

PROGETTO ESECUTIVO

Rafforzamento della rete ecologica nell'ambito del sistema dei laghi, delle torbiere e dei corsi d'acqua dell'alto appennino modenese

CUP D88E24000180007

ALLEGATO R.9

LOTTO 6 - RELAZIONE TECNICA ACQUISIZIONE DI SISTEMI DI ANALISI DATI FUNZIONALI AL SSD

giugno 2025

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1. Premessa

La presente relazione descrive il **Progetto Esecutivo del LOTTO 6 “RELAZIONE TECNICA ACQUISIZIONE DI SISTEMI DI ANALISI DATI FUNZIONALI AL SSD”**, parte del progetto complessivo di *“Rafforzamento della rete ecologica nell'ambito del sistema dei laghi, delle torbiere e dei corsi d'acqua dell'alto appennino modenese”*.

2. Obiettivi

L'intervento progettuale afferente al Lotto 6 si pone come obiettivo quello di fornire i materiali e sistemi di analisi dati specifici, necessari per l'installazione dei sistemi di supporto alle decisioni (SSD) inerenti la qualità chimico-fisica dell'acqua dei laghi e delle zone umide, la misura del livello della falda, il campionamento della flora e vegetazione descritti nella relazione tecnica specifica del lotto 5.

3.1. Lago Santo

Per la messa in opera del SSD del Lago Santo e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
Catamarano Aqua Marina Aircat 11'0" inclusi accessori (pompa manuale per gonfiaggio, 2 remi e sacca per il trasporto).	1
Bottiglia di campionamento Ruttner 1,8 litri inclusi accessori (peso messaggero in bronzo 450 g e 30 m di corda poliestere metro marcata diametro 6 mm)	1
Provette tipo Falcon in PP da 50 ml con appoggio	100
Siringhe in plastica sterili 100 ml	9
Supporto per membrana filtrante in PP Ø 47 mm	1
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m ² - spessore 0,45 mm - porosità 0,7 µm	20
Logger HOBO MX801 Submersible	4
Sensore conducibilità/temperatura/profondità HOBO mod. W-CTD-03 (Range 0-76mt)	4
Sensore ossigeno disciolto HOBO mod. W-DO	4
Adattatore per secondo sensore HOBO mod. W-ADAPT-2	4
Protezione contro le incrostazioni durante il campionamento HOBO mod. W-GUARD-2	4
Datalogger HOBO temperatura e livello dell'acqua mod. U20-001-04	1
Bobina di cavo in kevlar da 30 metri per sostegno datalogger	0,2
Tubo piezometrico in PVC rigido filettato e fessurato diametro 1"1/2 lunghezza 3 m, comprensivo di tappo a vite su ambo i lati. Tappo di testa lurchettabile dotato di lucchetto a chiave.	1

3.2. Lago Baccio

Per la messa in opera del SSD del Lago Baccio e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
Logger HOBO MX801 Submersible	1
Sensore conducibilità/temperatura/profondità HOBO mod. W-CTD-03 (Range 0-76mt)	1
Sensore ossigeno disciolto HOBO mod. W-DO	1
Adattatore per secondo sensore HOBO mod. W-ADAPT-2	1
Protezione contro le incrostazioni durante il campionamento HOBO mod. W-GUARD-2	1
Datalogger HOBO temperatura e livello dell'acqua mod. U20-001-04	1

Bobina di cavo in kevlar da 30 metri per sostegno datalogger	0,2
Tubo piezometrico in PVC rigido filettato e fessurato diametro 1"1/2 lunghezza 3 m, comprensivo di tappo a vite su ambo i lati. Tappo di testa lurchettabile dotato di lucchetto a chiave.	1
Provette tipo Falcon in PP da 50 ml con appoggio	50
Siringhe in plastica sterili 100 ml	2
Supporto per membrana filtrante in PP Ø 47 mm	1
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m2 - spessore 0,45 mm - porosità 0,7 µm	10

3.3. Lago Turchino

Per la messa in opera del SSD del Lago Turchino e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
Provette tipo Falcon in PP da 50 ml con appoggio	50
Siringhe in plastica sterili 100 ml	2
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m2 - spessore 0,45 mm - porosità 0,7 µm	10

3.4. Torbiera Maccherie

Per la messa in opera del SSD della torbiera Maccherie e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
Datalogger HOBO temperatura e livello dell'acqua mod. U20-001-04	1
Bobina di cavo in kevlar da 30 metri per sostegno datalogger	0,2
Tubo piezometrico in PVC rigido filettato e fessurato diametro 1"1/2 lunghezza 3 m, comprensivo di tappo a vite su ambo i lati. Tappo di testa lurchettabile dotato di lucchetto a chiave.	1
Provette tipo Falcon in PP da 50 ml con appoggio	50
Siringhe in plastica sterili 100 ml	2
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m2 - spessore 0,45 mm - porosità 0,7 µm	10

