x 1080
JZNYT2	1920 x 1080
KV8Q63	Width (pixels): 1920, Height (pixels): 1080
LNKKHF	1920 x 1080
LVHCQA	1920 x 1080
M23ULW	1920 x 1080
MM3TAV	1920 x 1080
N48MEA	1920 x 1080
NJMLLV	1920 x 1080
NQHNM8	1920 x 1080
NQZUMX	1920 x 1080
P3V8K9	1920 x 1080
PFWY4R	1920 x 1080
PXEYWA	1920 x 1080
Q8K8C9	1920 x 1080
QXTL8W	1920 x 1112 (image area 1920 x 1080)
REFN4Q	1920*1080
RF9GYA	1920 x 1080
RQ6K34	1920 x 1080
RZEPFU	1920 X 1080
T9PB33	1920 x 1080
TWCB7A	1920 x 1080
TXJT46	1920 x 1080
U8M2LQ	1920 x 1080
V2X39M	1920 x 1080
VCGJZT	1920 x 1080
VKRLLU	1920 x 1080
XDJYK6	1920 x 1080

TABLE 1

Question 1- 3 : Examination Questions	
WebCode	Response
XGLWVX	1920 x 1080
XV4PJ4	1920 x 1080

Question 1-3: What are the pixel dimensions of the MOV file?

Consensus Result: 1920 x 1080

TABLE 1

## Question 1-4 : Examination Questions

**Question 1-4: What is the bit rate of the recorded video in the MOV file?**

**Manufacturer's Response:** 16015859 bits per second (bps) [MedialInfo], 16016781 bps [FFprobe], 16 or 16.0 Megabits per second (Mbps) [MedialInfo and ExifTool]. Also acceptable are any of these expressed in kilobits per second (kbps): 16000 kbps, 16015.859 kbps, or 16016.781 kbps.

WebCode	Response
2PMJBM	16 Mb/s
2RNRFW	16 mb/s
2XE2PV	16.0 Mb/s
37NQ4U	16.x
39RLMW	16993 kbps
3QAKUF	16.0 Mb/s
3QWT2Y	16.0 Mb/s
4YJ98E	16.0 mb/s
6XMCVP	16 Mb/s
73WT6D	16.0 Mb/s
7EQ9RU	16.0 Mb/s
7NBD2E	16.0 Mb/s
8BK3RE	16993 kbps
8KV6DE	16993 kbps
8WK66G	16993 kbps
9Y4FGR	BitRate: 16 Mb/s
A8X93Q	16.0 Mb/s
A9N7GP	16993
ACNHCP	16.0 Mb/s
AV4RDP	16 Mbps
B23TTA	16019477 (16.0 Mb/s)
B3JPKA	16.0 Mb/s
B7J2GA	16.0 Mb/s
BJH3TB	16.0 Mb/s
CACG79	16.0 Mbps
CC4FK8	16 Mbps
CJ33AL	16 mpbs
CRD6VM	16 Mb/s
DBZD7M	16 Mbps
DJW977	16993 kbps

TABLE 1

Question 1- 4 : Examination Questions	
WebCode	Response
EDKJ6A	16.0 Mb/s
FKZPEL	16.0 Mb/second (Media Info), 16.993 Mb/second (Windows), 15.077 Mb/second (VLC)
GJLF2E	The bit rate of the recorded video in the MOV file is 16.0 MB/S.
GWBEV3	16 Mb/s
HNZDA2	16 Mb/s
HVA2KE	16 Mbs
J8J2UD	16.0 Mb/s
JZNYT2	16.0 Mb/s
KV8Q63	16.0 Mb/s.
LNKKHF	15.7 Mb/s
LVHCQA	16.0 Mb/s
M23ULW	16.016781
MM3TAV	16.0 mb/s
N48MEA	16.016781 Mbit/s
NJMLLV	16 Mb/s
NQHNM8	16 Mbps
NQZUMX	16 Mb/s
P3V8K9	16016 kb/s
PFWY4R	16.0 Mb/s
PXEYWA	16.0 Mb/s
Q8K8C9	16.0 Mb/s
QXTL8W	16993 kbps
REFN4Q	16 Mbps
RF9GYA	16993 kbps
RQ6K34	16.0 Mb/s
RZEPFU	16993 KB/SC
T9PB33	8 bits
TWCB7A	16.0 Mb/s
TXJT46	16.0mb/s
U8M2LQ	16.0 Mb/s
V2X39M	16.0 Mb/s
VCGJZT	16 Mb/s
VKRLLU	16.0 Mb/s

TABLE 1

Question 1- 4 : Examination Questions	
WebCode	Response
XDJYK6	16993
XGLWVX	16.0 Mb/s
XV4PJ4	10.0 Mb/s

Question 1-4: What is the bit rate of the recorded video in the MOV file?

Consensus Result: 16 Mb/s

TABLE 1

## Question 1- 5 : Examination Questions

Question 1-5: How many frames are there in the MOV file?

Manufacturer's 159Response:

WebCode	Response
2PMJBM	159
2RNRFW	159
2XE2PV	159
37NQ4U	159
39RLMW	159
3QAKUF	159
3QWT2Y	159
4YJ98E	159
6XMCVP	159
73WT6D	159
7EQ9RU	159
7NBD2E	159 Frame
8BK3RE	159
8KV6DE	159
8WK66G	159
9Y4FGR	159 (include frame 0)
A8X93Q	159
A9N7GP	159
ACNHCP	159
AV4RDP	159 frames
B23TTA	159 frames
B3JPKA	159
B7J2GA	159
BJH3TB	159
CACG79	159
CC4FK8	159
CJ33AL	158
CRD6VM	159
DBZD7M	159
DJW977	158
EDKJ6A	159

TABLE 1

Question 1- 5 : Examination Questions	
WebCode	Response
FKZPEL	159
GJLF2E	There are 159 frames in the MOV file.
GWBEV3	159
HNZDA2	159 frames
HVA2KE	159
J8J2UD	158
JZNYT2	159
KV8Q63	159
LNKKHF	159
LVHCQA	159
M23ULW	159
MM3TAV	159
N48MEA	159
NJMLLV	159
NQHNM8	158 frames
NQZUMX	159
P3V8K9	159
PFWY4R	159
PXEYWA	159
Q8K8C9	159
QXTL8W	158
REFN4Q	159
RF9GYA	159
RQ6K34	159
RZEPFU	159
T9PB33	159
TWCB7A	159
TXJT46	159
U8M2LQ	159
V2X39M	159
VCGJZT	159
VKRLLU	159
XDJYK6	159

TABLE 1

Question 1- 5 : Examination Questions	
WebCode	Response
XGLWVX	159 frames total - (0 to 158)
XV4PJ4	159

Question 1-5: How many frames are there in the MOV file?

Consensus Result: 159

TABLE 1

## Question 1- 6 : Examination Questions

Question 1-6: Is there an audio track present in the MOV file?

Manufacturer's NoResponse:

WebCode	Response
2PMJBM	No
2RNRFW	No
2XE2PV	No
37NQ4U	No
39RLMW	No
3QAKUF	No
3QWT2Y	No
4YJ98E	No
6XMCVP	No
73WT6D	No
7EQ9RU	No
7NBD2E	No
8BK3RE	No
8KV6DE	No
8WK66G	No
9Y4FGR	No
A8X93Q	No
A9N7GP	No
ACNHCP	No
AV4RDP	No
B23TTA	No
B3JPKA	No
B7J2GA	No
BJH3TB	No
CACG79	No
CC4FK8	No
CJ33AL	No
CRD6VM	No
DBZD7M	No
DJW977	No
EDKJ6A	No

TABLE 1

Question 1- 6 : Examination Questions	
WebCode	Response
FKZPEL	No
GJLF2E	No
GWBEV3	No
HNZDA2	No
HVA2KE	No
J8J2UD	No
JZNYT2	No
KV8Q63	No
LNKKHF	No
LVHCQA	No
M23ULW	No
MM3TAV	No
N48MEA	No
NJMLLV	No
NQHNM8	No
NQZUMX	No
P3V8K9	No
PFWY4R	No
PXEYWA	No
Q8K8C9	No
QXTL8W	No
REFN4Q	No
RF9GYA	No
RQ6K34	No
RZEPFU	No
T9PB33	No
TWCB7A	No
TXJT46	No
U8M2LQ	No
V2X39M	No
VCGJZT	No
VKRLLU	No
XDJYK6	No

TABLE 1

Question 1- 6 : Examination Questions	
WebCode	Response
XGLWVX	No
XV4PJ4	No

Question 1-6: Is there an audio track present in the MOV file?

Consensus Result: No

# Forensic Video Enhancement Responses

TABLE 2

**Question 2- 1 : Enhanced Video Examination**

**Question 2-1: Note methods or tools used and settings for the video enhancement here.**

**Manufacturer's Expected Response:** This was a free form question on methods and tools used. No manufacturer's response is provided.

WebCode	Response
2PMJBM	AmpedFive: Rotate, Perspective stabilization, Correct Perspective, Crop, Motion deblurring, Unsharp masking, Add text - \$POSITIONFRAMES. Video writer - MP4, H.264 encoding, visually lossless. Image writer - BMP
2RNRFW	The video file was loaded into Amped FIVE forensic software. The video was first rotated -180 degrees. The video was cropped to the license plate area of the image (x: 1281, y: 727, w: 317, h: 265). Overall contrast improvement was conducted with the Levels filter, set to 176 Highlights, 79 Midtones, and leaving Shadows at 0. A local stabilization filter was applied using static tracking on the license plate area (reference coordinates 0: x: 125, y: 107, w: 31, h: 80). The correct perspective filter was applied to bring the license plate parallel to the image plane using a roughly 2:1 width to height ratio (source points 125, 104 - 156, 129 - 153, 184 - 121, 157; target selection x: 154, y: 103, w: 65, h: 41). The position of each frame way applied to the video via text overlay. The resulting video was exported with H264 encoding in an MP4 format. The best single image of the video, Frame 158, was exported in the BMP format.
2XE2PV	method and notes made in Amped Five report attached. [Report was not included]
37NQ4U	The tool used for this proficiency test was VideoCleaner, version 5.8; Copyright, Forensic Protection, 2018. Specific settings used, and their parameters for this video were set as follows: 1. Turn on 'Specialty' tools. 2. Rotate Video 180 degrees. (For some reason, this video loaded upside down, requiring the video to be rotated.) 3. Crop: (set to '%'); Frame 0; Left: 70; Right: 22; Top: 75; Bottom: 12; Frame 158; Left: 70; Right: 24; Top: 80; Bottom: 8. 4. Perspective Changer - In order to final setting: Top Right (x-axis): 80, 75, 70; Bottom Right (x-axis): 80, 75, 70; Top Left (x-axis): 20, 25, 30; Bottom Left (x-axis): 20, 25, 30 5. Tools - Backlight: ON. The file was exported from VideoCleaner as an .AVI, and then imported into VLC Media Player. It was then exported from VLC Media Player as an MP4/H.264 file for submission. Assessed final reading on suspect license plate: "4NSC EJP" State of issue unknown.
39RLMW	Axon Investigate Pro 4.1.1 was used for enhancement. Lens Correction: K1 = -0.17 K2 = -0.55 to Stabilize to Standard Output - Best Quality. Input(s) 1. Crop. Lens Correction Stabilize 1.mp4 – file. F:\24-5581 Video\Lens Correction Stabilize 1.mp4. File Hash (SHA256): 096927ff849c2f315f5b7e1a7164a0d3cd59d3297e98fbf1cee27279cfbd4688. File Hash (MD5): 95fd94f757dd19ebbe7ce15d897369cd. Workflow. Crop – (x, y) = (1368, 726); size = 272x318. Output to MP4 – transcode video = H264; set even width/height = True; change pixel format = Yuv420P; remove delta frames = False; compression quality = 0; compression speed = Medium; transcode audio = Aac. Path: F:\24-5581 Video\cropped.mp4. Outputs. F:\24-5581 Video\cropped.mp4. File Hash (SHA256): 1a94a8713e00d342af44eab0df686d8db743798e99d3b90d2d86be1e0f883d1e. File Hash (MD5): 31147958fd4a4fb313dbf91411bf0a26. All Frames extracted from cropped.mp4 file. Parts E could not be completed by Axon Investigate Pro. The application does not allow the type of overlay.
3QAKUF	Amped 5 was used to analyze and process the video file. The filters used were: Rotate 180°; Correct Perspective to register the registration tag to a standard 2:1 rectangle; Perspective Stabilization to stabilize the registered frames; Crop; Histogram Equalization to improve the dynamic range; Retinex to improve the contrast; Levels to refine the contrast further; Wiener filter to reduce noise and distortion artifacts; Add Text to annotate the frame number; and Video Writer to generate the MPEG-4 file.

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
3QWT2Y	Using QuickHash v3.2.0, compared the downloaded file with the hash provided in the scenario, and they matched. Also using QuickHash, recorded the SHA-256 hash value in question 1-1. Brought the video into Amped FIVE (Build date:20220428 Revision:24474) to work on it. I did the following steps in this order; video loaded; rotate; correct perspective; levels; local stabilization; crop; resize; add text; image writer(for frames153;155;158); video writer; range selector; frame averaging; image writer(for frame average). See the report generated by the program Apmed Five for the details of each step done. I am going under the assumption, that I have uploaded the images from the other night because there is no way of checking what was uploaded and what I may not done yet.
4YJ98E	the above instructions are applied in the amped five software that was used for the analysis and the steps are shown.
6XMCVP	Amped Five revision 33279. VideoMaterial-instructions 2.BMP -- Perspective corrected, rotated, cropped, frames selected, stabilization applied, cropped, perspective corrected, magnification applied, colours adjusted. VideoMaterial-instructions 3 grayscale.BMP -- Perspective corrected, rotated, grayscale conversion, cropped, frames selected, stabilization applied, cropped, perspective corrected, magnification applied, colours adjusted. VideoMaterial (version 2).BMP -- Perspective corrected, magnification applied, rotated, perspective corrected, levels adjusted, cropped, magnification applied VideoMaterial-instructions with overlay.MP4 -- Perspective corrected, rotated, stabilization applied, cropped, magnification applied, text overlaid. Refer Amped Five report. [Report was not included]
73WT6D	All processes described below were performed using Amped FIVE. - Stabilization, perspective correction and crop: Video stabilization was achieved using Amped FIVE's 'Perspective Stabilization' filter, with the tracking target area encompassing the front grille, license plate, and headlights. (selection area: 173, 110 - 525, 110 - 525, 350 - 173, 350   motion type: Perspective   Tracking method: Static Tracking   Interpolation: Bicubic) The video was initially recorded with the camera upside down, and the metadata indicated a 180° rotation during playback. A 180° rotation filter was applied using Amped FIVE. Perspective correction was performed, and size adjustments were applied to achieve a 2:1 ratio on the license plate. (Source Points: 1405, 828 - 1437, 853 - 1435, 916 - 1403, 886   Target Selection: x: 1403, y: 827, w: 180, h: 90) Image was cropped around the license plate to as instructed (Selection: x: 1340, y: 757, w: 320, h: 240) - Video enhancement: Amped FIVE's curves adjustment filter was applied to enhance readability by increasing the contrast, observing the license plate text area, and using the following parameters: Value= x: 0, y: 0 / x: 44, y: 51 / x: 83, y: 95 / x: 125, y: 161 / x: 170, y: 192 / x: 255, y: 255 Red = x: 0, y: 0 / x: 210, y: 255 Green = x: 0, y: 0 / x: 220, y: 254 Blue = x: 8, y: 0 / x: 57, y: 70 / x: 107, y: 126 / x: 143, y: 168 Along with the video enhancement, frames 1, 3, 45, 134, 141, 151 and 155 were chosen to prepare a frame average (export described below). - Add text overlay and clip export: Amped FIVE's "Add Text" filter was used to overlay the frame numbers in the lower right corner. Starting with the first frame as frame 0 The resulting video was exported as mp4 using h264 codec. A Constant Frame Rate of 29.97 and a Constant Rate Factor of 1 (visually lossless) were used. - Frame selection: Frame 3 was selected and saved as VideoMaterial_Optimized-frame003.tif. Frame 150 was selected and saved as VideoMaterial_Optimized-frame150.tif. Frames 1, 3, 45, 134, 141, 151 and 155 were averaged and saved as VideoMaterial-FrameAVG.tif Note: Detailed process and settings available using Amped FIVE's project and reports. [Participant submitted data in a format that could not be reproduced in this report].

