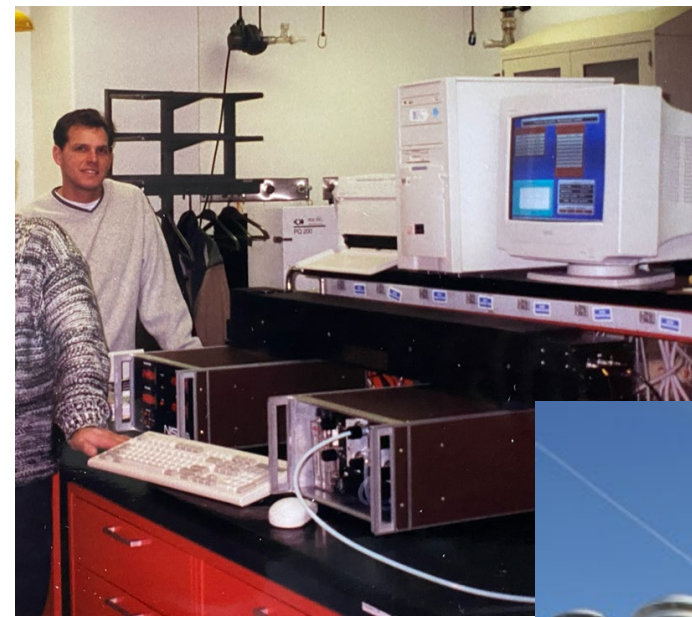


# Ozone Monitoring Training

National Ambient Air Monitoring  
Conference

August 12, 2024

# Welcome, and thank you for participating!



- Introductions
  - Scott Hamilton, EPA Region 5
  - Allison Smalley, EPA Region 5
  - EPA Regional staff / SRP leads
- Who else is in the room?
  - Technical (lab/field) / managers

1998

2018

# Agenda

- January 2023 O<sub>3</sub> TAD
- Lifecycle of Transfer Standard
- Transfer Standard Verification/Reverification
- AMTIC Spreadsheet
- Calibrations
  
- “Quiz” and Situational Q/A (Audience Participation)

# New O<sub>3</sub> Coefficient

- **OAQPS technical memo coming soon**
  - Final date for new cross section is 1/1/2026
- **O<sub>3</sub> Topics NAAMC Thursday morning:**
  - “Implementation of a New Value of the Ozone Absorption Cross-section at 253.65 nm - Melinda Beaver (EPA OAQPS)”
  - “Field Testing Nafion Dryers on Co-located CASTNET Ozone Analyzers - Kevin Mishoe (WSP)”

# Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone, January 2023

- Review traceability procedures
- Improve usability
- More prescriptive language
- Operational recommendations
- Update formatting like other EPA QA documents

***2-year phase in - \*Must be implemented by November 2025\****

# Definitions

- **Transfer Standard Levels are defined by distance from SRP**
  - Level 1 = SRP
  - Level 2 = compared to SRP
  - Level 3 = compared to Level 2
  - Level 4 = monitor at site reporting to AQS
- **Bench Standard** – stationary; traditional “primary standard”
- **Field Standard** – moves from site to site; traditional “field standard”
- **Push Button Calibration** – adjusting the internal calibration factor
- **Calibration Factors** – Internal to O<sub>3</sub> monitor. Sometimes termed coefficient, slope, background or offset. Terminology is vendor specific.
- **Verification** – 3 cycles can be done in one day (not a “6X6”). 6 points plus zero.
- **Reverification** – 1 cycle. 6 points plus zero.
- **Regression slope/intercept** – slope and intercept from a verification relationship

# Bench and Field Transfer Standards 'Rules'

All BENCH Standards - Annual reverification

All FIELD Standards – 6-month reverification

- All Level 2 must be **verified** to a Level 1 annually
- All transfer standards must be **verified** against a higher-level bench standard
- **Reverification** against an equal or higher level

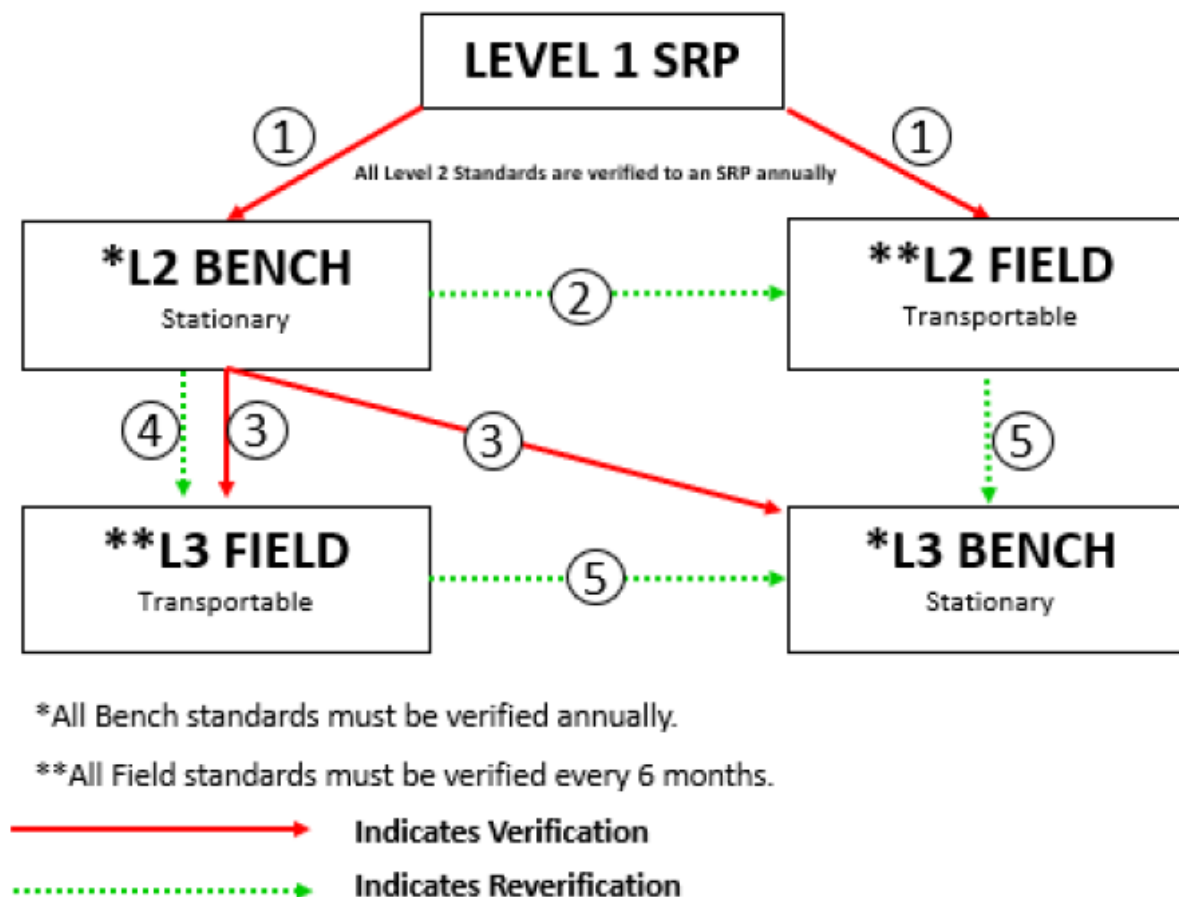


Figure 2-4 Verification Frequencies for Bench and Field Transfer Standards

# O<sub>3</sub> Transfer Standard Lifecycle Overview

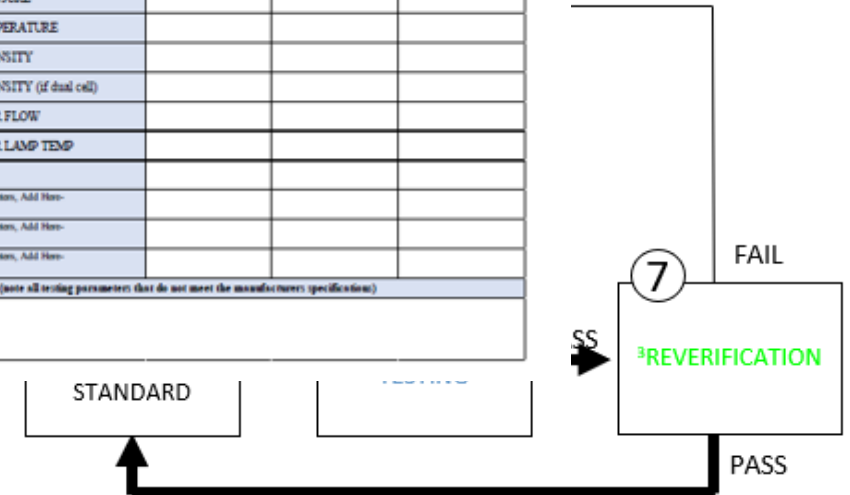
## O<sub>3</sub> Transfer Standard Lifecycle

Appendix B Example Acceptance Testing Data Sheet<sup>19</sup>

Ozone Transfer Standard Acceptance Testing			
1. Complete acceptance testing after proper warm up and while sampling area air.			
2. Compare all readings to the manufacturer's recommendation's.			
3. Readings not meeting the manufacturer's recommendation must be corrected prior to conducting verification.			
Operator:			
Organization:			
Instrument Make:			
Instrument Model:			
Instrument SN:			
Date Preventive Maintenance Performed:			
Transfer Standard Role:			
PARAMETERS	Prior to Transport	As Found	As Left
DATE			
TIME			
LAB TEMPERATURE			
LAB STANDARD PRESSURE			
SLOPE (CALIBRATION FACTOR)			
ZERO (CALIBRATION FACTOR)			
SAMPLE PRESSURE			
SAMPLE TEMPERATURE			
CELL #1 INTENSITY			
CELL #2 INTENSITY (if dual cell)			
PHOTOMETER FLOW			
PHOTOMETER LAMP TEMP			
BOX TEMP			
-Additional Parameters, Add Here-			
-Additional Parameters, Add Here-			
-Additional Parameters, Add Here-			
COMMENTS (note all testing parameters that do not meet the manufacturer's specifications)			

- ① Not you
- ② ③ QA System
- ④ Acceptance testing record TS diagnostics
- ⑤ 3 verification cycles
- ⑦ You want to stay in this use/reverify cycle
- ⑧ Assess and repair always upon failure

- Is everything working correctly?
- Not a new procedure
- Simple – Check diagnostics against manufacturers specifications
- Document As Found / As Left





# O<sub>3</sub> Transfer Standard Lifecycle Overview

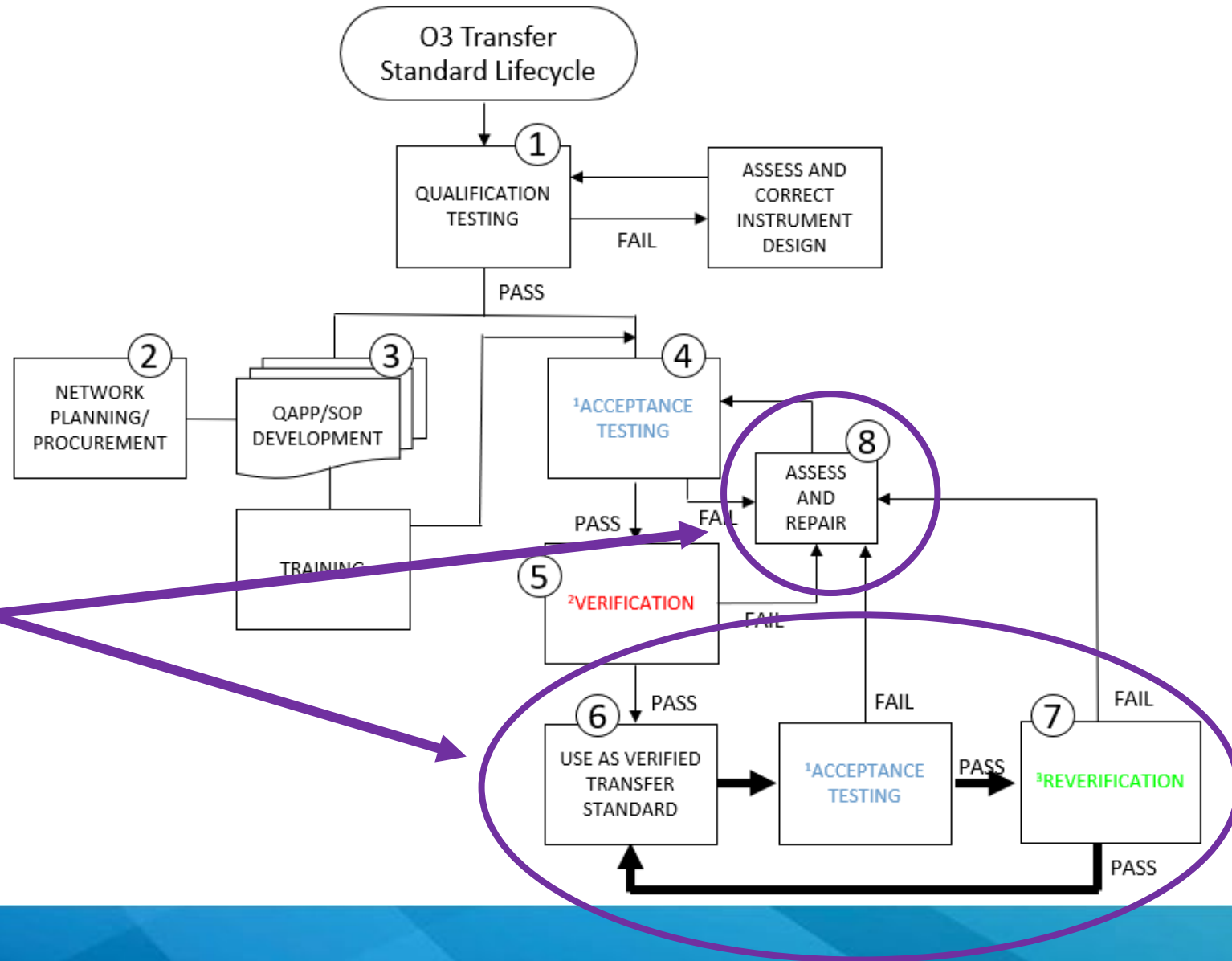
- ① Not you
- ②③ QA System
- ④ Acceptance Testing. Is a repair needed?
- ⑤ 3 verification cycles
- ⑦ You want to stay in this use/reverify cycle
- ⑧ Assess and repair always upon failure