3.5. Torbiera Boccaia

Per la messa in opera del SSD della torbiera Boccaia e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
Datalogger HOBO temperatura e livello dell'acqua mod. U20-001-04	1
Bobina di cavo in kevlar da 30 metri per sostegno datalogger	0,2
Tubo piezometrico in PVC rigido filettato e fessurato diametro 1"1/2 lunghezza 3 m, comprensivo di tappo a vite su ambo i lati. Tappo di testa luchettabile dotato di lucchetto a chiave.	1
Provette tipo Falcon in PP da 50 ml con appoggio	50
Siringhe in plastica sterili 100 ml	2
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m2 - spessore 0,45 mm - porosità 0,7 µm	10

3.6. Torbiera Le Lamacce

Per la messa in opera del SSD della torbiera Le Lamacce e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
Datalogger HOBO Pendant Temperatura 64K mod. UA-001-63	10
Datalogger HOBO temperatura e livello dell'acqua mod. U20-001-04	1
Bobina di cavo in kevlar da 30 metri per sostegno datalogger	0,2
Tubo piezometrico in PVC rigido filettato e fessurato diametro 1"1/2 lunghezza 3 m, comprensivo di tappo a vite su ambo i lati. Tappo di testa luchettabile dotato di lucchetto a chiave.	1
Provette tipo Falcon in PP da 50 ml con appoggio	50
Siringhe in plastica sterili 100 ml	2
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m2 - spessore 0,45 mm - porosità 0,7 µm	10

3.7. Torbiera Le Gore

Per la messa in opera del SSD della torbiera Le Gore e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
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Datalogger HOBO Pendant Temperatura 64K mod. UA-001-63	10
Interfaccia USB ottica mod. BASE-U-4	1
Datalogger HOBO temperatura e livello dell'acqua mod. U20-001-04	2
Bobina di cavo in kevlar da 30 metri per sostegno datalogger	0,2
Tubo piezometrico in PVC rigido filettato e fessurato diametro 1"1/2 lunghezza 3 m, comprensivo di tappo a vite su ambo i lati. Tappo di testa luchettabile dotato di lucchetto a chiave.	1
Provette tipo Falcon in PP da 50 ml con appoggio	50
Siringhe in plastica sterili 100 ml	2
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m2 - spessore 0,45 mm - porosità 0,7 µm	10

3.8. Pozza temporanea Ghiacci di Monte Albano

Per la messa in opera del SSD della pozza temporanea Ghiacci di Monte Albano e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
Datalogger HOBO temperatura e livello dell'acqua mod. U20-001-04	1
Bobina di cavo in kevlar da 30 metri per sostegno datalogger	0,2
Tubo piezometrico in PVC rigido filettato e fessurato diametro 1"1/2 lunghezza 3 m, comprensivo di tappo a vite su ambo i lati. Tappo di testa luchettabile dotato di lucchetto a chiave.	1
Provette tipo Falcon in PP da 50 ml con appoggio	50
Siringhe in plastica sterili 100 ml	2
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m2 - spessore 0,45 mm - porosità 0,7 µm	10

3.9. Pozza temporanea Lago Crocette

Per la messa in opera del SSD della pozza temporanea Lago Crocette e relativa gestione si prevede l'acquisto del seguente materiale.

Tipologia	Quantità
Datalogger HOBO temperatura e livello dell'acqua mod. U20-001-04	1
Bobina di cavo in kevlar da 30 metri per sostegno datalogger	0,2

Tubo piezometrico in PVC rigido filettato e fessurato diametro 1"1/2 lunghezza 3 m, comprensivo di tappo a vite su ambo i lati. Tappo di testa lurchettabile dotato di lucchetto a chiave.	1
Provette tipo Falcon in PP da 50 ml con appoggio	50
Siringhe in plastica sterili 100 ml	2
Filtri in fibra di vetro tipo 698 F - Ø 47 mm - peso 75 g/m2 - spessore 0,45 mm - porosità 0,7 µm	10

4. Specifiche tecniche

Per le principali voci precedentemente elencate si riportano le specifiche tecniche dei modelli individuati.

In particolare si riportano le seguenti specifiche tecniche:

4.1. Catamarano Aircat 11'0"

AIRCAT 11'0"



Accessori in dotazione: borsa di trasporto, pompa di gonfiaggio e 2 remi.

