



Instrument Calibration for Status & Trend Networks Projects Section 3 - Status & Trend Networks Sampling Manual

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Presentation Outline

1. Definitions
2. General Requirements
3. Detailed Requirements,
Listed by Parameter
4. Troubleshooting



Definitions

(page 15 of Sampling Manual)

Initial Calibration (IC):

The instrument or meter electronics are **adjusted** to a theoretical value or a known value of a calibration standard.

Initial Calibration Verification (ICV):

The instrument or meter calibration is **checked, directly following the initial calibration**, by measuring a calibration standard of known value as if it were a sample. The measured result is compared to the calibration acceptance criteria.



Definitions

(page 15 of Sampling Manual)

Continuing Calibration Verification (CCV):

The instrument or meter calibration is **checked** or verified by measuring a calibration standard of known value as if it were a sample. The measured result is compared to the calibration acceptance criteria.

Acceptance Criteria:

The numerical limits within which calibration verifications are acceptable.



Bracketing Requirements

All field data must be bracketed by passing calibration or verification data.

- Chronologically

Need verification before collecting field data AND verification after collecting field data.

- Quantitatively

Standards used for calibration / verification must encompass range of values observed in field.



Specific Conductance Example

Bracket samples by standard range and time!

7:30 Calibrate (1000 $\mu\text{mhos/cm}$)



7:35 ICV (100 $\mu\text{mhos/cm}$)



10:00 Sample Collection (1525 $\mu\text{mhos/cm}$)



15:30 End of Day CCV (5000 $\mu\text{mhos/cm}$)

Documentation

Calibration log required for all calibrations and verifications

- SOP reference
- Meter ID
- Date / Time of each calibration or verification
- Info. about standards
- Instrument reading
- Result (Pass / Fail)
- Name of person performing each activity

CALIBRATION AND VERIFICATION LOG (FDEP SOP FT 1000-FT 1500, FD 1000-FD 4000)

Meter ID:

RQ:

Project:

Boldly "X" this box if there are qualified data on this page.

Notes: (1) Always wait for meter to stabilize before recording any readings.

(2) Report all digits displayed. Do not round before reporting measurements. (See special instructions for depth).

(3) For Calibrations, record calibrated meter reading. Do not record initial meter reading before calibration.

Temperature (Quarterly) FT 1400

Date of Last Temperature Verification

DO DEP SOP FT 1500	Name	Date	Time CT-ET	Temp °C	Baro-meter mmHg	D.O. Chart mg/L	Meter D.O. mg/L	% DO	Probe Charge	Probe Gain	Pass / Fail	Lab / Field
Calibr.											P / F	L / F
ICV											P / F	L / F
CCV											P / F	L / F
CCV											P / F	L / F

DO Acceptance criteria from Table ± 0.3 mg/L.

Rapid-Pulse Sensors: DO Gain Range 0.7 to 1.4; DO Charge Range 25-75.

Optical: DO gain range 0.85 to 1.15 (Pro DSS 0.75 to 1.50); DO charge N/A. **Steady-state & Galvanic Sensors:** DO Gain & Charge N/A.

Spec. Cond. FT 1200	Name	Date	Time CT-ET	Lot #	Expir. Date	Standard μ mhos/cm	Meter Reading μ mhos/cm	Pass / Fail	Lab / Field
Calibr.								P / F	L / F
ICV								P / F	L / F
CCV								P / F	L / F
CCV								P / F	L / F

Conductivity Acceptance criteria $\pm 5\%$

pH DEP SOP FT 1100	Name	Date	Time CT-ET	Lot #	Expir. Date	pH Buffer SU	Temp °C	Meter reading SU	mV	Pass / Fail	Lab / Field
Calibr.						7.				P / F	L / F
Calibr.						4.				P / F	L / F
Calibr.						10.				P / F	L / F
ICV										P / F	L / F
CCV										P / F	L / F
CCV										P / F	L / F

pH Acceptance criteria ± 0.2 SU; mV pH 7 Range 0 ± 50 ; mV pH 4 Range $+180 \pm 50$; mV pH 10 Range -180 ± 50 ;