## Major/Minor Repairs and Reverifications

1. Follow troubleshooting flowchart (objective action limits)
2. Major repair – any component directly impact measurement (detector, pressure sensor, temp sensor, etc.)
  - must conduct new verification
3. Minor repair – does not directly impact measurement (PM, pump replacement, O<sub>3</sub> generator, minor leak, display, etc.)
  - new verification not required
4. Document As-Found, As-Left Conditions
  - Complete acceptance testing

# O<sub>3</sub> Transfer Standard Lifecycle Overview



① Not you

②③ QA System

④ Acceptance testing TS diagnostics

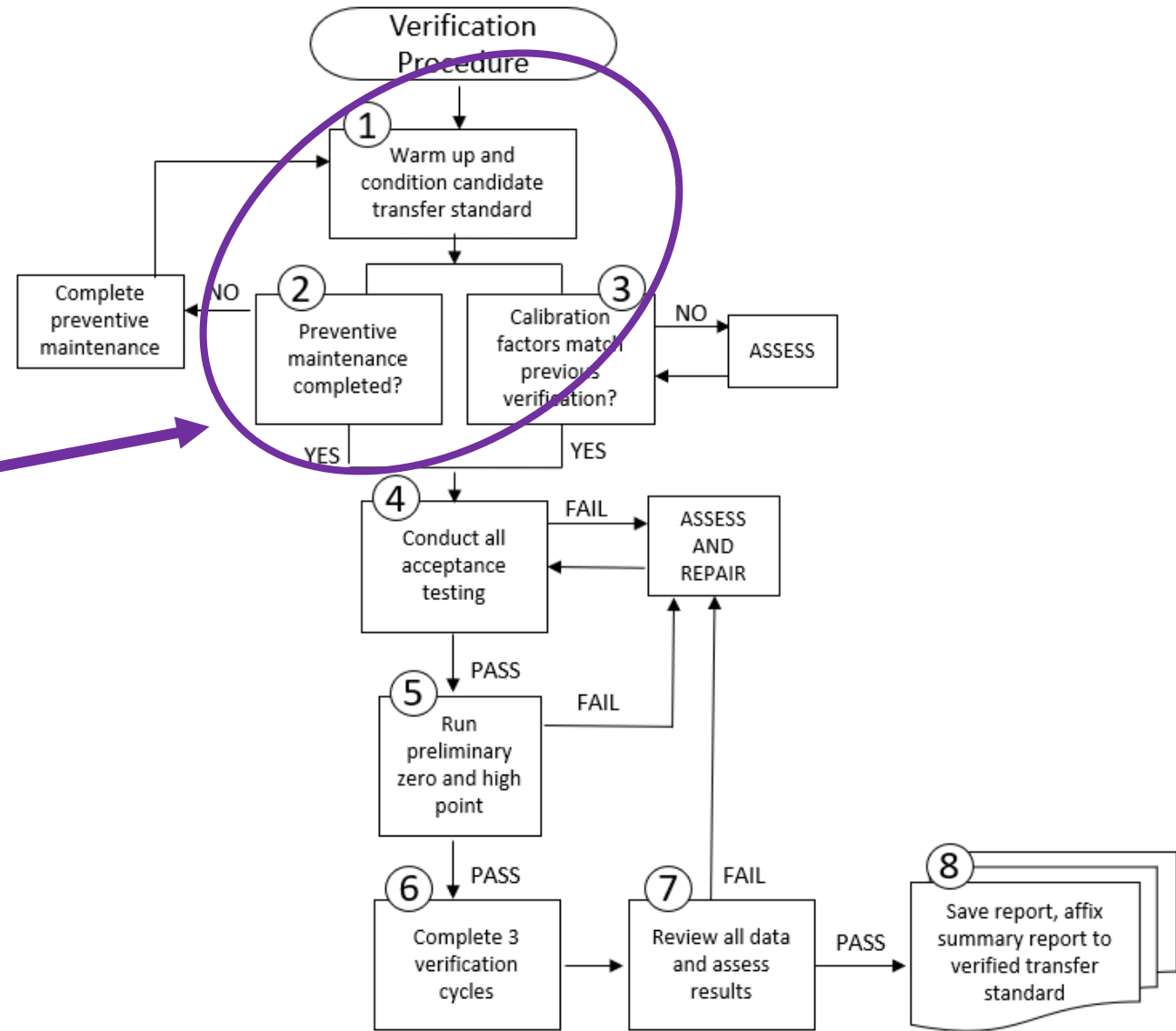
⑤ 3 verification cycles

⑥⑦ You want to stay in this cycle

Verify → Use → Reverify cycle

⑧ Always assess and repair upon failure

# Verification Procedure Flowchart



①②③ Set up/preventive maintenance. Check documentation. **How is the TS functioning?**

④ Acceptance testing TS diagnostics

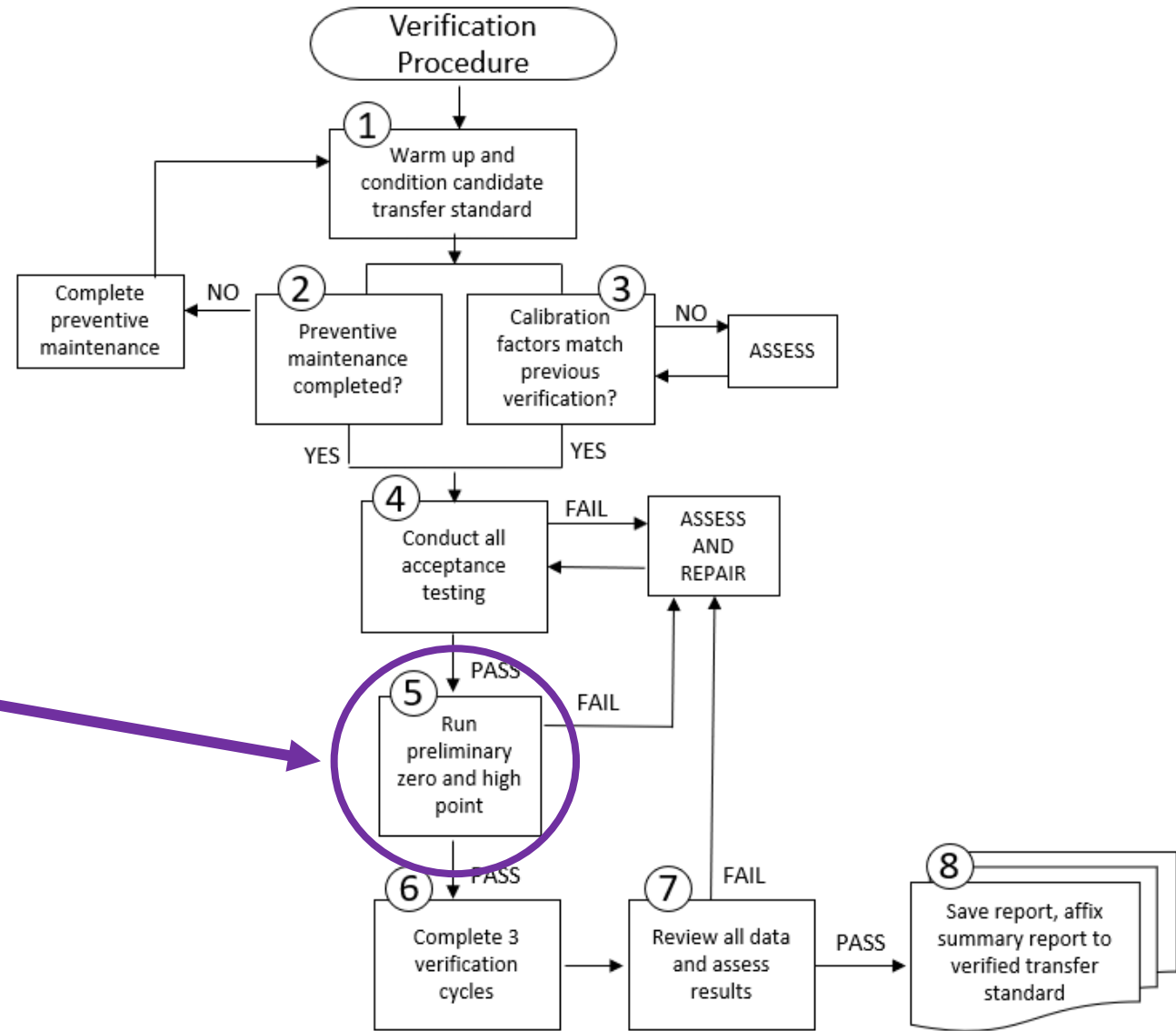
⑤ Do I need to calibrate? (action limits typically 50% of acceptance criteria)

⑥ 3-cycles; Automation?

⑦ AMTIC spreadsheet or other form used to easily assess if acceptance criteria are met

⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)

# Verification Procedure Flowchart



①②③ Set up/preventive maintenance. Check documentation. How is the TS functioning?

④ Acceptance testing TS diagnostics

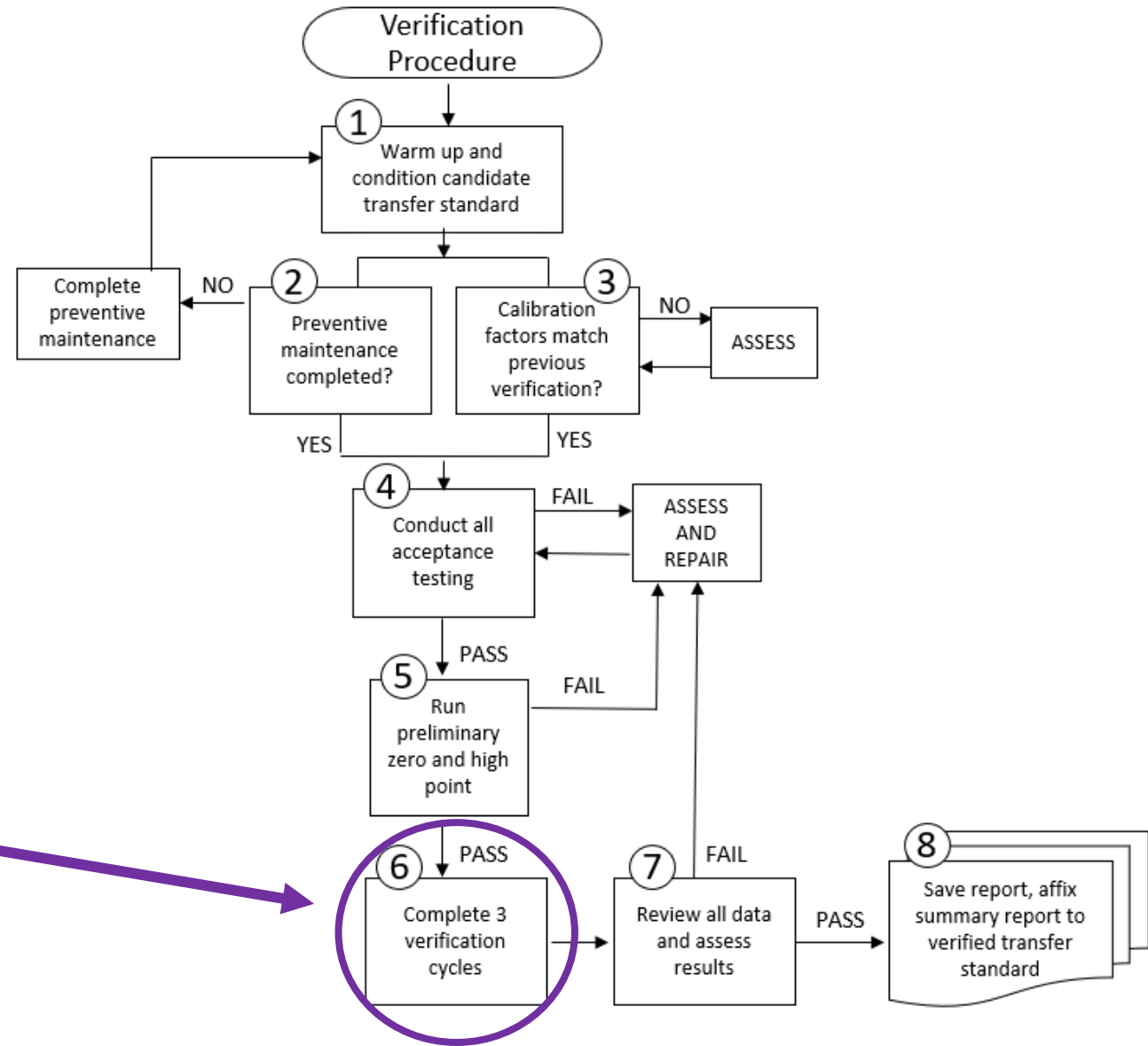
⑤ Do I need to calibrate? **(action limits typically 50% of acceptance criteria)**

⑥ 3-cycles; Automation?