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
7EQ9RU	<p>Amped FIVE Report. Report Generation: 2024-07-23 15:34:11. Project Name: 2024 Profficiency Test 24-5581. Author: [Name]. Description: Software version info: Build date: 20230704. Revision: 29850. Platform: Operating System: Microsoft Windows, 64 bit. CPU Model: Intel(R) Core(TM) i9-10900KF CPU @ 3.70GHz. Project File: VideoMaterial_FINAL.afp. Summary: VideoMaterial. Video Loader: Loads a video from file. Rotate: Rotates the image. Local Stabilization: Stabilizes a shaking video by keeping the current selection steady. The object of interest must be present in all frames. Supports different stabilization modes. Correct Perspective: Corrects the perspective of a plane of interest within the image (image rectification). Crop: Crops a region of interest of the image. Exposure: Adjusts the image exposure. Smart Adjust: Improves the local contrast of an image minimizing halo artifacts and the clipping of highlights. Unsharp Masking: Sharpens the image using an unsharp masking filter. Add Text: Adds text to the image. Supports several macros to dynamically change the content of the text. Font, color, size and position can be customized. This filter only supports 3-channel images. If a single-channel image is used, the filter will automatically convert it to a 3-channel image. Video Writer: Writes the current video to a file. Sparse Selector: Selects a list of frames that are defined by the user. Sequence Writer: Writes all frames as image files. 1/6 VideoMaterial Video Loader Loads a video from file. Details: The Video Loader decodes a standard-format video file into a sequence of frames that can be displayed and processed. Parameters: File: ../VideoMaterial.MOV Path of the video to load. Video Engine: FFMS Video decoder to use. Color Range: Limited Uses the color range specified in the video file or force it to full or limited (16-235). Works only with the FFMS Video Engine. Chroma Upsampling: Accurate Rounding (Slower) Selects the chroma upsampling method. Applies only to FFMS-based video engines. Audio Stream: None Audio Stream selection, useful when multiple streams are available. Original File: Original video file that has been converted from a proprietary DVR format or otherwise imported. Concatenate File List: List of files that were concatenated as part of the conversion process Additional Information: Video Streams: 1 Number of video streams in the video Audio Streams: 0 Number of audio streams in the video Subtitle Streams: 0 Number of subtitle streams in the video Rotate Rotates the image. Details: The Rotate filter rotates the image by an arbitrary angle. If the rotation angle is not a multiple of 90 degrees, the selected interpolation algorithm is used, otherwise the original pixel values are simply transposed. Parameters: Angle: 180 Rotation angle. Resize Image to Fit: true If unchecked, the image size is retained but portions of the image could be rendered outside the frame. Interpolation: Bicubic Interpolation algorithm used when the image is resized. Background Color: #000000 Color used to fill the portions of the frame outside the original image. Additional Information: This filter has no additional information. References: Anil. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall, pp. 253–255, 1989. ISBN: 0-13-336165-9. Anil. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall, pp. 320–322, 1989. ISBN: 0-13-336165-9. R. Keys, "Cubic convolution interpolation for digital image processing", in IEEE Transactions on Acoustics, Speech, and Signal Processing, Vol. 29, No. 6, pp. 1153-1160, December 1981. <a href="https://doi.org/10.1109/TASSP.1981.1163711">https://doi.org/10.1109/TASSP.1981.1163711</a> Hsieh Hou and H. Andrews, "Cubic splines for image interpolation and digital filtering", in IEEE Transactions on Acoustics, Speech, and Signal Processing, Vol. 26, No. 6, pp. 508–517, December 1978. <a href="https://doi.org/10.1109/TASSP.1978.1163154">https://doi.org/10.1109/TASSP.1978.1163154</a> Local Stabilization Stabilizes a shaking video by keeping the current selection steady. The object of interest must be present in all frames. Supports different stabilization modes. Details: The Local Stabilization tool shifts the different frames of a video horizontally and/or vertically in order to correct instability. The offset to be applied is calculated by obtaining the maximum of the cross-correlation function between each frame and a template, which is obtained by the reference area copied from the reference frame. Parameters: Background Color: #000000 Color used to fill the area outside the original image. Selection: Static Tracking Reference Selection(s) 0: x: 1399, y: 819, w: 59, h: 110 The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest. Additional Information: This filter has no additional information. 2/6 References: Anil. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall, pp. 400–402, 1989. ISBN: 0-13-336165-9. Correct Perspective Corrects the perspective of a plane of interest within the image (image rectification). Details: Correct Perspective maps a desired quadrangular region to a rectangular one, which corresponds to making the plane of interest parallel to the image plane. The pixel values are interpolated with a bicubic algorithm. The ratio between width and height of the output rectangle can be set by the user by drawing a selection or computed automatically from the input points. The automatic</p>

TABLE 2

## Question 2- 1 : Enhanced Video Examination

## WebCode Response

computation should only be used if the image is not cropped (i.e. the optical axis of the lens coincides with the center of the image) and there's no excess of distortion; in any case, the results of the automatic computation should not be relied upon for forensic purposes. The original quadrangular region can be refined by selecting its corners a second time on the rectified image, where they are better discernible. Parameters: Source Points: 1406, 833 - 1435, 855 - 1435, 912 - 1403, 884 Quadrilateral to transform into a rectangle. Target Selection: x: 1403, y: 842, w: 139, h: 71 Target rectangle to map the source points to. Additional Information: This filter has no additional information. References: Anil. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall, pp. 320–322, 1989. ISBN: 0-13-336165-9. R. Keys, "Cubic convolution interpolation for digital image processing", in IEEE Transactions on Acoustics, Speech, and Signal Processing, Vol. 29, No. 6, pp. 1153-1160, December 1981. <https://doi.org/10.1109/TASSP.1981.1163711> Hsieh Hou and H. Andrews, "Cubic splines for image interpolation and digital filtering", in IEEE Transactions on Acoustics, Speech, and Signal Processing, Vol. 26, No. 6, pp. 508–517, December 1978. <https://doi.org/10.1109/TASSP.1978.1163154> Crop Crops a region of interest of the image. Details: The Crop tool produces an output image which is only the selected square or rectangular region of the input image. Parameters: Selection: x: 1339, y: 765, w: 295, h: 205 The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest. Additional Information: This filter has no additional information. Exposure Adjusts the image exposure. Details: The Exposure tool performs a non-linear mapping of the input image values. It adjusts the image gamma applying a power function that has three parameters: Exposure, Offset and Recover. Exposure modifies the pixel values in the midtone-to-white range with minimal effect on the shadows. Decreasing (respectively increasing) the Offset darkens (resp. lightens) the pixel values in the midtone-to-black range with minimal effect on the highlights. Recover controls the overall brightness of the image. Parameters: Exposure: 1 Adjusts the exposure of the image. Offset: 0.1000 Adds or subtracts an offset to the pixel values. Recover: 0.7943 Recovers the saturated pixels of the image. Selection: Whole Image The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest. Additional Information: This filter has no additional information. References: Anil. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall, pp. 234–241, 1989. ISBN: 0-13-336165-9. Smart Adjust Improves the local contrast of an image minimizing halo artifacts and the clipping of highlights. Details: The Smart Adjust filter increases the contrast of an image by estimating a local minimum and maximum at each point, and then stretching the input intensity values, so that the local minimum becomes black and the local maximum becomes white. This can compensate for an uneven illumination or color casts, 3/6 reduce the effect of fog or haze, or both. The local minimum and maximum are computed using a constrained edge-preserving low-pass filter, described in (Guarnieri, Marsi and Ramponi, 2011): the constrained property guarantees that the details in the input image are always preserved without clipping, and the edge-preserving property avoids or strongly reduces the formation of halos around the sharp edges, which often affect local contrast-enhancement filters such as the Homomorphic Filter or Retinex. The Smart Adjust filter can also operate in one direction only: increase the pixel values, preserving the black, or decrease the pixel values, preserving the white. On color images, each RGB channel is processed independently. Parameters: Mode: Equalization The type of operation performed by the filter. Strength: 50 Adjusts the amount of contrast enhancement produced by the filter. Edge Threshold: 0 Adjusts the edge-preserving property of the filter. A value of 0 uses a different edge-detection method that does not require adjustment. Additional Information: This filter has no additional information. References: Gabriele Guarnieri, Stefano Marsi and Giovanni Ramponi, "High Dynamic Range Image Display With Halo and Clipping Prevention", in IEEE Transactions on Image Processing, Vol. 20, No. 5, pp. 1351-1362, May 2011. <https://doi.org/10.1109/TIP.2010.2092436> Unsharp Masking Sharpens the image using an unsharp masking filter. Details: The Unsharp Masking filter is implemented as a window-based operator, i.e. it relies on a convolution kernel to perform spatial filtering. The original image is first convolved with a Radius x Radius Gaussian kernel to produce its smoothed version, i.e. a low-passed image. The resulting image is then pixel subtracted from the original image in order to produce a description of image edges, i.e. a high-passed image. Only the pixel differences (edges) greater than certain Threshold values are retained, so that sharpening of small image details can be suppressed. In order to increase the sharpness of the original image, a percentage (proportional to Strength) of the thresholded

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
	<p>high-passed image is added back onto the original image. Parameters: Strength: 0.3500 Intensity of the sharpening effect: larger values provide increasing amounts of sharpening. Size: 99 Length, in pixels, of the side of the square filter window. High resolution images allow for a higher size. Threshold: 0 The minimum difference in pixel values that indicates an edge where sharpen must be applied. Areas of smooth tonal transition can be protected from the creation of blemishes in the facial, sky or water surface. Mode: Intensity Type of adjustment to be performed. Selection: Whole Image The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest. Additional Information: This filter has no additional information. References: Anil. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall, pp. 249–250, 1989. ISBN: 0-13-336165-9. Add Text Adds text to the image. Supports several macros to dynamically change the content of the text. Font, color, size and position can be customized. This filter only supports 3-channel images. If a single-channel image is used, the filter will automatically convert it to a 3-channel image. Details: The Add Text adds textual information to the image. Parameters: Text: \$ORIGINALPOSITIONFRAMES The text to add to the image. Text Style: bold 'segoe ui' 24 windows-1252, #FFFFFF, Right, Bottom Text appearance and layout. Background Color: #000000 The color used to paint the rectangle underneath the text, if required. Background Shape: Text The shape of the colored background, if activated. Date Format: %Y-%m-%d %a: Abbreviated weekday name %A: Full weekday name %b: Abbreviated month name %B: Full month name %d: Day of month as decimal number (01 - 31) %m: Month as decimal number (01 - 12) %U: Week of year as decimal number, with Sunday as first day of week (00 - 53) %w: Weekday as decimal number (0 - 6; Sunday is 0) %W: Week of year as decimal number, with Monday as first day of week (00 - 53) %x: Date representation for current locale %y: Year without century, as decimal number (00 - 99) %Y: Year with century, as decimal number %z, %Z: Either the time zone name or time zone abbreviation, depending on registry settings; no characters if time zone is unknown 4/6 Time Format: %H:%M:%S.%l %H: Hour in 24-hour format (00 - 23) %l: Hour in 12-hour format (01 - 12) %l: Milliseconds with leading zeros (000 - 999) %M: Minute as decimal number (00 - 59) %p: Current locale's A.M./P.M. indicator for 12-hour clock %S: Second as decimal number (00 - 59) %X: Time representation for current locale Start Page Number: 1 The first page for the Page Number macro. Selection: Whole Image The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest. Additional Information: This filter has no additional information. Video Writer Writes the current video to a file. Details: The Video Writer tool encodes all frames of the current clip to the specified video file format. Parameters: File: ../VideoMaterial-Final.mp4 Path of the file to save. Container and Video Codec: mp4 - H264 Container and codec used to store the media stream(s). Audio Codec: None Codec used to write the audio stream. Frame rate: 29.9700 Frame rate (in frames per second) of the output video. Note that some video formats support only a limited set of frame rates, and the frame rate may influence some properties of the output video (e.g. the GOP size) for some codecs. Quality: Visually Lossless If a codec with quality control has been selected, the following options can be selected: Default: Uses a Constant Rate Factor of 18 High: Uses a Constant Rate Factor of 12 Visually Lossless: Uses a Constant Rate Factor of 1 HW Acceleration: None Enables encoding acceleration of the on-board Graphic Processing Unit. Acceleration will be tested when the filter is applied. Additional Information: Video Streams: 1 Number of video streams in the video Audio Streams: 0 Number of audio streams in the video Subtitle Streams: 0 Number of subtitle streams in the video Sparse Selector Selects a list of frames that are defined by the user. Details: The Sparse Selector tool outputs multiple frames taken from user selected positions from an input video. Parameters: Frames: 0, 158 List of selected frames. Additional Information: This filter has no additional information. Sequence Writer Writes all frames as image files. Details: The Sequence Writer tool encodes all the frames of the current clip to a sequence of the still images in the chosen format. Parameters: Output Folder: C:\Users\user\Desktop\2024 Prof Test\VideoMaterial-Final-240723153222 Destination folder where to save the images. Format: Portable Network Graphics Format used to encode the image file. First Frame Number: 0 Number of the first frame. Image Filename: Best Images Write Image Sequence PDF: false Filename: sequence 5/6 Additional Information: This filter has no additional information. 6/6. [Participant submitted data in a format that could not be reproduced in this report].</p>