AQUA MARINA

PRODOTTI
I

ACCADEMIA
A

MEDIA
A

DBI

SUPPORTO



↑英

英



AIRCAT

SERIE CATAMARANI GONFIABILI

MISURE: 9'4" E 11'0"

I

Dotato di uno scafo a tunnel ultra stabile e di un ampio spazio sul ponte, questo catamarano gonfiabile è impressionante per la sua eccezionale capacità e la capacità di sfidare venti e onde a velocità sostenuta. E se avete voglia di un campeggio da asporto con la vostra famiglia? Basta portare tutta l'attrezzatura e godersi il viaggio.

Disponibile nelle misure 2,85 m e 3,35 m di lunghezza, entrambe con una larghezza di 1,6 m, AIRCAT è un'imbarcazione ideale per la sicurezza in acqua e un'imbarcazione da turismo. L'esclusivo design a prua aperta è il preferito dagli amanti della pesca e delle immersioni, offrendo una spaziosa piattaforma per stare in piedi o riposare.

Costruito con la tecnologia di saldatura ad alta frequenza esclusiva di Aqua Marina per le camere tubolari, combinando la tecnologia Drop Stitch Light applicata al ponte pneumatico, AIRCAT è nato per essere sicuro, rigido, super stabile, ma ultraleggero. Sono finiti i giorni in cui era necessario un rimorchio dedicato.

Ora basta riporlo nella borsa da trasporto, insieme a tutti gli accessori coordinati: può essere trasportato sui sedili posteriori della maggior parte delle auto. Il nostro nuovo AIRCAT sarà la garanzia di una giornata di divertimento e relax!



AQUA MARINA



SPECIFICHE



AIRCAT 9'4"		AIRCAT 11'0"
Modello BT-AC28S	MODELLO	Modello BT-AC33S
9'4" / 285cm	PRODOTTO	11'0" / 335cm
63" / 160cm	LUNGHEZZA	63" / 160cm
66,1 libbre / 30kg	LARGHEZZA	73,9 libbre / 33,5kg
Aria DWF	PESO	Aria DWF
4+1	PAVIMENTO	4+1
3,7 KW / 5CV	CAMERE D'ARIA	7,5 kW / 9,9 CV
880 libbre / 400kg	MOTORE FUORIBORDO	1100 libbre / 500kg
4	CARICO UTILE MASSIMO	5
	MASSIMO PASSEGGERI	

5

4.2. Sensori parametri chimico-fisici dell'acqua

HOBO[®]

Data Loggers

HOBO MX800 Multiparameter Water Quality Data Loggers

The ultimate solution for collecting critical water level & water quality data

An affordable, highly configurable solution for monitoring water conductivity, temperature, depth, and dissolved oxygen. HOBO MX800 series Bluetooth loggers come in an easy-to-deploy fully submersible model (MX801) and a direct-read model (MX802) for convenient data offload without removing the sensor from the water.

Supported Measurements:

Water conductivity/salinity, temperature, level, and dissolved oxygen



Key Advantages

- Fast data offload via Bluetooth to HOBOnnect app
- Interchangeable sensors – swap out sensors for different applications
- Water detect feature indicates when logger was out of the water (MX801)
- Built-in barometric pressure sensor plus time-saving direct data offload without removing sensor from the water (MX802)
- Guided calibration ensures accurate data

Minimum System Requirements



HOBOnnect
See pg 43



Mobile or
Windows
device

Get more water quality measurements with one data logger

An adapter lets you attach two sensors to one MX800 logger, so you can measure dissolved oxygen, conductivity, temperature, and depth with a single platform.



CT Sensor (W-CT)



CTD Sensor (W-CTDxx)



DO Sensor (W-DO)



► For complete information and accessories, please visit: www.onsetcomp.com

Sensors

W-CT and W-CTD-xx			W-DO
	Conductivity	Temperature	DO / Temperature
Range	Electrical conductivity and specific conductance: 0 to 100,000 $\mu\text{S}/\text{cm}$	-20° to 50°C (-40° to 122°F), non-freezing water	0 to 60 mg/L; 0-600% Saturation / -5 to 50°C (23 to 104°F), non-freezing
Accuracy	Conductivity: $\pm 1.2\%$ or 15 $\mu\text{S}/\text{cm}$ whichever is greater Salinity: $\pm 2\%$ of reading or 0.1 PSU, whichever is greater	$\pm 0.15^\circ\text{C}$ ($\pm 0.27^\circ\text{F}$) from 0° to 50°C (32° to 122°F)	Out-of-box: ± 0.2 mg/L over the range of 0 to 20 mg/L; ± 0.1 mg/L with user calibration / 0.15°C (0.27°F)
Resolution	0.1 $\mu\text{S}/\text{cm}$ from 0 to 1,000 $\mu\text{S}/\text{cm}$ 1 $\mu\text{S}/\text{cm}$ from 1,000 to 10,000 $\mu\text{S}/\text{cm}$ 10 $\mu\text{S}/\text{cm}$ from 10,000 to 100,000 $\mu\text{S}/\text{cm}$	0.01°C at 25°C (0.018°F at 77°F)	0.01 mg/L / 0.01°C (0.04°F)