⑦ AMTIC spreadsheet or other form used to easily assess if acceptance criteria are met

⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)

# Verification Procedure Flowchart



①②③ Set up/preventive maintenance. Check documentation. How is the TS functioning?

④ Acceptance testing TS diagnostics

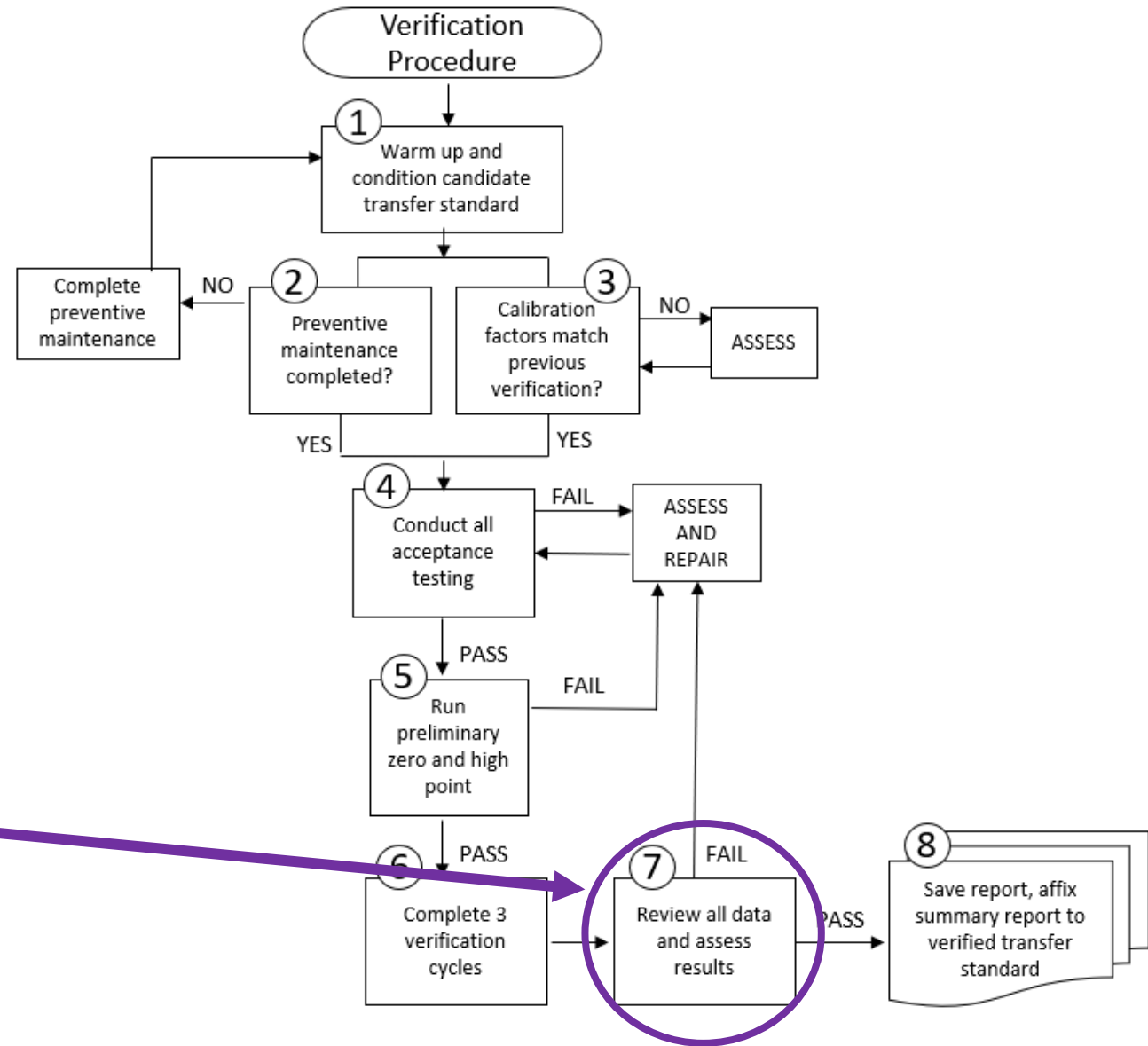
⑤ Do I need to calibrate? (action limits typically 50% of acceptance criteria)

⑥ 3-cycles; **Automation?**

⑦ AMTIC spreadsheet or other form used to easily assess if acceptance criteria are met

⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)

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①②③ Set up/preventive maintenance. Check documentation. How is the TS functioning?

④ Acceptance testing TS diagnostics

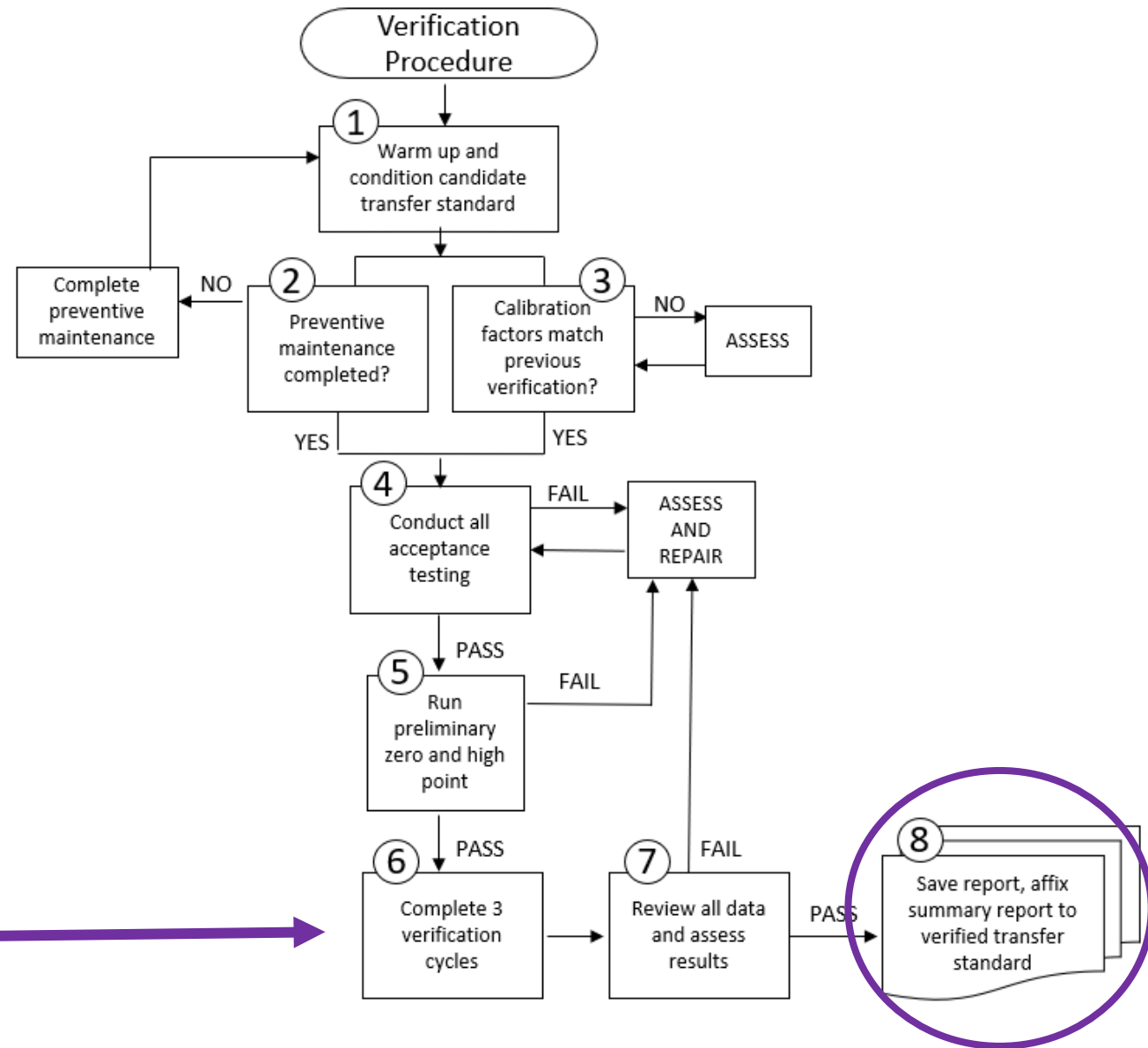
⑤ Do I need to calibrate? (action limits typically 50% of acceptance criteria)

⑥ 3-cycles; Automation?

⑦ **AMTIC spreadsheet** or other form used to easily assess if acceptance criteria are met

⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)

# Verification Procedure Flowchart



①②③ Set up/preventive maintenance. Check documentation. How is the TS functioning?

④ Acceptance testing TS diagnostics

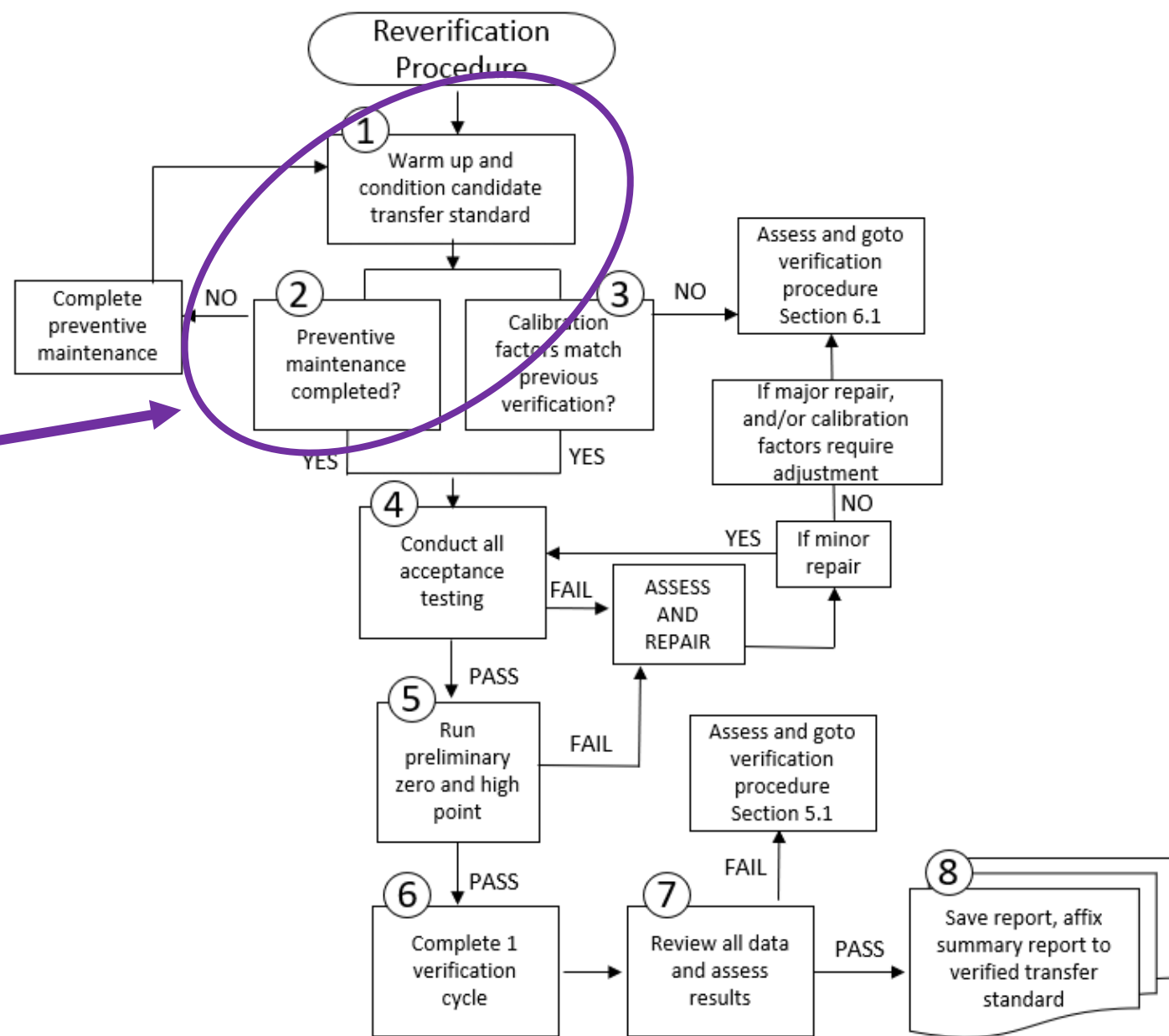
⑤ Do I need to calibrate? (action limits typically 50% of acceptance criteria)

⑥ 3-cycles; Automation?