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
7NBD2E	Open-source software Media Player Classic, version 1.7.9.145, used to change the perspective of the video. Open-source software VLC version 3.0.21, used to adjust the brightness of the video. Forensic software Omnivore version 1.5, which was used to stabilize the derived videos. The first video, titled 'license plate cut,' has a dimension of 656 x 34 pixels, with a data rate of 4596 Kbps. The second video, titled 'StabilizedDerivedVideo,' has a dimension of 1916 x 1076 pixels, with a data rate of 42195 Kbps, in mp4 format. Additionally, two screenshots were taken from the videos using the same software, saved in Tiff format. Frame overlay in text form was performed using open-source software Kinovea version 2023.1.2, represented as 0/135 in the 'license plate cut' video and as 0/154 in the second video, titled 'StabilizedDerivedVideo.' Open-source software Adobe Photoshop version CS6 was used to enhance the images in Tiff format. The first image has a dimension of 486 x 327 pixels, and the second one has a dimension of 862 x 570 pixels. In these images, the vehicle's license plate number was processed, which, due to the camera's angle, made visualization difficult. However, characters on the license plate with similar characteristics to the following were observed: '? KLER,' with the '?' symbol representing the number whose characteristics could not be determined.
8BK3RE	The video file was analyzed and enhanced utilizing Amped FIVE software (Build version 34212). Two still images were chosen (in addition to the submitted MP4 file) but were not submitted because the submission portal would only allow one entry. These images are available upon request. The below listed filters were used during the video enhancement process: * Video Loader: Loads a video from file * File Info: Save file information and EXIF metadata on the report * Hash Code: Calculates the input file hash code to check data integrity when loading the project * Rotate: Rotates the image * Correct Perspective: Corrects the perspective of a plane of interest within the image. * Local Stabilization: Stabilizes a shaking video by keeping the current selection steady * Crop: Crops a region of interest of the image * Retinex: Corrects an uneven illumination in the image using the Retinex algorithm * Levels: Adjusts intensity and color levels * Averaging Filter: Smooths the image with an averaging filter * Laplacian Sharpening: Sharpens the image using a Laplacian filter algorithm * Frame Size: Resizes the image canvas * Video Writer: Writes the current video to a file * Annotate: Draws annotations over the image * Video Writer: Writes the current video to a file

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
8KV6DE	Amped Five Software. Wondershare. Contrast: 8 Extends the intensity difference among pixels (linear gain). Brightness: 7 Adds or subtracts an offset to image pixels (bias). Mode: Linear The domain in which the image is mapped to. The Linear mode is the standard mode. The Logarithmic mode retains the black and white points and therefore prevents saturation. Selection: Whole Image The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest. Text: FRAME\$ORIGINALPOSITIONFRAMES The text to add Start Page Number: 1 The first page for the Page Number macro. Selection: x: 352, y: 4, w: 79, h: 24 The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest Exposure: 0 Adjusts the exposure of the image. Offset: -0.0100 Adds or subtracts an offset to the pixel values. Recover: 1 Recovers the saturated pixels of the image. Selection: Whole Image The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest in Maximum Shift: 20 The maximum horizontal and vertical shifts (in pixels) to correct. Frames: 29 The number of frames to be computed for the stabilization. Background Color: #000000 Color used to fill the area outside the original image. Size: 1 Length of the blur line, expressed in pixels. Angle: 0 Angle of the blur direction, expressed in degrees with respect to the horizontal. Noise: 0.0100 Estimate of the noise-to-signal power ratio. Mode: Linear Select if using a classical linear PSF or two isolated points to correct replica issues. Thickness: 1 Thickness of the blur, expressed in pixels. This parameter takes also into account an optical deblurring component. Boundary Conditions: Edge Tapering Reduces ringing artefacts near the boundaries of the image. Output Aspect Ratio: 32:5 The Aspect Ratio of the output image, expressed as a fractional number (the symbols "/" and ":" can both be used to express the fractional number i.e. 4/3 or 16:9). Mode: Retain Height The dimension to keep fixed. Interpolation: Bicubic Interpolation algorithm used when the image is resized. Angle: 180 Rotation angle. Resize Image to Fit: true If unchecked, the image size is retained but portions of the image could be rendered outside the frame. Interpolation: Bicubic Interpolation algorithm used when the image is resized. Background Color: #000000 Color used to fill the portions of the frame outside the original image. [Participant submitted data in a format that could not be reproduced in this report].
8WK66G	The video enhancement I used was a levels adjustment to brighten the image. I then used a sparse selector to select what I felt were the clearest frames, then used a frame average process to try and reduce the compression artifacts. This produces a single image rather than a video however so I have provided this (MJL-2-24-5581) as well as the video and still frames requested. Full details of the tools and settings can be seen in the report provided.
9Y4FGR	Software: hashMyFiles (file verification), MediaInfo (file information), exiftool (file information), Amped Five (video enhancement). In this part of the test (video enhancement instruction), our task was to improve the visibility of license plate numbers. We completed this task in two ways. Firstly, we performed all the steps in this part of the test and secondly apart of that we again performed all the steps in this part of the test but averaged only a few selected frames (148 to 158), which may contribute to better visibility of the numbers on the license plate. Below You can find tool and settings. 1st option: Amped Five (load file, rotation 180 degrees, local video stabilization, crop file, perspective correction, aspect ratio, superresolution, contrast, add frame numbers, save files). Results: VideoMaterial-[participant code]-9Y4FGR.mp4, VideoMaterial-[participant code]-9Y4FGR-153.png. 2nd option: Amped Five (load file, rotation 180 degrees, local video stabilization, crop file, select frames (from 148 to 158), frame averaging, perspective correction, aspect ratio, superresolution, contrast, save file). Result: VideoMaterial-[participant code]-9Y4FGR-averaging.png. Uploaded file name: File: Video-[participant code]-9Y4FGR.zip. SHA-256: b2dc277b5b7373113867262d81ca327d4b07fb5cdbecff38d3a0fdbdf7200844

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
A8X93Q	<p>The video file was loaded into Amped Five forensic software for processing and clarification. Once VideoMaterial.mov was loaded into the Amped Five software application, file detail information was displayed, and the video was able to be played so that the condition of the video and its overall quality could be assessed. The HASH feature was employed to confirm the SHA-256 hash generated previously by the Teracopy hashing application (report detail below). Next, the FILE INFO feature was used to generate additional file detail from multiple reporting applications: MedialInfo, FFProbe, and Exif View. The following information was collected: frame rate, pixel dimension, bit frame, number of frames in the video file, and if an audio track was present (see report details below). Preparing the image processing required it be rotated 180 degrees (see report details below). The test required the license plate in the video to have the perspective corrected to reflect the camera being parallel to the plate and to the license plate's 2:1 width to height ratio: The CORRECT PERSPECTIVE filter was used addressed both issues, correcting the perspective and sizing the plate to 172 x 86 pixels (see report details below). The video was stabilized with the LOCAL STABILIZATION filter and allowing the area directly around the license plate to be tracked by the stabilization filter (see report details below). The image around the license plate was cropped to 640 x 480 pixel using the CROP filter (see report details below). The license plate was clarified using an UNSHARPEN MASK filter to increase the detail of the license plate characters and the filter was configured to track just the area of the license plate (see report details below). The overlay of the frame count was done with the ADD TEXT feature which had a preinstalled setting for that task (see report details below). The VIDEO WRITER feature was used to generate a MP4 container and h.264 encoded visually lossless video of the processed video as specified in the enhancement instructions (see report details below). The SNAPSHOT tool on the video timeline was used to create three (3) still images in BMP format that represent the clearest images of the license plate from the processed video. Report Details: Summary: Filename: ../Q1/Extracted/24-5581 Video/VideoMaterial.MOV. File Size (bytes): 10622916. Format: mov,mp4,m4a,3gp,3g2,mj2. Codec: h264. Width (pixels): 1920. Height (pixels): 1080. Fps: 29.9700. Length (frames): 159. Duration (time): 00:00:05.305. Output File Details: Filename: 24-5581_[participant code]_VideoMaterial.mp4. File Size (bytes): 10702075. Format: mov,mp4,m4a,3gp,3g2,mj2. Codec: h264. Width (pixels): 640. Height (pixels): 480. Fps: 29.9700. Length (frames): 159. Duration (time): 00:00:05.305. Summary: VideoMaterial Video Loader: Loads a video from file. Parameters: File: Q1/Extracted/24-5581 Video/VideoMaterial.MOV. Video Engine: FFMS. Color Range: Limited. Audio Stream: None. Original File: Concatenate File List: Additional Information: Video Streams: 1. Audio Streams: 0. Subtitle Streams: 0. Hash Code Calculates the input file hash code to check data integrity when loading the project. Supports several hashing algorithms. Details: Parameters: Mode: SHA256 Hash Codes: 0: 84a361708461d90dc418e56be6b7e045799564f9210b926a97e16903785553f5. File Info: Saves file information and EXIF metadata on the report. Details: The File Info filter extracts the metadata displayed by the media interrogation tool EXIF View and prints all the available information in the report. Parameters: This filter has no parameters. Additional Information: Info: General Info: File Name: VideoMaterial.MOV File Path: D:\ProTest_2024_MW_Video\Q1\Extracted\24-5581 Video\VideoMaterial.MOV. File Size (bytes): 10622916. Type: Video. Format: mov,mp4,m4a,3gp,3g2,mj2. Color Channels: 3. Width (pixels): 1920. Height (pixels): 1080. Codec: h264. Fps: 29.9700. Length (frames): 159. Duration (time): 00:00:05.305. SAR (Storage Aspect Ratio): 16:9 (1.778). SAR (Sample Aspect Ratio): Undefined (0:1) (0.000). DAR (Display Aspect Ratio): 16:9 (1.778). PAR (Pixel Aspect Ratio): 1:1 (1.000). Color Range: Limited. Total Streams: 1. Video Streams: 1. Audio Streams: 0. Subtitles Streams: 0. Rotate: Rotates the image. Parameters: Angle: 180 Rotation angle. Resize Image to Fit: true. Interpolation: Bicubic Background Color: #000000. Correct Perspective: Corrects the perspective of a plane of interest within the image (image rectification). Parameters: Source Points: 1405, 829 - 1437, 854 - 1436, 914 - 1404, 886. Quadrilateral to transform into a rectangle. Target Selection: x: 1404, y: 829, w: 172, h: 86. Target rectangle to map the source points to. Local Stabilization: Stabilizes a shaking video by keeping the current selection steady. The object of interest must be present in all frames. Supports different stabilization modes. Parameters: Background Color: #000000. Selection: Static Tracking. Reference Selection(s) 0: x: 1401, y: 822, w: 180, h: 102. Crop: Crops a region of interest of the image. Parameters: Selection: x: 1159, y: 599, w: 640, h: 480. Unsharp Masking: Sharpens the image using an unsharp masking filter. Parameters: Strength: 0.5700. Size: 79. Threshold: 0. Mode: Intensity. Selection: Static Tracking.</p>

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
	Reference Selection(s). 158: x: 242, y: 250, w: 159, h: 56. Add Text: Adds text to the image. Supports several macros to dynamically change the content of the text. Font, color, size and position can be customized. Parameters: Text: FRAME: \$POSITIONFRAMES. The text to add to the image. Text Style: arial 14 windows-1252, #FFFFFF, Left, Bottom. Text appearance and layout. Background Color: #000000. The color used to paint the rectangle underneath the text, if required. Background Shape: None. The shape of the colored background, if activated. Start Page Number: 1. The first page for the Page Number macro. Selection: Whole Image. The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest. Video Writer: Writes the current video to a file. Parameters: File: Processed/24-5581_[participant code]_VideoMaterial.mp4. Container and Video Codec: mp4 - H264. Audio Codec: None. Frame rate: 29.9700 Quality: Visually Lossless. HW Acceleration: None. Additional Information: Video Streams: 1. Number of video streams in the video Audio Streams: 0. Number of audio streams in the video Subtitle Streams: 0. Number of subtitle streams in the video. [Participant submitted data in a format that could not be reproduced in this report].
A9N7GP	using Axon Investigate ver. 4.1.1, (researched on how to use GIMP and Blender 4.2, but did use in the results of this test) selected the workflow module; 1st filter I used was Lens correction - tried different ranges until I settled on one. Tried rotate filter so see if I could get a better view of license plate. I used the Level Adjustment filter to see if I could get the number on the license plate to appear clearer. Selected the stabilize filter to slow down the shakiness
ACNHCP	The video was reviewed using Axon Investigate v. 3.1.0 to evaluate the video. In order to complete the requested steps for the test, the video was processed in Amped Five, build date 20221208, revision 26914. The video of interest was imported using the video loader. This resulted in the video being imported upside down. The video was rotated 180 degrees. The Correct Perspective filter was applied to the area of the license plate and the output selection area was stretched on the horizontal axis to approximate the aspect ratio of a license plate. The interpolation was set to Nearest Neighbor. Perspective Stabilization was used to stabilize the movement of the license plate caused by the camera movement. The tracking method was set to Hybrid Tracking and the interpolation was set to Nearest Neighbor. The video was cropped to the area of the license plate. A levels adjustment was applied to the cropped video with the highlights set to 144, midtones 75 and shadows 6. The video was resized 2x using Nearest Neighbor interpolation. Once this was completed, Add Text was used to apply the frame number to each frame of the video starting at 0. The video was exported as an MP4 video file using H.264 video compression. Still images from Frame 0 and Frame 150 were exported from the video and saved as PNG files.
AV4RDP	Tool: Amped FIVE, Build date: 20240711 Revision: 34212. Methods used: Once the file was loaded in Amped Five the following filters were used; rotate, correct perspective, perspective stabilization, crop, levels, and unsharp masking. The enhanced video file was exported as an mp4 with the h264 codec. Refer to Amped FIVE report uploaded for more details.
B23TTA	Amped FIVE revision 33279. - Video Loader, - Rotate – 180 degrees, - Correct Perspective, – Width 100, Height 50, - Local Stabilisation – Dynamic tracking (X:1321, Y:770, W:176, H:126), - Perspective Stabilisation, – Perspective, Static Tracking, Bicubic, - Crop – X:1100, Y:650, W:640, H:360, - Resize – Zoom of 3, Bicubic interpolation, W:1920 H:1080, - Sparse Selector - Frames 0, 154, 155 - Frame Averaging, - Contrast Brightness – Contrast: 50, Brightness: 35, - Picture in picture

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
B3JPKA	<p>A. Conduct a perspective correction of the designated vehicle's license plate (that is, process the video such that it closely resembles the perspective of the license plate as if the camera lens was parallel with it). The license plate has a width-to-height ratio of 2:1. Actions taken: File loaded into Amped FIVE version 33279. Video appears upside down. 1. Edit &gt; Rotate &gt; +180.00 2. Edit &gt; Correct Perspective &gt; selected the area from top left hand corner. 3. Used the refinement, under the correct perspective tab, re-selected the four corners of the reg plate and applied. B. Conduct a video stabilization of the perspective-corrected video. Actions taken: 1. Stabilization &gt; Local Stabilization &gt; Whole Image. C. Crop around the license plate. The size of your cropped area is your choice, but the entire license plate must be visible in the cropped version. Actions taken: 1. Edit&gt; Crop &gt; Apply&gt; Dimensions: 362/ 214. D. Conduct a video enhancement of the license plate in the cropped version. Actions taken: 1. Adjust &gt; Levels &gt; highlighted to 161, shadow set to 18, midtones set at 89. E. Overlay the frame numbers as text near one of the corners of the video. Start with the first video frame as frame 0. Actions taken: 1. Presentation &gt; Add Text &gt; Selected \$POSITIONFRAMES - selected font/size, left top position. Font Colour - White. F. Export the final product as an MP4 file, with H.264 video encoding. Actions taken: 1. Write &gt; Video Writer - choose where to save/named file &gt; container .mp4 - video codec H264 &gt; apply. G. Select and export between one and three frames of your choice (as PNG, BMP, or TIFF image files) which you believe represent the clearest images of the license plate. Actions taken: 1. Write &gt; Image Writer - choose where to save/named files &gt; container PNG &gt; selected Frame 3 and Frame 155 &gt; apply</p>
B7J2GA	Amped Five v.13609, Adobe Photoshop v.25.0.0, Adobe Premiere v.24.0.0 rotate, correct perspective, unsharp masking, motion deblurring, local stabilization, crop
BJH3TB	<p>Visual examination and analysis by using forensic tool Amped FIVE – Forensic Image and Video Enhancement. This is the summary of working method or filter used: 1. Video Loader: Loads a video from file. 2. Hash Code: Calculates the input file hash code to check data integrity when loading the project. Supports several hashing algorithms. 3. Rotate: Rotates the image. 4. Correct Perspective: Corrects the perspective of a plane of interest within the image (image rectification). 5. Aspect Ratio: Corrects the aspect ratio of a video. 6. Range Selector: Selects a range of frames in a video. Supports the trimming of the original video stream with no transcoding. 7. Local Stabilization: Stabilizes a shaking video by keeping the current selection steady. The object of interest must be present in all frames. Supports different stabilization modes. 8. Crop: Crops a region of interest of the image. 9. Smart Adjust: Improves the local contrast of an image minimizing halo artifacts and the clipping of highlights. 10. Add Text: Adds text to the image. Supports several macros to dynamically change the content of the text. (use \$POSITIONFRAMES to add frame at the text) 11. Resize: Resizes the image.</p>