If mV are recorded: slope from 7 to 10 _____, slope from 4 to 7 _____ (both must be between 165 and 180 mV)

Does meter have a depth sensor that will be used to measure total depth & sample depth? YES / NO / NA (not surf. water project)

If YES, complete daily Calibr. & ICV below and list date of last quarterly depth verification: _____

If NO, what will be used? (circle one) **Secchi Disk Line / Sonar** Unique ID: _____; Date of last verification: _____

Depth Sensor (Daily Calibration & ICV)	Name	Date	Time CT-ET	Calibrated Value (0.00 or Offset), meters	ICV Value, meters	Pass / Fail	Lab / Field
Pressure mode in air						P / F	L / F

Report two decimal places. Round numbers ≤ 4 down, ≥ 5 up. ICV acceptance criteria $\pm 5\%$ or ± 0.05 m, whichever is greater.

COMMENTS:



Documentation

When documenting a date, always include month, day & year (MM/DD/YYYY)

Complete all required fields for each calibration log entry. (Acceptable to use arrows / ditto marks)

Spec. Cond. FT 1200	Name	Date	Time CT-ET	Lot #	Expir. Date	Standard μ hos/cm	Meter Reading μ hos/cm	Pass / Fail	Lab / Field
Calibr.	JANE DOE	3/23/2022	07:45	C3PO	04/30/2023	1000	1005	P/ F	L/ F
ICV	JANE DOE	3/23/2022	08:05	R2D2	05/31/2023	100	101	P/ F	L/ F
CCV	JANE DOE	3/23/2022	13:55	OBE1	06/30/2023	5000	5015	P/ F	L/ F
CCV	JANE DOE	3/23/2022	14:00	R2D2	05/31/2023	100	102	P/ F	L/ F

Conductivity Acceptance criteria $\pm 5\%$

Spec. Cond. FT 1200	Name	Date	Time CT-ET	Lot #	Expir. Date	Standard μ hos/cm	Meter Reading μ hos/cm	Pass / Fail	Lab / Field
Calibr.	JANE DOE	3/23/2022	07:45	C3PO	04/30/2023	1000	1005	P/ F	L/ F
ICV	*****	*****	08:05	R2D2	05/31/2023	100	101	P/ F	L/ F
CCV	*****	*****	13:55	OBE1	06/30/2023	5000	5015	P/ F	L/ F
CCV	*****	*****	14:00	R2D2	05/31/2023	100	102	P/ F	L/ F

Conductivity Acceptance criteria $\pm 5\%$



Standards

Do not reuse standards.

- Use a fresh aliquot of standard for each activity (IC, ICV, CCV).

Do not use expired standards.

- Unless they have been previously verified against other (non-expired) standards. – Contact QA Officer for requirements.

(Table 6, p. 133)

Parameter	Number of Decimal Places To Record	Calibration / Verification Frequency	Acceptance Criteria
pH	All Displayed	Daily IC, ICV, CCV	± 0.2 SU
Specific Conductance	All Displayed	Daily IC, ICV, CCV	± 5%
Dissolved Oxygen	All Displayed	Daily IC, ICV, CCV	± 0.3 mg/L
Temperature	All Displayed	Quarterly CCV	± 0.5 °C
Turbidity	All Displayed	<u>Daily</u> CCV; <u>Quarterly</u> IC, ICV, secondary standard verification;	0.1 - 10 NTU: ± 10%; 11-40 NTU: ± 8%; 41-100 NTU: ± 6.5%; > 100 NTU: ± 5%
Depth	<u>Cal. / Ver.:</u> 2 for electronic devices; 1 for manual devices <u>Field Meas.:</u> 2 if total depth < 0.6 m; 1 if total depth ≥ 0.6 m	<u>Daily:</u> IC, ICV for Sondes. <u>Quarterly:</u> Verify Sondes & Electronic Devices. <u>Every 6 months:</u> Inspect Manual Devices.	<u>ICV:</u> ± 5% or ± 0.05 m, whichever is greater; <u>Electronic Device Check:</u> ± 10%; <u>Line Increments:</u> ± 10%; <u>Total Length of Lines:</u> ± 5%;



Daily Calibration Procedures:

**Dissolved Oxygen (DO),
Specific Conductance, & pH**

Required: Initial Calibration (IC) at beginning of day.