Pressure & Depth (CTD Sensors only)

Part Number	W-CTD-01	W-CTD-02	W-CTD-03	W-CTD-01
Range	0 to 207 kPa (0 to 30 psia); 0 to 9 m (0 to 30 ft) water depth at sea level	0 to 400 kPa (0 to 58 psia); 0 to 30.6 m (0 to 100 ft) water depth at sea level	0 to 850 kPa (0 to 123.3 psia); 0 to 76.5 m (0 to 251 ft) water depth at sea level	0 to 145 kPa (0 to 21 psia); 0 to 4 m (0 to 13 ft) water depth at sea level
Water Level Accuracy*	Typical error: $\pm 0.05\%$ FS, 0.5 cm (0.015 ft) water	Typical error: $\pm 0.05\%$ FS, 1.5 cm (0.05 ft) water	Typical error: $\pm 0.05\%$ FS, 3.8 cm (0.125 ft) water	Typical error: $\pm 0.075\%$ FS, 0.3 cm (0.01 ft) water
Resolution	0.21 cm (0.007 ft)	0.41 cm (0.013 ft)	0.87 cm (0.028 ft)	0.14 cm (0.005 ft)
Raw Pressure Accuracy**	$\pm 0.3\%$ FS, 0.62 kPa (0.09 psi) maximum error	$\pm 0.3\%$ FS, 1.20 kPa (0.17 psi) maximum error	$\pm 0.3\%$ FS, 2.55 kPa (0.37 psi) maximum error	$\pm 0.3\%$ FS, 0.43 kPa (0.063 psi) maximum error

Data Loggers

Part number	MX801	MX802
Operating Range	-40° to 50°C (-40° to 122°F), cannot be frozen in ice	
Transmission Range	Approximately 30.5 m (100 ft) line-of-sight	
Wireless Data Standard	Bluetooth 5	
Maximum Cable Length	N/A	120m (400 ft)
Logging Rate	5 second to 18 hours	
Water Detect	Events are logged when logger is submerged or removed from the water (MX801 only)	N/A
Time Accuracy	±1 minute per month 0° to 50°C (32° to 122°F)	
	Barometric Pressure (MX802 only)	
Measurement & Calibrated Range	N/A	66 to 107 kPa (9.6 to 15.5 psia), -20° to 50°C (-4° to 122°F)
Accuracy*	N/A	Typical error: ±0.2 kPa (0.029 psi) Maximum error: ±0.5 kPa (0.073 psi)
Resolution	N/A	<0.01 kPa (0.0015 psi)
Battery	Four AA, 1.5 V lithium batteries, user replaceable	
Battery Life	With W-CTD or W-CT sensors: 2 years, typical with 1-minute logging interval or slower With W-DO sensor: 1-year, typical with 5-minute logging interval or slower	
Memory	730,000 measurements, divided between channels (4 Mbyte memory)	
Materials	Outer enclosure: Polycarbonate/PBT blend with brass inserts; Interior: Polycarbonate/PBT; Gasket: Silicone foam. Cable channel: Santoprene™ TPE	
Dimensions	Logger diameter: 4.14 cm (1.63 inches), Length without sensor: 20 cm (8 inches)	
Weight	MX801 Logger: 213g (7.51 oz)	MX802 Logger: 215g (7.58 oz)
Environmental Rating	IP68; waterproof to 100m (with sensor(s) attached)	IP67, NEMA6; Weatherproof (with cable or Termination Plug attached); this model is not waterproof
CE & UKCA Compliant	Yes	

* Pressure Accuracy: Absolute pressure sensor accuracy includes all sensor drift, temperature, and hysteresis-induced errors.

** Raw Pressure Accuracy: Absolute pressure sensor accuracy includes all sensor drift, temperature, and hysteresis-induced errors.

4.3. Sensori misura temperatura

HOBO® Pendant® Temperature Data Logger (UA-001-64) Manual

HOBO
Data Loggers



HOBO Pendant Temperature Data Logger

Models: UA-001-64

Required Items:

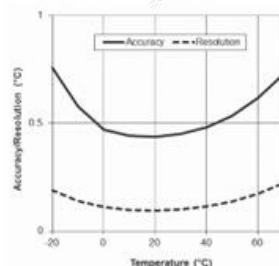
- HOBOWare 2.x or later
- USB cable
- Optic USB Base Station (BASE-U-4) or HOBO Waterproof Shuttle (U-DTW-1) & Coupler (COUPLER2-A)

The HOBO Pendant Temperature Data Logger is a waterproof, one-channel logger with 10-bit resolution and can record up to approximately 52,000 measurements or internal logger events. The logger uses a coupler and optical base station with USB interface for launching and data readout by a computer. Onset software is required for logger operation. Visit www.onsetcomp.com/support/help-center/software/hoboware.