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
CACG79	<p>Task A: Software Utilized: - Amped FIVE Revision 29850 Method: To complete the Task A, the following method applies using Amped Five Revision 29850 1. Load Video File VideoMaterial.MOV. Choose Filter Group Edit -&gt; Filter name Correct Perspective, this following parameter applied :- Source Points: 1406, 829 - 1445, 855 - 1441, 919 - 1400, 890 Quadrilateral to transform into a rectangle. Target Selection: x: 867, y: 481, w: 433, h: 220 Target rectangle to map the source points to. 2. To change the Aspect Ratio to 2/1, Choose Filter Group Edit -&gt; Filter Name Aspect Ratio and this following parameter applied :- Output Aspect Ratio: 2/1 The Aspect Ratio of the output image, expressed as a fractional number. Mode: Retain Height The dimension to keep fixed. Interpolation: Bicubic Interpolation algorithm used when the image is resized. Task B: Software Utilized: - Amped FIVE Revision 29850 Method: To complete the Task B, the following method applies using Amped Five Revision 29850 1. Choose Filter Group Stabilization -&gt; Filter Name Global Stabilization and this following parameter applied :- Maximum Shift: 199 The maximum horizontal and vertical shifts (in pixels) to correct. Frames: 159 The number of frames to be computed for the stabilization. Background Color: #000000 Color used to fill the area outside the original image. Task C: Software Utilized: - Amped FIVE Revision 29850 Method: To complete the Task C, the following method applies using Amped Five Revision 29850 1. Choose Filter Group Edit -&gt; Filter Name Crop and this following parameter applied :- Selection: x: 806, y: 469, w: 695, h: 595. Task D: Software Utilized: - Amped FIVE Revision 29850 Method: To complete the Task D, the following method applies using Amped Five Revision 29850 1. Choose Filter Group Adjust -&gt; Filter Name White Balance and this following parameter applied:-</p> <ul style="list-style-type: none"> <li>• Color Space: RGB The color space in which the processing is performed.</li> <li>• Exposure Correction (EV): 1.5000 Adjusts the overall brightness of the image.</li> <li>• Selection: Whole Image The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest.</li> <li>2. Choose Filter Group Adjust -&gt; Filter Name Temporal Tint and this following parameter applied:-</li> <li>• Exposure Correction (EV): 0.1000 Adjusts the overall brightness of the image.</li> <li>• Color Temperature (Kelvin): 8353 Color temperature used for Temperature Tint correction. Low = orange, 6500 = white, high = blue.</li> <li>• Tint Correction ([delta]uv percent): 3 Color tint used for Temperature Tint correction. Negative = purple, positive = green.</li> <li>• Mode: Map Selected Color to White The way the filter processes the image.</li> <li>3. Choose Filter Group Adjust -&gt; Filter Name Automatic Color Equalization and this following parameter applied:-</li> <li>• Method: Discrete Fourier Transform (DFT) Filtering method used in the piecewise linear approximation.</li> <li>• Strength: 7.4000 Strength of the filter. Higher values produce a stronger effect.</li> </ul> <p>Task E: Software Utilized: - Amped FIVE Revision 29850 Method: To complete the Task E, the following method applies using Amped Five Revision 29850 1. Choose Filter Group Presentation -&gt; Filter Name Add Text and this following parameter applied:- Text: \$POSITIONFRAMES The text to add to the image. Text Style: bold century 18 windows-1252, #FFFFFF, Left, Top Text appearance and layout. Background Color: #000000 The color used to paint the rectangle underneath the text, if required. Background Shape: Text The shape of the colored background, if activated. Date Format: %Y-%m-%d %a: Abbreviated weekday name %A: Full weekday name %b: Abbreviated month name %B: Full month name %d: Day of month as decimal number (01 - 31) %m: Month as decimal number (01 - 12) %U: Week of year as decimal number, with Sunday as first day of week (00 - 53) %w: Weekday as decimal number (0 - 6; Sunday is 0) %W: Week of year as decimal number, with Monday as first day of week (00 - 53) %x: Date representation for current locale %y: Year without century, as decimal number (00 - 99) %Y: Year with century, as decimal number %z, %Z: Either the time zone name or time zone abbreviation, depending on registry settings; no characters if time zone is unknown Time Format: %H: %M:%S.%l %H: Hour in 24-hour format (00 - 23) %I: Hour in 12-hour format (01 - 12) %l: Milliseconds with leading zeros (000 - 999) %M: Minute as decimal number (00 - 59) %p: Current locale's A.M./P.M. indicator for 12-hour clock %S: Second as decimal number (00 - 59) %X: Time representation for current locale Start Page Number: 0 The first page for the Page Number macro. Selection: Whole Image The selection where the filter is applied to. It may be the whole image, a static region, or a region containing a tracked object of interest. Task F: Software Utilized: - Amped FIVE Revision 29850 Method: To complete the Task E, the following method applies using Amped Five Revision 29850 1. Choose Filter Group Write -&gt; Filter Name Video Writer and this following parameter applied:-</p> <ul style="list-style-type: none"> <li>• File: [Name] TEST NO 24-5581-VideoMaterial.mp4 Path of the file to save.</li> <li>• Container and Video Codec: mp4 - H264 Container and codec used to store the media stream(s).</li> <li>• Audio Codec: None Codec used to write the audio stream.</li> <li>• Frame rate: 30 Frame rate (in frames per</li> </ul>

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
	second) of the output video. Note that some video formats support only a limited set of frame rates, and the frame rate may influence some properties of the output video (e.g. the GOP size) for some codecs. • Quality: Default If a codec with quality control has been selected, the following options can be selected: Default: Uses a Constant Rate Factor of 18 High: Uses a Constant Rate Factor of 12 Visually Lossless: Uses a Constant Rate Factor of 1 • HW Acceleration: None Enables encoding acceleration of the on-board Graphic Processing Unit. Acceleration will be tested when the filter is applied. Additional Information: • Video Streams: 1 Number of video streams in the video • Audio Streams: 0 Number of audio streams in the video • Subtitle Streams: 0 Number of subtitle streams in the video. [Participant submitted data in a format that could not be reproduced in this report].
CC4FK8	Methods: 1. Technical Overview of Digital Video Files. 2. Best Practices for Digital Forensic Video Analysis. 3. Fundamentals of Resizing Imagery and Considerations for Legal Proceedings. 4. Technical specification for forensic image processing SF/T 0152—2023. Tools: Cognitech Video Investigator V7.0, Mingjing video&image enhancement system V3.22,Adobe Premiere Pro 2022,Adobe Photoshop 2024. Settings: A.Extract video frames. B. Analyze all video frames and find that there are enough clear frames available for inspection. C. Exclude frames that are too blurry and select the clearest 14 frames as available frames, including frames 1, 4, 15, 140, 142, 144, 145, 148, 149, 150, 152, 154, 155, and 156. D. Align and stabilize the selected frames. E. Crop around the license plate. F. license plate images are stretched and deformed in a width-to-height ratio of 2: 1.Edge and corner positioning parameters: Upper left:-275.0; 76.7. Upper right: 456.7; -71.7. Bottom left: -230.0; 394.2. Bottom right: 479.2; 210.8. G. frame averaging. H. Adjust the brightness and contrast of the processing results, and sharpen the edges
CJ33AL	1. Used corrective perspective around the license plate. 2. Applied local stabilization using the license plate as the planar object. 3. Cropped around the plate. 4. Applied unsharp mask 5. Applied levels adjustment 6. Used Add Text filter using \$POSITIONFRAMES macro to label each frame # starting with 0. 7. Exported out as MP4 with h264 encoding. 8. Selected Frames 149, 155, and 158 to export out as single TIF images. Technique 2 1. Scrubbed through video and removed frames with strong levels of blur 2. Applied perspective stabilization around the license plate. 3. Frame averaged. 4. Levels adjustment 5. Sharpening 6. Correct perspective 7. Exported out as TIF image.
CRD6VM	Video rotated 180 degrees. Perspective correction used to correct license plate. Local stabilization applied using license plate as area of interest. Video cropped to area of interest. Smart Adjust (Mode: Equalization, Strength: 8, Edge Threshold: 2). Smart Resize (2x, Warped Distance). Annotation added showing position in frames. 2 .tif images exported. 1 video file exported (.mp4/h264/visually lossless)
DBZD7M	My first step was to use Adobe Photoshop version 25.6.0 to align the frames of the video (stabilization). To do that I needed to extract the frames of the video and import them as images. FFMPEG version 4.4.1 was used to do this. The command ffmpeg -i VideoMaterial.MOV frame-%03d.png was used to export all of the frames of the video as PNG image files. Because the license plate was only ever shown in the lower right quadrant of the video, I also used FFMPEG to crop the frames before importing them into Photoshop using the batch file shown below. This cropping will reduce the processing demand for frame alignment (excluding a large amount of data irrelevant to achieving stabilization of the license plate). Next I imported these cropped PNG images into Photoshop as a "stack". Once the frames were loaded as layers, all layers were selected and Auto-Align Layers was applied. Once Photoshop completed processing, the frames (layers) were aligned. A sample frame is shown below, illustrating how stabilization is achieved. Finally, the layers were exported again as frames to be loaded into Amped Five (build 31095). Trim Layers must be deselected. Finally, Amped Five reloads this cropped and aligned frames as a "sequence". The entire Amped Five "chain" (process) is reproduced below with annotations. This shows every step taken, in order, along with the relevant settings in each case. The Amped Five chain produced a MP4 video titled result.mp4. I exported frame zero, frame 150 and frame 158 as the clearest frames (two of which also happen to be based on iframe data). These notes should enable someone to duplicate the result achieved here.
DJW977	Amped FIVE

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
EDKJ6A	Used Amped FIVE for both the video and stills enhancement when ever files were copied / transferred Tera copy was used to ensure that file integrity was maintained. under Ampred FIVE I used the following filters to enhance the video. Video Loader: Loads a video from file. Rotate: Rotates the image. Local Stabilization: Stabilizes a shaking video by keeping the current selection steady. The object of interest must be present in all frames. Supports different stabilization modes. Correct Perspective: Corrects the perspective of a plane of interest within the image (image rectification). Aspect Ratio: Corrects the aspect ratio of a video. Crop: Crops a region of interest of the image. Local Stabilization: Stabilizes a shaking video by keeping the current selection steady. The object of interest must be present in all frames. Supports different stabilization modes. Unsharp Masking: Sharpens the image using an unsharp masking filter. Levels: Adjusts intensity and color levels. Resize: Resizes the image. Annotate: Draws annotations over the image. Video Writer: Writes the current video to a file. For the still image enhancement I used the following Ampd FIVE filters Video Loader: Loads a video from file. Rotate: Rotates the image. Local Stabilization: Stabilizes a shaking video by keeping the current selection steady. The object of interest must be present in all frames. Supports different stabilization modes. Correct Perspective: Corrects the perspective of a plane of interest within the image (image rectification). Aspect Ratio: Corrects the aspect ratio of a video. Crop: Crops a region of interest of the image. Local Stabilization: Stabilizes a shaking video by keeping the current selection steady. The object of interest must be present in all frames. Supports different stabilization modes. Unsharp Masking: Sharpens the image using an unsharp masking filter. Levels: Adjusts intensity and color levels. Resize: Resizes the image. Image Writer: Writes the current image to a new file. For a more indepth look at settings of the filters i have used i included a Amped Five report with each product. [Report was not included here.]
FKZPEL	1. Download files and verify hash values. 2. Extract working copy of file. 3. Adobe Premiere Pro (version 24.5.0) used to crop the video and apply Warp Stabilizer effect to video (No motion, position/scale/rotation, stabilize only, detailed analysis). 4. Export processed video as a sequence of bmp still images (159 images). 5. Adobe Photoshop (version 25.9.1) used to apply Perspective Warp to images (pinned near each of the four corners of the license plate, on the same plane, undistorted and adjusted to approximate 2:1 ratio). 6. Save processed images as tif still images (159 images). 7. Adobe Premiere Pro used to compose video from still images on a 1920x1080 canvas, crop video, and add text annotation near bottom right corner of video frame to indicate the frame number for each image throughout the duration of the video. 8. Export video as an .mp4 video using H.264 encoding as requested Note: The above sequence and methods are accepted under our Standard Operating Procedures. It was not indicated that exact frame timing was of concern in the final video, so the video to still image to video process is acceptable in this scenario. All intermediate file saving was completed using lossless formats to ensure that image quality was maintained throughout the process. 9. One frame (annotated frame number 150, I-frame in original video) was exported from the processed video. 10. Axon Investigate (version 4.1.1) was used to mark and export one frame (frame number 150, I-frame in original video) and a sequence of still images (Frames 140-156). 11. The individual frame (150) was processed using Adobe Photoshop to apply levels adjustments, transform the image (stretched horizontally), apply unsharp mask adjustments, and enlarge 300% (bicubic). 12. The still image sequence (140-156) were processed using Adobe Photoshop to frame average, transform the image (stretched horizontally), and apply levels and unsharp mask adjustments. 13. Results of processing include one processed video file, one still image from the processed video file, and two processed still images from the original video file
GJLF2E	Utilized Amped FIVE software for clarification purposes. Video Loader, File Info, Hash Code, Rotate, Correct Perspective, Global Stabilization, Crop, White Balance, Levels, Automatic Color Equalization, Add Text, Video Writer - Writes the current video to a file. Image Writer - Writes the current image to a new file. Image Writer - Writes the current image to a new file. Image Writer - Writes the current image to a new file.