⑦ AMTIC spreadsheet or other form used to easily assess if acceptance criteria are met

⑧ **Attach the summary to TS** so that users can easily access verification information (i.e., regression slope/intercept, expiration date)

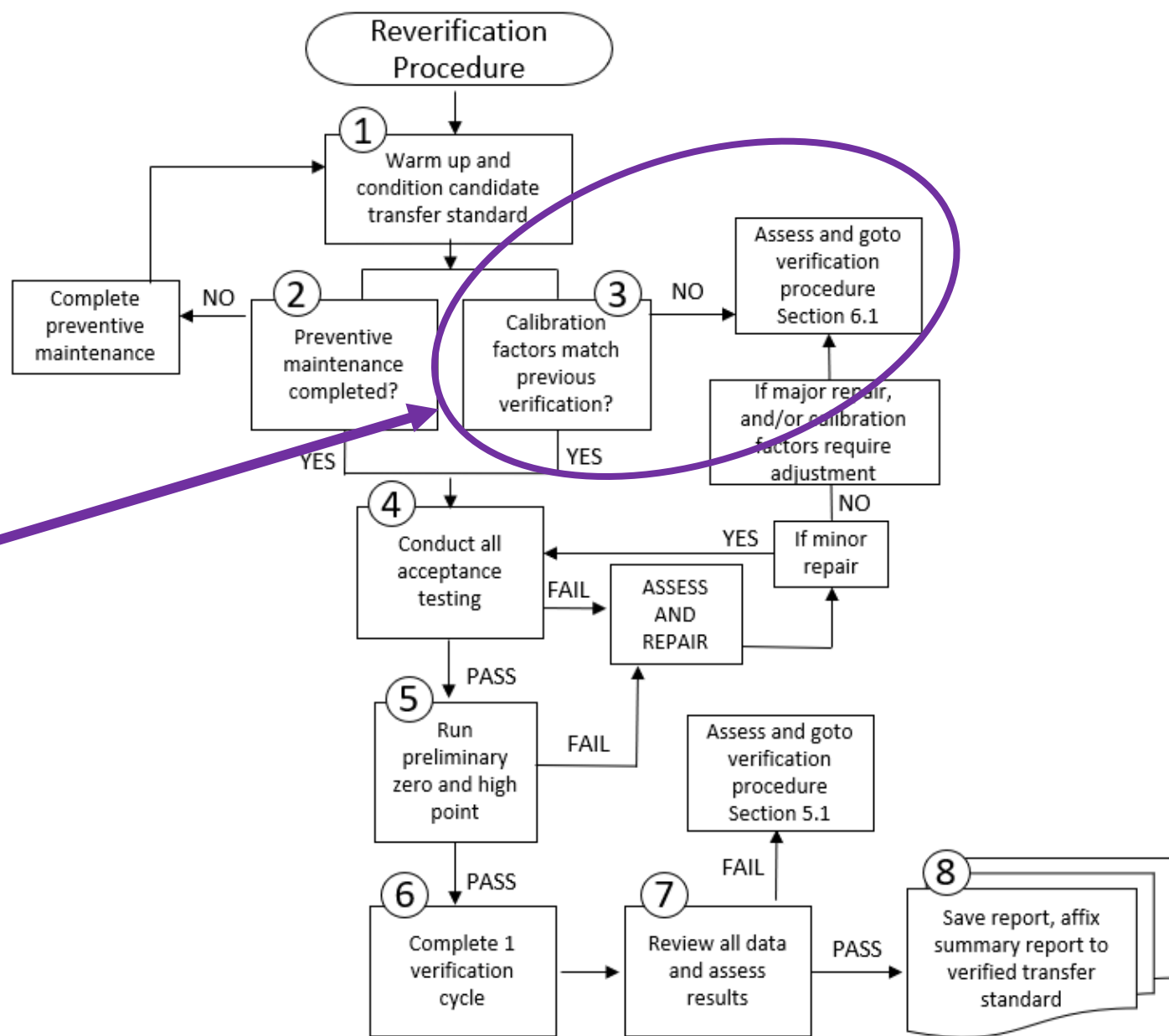
# Re-Verification Procedure Flowchart



- ① ② Same as verification
- ③ Cal factors should match; if not assess data impact
- ④ Acceptance Testing. Is a repair needed?
- ⑤ Is it going to pass action limit?
- ⑥ 1-cycle reverification
- ⑦ AMTIC spreadsheet or other automation
- ⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)



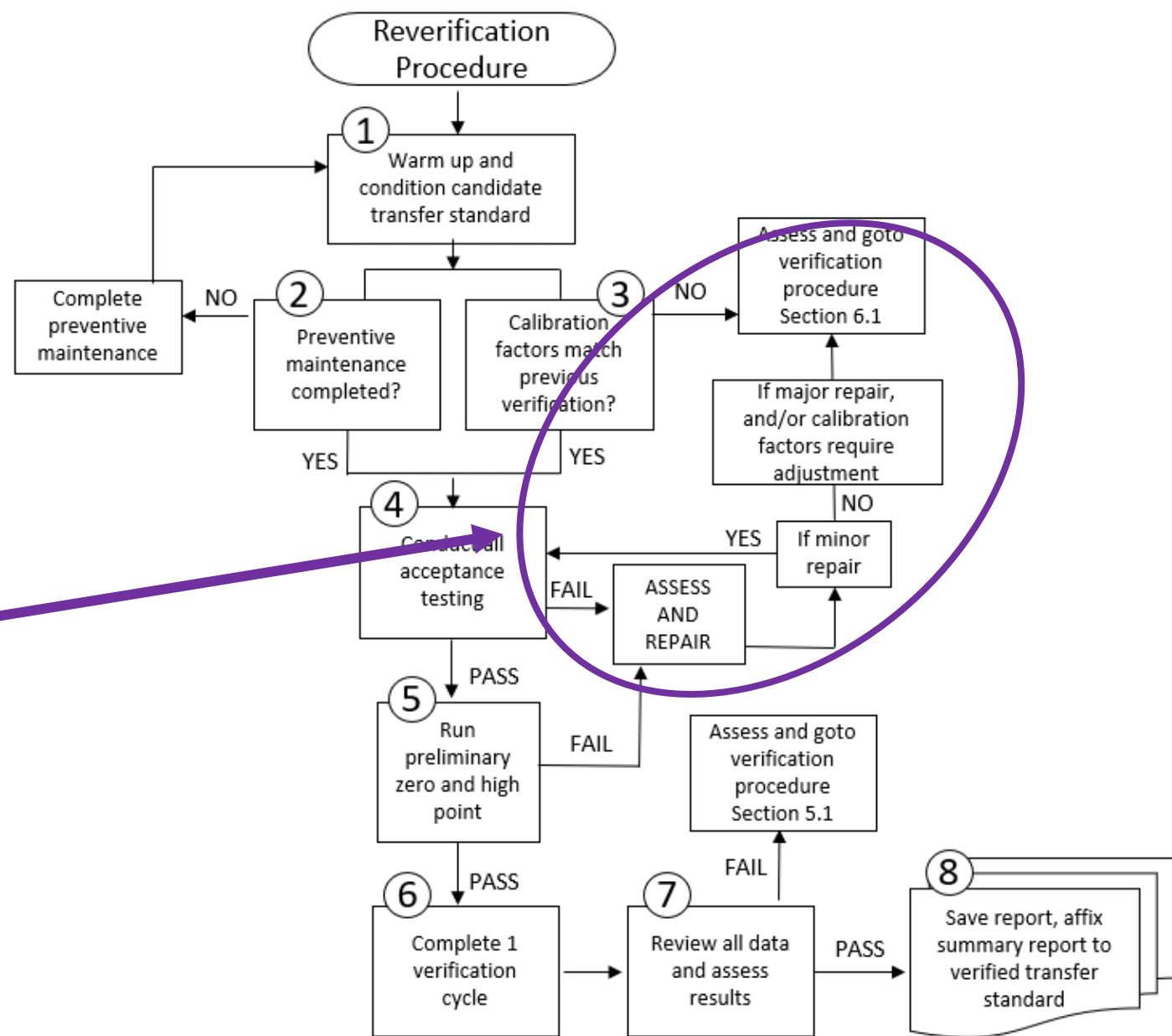
# Re-Verification Procedure Flowchart



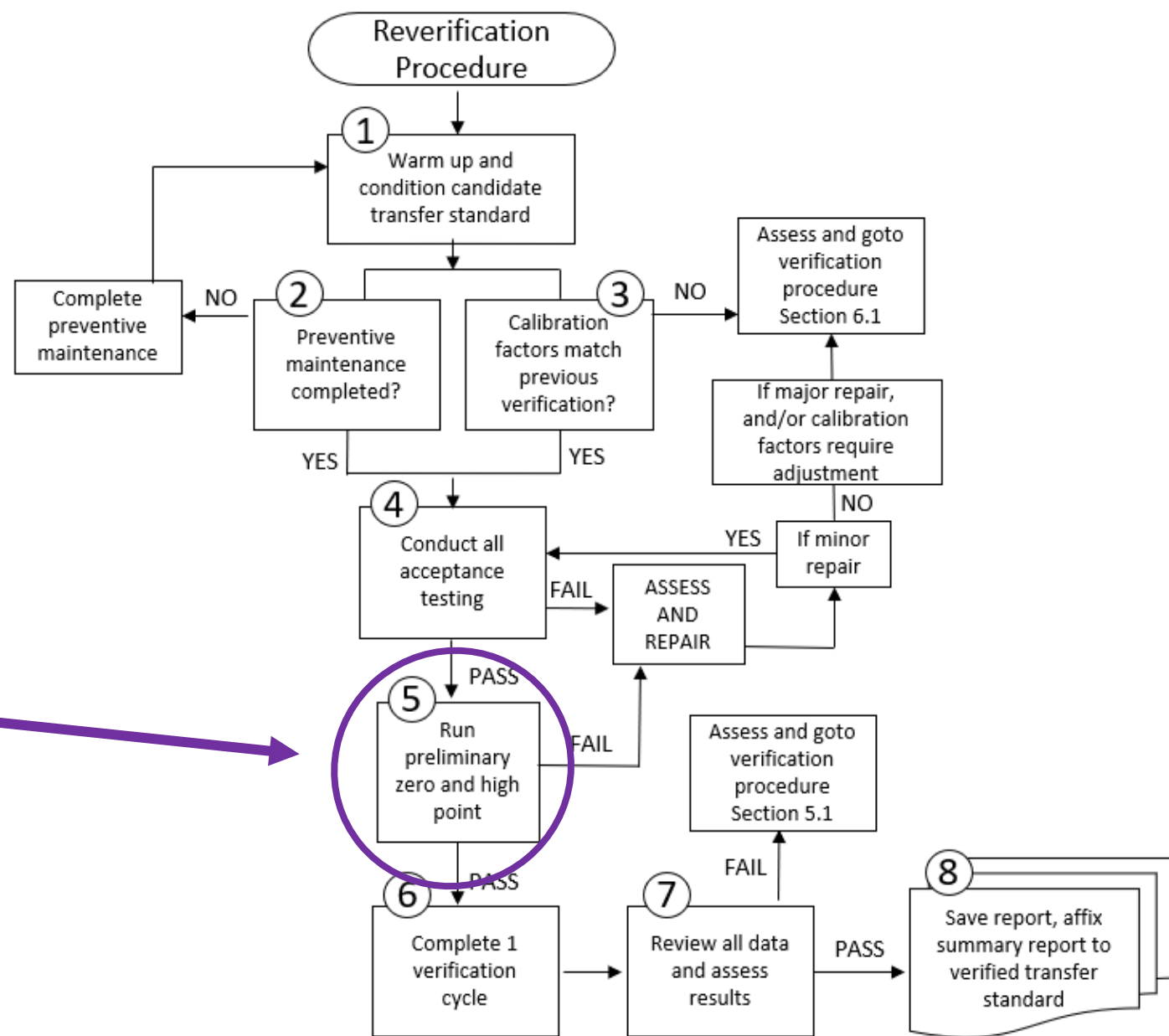
- ① ② Same as verification
- ③ **Cal factors must match; if not assess data impact**
- ④ Acceptance Testing. Is a repair needed?
- ⑤ Is it going to pass action limit?
- ⑥ 1-cycle reverification
- ⑦ AMTIC spreadsheet or other automation
- ⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)

# Re-Verification Procedure Flowchart

- ① ② Same as verification
- ③ Cal factors should match; if not assess data impact
- ④ Acceptance Testing. **Note major versus minor repair.**
- ⑤ Is it going to pass action limit?
- ⑥ 1-cycle reverification
- ⑦ AMTIC spreadsheet or other automation
- ⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)



# Re-Verification Procedure Flowchart



①② Same as verification

③ Cal factors should match; if not assess data impact

④ Acceptance Testing. Note major versus minor repair.