Required: Initial Calibration Verification (ICV) immediately following IC.

Required: Continuing Calibration Verification (CCV) at end of day.

Recommended: Mid-day CCV at sample site. Mid-day CCV required if end of day CCVs routinely fail.



pH

Check pH millivolts at least weekly (daily check recommended).

Always begin 3-point calibration with pH 7 buffer.

Rinse well with DI (required) and fresh buffer (recommended) before each calibration or verification activity.

Select buffers to bracket values measured in the field. May need buffers < 4 or > 10.

pH of buffer solutions varies with temperature. If using adjusted calibration values, need to adjust expected value for verifications.



This buffer will give pH values accurate to ± 0.02 at the following temperatures:	
Degrees C	pH
0	10.34
5	10.26
10	10.19
15	10.12
20	10.06
25	10.00
30	9.94
35	9.90
40	9.85
50	9.78
60	9.70



pH

When using a meter with auto buffer recognition and temperature-adjusted pH calibration values populated by the meter:

Document temperature-adjusted pH buffer value (from container / reference chart).

pH DEP SOP FT 1100	Name	Date	Time CT-ET	Lot #	Expir. Date	pH Buffer SU	Temp °C	Meter reading SU	mV	Pass / Fail	Lab / Field
Calibr.	JANE DOE	3/23/2022	6:45	8675309	1/31/2023	7.03	18.0	7.03	-37.9	P / F	L / F
Calibr.	JANE DOE	3/23/2022	6:47	7765577	1/31/2023	4.00	18.0	4.00	138.7	P / F	L / F
Calibr.	JANE DOE	3/23/2022	6:49	6488888	1/31/2023	10.08	18.0	10.08	-204.5	P / F	L / F
ICV	JANE DOE	3/23/2022	6:53	7765577	1/31/2023	4.00	18.3	4.02		P / F	L / F
CCV	JANE DOE	3/23/2022	14:10	6488888	1/31/2023	10.12	15.0	10.30		P / F	L / F
CCV										P / F	L / F

pH Acceptance criteria ± 0.2 SU; mV pH 7 Range 0 ± 50 ; mV pH 4 Range $+180 \pm 50$; mV pH 10 Range -180 ± 50 ;
 If mV are recorded: slope from 7 to 10 166.6, slope from 4 to 7 176.6 (both must be between 165 and 180 mV)



Specific Conductance

Always use Potassium Chloride (KCl) standards.

Rinse well with DI and fresh standard before each calibration point or reading.

Select standards to bracket values measured in the field.

If observed field values are lower than 100 $\mu\text{mhos/cm}$, you must use the 100 $\mu\text{mhos/cm}$ standard for CCV.

You do not need to use standards lower than 100 $\mu\text{mhos/cm}$.



Note: For all YSI models, manually enter standard value during calibration (no auto-recognition of standards).

Specific Conductance

If all field meas. < 100 $\mu\text{mhos/cm}$:

Spec. Cond. FT 1200	Name	Date	Time CT-ET	Lot #	Expir. Date	Standard $\mu\text{mhos/cm}$	Meter Reading $\mu\text{mhos/cm}$	Pass / Fail	Lab / Field
Calibr.	JANE DOE	3/23/2022	07:45	C3PO	04/30/2023	1000	1005	P / F	L / F
ICV	JANE DOE	3/23/2022	08:05	R2D2	05/31/2023	100	101	P / F	L / F
CCV	JANE DOE	3/23/2022	13:55	R2D2	05/31/2023	100	102	P / F	L / F
CCV								P / F	L / F

Conductivity Acceptance criteria $\pm 5\%$

If field meas. have wide range.