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
GWBEV3	<p>- Confirm Hash of downloaded .zip file from CTS. - Transfer to workstation and confirm hash again. - Extract .mov file from .zip file and hash, create working copy and confirm hash. - Ingest into Amped FIVE forensic analysis software. Hardware/Software Specs: Software version info: Build date: 20240711 Revision: 34212. Platform: Operating System: Microsoft Windows, 64 bit CPU Model: Intel(R) Xeon(R) Silver 4114 CPU @ 2.20GHz. - Interrogate media file, and answer questions 1.1 to 1.6. - Visual review of video. Note: at the end of the video there are more consecutive stable frames than in other sections of the video. - Perform processing according to test instructions. Three different processes were performed: 1. Enhancement 1: - Rotate: Multiple of 90 degree angle simply transposes the original pixel values. Parameters: Angle: 180 Rotation angle. Interpolation: Nearest. Background Color: #000000. - Correct Perspective: correct license plate area to become parallel to the lens with 2:1 aspect ratio. Parameters: Source Points: 1383, 896 - 1416, 921 - 1415, 984 - 1382, 954 Quadrilateral to transform into a rectangle. Target Selection: x: 1295, y: 896, w: 178, h: 89 Target rectangle to map the source points to. - Local Stabilization: stabilize the shaky license plate area by shifting the frames horizontally and vertically. Parameters: Background Color: #000000 Color used to fill the area outside the original image. Selection: Static Tracking Reference Selection(s) 0: x: 1372, y: 716, w: 246,h 202. - Crop: crop the image to contain the license plate area only. Parameters: Selection: x: 1376, y: 749, w: 242, h 145. - Levels: adjust intensity and color levels to contain the full range of available values. Parameters: Value: 224, 112, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the grayscale converted image. Red: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the red channel of image. Green: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the green channel of image. Blue: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the blue channel of image. Selection: Whole Image. - Contrast: increases the difference between lighter and darker areas. Parameters: Contrast: 20 Extends the intensity difference among pixels (linear gain). Selection: Whole Image. - Unsharp Mask: sharpen. Parameters: Strength: 1 Intensity of the sharpening effect: larger values provide increasing amounts of sharpening. Size: 15 Length, in pixels, of the side of the square filter window. Threshold: 0 Selection: Whole Image. - Range selector: selecting only a specific range of frames in the video. Parameters: First Frame: 140 Last Frame: 157. - Super Resolution: obtain a single higher resolution image by merging pixel information of all frames, Parameters: Zoom: 2 Zoom factor for the output image. Iterations: 10 Number of deblurring steps. Selection: x: 0, y: 0, w: 0, h: 0 Region of the image to optimize. - Annotate: draw information over the bottom of the image for output. Parameters: Annotation Tool: Text ("Super Resolution of enhanced Frs 140-157")Colors: Text #FFFFFF• , Background #000080• , Border None (Center: [239, 266], Rotation: 0°, Width: 477px, Height: 50px - Image Writer: write the current image to a new file Parameters: File: . . . /VideoMaterial_A5_Enh1_Frs140to157_SupRes.tif 2. Enhancement 2: - Rotate: Multiple of 90 degree angle simply transposes the original pixel values. Parameters: Angle: 180 Rotation angle. Interpolation: Nearest. Background Color: #000000 - Correct Perspective: correct license plate area to become parallel to the lens with 2:1 aspect ratio Parameters: Source Points: 1383, 896 - 1416, 921 - 1415, 984 - 1382, 954 Quadrilateral to transform into a rectangle. Target Selection: x: 1295, y: 896, w: 178, h: 89 Target rectangle to map the source points to. - Local Stabilization: stabilize the shaky license plate area by shifting the frames horizontally and vertically. Parameters: Background Color: #000000 Selection: Static Tracking Reference Selection(s) 0: x: 1372, y: 716, w: 246, h: 202 - Crop: crop the image to contain the license plate area only Parameters: Selection: x: 1376, y: 749, w: 242, h: 145 - Resize: enlarge the image, Parameters: Size: 484, 290 Size of output image in pixels. Interpolation: Nearest - Levels: adjust intensity and color levels to contain the full range of available values Parameters: Value: 224, 112, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the grayscale converted image. Red: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the red channel of image. Green: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the green channel of image. Blue: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the blue channel of image. Selection: Whole Image - Contrast: increases the difference between lighter and darker areas Parameters: Contrast: 20 Extends the intensity difference among pixels (linear gain). Selection: Whole Image - Unsharp Mask: sharpen Parameters: Strength: 1 Intensity of the sharpening effect: larger values provide increasing amounts of sharpening. Size: 15 Length, in pixels, of the side of the square filter</p>

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
	<p>window. Threshold: 0 Selection: Whole Image - Range selector: selecting only a specific range of frames in the video Parameters: First Frame: 140. Last Frame: 157 - Frame Averaging: reduce noise by creating a single image which is the average of all frames - Annotate: draw information over the bottom of the image for output Parameters: Annotation Tool: Text ("Frame Average of enhanced Frs 140-157") Colors: Text #FFFFFF• , Background #000080• , Border None (Center: [242, 266], Rotation: 0°, Width: 484px, Height: 50px) - Image Writer: write the current image to a new file Parameters: File: . . . /VideoMaterial_A5_Enh2_Frs140to157_FrAvg.tif 3. Enhancement 3: - Rotate: Multiple of 90 degree angle simply transposes the original pixel values. Parameters: Angle: 180 Rotation angle. Interpolation: Nearest. Background Color: #000000 - Correct Perspective: correct license plate area to become parallel to the lens with 2:1 aspect ratio Parameters: Source Points: 1383, 896 - 1416, 921 - 1415, 984 - 1382, 954 Quadrilateral to transform into a rectangle. Target Selection: x: 1295, y: 896, w: 178, h: 89 Target rectangle to map the source points to. - Local Stabilization: stabilize the shaky license plate area by shifting the frames horizontally and vertically. Parameters: Background Color: #000000 Selection: Static Tracking Reference Selection(s) 0: x: 1372, y: 716, w: 246, h: 202 - Crop: crop the image to contain the license plate area only Parameters: Selection: x: 1376, y: 749, w: 242, h: 145 - Resize: enlarge the image Parameters: Size: 968, 580 Size of output image in pixels. Interpolation: Nearest. - Levels: adjust intensity and color levels to contain the full range of available values Parameters: Value: 224, 112, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the grayscale converted image. Red: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the red channel of image. Green: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the green channel of image. Blue: 255, 127, 0 Highlights, Midtones and Shadows settings used to map the pixel values of the blue channel of image. Selection: Whole Image - Contrast: increases the difference between lighter and darker areas Parameters: Contrast: 50 Extends the intensity difference among pixels (linear gain). Selection: Whole Image - Unsharp Mask: sharpen Parameters: Strength: 1 Intensity of the sharpening effect: larger values provide increasing amounts of sharpening. Size: 15 Length, in pixels, of the side of the square filter window. Threshold: 0 Selection: Whole Image - Annotate: draw information over the bottom right of the image for output Parameters: Annotation Tool: Text ("Original Frame Number: \$ORIGINALPOSITIONFRAMES") Colors: Text #FFFFFF• , Background #000080• , Border None from frame 0 (Center: [726, 555], Rotation: 0°, Width: 484px, Height: 50px) to frame 158 (Center: [688, 555], Rotation: 0°, Width: 560px, Height: 50px) - Video Writer: write current video to a file Parameters: File: . . . /VideoMaterial_A5_Enh3.mp4 Container and Video Codec: mp4 - H264 Audio Codec: None Frame rate: 29.9700 Quality: Visually Lossless - Image Writer: write an image of the current first video frame to a new file Parameters: File: . . . /VideoMaterial_A5_Enh3_iFr000.tif. [Participant submitted data in a format that could not be reproduced in this report].</p>
HNZDA2	<p>Processing done in Amped Five. A corrective perspective was made to select the area of the license plate more rectangular. The video was then rotated -90 bicubic so it would not appear upside down. Local stabilization using static tracking was applied to reduce camera shakiness. A crop was applied to just show around the license plate area. A grayscale conversion was applied to remove color noise. The levels was applied to adjust contrast. The unsharp mask was applied to increase sharpness. Annotate was used to display frame numbers. Exported images saved as TIFF. The Amped Five report was included to show exact settings. [Report was not included here.]</p>
HVA2KE	<p>Using Amped FIVE. Video was rotated 180 degrees. Local Stabilization applied. Perspective correction to correct for distortion in plate. Additional Stabilization applied. Cropped to area of plate. Adjusted contrast and brightness using Smart Adjust. Resized the video to 2X using Smart resize. Added frame count to each frame starting at 0, ending at 158. Exported H.264 MP4 file for distribution. Exported Frame "0" as Tiff</p>

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
J8J2UD	Transferred 'VideoMaterial' video file from O'Drive to Edit 4 via writeblocked Codec 4. Extracted file contents (mov video). Imported file into Amped via 'Video Loader'. Per OIC request created two pieces of material: video with frame numbers and still image (both enhanced). Video Enhancement – AMPED FIVE - Video Loader (colour range full; - Rotate; - Correct Perspective; - Perspective Stabilisation (Local Stabilisation of planar objects, capable of tracking perspective transformations). - Cropped; - Frame Numbers added as text; - Levels Filter (intensity and colour levels); - Export: MP4, H264, Visually Lossless via video writer. Image Enhancement – AMPED FIVE: - Video Loader (colour range full), - Rotate, - Correct Perspective, - Perspective Stabilisation (Local Stabilisation of planar objects, capable of tracking perspective transformations). – Cropped, - Range Selector (For frames), - Frame Averaging, - Levels Filter (intensity and colour levels), - Export: PNG via Image WriterVideo. Full Amped Report saved in casework. Exported video (MP4, H264, Visually Lossless) and image (PNG). Video and Image MD5 hashed separately and each burnt onto separate DATA CDs using Epson TDM. Verified hashes. Video file exhibited as JS0188-1 on 08/08/24 15:00. Image file exhibited as JS0188-2 on 08/08/24 at 15:00. Digital copy of work provided to proficiency testing company, alongside questionnaire responses and Amped enhancement report. Enhanced video not converted through Adobe Premiere - as not required to be uploaded to DAMS. Questionnaire responses completed on word document. JS0188/1 - Processed video from clip 'Video Material.MOV' JS0188/2 - Processed still image from clip 'Video Material.MOV'
JZNYT2	1. Rotate the image by 180 degrees using the Rotate filter. 2. Set the least shaken interval of the video using the Range Selector. 3. Stabilize the shake by specifying only the license plate number portion using the Perspective Stabilization filter. 4. Correct the perspective of the tilted license plate number using the Correct Perspective filter. 5. Improve the image quality by using Curve, Level and Unsharp Mask, etc. filters. 6. Mark the frame in the upper right corner using the Text tool of Amped Five. 7. Verify and save the results using the Frame Average filter. 8. Unenable the Frame Average filter and render the final result of the video as MP4(H.264 Codec) Container.
KV8Q63	Zip File containing enhanced video and images of license plate (MD5 hash value: 55da4acfe8c4289d6f2e3ffccf7a5331). Methods/Tools: Amped FIVE Revision: 33279 As per the "Part 2:Video Enhancement Instructions, Task D: Conduct a video enhancement of the license plate in the cropped version" The settings for the video enhancement of the license plate in the cropped version using Amped FIVE Revision: 33279 are as follows: Resize Parameters: Size: 334, 220 (Width, Height) Size of output image in pixels. Zoom: 2 Interpolation: Bicubic Interpolation algorithm used when the image is resized. Unsharp Masking Parameters: Strength: 0.5000 Size: 99 Threshold: 0 Mode: Intensity Selection: Whole Image Contrast Brightness Parameters: Contrast: 25 Brightness: 17 Mode: Linear Selection: Whole Image Levels Parameters: Value: (Highlights: 234, Midtones: 104, Shadows: 0) Red: (Highlights: 255, Midtones: 127, Shadows: 0) Green: (Highlights: 255, Midtones: 127, Shadows: 0) Blue: (Highlights: 255, Midtones: 127, Shadows: 0) Selection: Whole Image [Participant submitted data in a format that could not be reproduced in this report].
LNKKHF	Used AmpedFive for the following: Rotate 180 degrees, correct perspective, stabilization-local stabilization with dynamic tracking, crop, adjust levels, unsharp mask, presentation-annotate for applying frame numbers, writer for video and still frames

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
LVHCQA	-The video file VideoMaterial.MOV was opened in Cognitech Video Investigator Release 64 build 7.0. -Video was rotated 180 degrees with Mirror Image. Position 4 Glyphs on the 4 corner of the plate and repositioned on each 159 frames. -Used the Rectification function (adjusted the video with Horizontal stretch to desired effect). Executed with Map to window center. - Position 4 Glyphs on the 4 corner of the plate and repositioned on each 159 frames. Executed Velocity with manual matching. - Performed Stabilization Reconstruction. -Using the select tool selected area of the video clip with the plate centered. Performed the Translational Crop function left 624 top 250 right 1277 bottom 762. - Executed Velocity with correlation matching (translational only). - Performed Motion deblur Wiener parameters with motion scale 100%. - Performed Sharpen with Sharpness at 1.0 and Radius at 1.5. - Exported Video clip as .avi file at 30 fps. - Open .avi file in Ominivore Viewer 3.4 and export all frames as BMP files with Overlay frame counter. - Open BMP files as movie in Cognitech Video Investigator Release 64 build 7.0. Exported as .avi file at 30 fps. - Open .avi file in Ominivore Viewer 3.4 and exported video clip as Lossless H264 MP4. Final frames.avi_lossless.mp4 (654 x 513). - Choose frames/BMP files 151, 152 and 153 for final representation of plate.
M23ULW	AMPED FIVE - Rotate (180°), - Correct Perspective, + Source Points (P1: 1407:833 ; P2: 1436:856 ; P3: 1435:913 ; P4 1404:885), + Output Selection (x: 1415 ; y: 859 ; w: 110 ; h: 55), Perspective Stabilization (Hybrid Tracking), + Settings (P1: 1384:911 ; P2: 1423:814 ; P3: 1721:632 ; P4: 1735:933, - Crop, + Selection (x: 1299 ; y: 788 ; w:352 ; h: 176), - Turbulence Deblurring, + Settings (Strength: 1.5453 ; Noise: 0.2907), - Unsharp Masking, + Settings (Strength: 0.2 ; Size: 43 ; Threshold: 20), - Automatic Color Equalization, + Settings (Method: Global ; Strength: 3.2), - Resize, + Zoom 1.5 Lanczos
MM3TAV	steps are shown in the uploaded report by amped software. [Report was not included here.]
N48MEA	Amped FIVE 20240711 Revision 34212, x64. Medex 2.167 Reference Library Version: 2.2.132. FFprobe 4.2.2, x64. MedialInfo 24.06, x64. In AF, imported VideoMaterial.MOV to complete Part 2 of proficiency test as per the test providers instructions. The following filters/processed were applied to VideoMaterial.MOV in Amped FIVE: Rotation - the canvas needed to be rotated 180. Crop - reduced the canvas size as the AOI is the license plate. Utilizing the following filters to clarify the recording: levels, contrast/brightness, and smart adjust. Perspective Stabilization: Applied the filter to the four corners of the license plate. Correct Perspective: Corrected the perspective of the license plate. Averaging filter: Removed a small amount of noise. Laplacian Sharpening filter: Sharpened the recording. Annotate: As per the instructions from CTS, added a macro to display the frame number during playback. Added frame number macro to lower right corner of recording. As per the instructions from CTS, exported the recording in a MP4 container with H264 encoding as 24-5581_Clarified.mp4.
NJMLLV	Please see the uploaded Amped 5 Report for all methods/tools utilized (CTS24-5581_AmpedFIVEreport_[Name]). [Report was not included here.]
NQHNM8	Adobe Premiere Pro. Corner Pin Filter: Upper Left = -516.0, -12.0, Upper Right = 2414.0, 113.8, Lower Left = -512.0, 740.6, Lower Right = 2414.0, 1121.9. Warp Stabilizer: Result = Smooth Motion, Smoothness = 50%, Method = Position, Scale, Rotation, Framing = Stabilize, Crop, Autoscal, Additional Scale = 100%. Crop: Left = 78.0%, Top = 56.0%, Right = 0.0%, Bottom = 0.0%. Motion: Position = -1277.0, -198.0, Scale = 300, Rotation = 0.0, Anchor Point = 960.0, 540.0, Anti-flicker Filter = 0.00. Levels: RBG Channels Input Levels = 44,1.00,192, Output Levels = 0,255. Timecode: Position 123.0, 988.4, Size = 15.0%, Opacity = 40.0%, Format = Frames, Timecode Source = Clip, Offset = 0. Export Settings: File Name = VideoMaterial_Adjusted.mp4, Format = H.264, Video Frame Size = Full HD (1920x1080), Video Frame Rate = 29.97, Video Field Order = Progressive
NQZUMX	Utilized AMPED5 software to examine the video. The rotate, correct perspective tool, local stabilization tool were used to better view the license plate. The crop tool, add text for frame numbers, frame averaging tool, sharpen tools, contrast brightness, exposure and levels tools were used for video enhancement to obtain a clearer image of the license plate. Used the video writer and image writer in AMPED5 to export the product files.