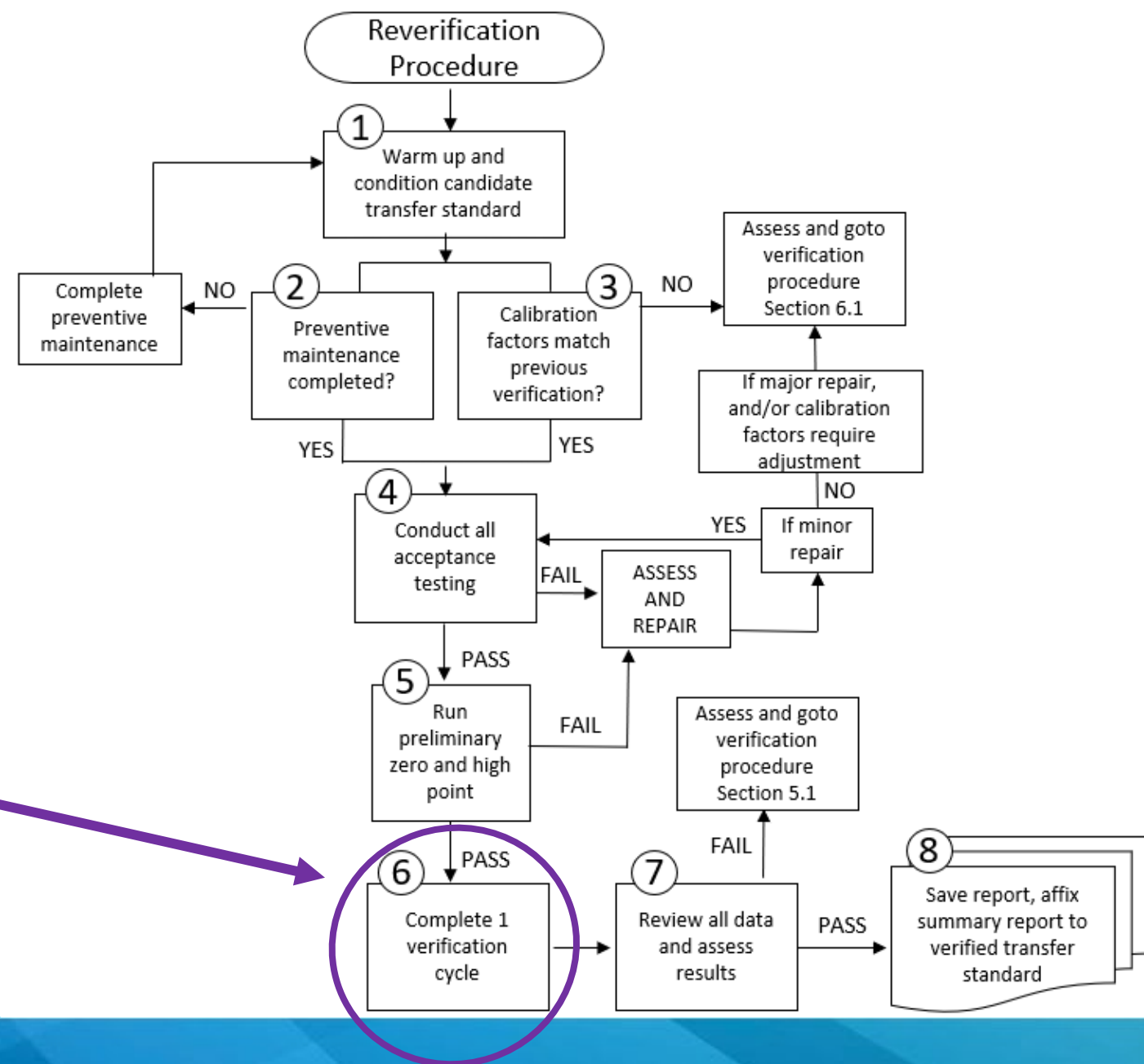
⑤ **Is it going to pass action limit?**

⑥ 1-cycle reverification

⑦ AMTIC spreadsheet or other automation

⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)

# Re-Verification Procedure Flowchart



- ① ② Same as verification
- ③ Cal factors should match; if not assess (data impact!)
- ④ Acceptance Testing. Major versus minor repair?
- ⑤ Is it going to pass action limit?
- ⑥ **1-cycle reverification**
- ⑦ AMTIC spreadsheet or other automation
- ⑧ Attach the summary to TS so that users can easily access verification information (i.e., regression slope/intercept, expiration date)

# O<sub>3</sub> Verification/Reverification Spreadsheet Overview

- Conditionally formatted for Acceptance Criteria
- Prints summary sheet - affix to transfer standard
- Archive of historical verification/reverification data for each transfer standard
- Especially good for smaller Monitoring Organizations

# Where is the current ozone TAD spreadsheet?

- AMTIC!
  - <https://www.epa.gov/amtic>



The screenshot shows the EPA website header with the logo and navigation menu. Below the header, the text "CONTACT US" is visible. The main heading reads "Ambient Monitoring Technology Information Center (AMTIC)". Below this is a large image of air monitoring equipment with a dark blue overlay box containing the AMTIC logo and a description of the center's mission. A "Learn More About AMTIC" button is also present in the overlay.

**EPA** United States Environmental Protection Agency

Search EPA.gov

Environmental Topics ▾ Laws & Regulations ▾ Report a Violation ▾ About EPA ▾

CONTACT US

## Ambient Monitoring Technology Information Center (AMTIC)

**AMTIC**

The Ambient Monitoring Technology Information Center (AMTIC) provides information on air monitoring programs and methods, quality assurance and control procedures, and federal regulations.

[Learn More About AMTIC](#)

## Announcements

### 2024 National Ambient Air Monitoring Conference

Join us August 12-15 2024 in New Orleans, LA for the 2024 National Ambient Air Monitoring Conference. Details can be found on the conference website.

[Visit the Site](#)

### Sampling Schedule

The 2024 sampling calendar for TSP, PM<sub>10</sub>, PM<sub>2.5</sub>, and VOCs is now available.

[Download Now](#)

### Final Rule

The final rule to revise 40 CFR part 50, appendix D, Reference Measurement Principle and Calibration Procedure for the Measurement of Ozone in the Atmosphere.

[View the Announcement](#)

### Air Monitoring Networks

[EPA, states and tribes work together to monitor air quality.](#)

### Training and Conferences

[Stay current with emerging topics related to air monitoring.](#)

### Air Monitoring Methods

[Access approved methodologies for air pollution monitoring.](#)

### Quality Assurance

[Understand quality assurance procedures.](#)

## National Quality Assurance Programs

This section provides information on the National Quality Assurance Programs overseeing EPA's Ambient Air Monitoring Program, including the National Performance Evaluation Program (NPEP). A critical element in any quality assurance program is the process of independent assessment. Independent assessment provides for a level of objectivity and consistency in the determination of data quality. As the Federal organization responsible for the implementation and oversight of the Ambient Air Monitoring Program, OAQPS, in partnership with the EPA Regions and the National Environmental Research Laboratory (NERL), have always provided the function of independent assessment that includes: site characterization and network reviews, technical systems audits and performance evaluations. Performance evaluations (PE) are a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

- [National Performance Assessment Program for O<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, and CO](#)
- [PM<sub>2.5</sub> Performance Evaluation Program](#)
- [PM<sub>2.5</sub> Gravimetric Round Robin](#)
- [Ozone Standard Reference Photometer Program](#)
- [Ambient Air Protocol Gas Verification Program](#)
- [QC of Filters for PM<sub>2.5</sub>, PM<sub>10</sub> and Low Volume Pb](#)
- [Lead Performance Evaluation Program \(Pb-PEP\)](#)
- [Technical Systems Audits](#)

# Ambient Air Monitoring Quality Assurance

## Background

The EPA's Ambient Air Monitoring Group (AAMG) oversees various QA/QC programs and activities to support air quality measurement. This page provides information on the various aspects of the EPA's ambient air monitoring QA program.

### On this page:

- [QA Rules and Regulations](#)
- [National Quality Assurance Programs](#)
- [Quality Assurance Guidance Documents](#)
- [Data Certification/Validation](#)
- [Quality Indicator Assessment Reports](#)
- [Newsletters](#)
- [Pollutant/Network Specific QA](#)
- [Training](#)
- [Other QA Links](#)

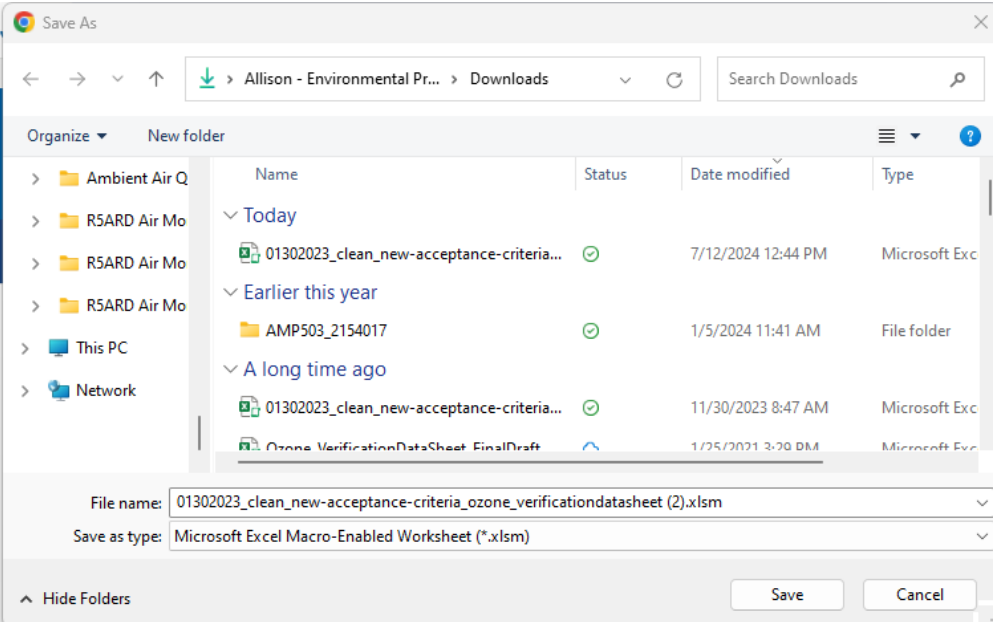
# Ozone Standard Reference Photometer Program (SRP)

The Standard Reference Photometer Program is used to certify the State, Local, and Tribal monitoring organizations' ozone primary and transfer standards and is implemented through the Office of Radiation and Indoor Air (ORIA). Certification programs like the SRP program provide independent testing of products and or instrumentation and are used to provide a sense of quality and comparability. The following documents provide information on the SRP program.

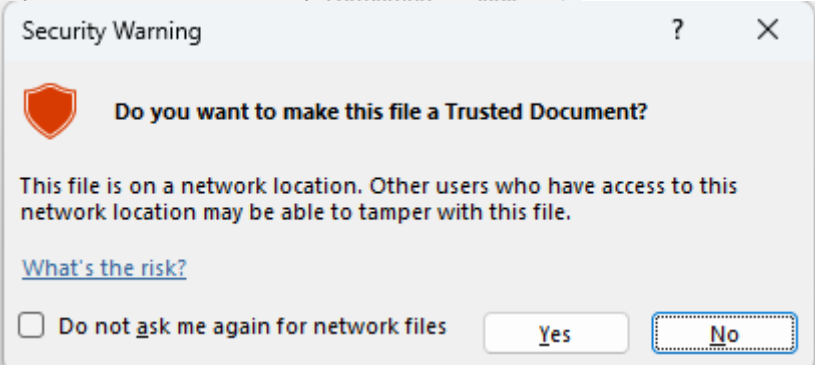
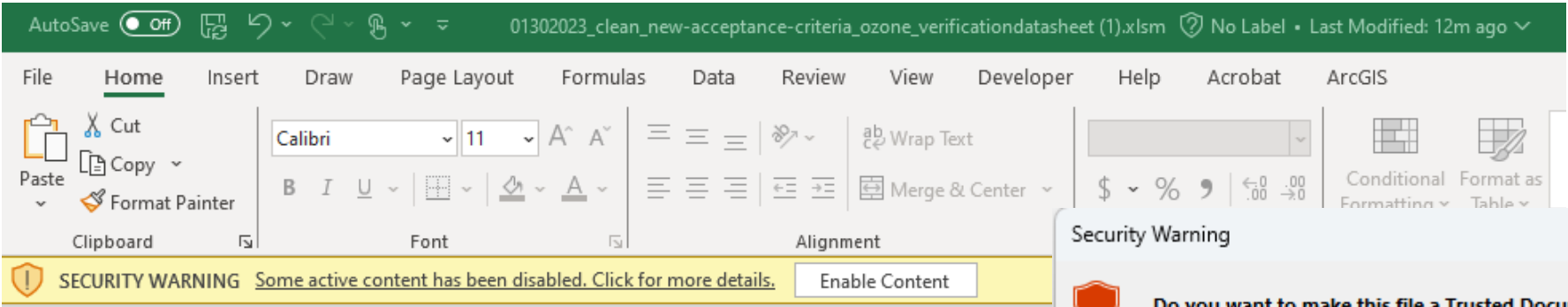
- [Quality Assurance Project Plan for the Standard Reference Photometer Program \(pdf\)](#) (982.3 KB, February 2017)
- [Standard Operating Procedure \(SOP\) for the Verification and Re-Verification of EPA's Ozone Standard Reference Photometers \(pdf\)](#) (5.1 MB, September 2015)
- [Technical Assistance Document - Transfer Standards For Calibration of Air Monitoring Analyzers for Ozone \(pdf\)](#) (1.4 MB, January 2023)
- [Ozone Transfer Standard Verification Summary Sheet \(xlsm\)](#)



# Save and enable the macros



Generate a new spreadsheet each time a transfer standard needs a new verification cycle