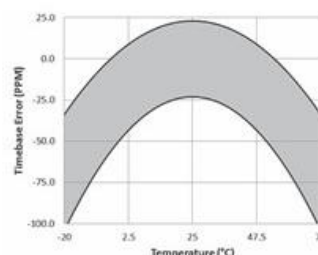
Specifications

Measurement Range	-20° to 70°C (-4° to 158°F)
Alarms	High and low alarms can be configured for total amount of contiguous or non-contiguous time outside of user-defined limits between -20° and 70°C (-4° to 158°F)
Accuracy	±0.53°C from 0° to 50°C (±0.95°F from 32° to 122°F), see Plot A
Resolution	0.14°C at 25°C (0.25°F at 77°F), see Plot A
Drift	Less than 0.1°C/year (0.2°F/year)
Response Time	Airflow of 2 m/s (4.4 mph): 10 minutes, typical to 90% Water: 5 minutes, typical to 90%
Time Accuracy	±1 minute per month at 25°C (77°F), see Plot B
Operating Range	In water/ice: -20° to 50°C (-4° to 122°F) In air: -20° to 70°C (-4° to 158°F)
Water Depth Rating	30 m from -20° to 20°C (100 ft from -4° to 68°F), see Plot C
NIST Traceable Certification	Available for temperature only at additional charge; temperature range -20° to 70°C (-4° to 158°F)
Battery Life	1 year typical use; deployments in extremely cold or hot temperatures or at logging intervals faster than one minute may significantly reduce battery life.
Memory	64K bytes (approximately 52K sample and event readings)
Materials	Polypropylene case; stainless steel screws; Buna-N o-ring
Weight	15.0 g (0.53 oz)
Dimensions	58 x 33 x 23 mm (2.3 x 1.3 x 0.9 inches)
Environmental Rating	IP68; not rated for use in direct sunlight.
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

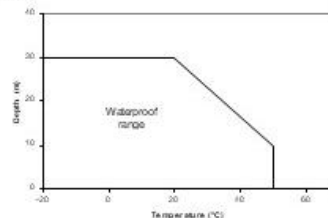
Passed RTCA DO160G, part 21H



Plot A



Plot B



Plot C

Connecting the Logger

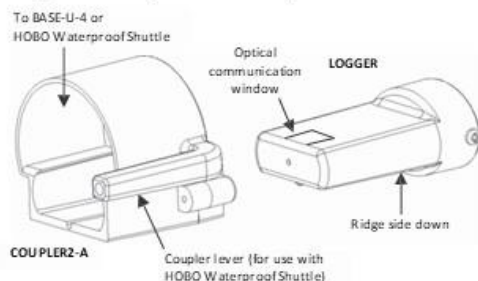
The HOBO Pendant logger requires the following to connect to the computer:

- Optic USB Base Station (BASE-U-4) or HOBO Waterproof Shuttle (U-DTW-1); coupler (COUPLER2-A); HOBOware 2.2 or later

If possible, avoid connecting at temperatures below 0°C (32°F) or above 50°C (122°F).

1. Plug the USB connector on the base station into an available USB port on your computer.
2. Insert the logger and the base station into the coupler, as shown in the following diagram.

For BASE-U-4 or the HOBO Waterproof Shuttle, firmly insert the optical end of the base station into the D-shaped end of the coupler and make sure that the ridge on the logger is aligned with the groove in the coupler.



3. If you are using the HOBO Waterproof Shuttle, briefly press the coupler lever to put the shuttle into base station mode.
4. If the logger has never been connected to the computer before, it may take a few seconds for the new hardware to be detected.
5. Use the logger software to set up the alarms and to launch and read out the logger.

You can read out the logger or check its status while it continues to log, stop it manually with the software, or let it record data until the memory is full. Refer to the software user's guide for complete details on launching, reading out, and viewing data from the logger.

Important: Do not cover the optical communication window in the logger (shown in diagram above) with a label or sticker as that may interfere with the communications with the base station or shuttle.

Triggered Start

You can configure this logger to start at your command, using the magnet in the coupler to trigger a start.

1. Use HOBOware to launch the logger with Using Coupler selected. Remove the logger from the coupler.
2. Bring the logger and an empty coupler or strong magnet to the deployment location.