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
P3V8K9	Software used: Amped FIVE 31095. Clarification Steps: Rotate/Angle: 180/Resize Image to Fit: true/Interpolation: Bicubic/Background Color: #000000. Correct Perspective/Source Points: 1383, 899-1413, 921-1412, 982-1382, 952/Target Selection: x:870, y:495, w:180, h:90. Local Stabilization/Background Color: #000000/Selection: Static Tracking, Reference Selection(s) 0: x:918, y:288, w:308, h:283. Crop/Selection: x:839, y:247, w:489, h:371. Deblocking/Strength: 2/Selection: Whole Image. Contrast Brightness/Contrast: 20/Brightness: 20/Mode: Linear/Selection: Whole Image. Levels/Value: 235, 110, 10/Red: 255, 127, 0/Green: 255, 127, 0/Blue: 255, 127, 0/Selection: Whole Image. Unsharp Masking/Strength: 0.2000/Size: 21/Threshold: 0/Mode: Intensity/Selection: Whole Image. Add Text/Text: \$POSITIONFRAMES/Text Style: 'segoe ui'20 windows-1252, #FFFFFF, Left, Bottom/Background Color: #000000/Background Shape: Selection/Selection: Whole Image. Video Writer/Container and Video Codec: mp4-H264/Audio Codec: none/Frame rate: 29.97/Quality: Visually Lossless/HW Acceleration: None. Sparse Selector/Frames: 0, 150. Sequence Writer/Format: Bitmap/First Frame Number: 0/Image Filename: 24/5581 Clarified Image/Write Image Sequence PDF: false. [Participant submitted data in a format that could not be reproduced in this report].
PFWY4R	all methods are clarified in the report with steps. [Report was not included here.]
PXEYWA	6/24/2024 at 11:03am I was emailed from CTS Lab Account Invite. 6/24/2024 11:04 am I was emailed from [Name] with further instruction on the proficiency testing process. 6/24/2024 11:22 am I completed the first step to create a account with CTS. 6/24/2024 11:31 am I completed the second step joining the group. 6/24/2024 11:39 am [Name] sent me an email advising me that he assigned the test. 6/24/2024 11:46 am I downloaded the zip file from the test. 6/24/2024 11:50 am I started to complete the Hash verification of the zip file, unzipped original, and unzipped copy of the original. 7/17/2024 8:45am Took the copy of the original and placed it into AMPED FIVE. Completed: Video Loader, File Info, Hash Code, Rotate, Correct Perspective, Global Stabilization, Crop, Levels, Automatic Color Equalization, Add Text. 8-9-2024 at 9:28am Started back working on the case and opened project in AMPED FIVE. Completed: Video Writer – mp4 H264, Image Writer on the three best images of the suspected plate, Exported the Report from AMPED FIVE.
Q8K8C9	Tools: Amped FIVE Build Date 20240416, Revision 33279. Settings: Rotate, Correct Perspective, Global Stabilization, Local Stabilization, Crop, Resize, Levels, Unsharp Masking, Add Text, Video Writer, IFrames Selector, Sparse Selector, Sequence Writer.
QXTL8W	Source file imported into Adobe Premiere Pro: Video Motion > Position 1165/614, Scale 500 Video Effects > Distort > Corner Pin - Upper Left -4620/0, Upper Right 2030/329, Lower Left -5915/1432, Lower Right 2379/1519 Video Effects > Distort > Warp Stabiliser - Stabilisation: No Motion, Method: Subspace Warp Clip > Field Options > Flicker Removal Lumetri Color: Auto Video Effects > Video > Metadata & Timecode Burn-in > Size 15%, Opacity 100%, Metadata: Clip Timecode, Position 29/110, Size 100%, Format: Frames, Offset 00:00:00:00
REFN4Q	Tools used: FFmpeg (version 6.6.1), Python 3.8.10, opencv-python (version 4.6.0.66), numpy(version 1.24.4), VISystem(version 5.0.0), Photoshop (version 23.4.1). Processes: 1. Extracted frames from VideoMaterial.mov using FFmpeg. 2. Did a perspective transformation on all the frames using a python program. The width-to-height ratio of the license plate was set to be 2:1. 3. Conducted a video stabilization using VISystem. The license plate area was designated as the ROI and the stabilization process was repeated 3 times to get a fine alignment. 4. Cropped around the license plate using VISystem. 5. Made adjustments on the frames using the Camera Raw Filter in Photoshop (Exposure: +0.6; Whites: +45; Clarity: +40; Dehaze: +30). Used Levels adjustment in Photoshop to correct the tonal range and color balance of the frames ( Midtone: 0.75; R channel: 0,161; G channel: 0,164; B channel: 0,155). 6. Overlaid the frame numbers as text near one of the upper left corner of the video using a python program. 7. Converted the result images into a video named Result.mp4 using FFmpeg (-c:v libx264 -r 3 -pix_fmt yuv420p).

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
RF9GYA	Two images were taken from the video done with enhancements and perspective correction requested for the test. The images are named VideoMaterial134 and VideoMaterial155. Another still image was made from frame averaging frames 0, 60, 150, 156 and 158. The frame averaged image was opened in photoshop and cropped, Camera Raw Filter was used, resized to 200% using nearest neighbor, Unsharp mask was applied to the Lightness layer of a LAB image and changed back to RGB. The image name is Multiple_FA_NoPerspCorr. Between the two different approaches on the images, approximately five of the seven characters on the license plate can be determined. Video Enhancement – Methods and tools Lumetri Color in Adobe Premiere Pro was used for the enhancements. Light and RGB Color / Curves was used in the enhancement process. 1. Warp Stabilizer was used in Adobe Premiere Pro v24.5.0. The settings used are as follows. A. Result – No Motion, Method – Subspace warp, Borders/Framing – Stabilize, Crop, Auto-Scale. 2. The image was then cropped using the following settings. A. Left – 70%, Top – 78%, Right – 20%, Bottom – 4%, Edge Feather – 0. 3. The enhancement was performed using the below listed Lumetri Color Settings. A. Basic Correction settings. Color – no changes, Light – Exposure – (0.8), Contrast – (19.6), Highlights – (0), Shadows – (6.3), Whites – (9.8), Blacks (-16.1). B. Curves. 4. Frame numbers were added using metadata & Timecode Burn-in. A. Size 15%, Opacity 40%. B. Line 1 – Position – 1450.0-720.0. C. Size – 100%. D. Format – Frames. E. Offset – 00;00;00;00. 5. All frames were exported (once before enhancements and again after enhancements were made. 6. The enhanced frames were taken into photoshop and a "Perspective Warp" transform was done to change the perspective of the license plate. An action was created and the same action was applied to all remaining frames. 7. The perspective corrected frames were brought into Premiere Pro as a sequence, dropped on the timeline and an MP4 of the stabilized, perspective corrected video was exported. 8. Three of the better frames were saved to turn in for the proficiency test.
RQ6K34	The video was enhanced using Amped FIVE. The following processes/filters were applied to video: -correct perspective, -rotate (-90), -perspective stabilization, -crop (x: 810, y: 467, w:133, h:71), -curves (x:0, y:0)(x:89, y:155)(x:255, y:255), -unsharp masking (strength: 0.23, size: 49, threshold: 0), -resize (output: 266x142), -add text (frame numbers). Exported video as a lossless mp4. Exported frame 158 as a bmp. Applied frame averaging to frames 149-158. Exported averaged frame as a bmp. Additional software settings are retained in my technical notes; however, they seemed excessive to include in this form.
RZEPFU	load video-rotate-correct perspective-local stab.-crop-laplacian sahrp-contrastbrightness-addtext. we used amped five

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
T9PB33	<p>Opened the exhibit file labelled "VideoMaterial.MOV" in Amped FIVE (revision 34212). Created four chains using the MOV so that different processes could be attempted. Added the File Info and Hash Code filters to all three chains. The video has been rotated 180 degrees. Used the Rotate filter to correct the rotation on all chains. On playback video is jittery. The car is stationary, but the video appears to be affected by vibrations. The car is parked at an angle to the camera so that the registration plate is not clear. The footage is recorded during the day in colour however the car is in shadow. The registration plate is still visible. The Amped FIVE report contains detailed information of the filters used. As per the instructions the following processes were applied: Chain 1 - Correct Perspective filter was used to correct the perspective of the registration plate and make it appear that it was more front on with the camera. The IFrame Selector filter was used to show only the I frames in the footage. Perspective Registration was added to align the perspective of the I frames. The footage was cropped to focus on the registration plate. The Smart Resize filter was used to zoom the cropped selection while keeping the aspect ratio. Smart Adjust was used to improve the contrast of the image. The Add Text filter was used to add the original frames of the video to the bottom right corner starting at frame 0. Used the Image Writer to export two frames of the footage as still images in PNG format. Used the Video Writer to export an MP4 video with H264 codec at the original FPS. Used the Video Writer to export an MP4 video with H264 codec at 2 FPS to slow the footage down. Chain 2 – Correct Perspective filter was used to correct the perspective of the registration plate and make it appear that it was more front on with the camera. The Range Selector was added to select a range of frames where there was less movement in the video. The Perspective Stabilisation filter was added to stabilise the footage and correct for the vibrations. The footage was cropped to focus on the registration plate. The Smart Resize filter was used to zoom the cropped selection while keeping the aspect ratio. The Parametric Curves filter was used to adjust the lights, darks, and shadows in the image to assist with edge definition of the characters. The Add Text filter was used to add the original frames of the video to the bottom right corner starting at frame 0. Used the Image Writer to export two frames of the footage as still images in PNG format. Used the Video Writer to export an MP4 video with H264 codec at the original FPS. Used the Video Writer to export an MP4 video with H264 codec at 2 FPS to slow the footage down. Chain 3 – Correct Perspective filter was used to correct the perspective of the registration plate and make it appear that it was more front on with the camera. The Perspective Stabilisation filter was added to stabilise the footage and correct for the vibrations. Perspective Super Resolution was used to create a single image by merging all frames from the video once stabilised. The footage was cropped to focus on the registration plate. The Smart Resize filter was used to zoom the cropped selection while keeping the aspect ratio. The Parametric Curves filter was used to adjust the lights, darks, and shadows in the image to assist with edge definition of the characters. The Add Text filter was used to add the original frames of the video to the bottom right corner starting at frame 0. Used the Image Writer to export the image in PNG format. Chain 4 - Correct Perspective filter was used to correct the perspective of the registration plate and make it appear that it was more front on with the camera. The Range Selector was added to select a range of frames where there was less movement in the video. The Perspective Stabilisation filter was added to stabilise the footage and correct for the vibrations. Perspective Registration was added to align the perspective of the available frames. The Parametric Curves filter was used to adjust the lights, darks, and shadows in the image to assist with edge definition of the characters. The footage was cropped to focus on the registration plate. The Smart Resize filter was used to zoom the cropped selection while keeping the aspect ratio. The Add Text filter was used to add the original frames of the video to the bottom right corner starting at frame 0. Used the Image Writer to export two frames of the footage as still images in PNG format. Used the Video Writer to export an MP4 video with H264 codec at the original FPS. Used the Video Writer to export an MP4 video with H264 codec at 2 FPS to slow the footage down.</p>

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
TWCB7A	Amped FIVE software was used. Build date: 20231018. Revision: 31095. 1. Rotate: The video was rotated by 180 degrees, with bicubic interpolation. 2. Correct Perspective: Based on Frame 158: a. The approximate four corners of the front licence plate ((1384, 901), (1412, 923), (1411, 979), (1382, 952)) were selected to correct for the perspective of the front licence plate. b. As the resulting target selection had a height of 80 pixels, the width of the resulting target selection was changed to 160 pixels before centering the selection ((880, 500), width: 160 pixels, height: 80 pixels). 3. Perspective Stabilization: The front of the car ((986, 312), (1418, 345), (1418, 510), (986, 488)) was selected for stabilisation based on perspective, hybrid tracking (which compared the current frame with both the first and the previous frame) and bicubic interpolation. 4. Crop: The video was cropped to the region of interest around the front licence plate ((854, 284), width: 480 pixels, height: 255 pixels)). 5. Levels: The levels of the video were adjusted, with highlights of 200, midtones of 105 and shadows of 10 for value. 6. Contrast Brightness: The contrast and brightness of the video were both adjusted to 35, using the linear mode. 7. Add Text: The frame number was added to the lower right corner of the video. 8. Video Writer: The final product was saved as a .mp4 file, with H264 video codec, a frame rate of 29.9700 frames per second and visually lossless quality. 9. Sparse Selector: Three frames (0, 149 and 155) were selected to represent the clearest images of the front licence plate. 10. Sequence Writer: The above three frames were saved as .png files.
TXJT46	Amped FIVE software was utilized for all steps with this request: Rotate the file 180 degrees to proper orientation. Correct perspective of a plane of interest within the image to the following settings: <ul style="list-style-type: none"> <li>• Source Points: 1406, 831 - 1437, 855 - 1436, 915 - 1404, 883. Quadrilateral to transform into a rectangle.</li> <li>• Target Selection: x: 859, y: 469, w: 171, h: 146. Target rectangle to map the source points to. Local Stabilization - stabilized to the license plate. Crop - cropped to the area of interest of the license plate. Levels- adjust intensity and color levels to the value of 122, 77, 32. Resize - enlarge the image to 586x488. Add Text- Add the frame numbers to corner as requested</li> </ul>
U8M2LQ	[Participant did not complete the enhancement section]
V2X39M	Test documentation was reviewed and a subfolder containing VideoMaterial.MOV was downloaded. The item was archived according to laboratory policy and verified via hash. A working copy was also created and verified with a hash value comparison. Amped FIVE was used to review the file properties, observe the recording and video/image clarification. The following filters were applied: <ul style="list-style-type: none"> <li>• Rotate; 180</li> <li>• Corrective perspective by using four corners of license plate</li> <li>• Aspect applied using noted ratio in instructions. Used measurement tool to confirm ratio was approximately 2:1.</li> <li>• Applied Global Stabilization (Maximum Shift: 50, Frames 29)</li> <li>• Crop to ensure license plate was visible throughout frames</li> <li>• Adjusted Brightness Contrast (Logarithmic, Contrast 15, Brightness 16)</li> <li>• Unsharp Masking (0.3600, 15, 0)</li> <li>• Added Text Marco to include page/frame number in upper left corner (0-158)</li> <li>• Video was saved as "MP4" format using H264 Codec with visually lossless quality (Video Writer)</li> <li>• Used Bookmarks to select 7 best clarified frames. Narrowed down to 3 best frames. Saved as TIF Format.</li> <li>• Work product was archived according to laboratory procedures and verified. Files for upload: <ul style="list-style-type: none"> <li>• [Lab]-24-0118_frame 149_clarified.tif</li> <li>• [Lab]-24-0118_frame 153_clarified.tif</li> <li>• [Lab]-24-0118_frame 158_clarified.tif</li> <li>• [Lab]-24-0118_Video_Clarified.mp4</li> </ul> </li> </ul>