# Instructions tab

Verification Data Spreadsheet Instructions	
<p><i>This spreadsheet provides a standardized mechanism to input and archive verification data, calculate acceptance criteria, generate the verification summary sheet and automatically generate control charts. The spreadsheet and spreadsheet instructions will be updated on AMTIC when improvements are made. This spreadsheet is meant to provide support to users implementing this document. Users may prefer to generate their own calculation and documentation procedures.</i></p>	
<p><i>Instructions:</i></p> <p><i>Verification</i></p> <ol style="list-style-type: none"><li>1.) SAVE AS Document to new name and location.</li><li>2.) Begin on the Verification Tab.</li><li>3.) Complete all information in the blue cells.</li><li>4.) Run all points and fill in the data in cycle 1, 2 and 3 tables.</li><li>5.) Review acceptance criteria table as the verification cycles are completed.</li><li>6.) After a final review of data, click the 'Submit Verification Data Form' button. This will create a pdf of the verification form, write the verification data to the archive tab, protect the verification data sheet, and create the Transfer Standard Summary Sheet.</li><li>7.) Save File.</li><li>8.) Print pdf and affix the Transfer Standard Summary Sheet to the top of the transfer standard.</li></ol>	<p><i>Cell Key</i></p> <ol style="list-style-type: none"><li>1. Orange cells are calculated cells.</li><li>2. Grey cells are automatically filled.</li><li>3. Blue cells are user fillable cells.</li><li>4. All acceptance criteria are automatically calculated.</li><li>5. When an acceptance criteria passes, the cell turns green.</li><li>6. When an acceptance criteria fails, the cell turns red.</li></ol>
<p><i>Reverification</i></p> <ol style="list-style-type: none"><li>1.) When a reverification is required, locate the Excel verification data sheet and open it. All data except the Reverification tab will be protected.</li><li>2.) Complete all information in the blue cells.</li><li>3.) Run all points and fill in the data in the reverification table.</li><li>4.) Review acceptance criteria table as the reverification is completed.</li><li>5.) After a final review of data, click the 'Submit Reverification Data Form' button. This will create a pdf of the reverification form, write the verification data to the archive tab, clear the reverification data sheet, and create the Transfer Standard Summary Sheet.</li><li>6.) Save File.</li><li>7.) Print pdf and affix the Transfer Standard Summary Sheet to the top of the transfer standard.</li><li>8.) When the next reverification is required, locate the Excel verification data sheet and open it. All data except the Reverification tab will be protected.</li><li>9.) Repeat Reverification Steps 1-8 as needed.</li></ol>	
<h2>Entries will go in the blue cells</h2>	
<p>Instructions   Summary   Verification   Reverification   Archive   +</p>	

# Start at the verification tab...

This is the name that will be given to the PDFs and Excel sheets once saved

O3 Transfer Standard Verification Data Form		
Institute Conducting Verification:		
Operator:		
Cycle 3 Date:		
Naming Convention		
<b>Transfer Standard of Higher Authority</b>		
Transfer Standard Role:		
Make:		
Model:		
Serial Number:		
Verification Date:		
<b>Calibration Factors</b>		
Span Setting:		
Zero Setting:		
<b>Candidate Transfer Standard Information</b>		
Candidate Transfer Standard Role:		
Make:		
Model:		
Serial Number:		
Preventive Maintenance Date:		
Acceptance Testing Date:		
<b>Calibration Factors (describe calibration factor changes in comments)</b>		
	<b>Span Setting</b>	<b>Zero Setting</b>
As Found:		
As Left:		
Comments:		
		<b>Acceptance Criteria Checklist</b>
		<b>Verification Results:</b>
		Standard Role check: <b>fail</b>
		Acceptance Testing Completed: <b>error</b>
		Per Point Difference: <b>fail</b>
		Regression Slope Check: <b>fail</b>
		Regression Intercept Check: <b>error</b>
		Std Deviation Slope: <b>error</b> error
		Std Deviation Intercept: <b>error</b> error

Your agency's name

Your name/initials

Submit Verification Data Form

# Start at the verification tab...

**O3 Transfer Standard Verification Data Form**

Institute Conducting Verification:   
Operator:   
Cycle 3 Date:   
Naming Convention:

**Transfer Standard of Higher Authority**

Transfer Standard Role:

**Higher level TS** (highlighted box) points to:  
Make:   
Model:   
Serial Number:   
Verification Date:

**Calibration Factors**

Span Setting:   
Zero Setting:

**Candidate Transfer Standard Information**

Candidate Transfer Standard Role:   
Make:   
Model:   
Serial Number:   
Preventive Maintenance Date:   
Acceptance Testing Date:

**Candidate TS** (highlighted box) points to:  
Candidate Transfer Standard Role:   
Make:   
Model:   
Serial Number:   
Preventive Maintenance Date:   
Acceptance Testing Date:

**Calibration Factors (describe calibration factor changes in comments)**

	Span Setting	Zero Setting
As Found:	<input type="text"/>	<input type="text"/>
As Left:	<input type="text"/>	<input type="text"/>
Comments:	<input type="text"/>	

**Acceptance Criteria Checklist**

**Verification Results:** fail

Transfer Standard Role check:	error	
Preventive Maintenance Completed:	fail	
Acceptance Testing Completed:	fail	
Per Point Difference:	fail	
Regression Slope Check:	fail	
Regression Intercept Check:	error	
Std Deviation Slope:	error	error
Std Deviation Intercept:	error	error

**Submit Verification Data Form** (button)

**Run a zero and span point to determine if your candidate standard should be calibrated prior to verification** (text with lightbulb icon)

# Run your verification cycles

Each cycle requires at least 6 concentration points, plus a zero

Concentration points should be approximately evenly spaced from 0 to the calibration scale. Example for a cal scale of 200 ppb: 0, 30, 70, 100, 135, 170, 200



Cycle 1 Verification Data

Higher Level Standard		Candidate Transfer		Regression Statistics		Pass/Fail
NIST SRP SN 6	TEI 49iPS SN 1104947197	Percent Difference	Absolute Difference	Regression Slope:	Regression Intercept:	
Zero:	0.4	NA	-0.3	0.9964	-0.26	pass
Point 1:	217.7	-0.6%	-1.2			pass
Point 2:	193.3	-0.5%	-1.0			pass
Point 3:	168.0	-0.5%	-0.8			pass
Point 4:	142.9	-0.4%	-0.6			pass
Point 5:	115.0	-0.4%	-0.4			pass
Point 6:	75.7	-0.6%	-0.5			pass
Point 7:	42.7	-0.9%	-0.4			pass
Point 8:	25.0	-2.3%	-0.6			pass
Point 9:		-	0.0			-
Point 10:		-	0.0			-
Zero:	0.3	NA	-0.2			pass

Cycle 2 Verification Data

Higher Level Standard		Candidate Transfer		Regression Statistics		Pass/Fail
NIST SRP SN 6	TEI 49iPS SN 1104947197	Percent Difference	Absolute Difference	Regression Slope:	Regression Intercept:	
Zero:	0.4	NA	-0.2	0.9972	-0.23	pass
Point 1:	218.9	-0.4%	-0.8			pass
Point 2:	193.6	-0.4%	-0.8			pass
Point 3:	168.0	-0.4%	-0.7			pass
Point 4:	139.5	-0.4%	-0.5			pass
Point 5:	114.8	-0.6%	-0.7			pass
Point 6:	75.2	-0.7%	-0.5			pass
Point 7:	42.5	-0.8%	-0.3			pass
Point 8:	24.5	-1.0%	-0.2			pass
Point 9:		-	0.0			-
Point 10:		-	0.0			-
Zero:	0.3	NA	-0.2			pass

Cycle 3 Verification Data

Higher Level Standard		Candidate Transfer		Regression Statistics		Pass/Fail
NIST SRP SN 6	TEI 49iPS SN 1104947197	Percent Difference	Absolute Difference	Regression Slope:	Regression Intercept:	
Zero:	0.4	NA	-0.4	0.9988	-0.25	pass
Point 1:	215.4	-0.3%	-0.6			pass
Point 2:	192.5	-0.2%	-0.4			pass
Point 3:	166.9	-0.3%	-0.4			pass
Point 4:	138.7	-0.3%	-0.4			pass
Point 5:	114.1	-0.4%	-0.5			pass
Point 6:	74.7	-0.1%	-0.1			pass
Point 7:	42.1	-0.6%	-0.2			pass
Point 8:	24.4	-0.8%	-0.2			pass
Point 9:		-	0.0			-
Point 10:		-	0.0			-
Zero:	0.3	NA	-0.3			pass

# Check your acceptance criteria

## Does everything pass?

Acceptance Criteria Checklist	
<b>Verification Results:</b>	<b>fail</b>
Transfer Standard Role check:	pass
Preventive Maintenance Completed:	fail
Acceptance Testing Completed:	fail
Per Point Difference:	pass
Regression Slope Check:	pass
Regression Intercept Check:	pass
Std Deviation Slope:	pass
Std Deviation Intercept:	pass

no



Troubleshoot to resolve issues

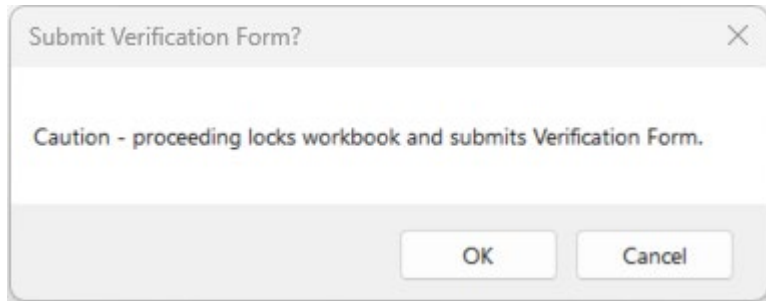
Acceptance Criteria Checklist	
Verification Results:	pass
Transfer Standard Role check:	pass
Preventive Maintenance Completed:	pass
Acceptance Testing Completed:	pass
Per Point Difference:	pass
Regression Slope Check:	pass
Regression Intercept Check:	pass
Std Deviation Slope:	pass
Std Deviation Intercept:	pass

yes

Press submit!

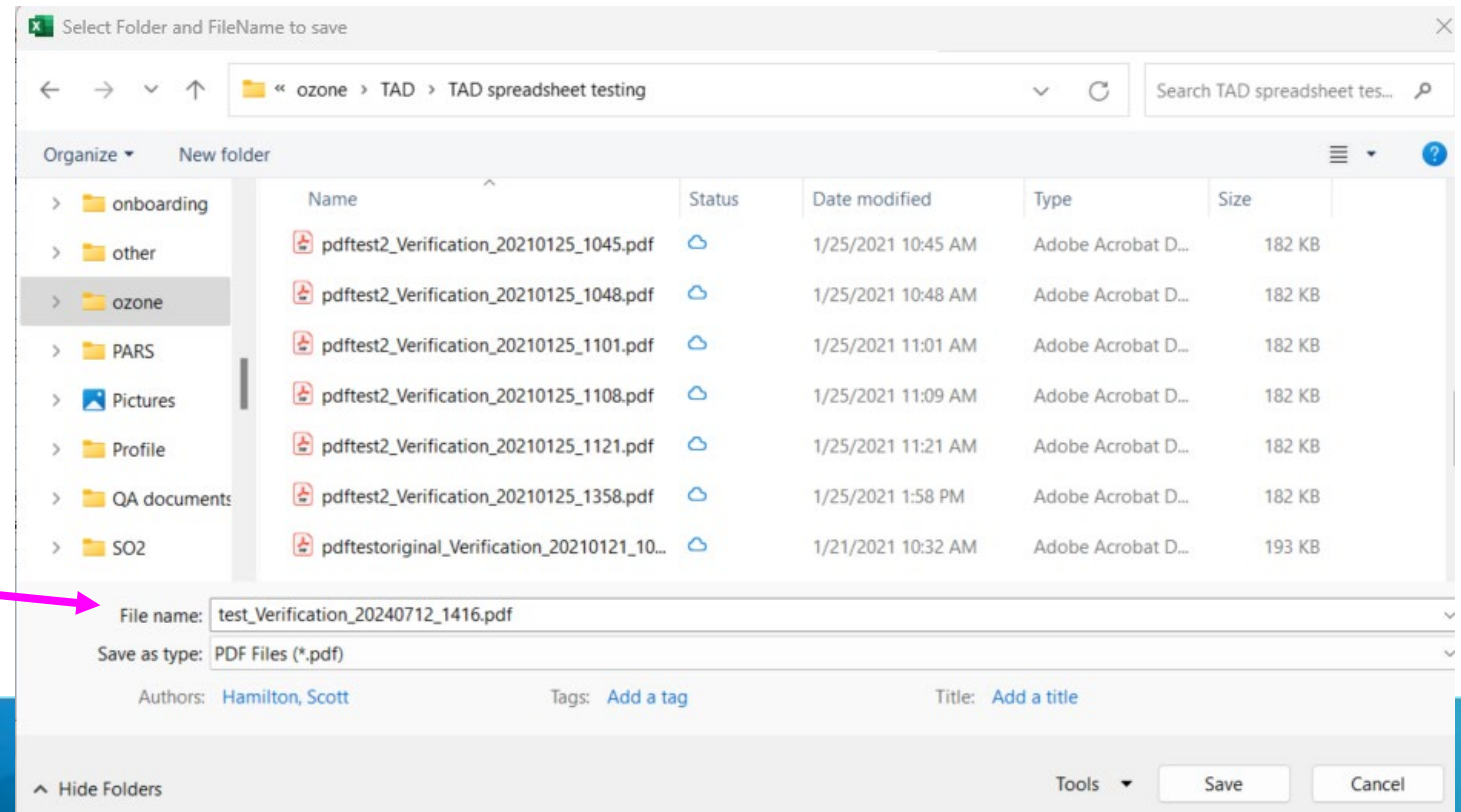
Submit Verification Data Form

# Pressing 'submit'



Save to your agency's files- does not go to EPA

Prepopulates to: naming convention + type of run + date/time



# Verification is complete!

Can sign and attach verification PDF to instrument

O3 Transfer Standard Verification Data Form		
Institute Conducting Verification:	USEPA Region 3	
Operator:	Scott Hamilton	
Cycle 3 Date:	6/16/2024	
Naming Convention	7197	
<b>Transfer Standard of Higher Authority</b>		
Transfer Standard Role:	Level 1 SRP	
Make:	NIST	
Model:	SRP	
Serial Number:	6	
Verification Date:	6/23/2023	
<b>Calibration Factors</b>		
Span Setting:	1.000	
Zero Setting:	0.0	
<b>Candidate Transfer Standard Information</b>		
Candidate Transfer Standard Role:	Level 2 Field	
Make:	TEI	
Model:	491PS	
Serial Number:	1104947197	
Preventive Maintenance Date:	3/20/2024	
Acceptance Testing Date:	3/20/2024	
<b>Calibration Factors (describe calibration factor changes in comments)</b>		
	<b>Span Setting</b>	<b>Zero Setting</b>
As Found:	1.012	-0.1
As Left:	1.012	-0.1
Comments:		
<b>Acceptance Criteria Checklist</b>		
Verification Results:	pass	
Transfer Standard Role check:	pass	
Preventive Maintenance Completed:	pass	
Acceptance Testing Completed:	pass	
Per Point Difference:	pass	
Regression Slope Check:	pass	
Regression Intercept Check:	pass	
Std Deviation Slope:	pass	
Std Deviation Intercept:	pass	
Signature:		
Date:		

Verification tab is no longer editable

Submit Verification Data Form

Verification Data Form has already been submitted. This form is now locked to prevent changes.