Important: Any magnet can trigger a start. This can be helpful, but it can also cause a premature start. Keep the logger away from strong magnetic fields until you are ready to begin logging.

3. When you are ready for the logger to start logging, insert the logger into the empty coupler (or place it next to a strong magnet) and remove it after three seconds.

Important: The logger will not launch if the base station is in the coupler.

4. Verify that the logger's light is blinking at least every four seconds.

Sample and Event Logging

The logger can record two types of data: samples and internal logger events. Samples are the measurements recorded at each logging interval (for example, temperature every minute). Events are independent occurrences triggered by a logger activity, such as Bad Battery or Host Connected. Events help you determine what was happening while the logger was logging.

Operation

Lights (LEDs) on the front of the logger confirm logger operation. The following table explains when the lights blink during logger operation.

When	The Lights:
The logger is logging faster than four seconds	Blink at the logging interval: • Green LED if temperature is OK • Red LED if high alarm has been triggered • Blue LED if low alarm has been triggered
The logger is logging at four seconds or slower	Blink every four seconds: • Green LED if temperature is OK • Red LED if high alarm has been triggered • Blue LED if low alarm has been triggered
The logger is awaiting a start because it was configured to start logging At Interval, On Date/Time, or Using Coupler	Green light blinks once every eight seconds until launch begins

Protecting the Logger

The logger can be damaged if the water depth rating is exceeded. The depth rating is approximately 30 m (100 ft) at temperatures below 20°C (68°F), but is less in warmer water. Refer to Plot C for details.

Do not store the logger in the coupler. Remove the logger from the coupler when you are not using it. When the logger is in the coupler or near a magnet, it consumes more power and will drain the battery prematurely.

Keep the logger away from magnets. Being near a magnet can cause false coupler events to be logged. It can also launch the logger prematurely if it was waiting for a trigger start.

Periodically inspect the desiccant and dry it if it is not bright blue. The desiccant pack is located in the cap of the logger. To dry the desiccant, remove the desiccant pack from the cap and leave the pack in a warm, dry location until the bright blue color is restored. (Refer to the *Battery* section for instructions on removing and replacing the logger cap.)

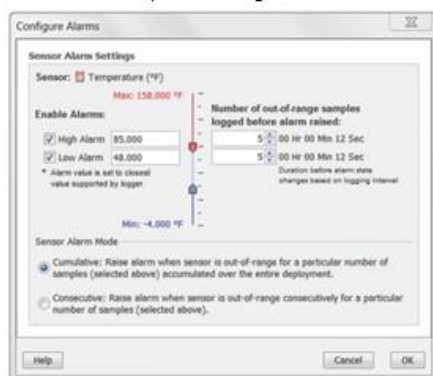
Temperature Range	Desiccant Maintenance Schedule
Less than 30°C (86°F)	Approximately once per year
30° to 40°C (86° to 104°F)	Approximately every six months
Over 40°C (104°F)	Approximately every three months

Note: Static electricity may cause the logger to stop logging. To avoid electrostatic discharge, transport the logger in an anti-static bag, and ground yourself by touching an unpainted metal surface before handling the logger. For more information, search for "static discharge" in on www.onsetcomp.com.

Alarms

Configure alarms to flash a warning on the high or low LEDs if monitored sensor falls outside user-selectable limits.

1. From the Launch Logger window in HOBOWare, click the Alarms button to open the Configure Alarms window.



2. Select the check box for the High Alarm and/or the Low Alarm. Type a value in each box to define the alarm threshold or use the sliders.
3. Type the number of out-of-range samples that are needed to trigger each alarm.
4. Choose an Alarm Mode. If you select Cumulative, the alarm is triggered after a specific number of samples have been logged above or below an allowed value, even if the samples are not logged consecutively. If you select Consecutive, the alarm is triggered only when the value has been above or below an allowed value for a specific amount of time. If the value goes back in range before triggering the alarm, the count is reset.
5. Click OK when done.

Battery

The logger requires one 3-Volt CR-2032 lithium battery. Battery life varies based on the temperature and the frequency at which the logger is recording data (the logging interval). A new battery typically lasts one year with logging intervals greater than one minute. Deployments in extremely cold or hot temperatures, or logging intervals faster than one minute, may significantly reduce battery life. Continuous logging at the fastest logging rate of one second will deplete the battery in as little as two weeks.

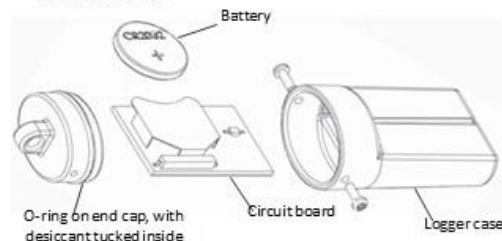
Replacing the Battery

You will need a small Phillips head screwdriver and silicone-based O-ring grease, such as Parker Super-O-Lube, to complete

these steps (no petroleum-based lubricants). The logger should be wiped clean and dried completely before opening it.