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
VCGJZT	Amped Five version 22997 was used for the submitted work. For the Video file and stills A and B the below process was used. The video was rotated through 180 degrees to display correctly. Correct perspective filter was applied. Perspective stabilisation was applied, nearest neighbour interpolation was used. Crop to area around license plate, size 500 x 280. Frame position filter applied. Remove frames filter applied to remove poor quality frames interfering with tracking. Levels adjustment on histogram applied, highlights 149, midtones 83, shadows 18. Unsharp masking filter applied to sharpen image, strength 0.3400, size 99, threshold 0. Write the file as a Mp4, h264 encoded video file at 29.97 fps, visually lossless setting. The same method was applied with a write image filter used for stills A and B in Bitmap format. Still C - Frame averaged. The video was rotated through 180 degrees to display correctly. Correct perspective filter was applied. Sparse selector applied to select best frames for tracking. Perspective stabilisation was applied, bicubic interpolation was used for a smoother image. Frame average filter applied. Levels adjustment on histogram applied, highlights 114, midtones 57, shadows 0. Laplacian sharpen filter applied to define edges, strength 0.7600, mode=intensity. Crop to area around license plate size 455 x 277. Write file as a Bitmap
VKRLLU	Imported MOV file in to Amped FIVE (Revision: 33279) Used Rotate filter to rotated image by 180 decrease. Used Corrected Perspective filter to adjust the perspective of the license plate. Selecting the license plate, used Perspective Stabilization filter to stabilise the license plate. Used Crop filter to crop around the license plate. Sharpened the video using the Unsharp Masking filter. Selecting only the license plate area, used the White Balance filter. Used the Curves filter to lighten and increase the contrast of the video. Used the Add Text filter to overlay frame numbers in bottom left hand corner, starting with the first frame as 0. Exported as MP4 file with H264 video encoding. Exported frames 154 and 155 as PNG files. Amped FIVE report generated saved to project folder.
XDJYK6	2024 CTS Proficiency Test - Below is the process used to reach the requested video enhancements after examining the provided test material. Various forensic accepted software programs, which are available to the Forensic Imaging Unit, were used to export the requested test files. Video File – VideoMaterial.mov, 10.1 MB (10,622,916 bytes). Video Length 00:00:05 Seconds. MPEG Video (H264) 1920x1080, 29.97 fps, 16,016 kbps, yuv420p. Axon Investigate v.4.1.1: Examine video file and exported still images of full length of file – 159 frames TIF format. Explored options for perspective adjustments, stabilization, and exports. One still image capture used for final submission. Adobe Photoshop 2024 v.25.9.1: Imported video file to explore options for perspective adjustments, stabilization, and exports. Decided to crop video to area of interest, which is the front of the vehicle, verses stabilizing the whole video frame. Used Perspective Warp effect to obtain requested angle of license plate. Unable to export to MP4 file after effect applied. Exported video frames as layers with the effect applied. Still image captures of license plate enhanced with Levels 20-1.50-200. Adobe Premiere Pro 2024 v.24.5.0: Imported video file to explore options for perspective adjustments, stabilization, and exports. Unable to render desired perspective adjustment. Decided to import 159 still image layers (which was cropped to the front area of the vehicle and had Perspective Warp applied) from Photoshop files to create a video file for playback. Used Warp Stabilizer > No Motion > Perspective Scale > Stabilize Only > Detailed Analysis. Cropped tighter to license plate area, applied levels (16-1.82-200) adjustment and unsharp mask filter (64-8.0-0) Note: The above sequence and methods are accepted under our Standard Operating Procedures. It was not indicated that exact frame timing was of concern in the final video, so the video to still image to video process is acceptable in this scenario. All intermediate file saving was completed using lossless formats to ensure that image quality was maintained throughout the process.

TABLE 2

Question 2- 1 : Enhanced Video Examination	
WebCode	Response
XGLWVX	<p>** Cannot upload more than one file - enhanced video file selected - full outline of additional files included below ** Amped-FIVE video software utilised to perform enhancing process. Specs: Software version info - Build date: 20240711, Revision: 34212. Summary of processing tools utilised: &gt; Video Loader - Imported original provided video file "VideoMaterial.MOV." &gt; Rotate - Rotated the image 180 degrees. **NOTE this tool was used as the clip imported upside down** &gt; Correct Perspective - Corrected the perspective of the licence. The four corners of the licence used as source points. Width-to-height ratio of 2:1 achieved by stretching width to match the pixels of the height. (184w x 92h pixels). &gt; Local Stabilization - Static tracking, selection was around the licence plate area. &gt; Crop - Cropped so that licence occupies approximately middle 1/3rd of frame. Allowing buffer space around it. &gt; Levels - Adjusted midtones. &gt; Parametric Curves - Adjusted highlights, midtones, and shadow. &gt; Add Text - Added frame count as numbers in bottom right corner of frame. White text. &gt; Video Writer - Exported video file as H.264 MP4 named "Processed Video File". &gt; Image Writer - Exported frame 0 as PNG named "Frame Select 1". &gt; Image Writer - Exported frame 150 as PNG named "Frame Select 2"</p>
XV4PJ4	<p>1. ffmpeg =&gt; individual frames frame001.bmp - frame159.bmp, 2. Photoshop =&gt; perspective warp each frame squaring up plate and saved as jpg files, 3. ffmpeg =&gt; concatenate using ffmpeg -f concat -i files.txt -c copy output.mp4 where files.txt is a list of the changed perspective jpg files. 4. import output.mp4 into Premiere 5. Warp Stabilize filter with no motion, position/scale/rotation, stabilize/crop/autoscale. 6. Add Timecode effect with frame number next to plate. 7. Enlarge 372% and position the frame at -822 x -920. 8. Sharpen 40. 9. Adjust positioning of Timecode to lower left corner. 10. Export to VideoMaterial_enhanced.mp4 in H.264 format. 11. Selected Frame 156 from original individual frames from step 1. 12. Enhanced and cropped frame and saved it to frame156_crop_persp_b&amp;c.bmp</p>

**Question 2-1:** Note methods or tools used and settings for the video enhancement here.

**Consensus Result:** This was a free form question on methods and tools used. No consensus response expected.

# Forensic Video Enhancement Observations

## TABLE 3

**Part 2: Video Enhancement Instructions** - Perform the tasks listed below and provide an enhanced derivative video for review.

- A. Trim the video so it starts at frame 544 - the first frame of time stamp 04:22:35 PM, and ends at frame 1758 - the first frame of time stamp 04:23:56 PM.
- B. Adjust the frame rate so that it plays back as close to real time as possible.
- C. Crop the video in at least to the top right quarter of the frame. You can crop closer into the subjects if you want.
- D. Enhance/clarify the video. Use any methods or software tools deemed necessary to improve the viewers ability to see and or understand what is happening in the scene. Note the method or tools used and settings below
- E. Enlarge your new cropped video by 2x.
- F. Save your enhanced video in .mp4 format with a visually lossless or low constant rate factor (CRF).

WebCode	Observational Notes
2PMJBM	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. The output PNG image file for frame 139 appears to have undergone different or additional processing compared to the output MP4 file, when visually compared. No explicit mention of this different/additional processing is provided in the participant's notes.
2RNRFW	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
2XE2PV	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
37NQ4U	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step B observational note: Processing notes do not include evidence of stabilization. Step C observational note: Cropping was completed however, the entire license plate was not visible, as requested. Step F observational note: Review of the output MP4 video file revealed that frames 156 and 158 are missing (even though the participant provided a still image of frame 158). Step G observational note: The two exported images were provided in JPG format, which is not one of the three requested still image formats (PNG, BMP, or TIFF).
39RLMW	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Participant's notes indicate that two output MP4 files were produced but no MP4 files were provided in the participant's materials. Participant used a lens correction filter in an attempt to correct the perspective but the perspective did not appear corrected. Frame numbers were not overlaid for the output video file, as requested; the participant noted that the tool they used (Axon Investigate Pro) "does not allow the type of overlay."
3QAKUF	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
3QWT2Y	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
4YJ98E	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). The participant provided no output MP4 video or still image files. They provided only a PDF report from Amped FIVE software which does include bookmarked images at various stages. Based on the FIVE report, some enhancement and perspective correction were applied but no stabilization filters were employed.
6XMCVP	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
73WT6D	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.

TABLE 3

Forensic Video Enhancement Observations	
WebCode	Observational Notes
7EQ9RU	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
7NBD2E	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step A observational note: Participant used Media Player Classic in an attempt to correct the perspective but the perspective did not appear corrected. Step E observational note: Individual frame numbers were not overlaid on the output video files; instead, static displays of "0/135" and "0/154" were overlaid.
8BK3RE	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
8KV6DE	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step F observational note: The supplied output video file is a QuickTime MOV file, not an MP4 as requested, though they are related container formats. Based on the overlaid frame numbering, the supplied video file also appears to only include the first 50 frames of the original video, and is missing frames (e.g., frame 20), some frame numbers extend across frames having different content (e.g., frame 21), and the frame rate is inconsistent throughout the output video file. However, these issues may be accounted for by one or more of the processes applied in Amped FIVE, but the supplied notes appear to be incomplete (e.g., filter names and possibly settings are missing).
8WK66G	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
9Y4FGR	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
A8X93Q	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
A9N7GP	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step A observational note: Participant used lens correction and rotate filters in an attempt to correct the perspective but the perspective did not appear corrected. Step C observational note: Cropping was conducted but the entire license plate is not visible throughout the cropped version, as requested. Step E observational note: Frame numbers were not overlaid for the output video file, as requested, though the output still image does include a frame number.
ACNHCP	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
AV4RDP	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
B23TTA	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step D observational note: The supplied MP4 file features a picture-in-picture of a perspective-corrected/ stabilized/ cropped/ frame-averaged/ enhanced inset using three source frames over what appears to be the original video. Step E observational note: No MP4 file was provided of the perspective-corrected/ stabilized/ cropped/ enhanced video by itself with overlaid frame numbers, as requested.
B3JPKA	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.

TABLE 3

Forensic Video Enhancement Observations	
WebCode	Observational Notes
B7J2GA	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step E observational note: None of the supplied output MP4 files include overlaid frame numbers, as requested, though the three output PNG image files do include frame numbers. The output PNG image files appear to have undergone different or additional processing compared to the output MP4 files.
BJH3TB	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. Based on the overlaid frame numbering and frame counts, the supplied video files include only the first 20 frames of the original video.
CACG79	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. The supplied PNG still image file appears to have undergone additional enhancement or spotlighting around the plate's characters, which is not documented in the participant's notes.
CC4FK8	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step D observational note: It is not evident that the stabilized/perspective corrected video file was enhanced or clarified. The brightness/contrast adjustments appear only to have been applied to frame-averaged still images.
CJ33AL	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
CRD6VM	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
DBZD7M	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
DJW977	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. The output MP4 video file contains only three frames compared to 159 frames from the original MOV file. No details regarding the processes employed were provided, other than the software (Amped FIVE), so it is difficult to evaluate the video processing as a whole.
EDKJ6A	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. The provided "FRAME 0.bmp" and "FRAME 154.bmp" image files are bit-for-bit identical. A review of the supplied Amped FIVE HTML report indicates in the "Image Writer" filter that "Frame Position: 154" was exported as "FRAME 0.bmp" and not "FRAME 154.bmp."
FKZPEL	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
GJLF2E	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
GWBEV3	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
HNZDA2	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
HVA2KE	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.

TABLE 3

Forensic Video Enhancement Observations	
WebCode	Observational Notes
J8J2UD	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
JZNYT2	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. The frame numbering appears to have been reset to "0" regardless of the range of frames selected by the participant; the intent of the frame numbering was to preserve the numbering of the supplied MOV file. The two still images appear to have undergone different enhancement processes, even though that is not explicitly discussed in the participant's notes.
KV8Q63	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. Clearly, the video content was perspective-corrected and stabilized, but the supplied Amped FIVE notes include only the video enhancement processes. A review of the output MP4 video file revealed that several frames (frames 16, 64, 81, 88, 104, 110, 111, 116, 124, and 130) contain black raster video data and no image data from the supplied MOV file. This may have been introduced during a stabilization process, but as stated above, no such process is included in the participant's notes.
LNKKHF	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
LVHCQA	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. Frame numbers are out of chronological order in the output MP4 file. Still images with overlaid numbers 151, 152, and 153 (provided as Bitmap images) are actually the 152nd, 151st, and 155th frames, respectively, as they appear in the output MP4 file.
M23ULW	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
MM3TAV	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). The participant provided no output MP4 video or still image files. They provided only a PDF report from Amped FIVE software which does include bookmarked images at various stages. Based on the FIVE report, some enhancement and perspective correction were applied but no stabilization filters were employed.
N48MEA	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. The two exported Bitmaps for frames 150 and 158 appear to have undergone a different clarification process(es) compared to the output MP4 file. The production of the still images is not discussed in the participant's notes.
NJMLLV	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
NQHNMB	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. A review of the output MP4 video file revealed that frames 0 and 1 contain identical content (other than the overlaid frame number) but are unique frames within the supplied MOV file. Also, the total number of frames in the output MP4 file is 158, not 159 as in the supplied MOV file.
NQZUMX	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step D observational note: An enhancement of the video was not conducted. The supplied MP4 file is the perspective-corrected/ stabilized/ cropped form of the video, but the enhancements were applied afterward for the production of the still image files.

TABLE 3

Forensic Video Enhancement Observations	
WebCode	Observational Notes
P3V8K9	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
PFWY4R	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). The participant provided no output MP4 video or still image files. They provided only a PDF report from Amped FIVE software which does include bookmarked images at various stages. The only enhancements/ clarifications applied were various deblurring filters. Global stabilization and perspective correction was applied based on the FIVE report.
PXEYWA	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
Q8K8C9	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
QXTL8W	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. The total number of frames in the output MP4 file is 157, not 159 as in the supplied MOV file; frames 157 and 158 are missing from the output MP4 file. The supplied BMP image file for frame 0 appears to have undergone different or additional enhancement compared to the output MP4 file.
REFN4Q	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
RF9GYA	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
RQ6K34	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. Review of the output MP4 video file revealed that frame 130 contains black raster video data and no image data from the supplied MOV file.
RZEPFU	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following exception(s). Step G observational note: Three exported images were provided but in JPG/JFIF format, which is not one of the three requested still image formats (PNG, BMP, or TIFF).
T9PB33	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
TWCB7A	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
TXJT46	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
U8M2LQ	[Participant did not provide any material for this portion of the test.]
V2X39M	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
VCGJZT	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
VKRLLU	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.