Some > 1000 $\mu\text{mhos/cm}$ and some < 100 $\mu\text{mhos/cm}$:

Spec. Cond. FT 1200	Name	Date	Time CT-ET	Lot #	Expir. Date	Standard $\mu\text{mhos/cm}$	Meter Reading $\mu\text{mhos/cm}$	Pass / Fail	Lab / Field
Calibr.	JANE DOE	3/23/2022	07:45	C3PO	04/30/2023	1000	1005	P / F	L / F
ICV	JANE DOE	3/23/2022	08:05	R2D2	05/31/2023	100	101	P / F	L / F
CCV	JANE DOE	3/23/2022	13:55	OBE1	06/30/2023	5000	5015	P / F	L / F
CCV	JANE DOE	3/23/2022	14:00	R2D2	05/31/2023	100	102	P / F	L / F

Conductivity Acceptance criteria $\pm 5\%$



Dissolved Oxygen

Calibrate with water-saturated air or air-saturated water

Temperature sensitive

Use room temperature water

Allow meter temperature & DO to stabilize before calibrating

Inspect probe for damage daily

Check DO gain and charge at least weekly. (Gain for both membrane & optical; Charge for membrane probes)

If an internal barometer is part of the multiprobe device – Verify annually





Dissolved Oxygen

Document the following for each calibration or verification:

- Barometer value (760 mmHg or internal barometer reading)
- Temperature (°C)
- DO mg/L
- DO % saturation

Compare DO mg/L meter reading to “Solubility of Oxygen in Water” reference table value for matching temperature and barometric pressure.

Solubility of oxygen in fresh water at various temperatures and pressures. (Solubility shown in milligrams per liter.)																		
Values based on published equations by Benson and Krause (1980 and 1984). Results from DOTABLES program at https://water.usgs.gov/software/DOTABLES/ .																		
Temp. (°C)	Barometric Pressure (mm Hg)																	
	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767
19.0	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.4	9.4
19.1	9.1	9.1	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
19.2	9.1	9.1	9.1	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.3	9.3	9.3	9.3	9.3	9.3	9.3
19.3	9.1	9.1	9.1	9.1	9.1	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.3	9.3	9.3	9.3	9.3

(Table 6, p. 133)

Parameter	Number of Decimal Places To Record	Calibration / Verification Frequency	Acceptance Criteria
pH	All Displayed	Daily IC, ICV, CCV	± 0.2 SU
Specific Conductance	All Displayed	Daily IC, ICV, CCV	$\pm 5\%$
Dissolved Oxygen	All Displayed	Daily IC, ICV, CCV	± 0.3 mg/L
Temperature	All Displayed	Quarterly CCV	± 0.5 °C
Turbidity	All Displayed	<u>Daily</u> CCV; <u>Quarterly</u> IC, ICV, secondary standard verification;	0.1 - 10 NTU: $\pm 10\%$; 11-40 NTU: $\pm 8\%$; 41-100 NTU: $\pm 6.5\%$; > 100 NTU: $\pm 5\%$
Depth	<u>Cal. / Ver.:</u> 2 for electronic devices; 1 for manual devices <u>Field Meas.:</u> 2 if total depth < 0.6 m; 1 if total depth ≥ 0.6 m	<u>Daily:</u> IC, ICV for Sondes. <u>Quarterly:</u> Verify Sondes & Electronic Devices. <u>Every 6 months:</u> Inspect Manual Devices.	<u>ICV:</u> $\pm 5\%$ or ± 0.05 m, whichever is greater; <u>Electronic Device Check:</u> $\pm 10\%$; <u>Line Increments:</u> $\pm 10\%$; <u>Total Length of Lines:</u> $\pm 5\%$;



Temperature

Required: quarterly CCV.

Compare meter reading to NIST traceable thermometer reading.

Perform verification at 2 different temperatures (e.g. ice bath & warm water bath)



Quarterly Temperature Verification Regional Operation Centers

DEP SOP FT 1400; Acceptance Criteria for Temp. $\pm 0.5^{\circ}\text{C}$.

Correction factor needed if acceptance criteria are exceeded.

Record all digits displayed for temperature readings. Do not round before reporting measurements.