To replace the battery:

1. Avoid electrostatic discharge while handling the logger and internal circuit board; ground yourself by touching an unpainted metal surface. Hold the circuit board by its edges and avoid touching electronics.
2. Working on a clean, dry surface, remove the two screws that secure the end cap to the case and remove the cap.
3. Examine the desiccant pack that is tucked into the cap. If the desiccant is not bright blue, put the desiccant pack in a warm, dry place until the blue color is restored. Or, for faster drying, the desiccant can be dried for two hours in a 70°C (160°F) oven.
4. Gently tap the case to loosen the circuit board and remove it from the case.



5. Carefully push the battery out of the holder with a small, nonmetallic blunt instrument.
6. Insert a new battery, positive side facing up.
7. Return the circuit board and label to the case, carefully aligning the circuit board with the grooves in the case so that the battery faces the ridged side of the case.
8. Remove the O-ring from the end cap. Use the thumb and finger of one hand to hold the cap from the top and bottom, and use the thumb and fingers on your other hand to slide the O-ring to form a loop as shown. Use this loop to roll the O-ring off the cap.



9. Inspect the O-ring for cracks or cuts and replace it if any are detected (the O-ring is included in the Pendant replacement parts kit, UA-PARTSKIT).
10. Using your fingers (not cloth or paper), spread a small dot of silicone-based grease on the O-ring, just enough to moisten it all the way around and making sure that the entire O-ring surface is completely coated with grease. As you work the grease into the O-ring, make sure there is no grit or debris on the O-ring.

11. Place the O-ring back on the end cap, making sure it is fully seated and level in the groove. Make sure the O-ring is not pinched or twisted and that no dirt, lint, hair, or any debris is trapped on the O-ring. This is necessary to maintain a waterproof seal.
12. Very slightly grease the inside rim of the case, especially around the screw holes with the silicone grease, just enough to moisten the inside edges without touching any circuitry. Make sure that there is no excess lubricant that could get onto the logger electronics or label. Make sure there is no debris on this surface.
13. Check that the desiccant pack is tucked into the cap.
14. Carefully push the end cap into the lubricated case until the screw holes are aligned. Visually check that the O-ring forms a uniform seal all around.
15. Re-fasten the screws. Tighten the screws until you feel them hit the bottom of the screw holes, but not so tight that they distort the clear housing.

 **WARNING:** Do not cut open, incinerate, heat above 85°C (185°F), or recharge the lithium battery. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations for lithium batteries.

4.4. Sensori misura livello della falda

HOBO® U20 Water Level Logger (U20-001-0x and U20-001-0x-Ti) Manual

HOBO
Data Loggers



The HOBO U20 Water Level Logger is used for monitoring changing water levels in a wider range of applications including streams, lakes, wetlands, tidal areas, and groundwater. The loggers are typically deployed in existing wells or stilling wells installed specifically for deploying the loggers. This logger features high accuracy at a great price and HOBO ease-of-use, with no cumbersome vent tubes or desiccants to maintain.

The logger uses a maintenance-free absolute pressure sensor and features a durable stainless steel or titanium housing (depending on model) and ceramic pressure sensor. The HOBO Water Level Titanium is recommended for saltwater deployment for recording water levels and temperatures in wetlands and tidal areas. The logger uses precision electronics to measure absolute pressure and temperature and has enough memory to record over 21,700 combined pressure and temperature measurements.

HOBO Water Level Logger

Models:

- U20-001-01 (30-foot depth) and U20-001-01-Ti (30-foot depth/Titanium)
- U20-001-02 (100-foot depth) and U20-001-02-Ti (100-foot depth/Titanium)
- U20-001-03 (250-foot depth) and U20-001-03-Ti (250-foot depth/Titanium)
- U20-001-04 (13-foot depth) and U20-001-04-Ti (13-foot depth/Titanium)

Required Items:

- Coupler (COUPLER2-B) with USB Optic Base Station (BASE-U-4) or HOBO Waterproof Shuttle (U-DTW-1)
- HOBOware® Pro

Accessories:

- Cable (CABLE-1-300or CABLE-1-50) and Cable Crimp (CABLE-1-CRIMP)
- Replacement Coupler (COUPLER2-B)