# Summary tab

## O<sub>3</sub> Transfer Standard Verification Summary Sheet

### Candidate Transfer Standard Information

Candidate Transfer Standard Role:	Level 2 Field
Make:	TEI
Model:	49iPS
Serial Number:	1104947197
Current Verification Expiration Date:	9/19/2024

Agency:	EPA Region 5 TTP
Operator:	Scott Hamilton
Candidate Standard As-left Slope:	1.012
Candidate Standard As-left Intercept:	-0.1

### Regression Slope/Intercept Summary (3 Verification Cycles)

	Slope	Intercept
Cycle 1 (2024-03-19)	0.9964	-0.2570
Cycle 2 (2024-03-19)	0.9972	-0.2341
Cycle 3 (2024-03-19)	0.9988	-0.2484
Average	0.9975	-0.2465
ACCEPTANCE CRITERIA UPPER	1.0125	1.2535
ACCEPTANCE CRITERIA LOWER	0.9825	-1.7465

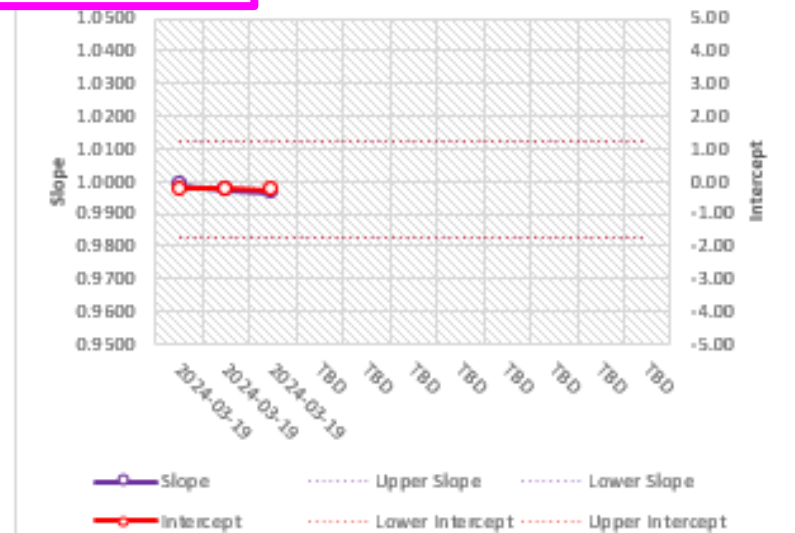
### Regression Slope/Intercept History

Date	Slope	Intercept
2024-03-19	0.9988	-0.25
2024-03-19	0.9972	-0.23
2024-03-19	0.9964	-0.26

Acceptance criteria for future re-verifications

### Control Charts

#### Verification Control Chart



Equation 10

$$\text{Standard } O_3 \text{ Conc} = \frac{1}{\bar{m}} (\text{Indicated } O_3 \text{ Conc} - \bar{b})$$

Print Summary Sheet





# Reverification

 Use the same file as the verification

- Enter info into the reverification tab's blue cells, and be sure that acceptance criteria all met before submitting reverification form

### O3 Transfer Standard Reverification Data Form

<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Institute Conducting Verification:</td><td>EPA R5</td></tr> <tr><td>Operator:</td><td>Scott Hamilton</td></tr> <tr><td>Date:</td><td>6/1/2024</td></tr> <tr><td>Naming Convention</td><td>7197</td></tr> <tr><td colspan="2" style="text-align: center;"><b>Transfer Standard of Higher Authority</b></td></tr> <tr><td>Transfer Standard Role:</td><td>Level 1 SRP</td></tr> <tr><td>Make:</td><td>NIST</td></tr> <tr><td>Model:</td><td>SRP</td></tr> <tr><td>Serial Number:</td><td>6</td></tr> <tr><td>Verification Date:</td><td>6/26/2023</td></tr> <tr><td colspan="2" style="text-align: center;"><b>Calibration Factors</b></td></tr> <tr><td>Span Setting:</td><td>1.000</td></tr> <tr><td>Zero Setting:</td><td>0.0</td></tr> <tr><td colspan="2" style="text-align: center;"><b>Candidate Transfer Standard Information</b></td></tr> <tr><td>Candidate Transfer Standard Role:</td><td>Level 2 Bench</td></tr> <tr><td>Make:</td><td>TEI</td></tr> <tr><td>Model:</td><td>49iPS</td></tr> <tr><td>Serial Number:</td><td>1104947197</td></tr> <tr><td>Preventive Maintenance Date:</td><td>6/1/2024</td></tr> <tr><td>Acceptance Testing Date:</td><td>6/1/2024</td></tr> <tr><td colspan="2" style="text-align: center;"><b>Calibration Factors (must match verification)</b></td></tr> <tr><td></td><td style="text-align: center;"><b>Span Setting</b></td><td style="text-align: center;"><b>Zero Setting</b></td></tr> <tr><td>As Found:</td><td style="text-align: center;">1.012</td><td style="text-align: center;">-0.1</td></tr> <tr><td>Comments:</td><td colspan="2" style="height: 100px;"></td></tr> </table>	Institute Conducting Verification:	EPA R5	Operator:	Scott Hamilton	Date:	6/1/2024	Naming Convention	7197	<b>Transfer Standard of Higher Authority</b>		Transfer Standard Role:	Level 1 SRP	Make:	NIST	Model:	SRP	Serial Number:	6	Verification Date:	6/26/2023	<b>Calibration Factors</b>		Span Setting:	1.000	Zero Setting:	0.0	<b>Candidate Transfer Standard Information</b>		Candidate Transfer Standard Role:	Level 2 Bench	Make:	TEI	Model:	49iPS	Serial Number:	1104947197	Preventive Maintenance Date:	6/1/2024	Acceptance Testing Date:	6/1/2024	<b>Calibration Factors (must match verification)</b>			<b>Span Setting</b>	<b>Zero Setting</b>	As Found:	1.012	-0.1	Comments:			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td colspan="2" style="text-align: center;"><b>Acceptance Criteria Checklist</b></td></tr> <tr><td>Verification Results:</td><td style="text-align: center;">pass</td></tr> <tr><td>Transfer Standard Role check:</td><td style="text-align: center;">pass</td></tr> <tr><td>Preventive Maintenance Completed:</td><td style="text-align: center;">pass</td></tr> <tr><td>Acceptance Testing Completed:</td><td style="text-align: center;">pass</td></tr> <tr><td>Calibration Factor Check:</td><td style="text-align: center;">pass</td></tr> <tr><td>Per Point Difference:</td><td style="text-align: center;">pass</td></tr> <tr><td>Regression Slope Check:</td><td style="text-align: center;">pass</td></tr> <tr><td>Regression Intercept Check:</td><td style="text-align: center;">pass</td></tr> <tr><td>Slope Acceptance Criteria:</td><td style="text-align: center;">pass</td></tr> <tr><td>Intercept Acceptance Criteria:</td><td style="text-align: center;">pass</td></tr> </table> <div style="text-align: center; margin-top: 20px; background-color: #555; color: white; padding: 10px; width: fit-content; margin: 0 auto;"> <b>Submit Reverification Data Form</b> </div>	<b>Acceptance Criteria Checklist</b>		Verification Results:	pass	Transfer Standard Role check:	pass	Preventive Maintenance Completed:	pass	Acceptance Testing Completed:	pass	Calibration Factor Check:	pass	Per Point Difference:	pass	Regression Slope Check:	pass	Regression Intercept Check:	pass	Slope Acceptance Criteria:	pass	Intercept Acceptance Criteria:	pass
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Slope Acceptance Criteria:	pass																																																																									
Intercept Acceptance Criteria:	pass																																																																									

Reverification Data					
	Higher Level Standard	Candidate Transfer	Percent Difference	Absolute Difference	Per Point Difference
	NIST SRP SN 6	TEI 49iPS SN 1104947197			
Zero:	0.0	0.1	NA	0.1	pass
Point 1:	198.2	200.8	1.3%	2.6	pass
Point 2:	174.4	176.7	1.3%	2.2	pass
Point 3:	151.6	153.7	1.4%	2.1	pass
Point 4:	129.0	130.5	1.2%	1.5	pass
Point 5:	109.7	111.0	1.2%	1.3	pass
Point 6:	72.5	73.2	1.0%	0.7	pass
Point 7:	40.8	41.0	0.5%	0.2	pass
Point 8:	23.6	23.5	-0.5%	-0.1	pass
Point 9:			-	0.0	-
Point 10:			-	0.0	-
Zero:	0.0	0.2	NA	0.2	pass

# Summary tab

## O<sub>3</sub> Transfer Standard Verification Summary Sheet

### Candidate Transfer Standard Information

Candidate Transfer Standard Role:	Level 2 Bench
Make:	Thermo
Model:	49iPS
Serial Number:	1104947197
Current Verification Expiration Date:	6/20/2025

### Regression Slope/Intercept Summary (3 Verification Cycles)

	Slope	Intercept
Cycle 1 (2024-05-16)	1.0154	-0.3893
Cycle 2 (2024-05-16)	1.0137	-0.1384
Cycle 3 (2024-05-16)	1.0149	-0.3076
Average	1.0147	-0.2784
ACCEPTANCE CRITERIA UPPER	1.0297	1.2216
ACCEPTANCE CRITERIA LOWER	0.9997	-1.7784

### Regression Slope/Intercept History

Date	Slope	Intercept
2024-06-20	1.0120	-0.25
2024-06-01	1.0143	-0.23
2024-05-16	1.0149	-0.31
2024-05-16	1.0137	-0.14
2024-05-16	1.0154	-0.39

### Control Charts

#### Reverification Control Chart

The chart displays two data series: Slope (blue line with circles) and Intercept (red line with circles). The x-axis shows dates from 2024-06-20 to 2024-05-16, with subsequent points marked as TBD. The left y-axis represents Slope (0.9500 to 1.0500) and the right y-axis represents Intercept (-5.00 to 5.00). Horizontal dashed lines indicate control limits: Upper Slope (1.0297), Lower Slope (0.9997), Upper Intercept (1.2216), and Lower Intercept (-1.7784). All data points remain within these control limits.

Equation 10

Standard C

Track slope/intercept history across verification/reverification cycles

↑

→

Print Summary Sheet



# Unbroken Chain of Calibrations at Each Level (NIST traceability)

- Equation 10 
$$\text{Standard } O_3 \text{ Conc} = \frac{1}{m} (\text{Indicated } O_3 \text{ Conc} - b)$$