Meter ID#: _____ Date of Last Verification: _____

Date: _____ Time: _____ ETZ / CTZ NIST Reference Device ID#: _____

Cold Bath (between $0 - 10^{\circ}\text{C}$): Sonde: _____ $^{\circ}\text{C}$; NIST: _____ $^{\circ}\text{C}$; Result: Pass / Fail

Warm Bath (between $30 - 40^{\circ}\text{C}$): Sonde: _____ $^{\circ}\text{C}$; NIST: _____ $^{\circ}\text{C}$; Result: Pass / Fail

Is Correction Factor Needed? Y / N If yes, describe: _____

Person Performing Verification: _____

Comments: _____

(Table 6, p. 133)

Parameter	Number of Decimal Places To Record	Calibration / Verification Frequency	Acceptance Criteria
pH	All Displayed	Daily IC, ICV, CCV	± 0.2 SU
Specific Conductance	All Displayed	Daily IC, ICV, CCV	$\pm 5\%$
Dissolved Oxygen	All Displayed	Daily IC, ICV, CCV	± 0.3 mg/L
Temperature	All Displayed	Quarterly CCV	± 0.5 °C
Turbidity	All Displayed	<u>Daily</u> CCV; <u>Quarterly</u> IC, ICV, secondary standard verification;	0.1 - 10 NTU: $\pm 10\%$; 11-40 NTU: $\pm 8\%$; 41-100 NTU: $\pm 6.5\%$; > 100 NTU: $\pm 5\%$
Depth	<u>Cal. / Ver.:</u> 2 for electronic devices; 1 for manual devices <u>Field Meas.:</u> 2 if total depth < 0.6 m; 1 if total depth ≥ 0.6 m	<u>Daily:</u> IC, ICV for Sondes. <u>Quarterly:</u> Verify Sondes & Electronic Devices. <u>Every 6 months:</u> Inspect Manual Devices.	<u>ICV:</u> $\pm 5\%$ or ± 0.05 m, whichever is greater; <u>Electronic Device Check:</u> $\pm 10\%$; <u>Line Increments:</u> $\pm 10\%$; <u>Total Length of Lines:</u> $\pm 5\%$;



Turbidity (Groundwater Projects Only)

Reading a standard or sample:

Place meter on level surface.

Check cuvette for scratches.

Dry cuvette with lint-free wipe.

Handle cuvette carefully (no fingerprints or dirt on glass).

Ensure cuvette orientation is correct when inserting into meter.





Turbidity (Groundwater Projects Only)

*Use portable turbidimeter with tungsten filament light source
(e.g. Hach 2100P or Hach 2100Q)*

Two types of standards

Primary Formazin (Required)

Used for calibrations or verifications.

Require agitation before use.

Temperature sensitive (use between 0°C and 25°C).

Secondary Gel (Optional)

Values are assigned by instrument user after each meter calibration.
Assigned values are instrument- and calibration-specific.

If meter is recalibrated, must also redo verification of secondary gel standards.

Used for CCVs only.

Do not require agitation and are less temperature sensitive.





Turbidity (Groundwater Projects Only)

Quarterly Requirements:

IC using at least 2 primary formazin standards.

ICV immediately after IC using at least 1 primary formazin standard.

If using secondary gel standards, verify all secondary gel standards immediately after ICV.

Read each gel standard and assign current reading as the standard's value.

Daily Requirements:

CCV using at least 1 secondary gel standard or primary formazin standard.

For all verifications (ICV & CCVs)

Do not use turbidity-free water or <0.1 NTU standard.

Documentation: Turbidity Calibration Log

Quarterly Activities

Daily Activities

Meter ID: _____ Date of Last Calibration: _____ Project Name: _____

Quarterly Calibration

Sampler Name: _____ Date: _____ Time: _____ ETZ / CTZ (circle one)

Standard Value (Use Primary Formazin Standards)	Exp. Date	Lot #	Type of Information Displayed During Calibration? (circle one)	Value Displayed NTU	Calibration Pass / Fail (circle one)
NTU			Meter Reading / Next Value		P / F
NTU			Meter Reading / Next Value		P / F
NTU			Meter Reading / Next Value		P / F
NTU			Meter Reading / Next Value		P / F

Initial Calibration Verification (ICV) (Only perform ICV immediately after quarterly calibr. Do not use < 0.1 NTU standard for ICV.)