TABLE 3

Forensic Video Enhancement Observations	
WebCode	Observational Notes
XDJYK6	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
XGLWVX	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps.
XV4PJ4	Submitted enhanced file(s) were reviewed by an expert who confirmed that this participant completed all requested video enhancement steps with the following notes. The output MP4 file has an additional frame (total of 160 frames compared to 159 frames in supplied MOV file). Frame 159 of the output MP4 file appears to be a duplicate of frame 158 but with a slight vertical shift upward. The exported Bitmap for frame 156 appears to have undergone a different enhancement process than the output MP4 file.

# Additional Comments

TABLE 4

WebCode	Additional Comments
2RNRFW	There is no circumstance in which a request for clarification of a license plate or other object would be provided to a requestor in a video format. The processing order presented by this test is not in line with best practices (scientific image generation model).
7EQ9RU	I stabilized the video prior to correcting the perspective, which is the correct order and follows current best practices.
7NBD2E	Open-source software ExifTool was used to view the properties of the video analyzed in the study, utilizing the cmd command console. A FRED workstation was used.
8WK66G	The video enhancement I used was a levels adjustment to brighten the image. I then used a sparse selector to select what I felt were the clearest frames, then used a frame average process to try and reduce the compression artifacts. This produces a single image rather than a video however so I have provided this (MJL-2-24-5581) as well as the video and still frames requested. Full details of the tools and settings can be seen in the report provided.
A8X93Q	I uploaded four (4) files, but I was not able to confirm they were successfully uploaded: 24-5581_[participant code]_VideoMaterial.mp4, 24-5581_[participant code]_VideoMaterial_Frame 0.bmp, 24-5581_[participant code]_VideoMaterial_Frame149.bmp, 24-5581_[participant code]_VideoMaterial_Frame158.bmp.
ACNHCP	Based on the way this test was written, specifically in the Video Enhancement instructions, it seems as if the test is testing the knowledge of using Amped Five and not necessarily how to process a video/image for a license plate. If not for the instructions provided, I would have processed this case somewhat differently, but still received similar results.
B3JPKA	This request is outside the scope of our usual unit requests.
B7J2GA	This test was conducted at the [Laboratory] with 10 expert personnel.
CJ33AL	The provided instructions for enhancement are different than what analyst would normally do. Therefore, instructions were followed first and then a second analysis was conducted as the analyst would normally do. The second analysis result is named Technique 2. Flies were uploaded as a zip file due to uncertainty that multiple files were being attached. Please reach out if 5 files (4 images and 1 mp4 are not received).
EDKJ6A	Another really challenging test the only comment I would like to make is that I Personally would not of followed the method asked to get any Vehicle index plate details from the car, personally I would not of produced any video I would of produced a still following majority of the steps I have done in the test but along with frame averaging.
FKZPEL	I appreciate the complexity and difficulty of creating these types of tests however, I felt like this test came out a little too much on the awkward side and missed the mark a little bit. Being prescribed a specific set of instructions on how to process the video, and in a specific order, led to some concerns and issues with our workflow. Having used Amped FIVE before, I know that these processes and this sequencing can be easily accomplished with that tool. Our laboratory does not currently have Amped FIVE, so we have to use workarounds with other tools that we do have access to, which may limit our results and greatly increases the amount of time required to accomplish a task. It is important to our unit that analysts review requests, communicate with the customer on possible deliverables using their knowledge and experience to help the customer decide on the best presentation format, know when they do not have the right toolset for a requested work, and that they clearly articulate any limitations with outputs or inability to produce requested work. Due to the sample video, there was also some level of thinking that we would never produce the requested work had this been a real case. I understand that tests don't always accurately represent real scenarios but in this particular scenario it was a little bit difficult to divorce yourself from the idea that you wouldn't do this on a real case. In this instance, simple still image extraction and basic processing would have been sufficient for a detective to review for a potential lead on the license plate and vehicle. Even if we needed to perform additional processing on the video, we would not produce a video file showing the stabilized and perspective-corrected plate. The stabilization and perspective-correction may still be performed, but it would be in service of performing an additional technique such as frame averaging. In which case, not all frames of the video would be utilized, and a

TABLE 4

WebCode	Additional Comments
	video file would not be delivered to the customer. Only the resulting frame averaged image would be delivered. Overall, I feel like these tests are moving in a good direction and I appreciate that analysts are being tested on more complex techniques, understanding of video evidence, and understanding of their tools.
GJLF2E	1 - The workflow to achieve the method requested differs from other forensic video accreditation standards. 2 - Directions on submission could allow multiple files to be submitted if that is what is requested. 3 - When submitting notes or tools used it would be beneficial to submit the report that comes from the software rather than "Note methods or tools used and settings" as the software report would contain all of those requested.
GWBEV3	The uploaded zipped file contains 1 video file, 3 still image files, and the AmpedFIVE Report, which provides additional details about the three enhancement processes performed.
J8J2UD	Was unsure if separate files required so have combined examination into 1 video and 1 still. The video combines sections B/D/E/F The enhanced still combines A/C/G Unsure if multiple files were uploaded. Also completed hashed of produced work. A triage enhancement document, a peer review of enhancement document and overall job quality check.
KV8Q63	The "Part 2: Video Enhancement Instructions" were followed as provided by CTS and an enhanced derivative video was exported without omitting any frames from the original video.
LNKKHF	In a "real" case, the goal is to read the license plate. So, in addition to producing the video requested, AmpedFive software was used to apply perspective stabilization and perspective super resolution with the goal of producing an image that incorporates frame averaging.
LVHCQA	The instructions were not clear on how to upload the four file that were requested. I zipped mine and named it [participant code]-24-5581_[participant code]_[Name].zip. I original thought I could upload each file, but noticed that each time you uploaded the precious file was replaced. The file upload instructions need contain more specific instructions.
M23ULW	Depending of the tool used, when may have differents values for the bitrate or the frame rate. For this exercice, we decided to answer with the most precise values we can get, but in a real case, for a variable framerate video, we wil preferer to report a rounded framerate. For this kind of enhancement, we think that it will be more efficient to stabilize before correct pespective, but we decided to respect the order of the exercice instructions. When we have to enhance plates in real cases, we can make proposals for the differents caracters of the plate in addition of the enhanced pictures.
N48MEA	Feedback. Part 1: Question 1-2. Multiple tools provided different frame rates, with some reporting as variable and others as 29.97 fps. As a numerical value was specifically requested, the answer provided was the average frame rate of 29.97 fps.
NJMLLV	Part 1: I would suggest picking one hash algorithm and keeping it the same throughout the test. We were given the MD5 and SHA1 to authenticate the downloaded and asked to produce a SHA256 for the .MOV file. Part 2: Is to prescriptive. The information in "A" is helpful to know the ratio of the plate. The instructions should ask the individual to process the video to obtain the best image of the plate (up to 3 images). Allow the examiner to perform the work in the manner they would in actual case. If the intent is to be able to demonstrate the ability to perform some of the functions, write it out in one instruction and not break out into individual steps. For example: Process and stabilize the video and obtain the best cropped images of the license plate which has a known width to height ratio 2:1. The resulting images and video should show the plate having approximately the same ratio of the known plate. The text overlay portion is a good process for producing a demonstrative product for a court environment; however, this is not necessary for demonstrating proficiency in video processing/analysis.
NQHNM8	1-2). What is the reported frame rate of the MOV files (report as a numeric value in fps) Media Info: 29.970 fps variable (28.571fps to 30.000fps) Camtasia: 29.97 fps exiftool: 29.972 GSpot: 28.571 Windows: 29.97 VLC: 29.971726
PFWY4R	Amped Five professional is used for video analysis
QXTL8W	It wasn't clear from the instructions whether both a still capture from the enhanced video and the video were required, so both have been supplied: 'Frame 0 capture.bmp' and 'Stabilised and enhanced.mp4'.
RF9GYA	I believe this test would have been best completed using Amped Five which we don't have, making it

TABLE 4

WebCode	Additional Comments
	more difficult to perform and most likely giving inferior results. We have a limited toolset in our department due to constant budget constraints. I am sure there are many agencies that are in the same predicament that we are that don't have the tools you may assume that we all have.
RQ6K34	There should be 3 files uploaded to the data sheet "Processed Video (License Plate).mp4", "Still image (frame 158).bmp", and "Still image (frame average 149-158).bmp".
T9PB33	A zip folder containing case notes, attachments, and the processed videos and images has been uploaded.
TWCB7A	As the issue with perspective occurs at the scene stage of the image generation model, perspective issue should be corrected towards the end of the workflow, as stated in <a href="https://blog.ampedsoftware.com/2023/09/12/correct-the-perspective-of-a-license-plate">https://blog.ampedsoftware.com/2023/09/12/correct-the-perspective-of-a-license-plate</a> . In addition, in order to obtain a clearer image of the licence plate number, multiple frames from the video could be selected to be enhanced, for example frame averaging to give a resultant frame, instead of performing the enhancement on the entire video and selecting one to three frames from the enhanced video as instructed in this test.
U8M2LQ	This is not part of our laboratory typical analysis and was left blank
V2X39M	**[CTS] confirmed on 8/16/2024 that 4 files (3 images and 1 video) were uploaded to the portal. After viewing on three different computers, it appeared like only 1 was uploaded. Email exchanged archived.
VCGJZT	In the video, lower quality frames of the license plate were removed due to resulting in a poor viewer experience and lower quality output. However this can be identified with the frame numbers as they are representative of the position in the original video. Removing these frames for frame averaging results in a clearer image and clearer video.
VKRLLU	Unclear whether on upload both the Video sequence and stills have actually uploaded as each had to be done separately, may be worth in future listing what the user has uploaded
XDJYK6	Mixed feelings on the "test". Had to spend more time figuring out how to complete the tasks requested since I do not have access to other forensic video programs, like Amped Five. After examining the video file provided, I would of most likely just captured a few best still images, maybe stacked them and exported a good image of the relevant license plate. This might have taken me 10-20 minutes max. I spent more time "exploring" options and "experimenting" with the software which I have access to to accomplish the task requested, especially in the work order described. The good part was that I learned more about other "tools" in the software programs which might be used to accomplish the proficiency test request. Tried to do it all within one software package, but unable to. Basically I had to move in between three different software programs. I spent hours looking at options and exported files to see what I could produce to get the best results, in my opinion. Long story short, this proficiency test definitely pushed the envelope of video processing on such a short piece of video, with little variations beyond sharp and out of focus frames. I was tempted to just create a short video clip using only the "good frames".
XGLWX	Noting again that I could not upload more than one file in the 'Enhanced Video Examination'. Two exported still image .PNG files generated but not able to be uploaded.

-End of Report-  
(Appendix may follow)

## Test No. 24-5581: Forensic Video Analysis

DATA MUST BE SUBMITTED BY **Aug. 19, 2024, 11:59 p.m. EDT** TO BE INCLUDED IN THE REPORT

Participant Code: U1234B

WebCode: X4XX4U

### Scenario:

A vehicle of interest was parked outside of a small office building shortly before a fire broke out in the building, which resulted in millions of dollars in damage. Arson is suspected as the cause. A surveillance camera was attached to the exterior wall of the building and captured a portion of the front of the vehicle but at an extreme angle (i.e., the camera sensor is nearly perpendicular to the front plane of the vehicle) just as power was lost to the building due to the fire. The recorded video was stored in the cloud. The surveillance camera was loosely mounted to the wall and a large air handler nearby caused the camera to vibrate during capture.

A video file export of the designated recording was made by investigators in QuickTime MOV format. Investigators request video enhancement of the MOV file to see the license plate of the vehicle more clearly.

### Test Instructions:

*This test is designed to measure your knowledge and skill in the following digital forensic video processes: Data verification, Media characterization, Video processing, and Video enhancement.*

*The skills assessed in this exercise are based on the following best practice documents from the Scientific Working Group on Digital Evidence (swgde.org):*

1. *Technical Overview of Digital Video Files*
2. *Best Practices for Digital Forensic Video Analysis*
3. *Fundamentals of Resizing Imagery and Considerations for Legal Proceedings*

*Because of the inherent subjectivity of video "enhancement" due to differences in an individual's personal preferences and vision, you will be asked to perform specific tasks including processing the file in a way that is designed to show your understanding of a certain principle or concept. It is critical that you read the instructions carefully and execute all of the tasks.*

### Evidence:

To verify a complete and accurate download, use the tool of your choice to verify the integrity of the file.

24-5581 Video.zip MD5 hash value: 2312885104ef9ce990e9a123fddbc307

24-5581 Video.zip SHA1 hash value: 8d75f880e6ea5c439bf96ebbb63770df308d78c9

1-1). What is the SHA-256 hash value of the MOV file?

1-2). What is the reported frame rate of the MOV file? (report as a numeric value in fps)

1-3). What are the pixel dimensions of the MOV file?

1-4). What is the bit rate of the recorded video in the MOV file?

1-5). How many frames are there in the MOV file?

1-6). Is there an audio track present in the MOV file?

Yes  No

**Part 2: Video Enhancement Instructions**

Perform the tasks listed below and provide an enhanced derivative video file and image files, as requested, for review.

- A. Conduct a perspective correction of the designated vehicle’s license plate (that is, process the video such that it closely resembles the perspective of the license plate as if the camera lens was parallel with it). The license plate has a width-to-height ratio of 2:1.
- B. Conduct a video stabilization of the perspective-corrected video.
- C. Crop around the license plate. The size of your cropped area is your choice, but the entire license plate must be visible in the cropped version.
- D. Conduct a video enhancement of the license plate in the cropped version.
- E. Overlay the frame numbers as text near one of the corners of the video. Start with the first video frame as frame 0.
- F. Export the final product as an MP4 file, with H.264 video encoding.
- G. Select and export between one and three frames of your choice (as PNG, BMP, or TIFF image files) which you believe represent the clearest images of the license plate.

Uploaded file name:

2-1). Note methods or tools used and settings for the video enhancement here.

### Additional Comments

*Please note: Any additional formatting applied in the free form space below will not transfer to the Summary Report and may cause your information to be illegible. This includes additional spacing and returns that present your responses in lists and tabular formats.*

## RELEASE OF DATA TO ACCREDITATION BODIES

The Accreditation Release is accessed by pressing the "Continue to Final Submission" button online and can be completed at any time prior to submission to CTS.

CTS submits external proficiency test data directly to ANAB and/or A2LA. Please select one of the following statements to ensure your data is handled appropriately.

- This participant's data is intended for submission to ANAB and/or A2LA. (Accreditation Release section below must be completed.)
- This participant's data is **not** intended for submission to ANAB and/or A2LA.

Have the laboratory's designated individual complete the following steps **only if your laboratory is accredited in this testing/calibration discipline** by one or more of the following Accreditation Bodies.

**Step 1: Provide the applicable Accreditation Certificate Number(s) for your laboratory.**

ANAB Certificate No.

A2LA Certificate No.

**Step 2: Complete the Laboratory Identifying Information in its entirety.**

Authorized Contact Person and Title

Laboratory Name

Location (City/State)