Example: regression slope = 1.001

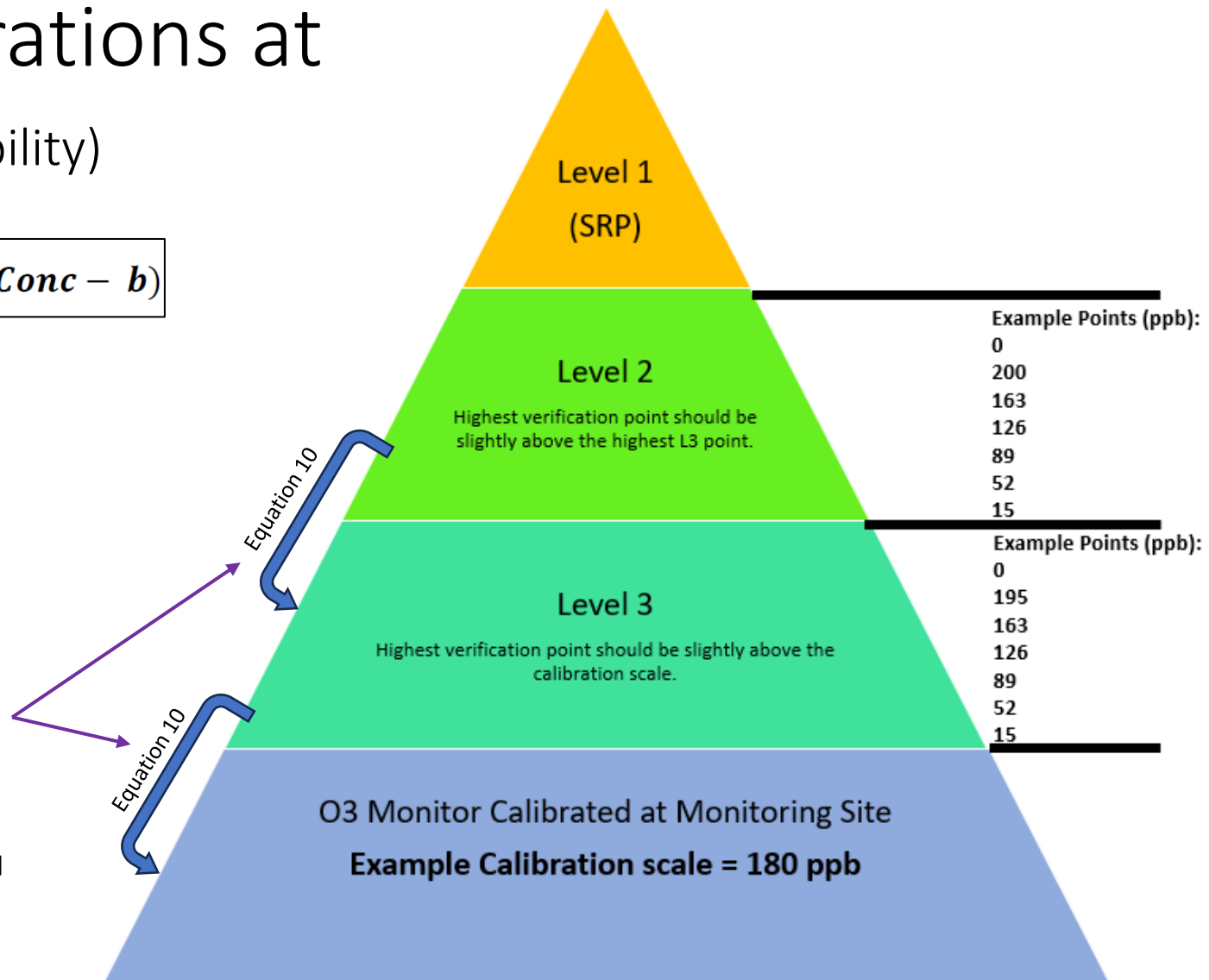
intercept = 0.3 ppb

indicated = 199.2 ppb

Standard  $O_3$  Conc =  $1/1.001 (199.2 - 0.3) = \mathbf{198.7 \text{ ppb}}$

**(use this number to calibrate)**

- Set span by conducting a push button calibration at all levels followed by verification
- Calibration field procedure = follow your SOP  
Bookend data! VERIFICATION / CALIBRATION / VERIFICATION



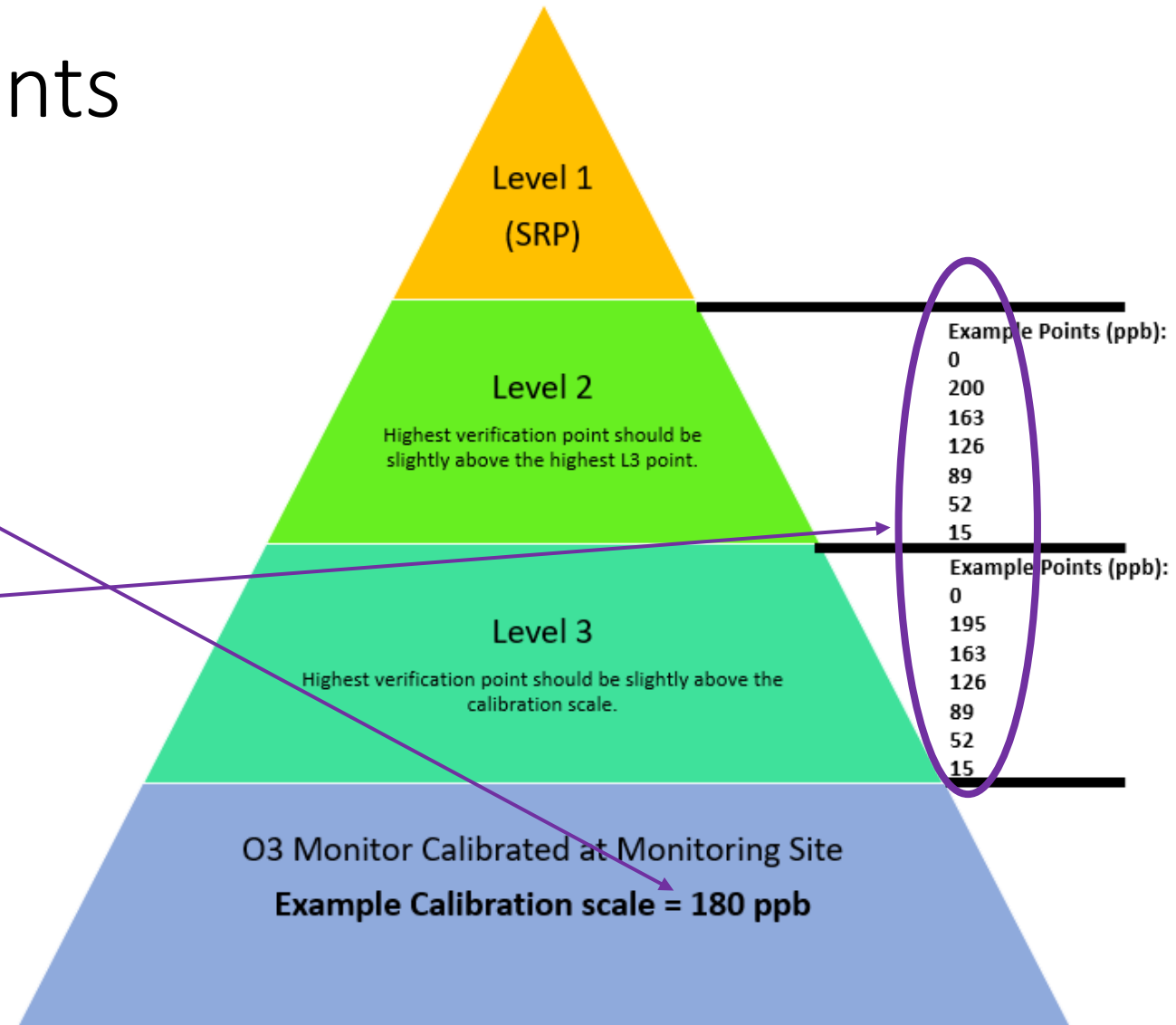
# Calibration Scale and Points

- Calibration Scale and Verification Points

- Scale is 1.5 times highest hourly O<sub>3</sub> or NAAQS

Highest O<sub>3</sub> concentration = 120 ppb \* 1.5 = **180 ppb**

- Highest Verification point at each level slightly above calibration scale at level below it.
- Approximately equally spaced
- Record “stable” points
  - Objective method and follow SOP
  - Be consistent



# To Summarize on Equation 10...

## **Transfer Standard Verifications:**

- Use equation 10 to set span point
- Complete verification using front panel display
- **Use front panel display for Quality Checks**

## **O<sub>3</sub> Monitor Calibration:**

- Use equation 10 to set span point
- **Use data logger channel** when conducting monitor Verification and Quality Checks (because this is the data reported to AQS)

# Quiz Questions

1. Which **best** describes the current O<sub>3</sub> NAAQS?
- a) 0.12 ppm hourly
  - b) 0.08 ppb hourly
  - c) 0.08 ppm annual 4<sup>th</sup> high
  - d) 0.070 ppm annual 4<sup>th</sup> high averaged over 3 years

# Quiz Questions

2. What is the **best** way to train new employees on O<sub>3</sub> monitoring?
- a) Have new staff write your QAPP before conducting hands on work
  - b) Conduct shadowing and mentoring with seasoned staff
  - c) Training is overrated and not necessary
  - d) Request new staff read all instrument manuals before touching any equipment

# Quiz Questions

3. Who is responsible to conduct acceptance testing?
- a) Site operators
  - b) Person conducting verification or reverification
  - c) EPA Regional Office
  - d) Greg Noah



# Quiz Questions

4. Can I build my own O<sub>3</sub> transfer standard?

- a) No
- b) Yes, if it meets 40 CFR 50

***Should*** I build my own O<sub>3</sub> transfer standard?

- a) No, there are ample commercially available devices on the market
- b) Yes, I like fooling around with electronics and science stuff

# Quiz Questions

5. Can I use a device that does not have a photometer?
- a) Yes, if it meets 40 CFR 50 Appendix D § 4.3
  - b) Yes, if my QAPP specifies a procedure
  - c) Yes, if the O<sub>3</sub> generator is approved by my EPA Regional Office
  - d) No, all O<sub>3</sub> transfer standards must meet the specifications in 40 CFR Part 50 Appendix D § 4.3

# Quiz Questions

6. If my **L3 Field TS verification** was conducted on April 1, 2024, and I first took it to the field on June 1, 2024, when is the reverification due?

- a) April 1, 2025 (1-year after verification)
- b) December 1, 2024 (6-months after the first use)
- c) October 1, 2024 (6-months after the verification)
- d) Not until the device starts acting up

# Quiz Questions

7. When does a field standard become a bench standard?
- a) 1-month after being put into service
  - b) When the device is used as a bench standard and properly labelled
  - c) When the field operator needs to use it as a bench standard
  - d) When the device is reverified and properly labelled

# Quiz Questions

8. When does a bench standard become a field standard?
- a) 1-month after being put into service
  - b) When the device is used as a field standard and properly labelled
  - c) When needed as a field standard (i.e., needed back up)
  - d) When the device is reverified and properly labelled

# Quiz Questions

9. Can I use my transfer standard 1 day after the verification has expired?

- a) Yes, these re-verification time periods are only recommendations
- b) Maybe, depending on whether it has been operating properly
- c) Maybe, but only for APEs (not for calibrations)
- d) No

# Quiz Questions

10. If my verification expired by 15 days, how many cycles is required for a reverification?

- a) A full 6X6 is required
- b) 1 cycle
- c) 3 cycles
- d) Depends on what my QAPP says

What about 50 days?

# Quiz Questions

11. What is the correct sequence for conducting a verification?
- a) Acceptance testing, warm up and condition, run preliminary zero and high point
  - b) Run preliminary zero and high point, warm up and condition, acceptance test
  - c) Just set it up and run 3 cycles at 100, 200, 300, and 400 ppb (80% URL)
  - d) Warm up and condition, check documentation, acceptance testing, run preliminary zero and span



# Quiz Questions

12. Is the previous verification regression slope and intercept important to my reverification process?

- a) No, I just ignore all previous data to simplify the process and create less burden
- b) Yes, I look at this to determine acceptance criteria for reverification
- c) No, just set it up and run 3 cycles

# Quiz Questions

13. My datalogger channel does **not** have a regression slope and intercept for the current calibration. Do I use Equation 10 to set the span point during a **push button calibration**?

- a) No, I really don't need the equation thing
- b) No, since this is how we have always done it
- c) Yes, the regression slope and intercept with Equation 10 creates the unbroken chain of calibrations required by the NIST 7 Essential Elements of Traceability.
- d) Maybe, depending on what my QAPP says

# Quiz Questions

14. What factors impact residence time?

- a) Inlet line length, type and shelter temperature
- b) Inlet line length, line inside diameter, and sample flow
- c) Inlet line length, inside diameter, sample flow, manifold volume and flow (if applicable)
- d) Both b and c are correct

# Quiz Questions

15. When conducting biweekly precision checks and annual performance evaluations, should **Target or Actual** concentrations be reported to AQS?

- a) Call Brannon Seay and ask him for every point.
- b) Use the target concentration because it doesn't change and is easiest.
- c) Use the actual concentration because that is the value that the verified photometer is reporting.
- d) Flip a coin.

# Quiz Questions

16. Should I pay attention to the monitoring station siting when visiting a site?

- a) No because that's not my job
- b) Yes, siting criteria are in CFR and important for regional and national consistency
- c) Call Bilal at 867-5309 from EPA Region 9 and ask each time I go to a site

# Quiz Questions

17. If my highest 1-hour O<sub>3</sub> concentration measured in the last three years is 100 ppb, then what should my calibration scale be?

- a) 100 ppm
- b) 100 ppb
- c) 150 ppb
- d) 1.5 times the NAAQS

Do these look like good points to run?

0, 150, 125, 100, 75, 50, 25

# What would you do if...

...you went to a monitoring site to do a biweekly precision check and the monitor was reading 86 ppb O<sub>3</sub> upon arrival?

...you went to a monitoring site to conduct a biweekly precision check and the shelter temp was 35C?

...you went to a monitoring site to conduct a biweekly precision check and the monitor was totally dead?

# What would you do if...

...you went to a monitoring site and the TTP zero is reading 10 ppb and the high point is reading 15% high?

...you went to a monitoring site and the TTP zero is reading 0 ppb, the high point is reading minus 15%?

...you went to a monitoring site to conduct a biweekly precision check and the precision point is bouncing between 72 ppb and 79 ppb?



# What would you do if...

...you received a transfer standard for L3 reverification, and the flow was below the required flow in the manual?

...you received a generator only transfer standard for verification?

...you received a transfer standard for reverification, and there is no previous documentation?

# What would you do if...

...you went to a monitoring site and the TTP auditor won't tell you the expected concentration?

...you went to a monitoring site to conduct a calibration. The zero was 0.1 ppb and high point was 5% high?

...you received a transfer standard for reverification, and it was reading 5% high at 200 ppb?

...you went to a monitoring site to conduct a biweekly precision check and the transfer standard was reading 85 ppb?

# What would you do if...

...you are conducting an APE the span point is only at 80% of expected and is climbing by 1 ppb slowly?

...you went to a monitoring site and noticed a spider living in the inlet?

...you went to a monitoring site and calculated a residence time of 39 seconds?

...you went to a monitoring site and completed a push button calibration. What must you do next?

# Final Questions