Sampler Name: _____ Date: _____ Time: _____ ETZ / CTZ (circle one)

Standard Value (Use A Primary Formazin Standard)	Exp. Date	Lot #	Meter Reading NTU	Pass / Fail (circle one)
NTU				P / F

Secondary Gel Standard Quarterly Verification (perform gel standard verification immediately after quarterly calibr. and ICV)

Sampler Name: _____ Date: _____ Time: _____ ETZ / CTZ (circle one)

Standard Value Range NTU	Previous Value Assigned NTU	Exp. Date	Lot #	Meter Reading NTU (new value assigned)	Acceptable Range, NTU (Calculate using new value assigned & acceptance criteria*)
0 – 10					
10 – 100					
100 - 1000					

Daily Continuing Calibration Verification (CCV) (required every day that meter is used)

Date	Time (24hr) CT-ET	Sampler Name	Standard Type (circle one)	Standard Value NTU	Exp. Date	Lot #	Meter Reading NTU	Pass / Fail
			Formazin / Gel					P / F
			Formazin / Gel					P / F
			Formazin / Gel					P / F
			Formazin / Gel					P / F
			Formazin / Gel					P / F
			Formazin / Gel					P / F
			Formazin / Gel					P / F
			Formazin / Gel					P / F
			Formazin / Gel					P / F

Comments:

*Acceptance Criteria: 0.1-10 NTU → ± 10 %; 11-40 NTU → ± 8 %; 41-100 NTU → ± 6.5 %; >100 NTU → ± 5 %;

Acceptable ranges for common standards: 20 NTU (18.4 - 21.6 NTU); 100 NTU (93.5 - 106.5 NTU); 800 NTU (760 - 840 NTU)

(Table 6, p. 133)

Parameter	Number of Decimal Places To Record	Calibration / Verification Frequency	Acceptance Criteria
pH	All Displayed	Daily IC, ICV, CCV	± 0.2 SU
Specific Conductance	All Displayed	Daily IC, ICV, CCV	$\pm 5\%$
Dissolved Oxygen	All Displayed	Daily IC, ICV, CCV	± 0.3 mg/L
Temperature	All Displayed	Quarterly CCV	± 0.5 °C
Turbidity	All Displayed	<u>Daily</u> CCV; <u>Quarterly</u> IC, ICV, secondary standard verification;	0.1 - 10 NTU: $\pm 10\%$; 11-40 NTU: $\pm 8\%$; 41-100 NTU: $\pm 6.5\%$; > 100 NTU: $\pm 5\%$
Depth	<u>Cal. / Ver.:</u> 2 for electronic devices; 1 for manual devices <u>Field Meas.:</u> 2 if total depth < 0.6 m; 1 if total depth ≥ 0.6 m	<u>Daily:</u> IC, ICV for Sondes. <u>Quarterly:</u> Verify Sondes & Electronic Devices. <u>Every 6 months:</u> Inspect Manual Devices.	<u>ICV:</u> $\pm 5\%$ or ± 0.05 m, whichever is greater; <u>Electronic Device Check:</u> $\pm 10\%$; <u>Line Increments:</u> $\pm 10\%$; <u>Total Length of Lines:</u> $\pm 5\%$;

Depth (Surface Water Projects Only)

Parameter	Number of Decimal Places To Record	Calibration / Verification Frequency	Acceptance Criteria
Depth	<u>Cal. / Ver.:</u> 2 for electronic devices; 1 for manual devices <u>Field Meas.:</u> 2 if total depth < 0.6 m; 1 if total depth ≥ 0.6 m	<u>Daily:</u> IC, ICV for Sondes. <u>Quarterly:</u> Verify Sondes & Electronic Devices. <u>Every 6 months:</u> Inspect Manual Devices.	<u>ICV:</u> $\pm 5\%$ or ± 0.05 m, whichever is greater; <u>Electronic Device Check:</u> $\pm 10\%$; <u>Line Increments:</u> $\pm 10\%$; <u>Total Length of Lines:</u> $\pm 5\%$;

Rounding Rule:

Numbers ≤ 4 are rounded down (e.g. 5.14 becomes 5.1).

Numbers ≥ 5 are rounded up (e.g. 5.15 becomes 5.2).



Depth (Surface Water Projects Only)

Daily Requirement: *Zero depth sensor on field multi-parameter meters (if applicable) and perform ICV.*

Acceptance criteria: $\pm 5\%$ or ± 0.05 m, whichever is greater.



photo source: <https://sontek.com>



Depth (Surface Water Projects Only)

Quarterly Requirements:

Check all electronic devices used for depth measurement by comparing reading to a reference device (graduated bucket, metal measuring tape, verified secchi disk line).

Acceptance criteria: $\pm 10\%$.





Depth (Surface Water Projects Only)

Every 6 Months:

Compare all lines used for depth measurement to a reference device (meter stick or metal measuring tape). Redo markings as needed.

1. Check incremental markings. Acceptance criteria: $\pm 10\%$.
2. Check total length (up to greatest anticipated depth in field). Acceptance criteria: $\pm 5\%$.



Quarterly Depth Verification Log

Depth Verification Regional Operation Centers

SOP - S&T Sampling Manual and ROC Training Manual.

Report two decimal places for electronic devices. Report one decimal place for manual devices.

Numbers ≤ 4 , are rounded down; numbers ≥ 5 are rounded up.

QUARTERLY VERIFICATION OF ELECTRONIC DEVICES (SONDE, SONAR DEVICE, ETC.)

Meter / Device ID#: _____ Date of Last Verification: _____
Date: _____ Time: _____ ETZ / CTZ Verification Location: _____
Person Performing Verification: _____
Reference Device: Graduated Bucket / Metal Measuring Tape / Meter Stick / Other _____
Depth measurements: Reference Device: _____ m ; Device Being Tested: _____ m
Result: Pass / Fail (acceptance Criteria 10%)

6 MONTH VERIFICATION OF MANUAL DEVICES (SECCHI DISK, WEIGHTED LINE, ETC.)

Secchi/Weighted Line ID#: _____ Date of Last Verification: _____
Date: _____ Time: _____ ETZ / CTZ Verification Location: _____ Lab _____
Person Performing Verification: _____
Reference Device: Metal Measuring Tape / Meter Stick / Other _____
Incremental markings of 0.1 m checked: YES / NO Result: Pass / Fail (acceptable criteria 10%)
Total length of line (up to anticipated depth encountered in field) checked: YES / NO
Total Length: indicated by line markings _____ m ; measured by reference device _____ m
Result: Pass / Fail (acceptable criteria of 5%) Markings redone: YES / NO



Depth (Surface Water Projects Only)

When comparing depth measuring device to reference device, document readings from both devices.

- Quarterly verifications for electronic devices.
- 6-month verifications of manual device total length

6 MONTH VERIFICATION OF MANUAL DEVICES (SECCHI DISK, WEIGHTED LINE, ETC.)

Secchi/Weighted Line ID#: _____ Date of Last Verification: _____
Date: _____ Time: _____ ETZ / CTZ Verification Location: _____ Lab _____
Person Performing Verification: _____
Reference Device: Metal Measuring Tape / Meter Stick / Other _____
Incremental markings of 0.1 m checked: YES / NO Result: Pass / Fail (acceptable criteria 10%)
Total length of line (up to anticipated depth encountered in field) checked: YES / NO
Total Length: indicated by line markings 6.0 m ; measured by reference device 6.1 m
Result: Pass / Fail (acceptable criteria of 5%) Markings redone: YES / NO



Troubleshooting

Calibration (IC) or ICV fails

- Perform maintenance / cleaning and attempt IC again.
- Do not use meter for data collection until issue is resolved.

CCV fails

- Rinse probe with standard and attempt CCV again.
- If failure still present, affected field data must be “J” qualified w/ a comment describing the problem.

Bracketing requirements not met

- Affected field data must be “J” qualified w/ a comment describing the problem.



QUESTIONS?