Specifications

Pressure (Absolute) and Water Level Measurements U20-001-01 and U20-001-01-Ti

Operation Range	0 to 207 kPa (0 to 30 psia); approximately 0 to 9 m (0 to 30 ft) of water depth at sea level, or 0 to 12 m (0 to 40 ft) of water at 3,000 m (10,000 ft) of altitude
Factory Calibrated Range	69 to 207 kPa (10 to 30 psia), 0° to 40°C (32° to 104°F)
Burst Pressure	310 kPa (45 psia) or 18 m (60 ft) depth
Water Level Accuracy*	Typical error: $\pm 0.05\%$ FS, 0.5 cm (0.015 ft) water Maximum error: $\pm 0.1\%$ FS, 1.0 cm (0.03 ft) water
Raw Pressure Accuracy**	$\pm 0.3\%$ FS, 0.62 kPa (0.09 psi) maximum error
Resolution	<0.02 kPa (0.003 psi), 0.21 cm (0.007 ft) water
Pressure Response Time [90%]***	<1 second; measurement accuracy also depends on temperature response time

Pressure (Absolute) and Water Level Measurements U20-001-02 and U20-001-02-Ti

Operation Range	0 to 400 kPa (0 to 58 psia); approximately 0 to 30.6 m (0 to 100 ft) of water depth at sea level, or 0 to 33.6 m (0 to 111 ft) of water at 3,000 m (10,000 ft) of altitude
Factory Calibrated Range	69 to 400 kPa (10 to 58 psia), 0° to 40°C (32° to 104°F)
Burst Pressure	500 kPa (72.5 psia) or 40.8 m (134 ft) depth
Water Level Accuracy*	Typical error: $\pm 0.05\%$ FS, 1.5 cm (0.05 ft) water Maximum error: $\pm 0.1\%$ FS, 3 cm (0.1 ft) water
Raw Pressure Accuracy**	$\pm 0.3\%$ FS, 1.20 kPa (0.17 psi) maximum error
Resolution	<0.04 kPa (0.006 psi), 0.41 cm (0.013 ft) water
Pressure Response Time [90%]***	<1 second; measurement accuracy also depends on temperature response time

Pressure (Absolute) and Water Level Measurements U20-001-03 and U20-001-03-Ti

Operation Range	0 to 850 kPa (0 to 123.3 psia); approximately 0 to 76.5 m (0 to 251 ft) of water depth at sea level, or 0 to 79.5 m (0 to 262 ft) of water at 3,000 m (10,000 ft) of altitude
Factory Calibrated Range	69 to 850 kPa (10 to 123.3 psia), 0° to 40°C (32° to 104°F)
Burst Pressure	1200 kPa (174 psia) or 112 m (368 ft) depth
Water Level Accuracy*	Typical error: $\pm 0.05\%$ FS, 3.8 cm (0.125 ft) water Maximum error: $\pm 0.1\%$ FS, 7.6 cm (0.25 ft) water
Raw Pressure Accuracy**	$\pm 0.3\%$ FS, 2.55 kPa (0.37 psi) maximum error

Specifications (continued)

Pressure (Absolute) and Water Level Measurements U20-001-03 and U20-001-03-Ti (continued)

Resolution	<0.085 kPa (0.012 psi), 0.87 cm (0.028 ft) water
Pressure Response Time(90%)*	<1 second; measurement accuracy also depends on temperature response time

Pressure (Absolute) and Water Level Measurements U20-001-04 and U20-001-04-Ti

Operation Range	0 to 145 kPa (0 to 21 psia); approximately 0 to 4 m (0 to 13 ft) of water depth at sea level, or 0 to 7 m (0 to 23 ft) of water at 3,000 m (10,000 ft) of altitude
Factory Calibrated Range	69 to 145 kPa (10 to 21 psia), 0° to 40°C (32° to 104°F)
Burst Pressure	310 kPa (45 psia) or 18 m (60 ft) depth
Water Level Accuracy*	Typical error: $\pm 0.075\%$ FS, 0.3 cm (0.01 ft) water Maximum error: $\pm 0.15\%$ FS, 0.6 cm (0.02 ft) water
Raw Pressure Accuracy**	$\pm 0.3\%$ FS, 0.43 kPa (0.063 psi) maximum error
Resolution	<0.014 kPa (0.002 psi), 0.14 cm (0.005 ft) water
Pressure Response Time(90%)*	<1 second; measurement accuracy also depends on temperature response time

Temperature Measurements (All Models)

Operation Range	-20° to 50°C (-4° to 122°F)
Accuracy	$\pm 0.44^\circ\text{C}$ from 0° to 50°C ($\pm 0.79^\circ\text{F}$ from 32° to 122°F), see Plot A
Resolution	0.10°C at 25°C (0.18°F at 77°F), see Plot A
Response Time (90%)	5 minutes in water (typical)
Stability (Drift)	0.1°C (0.18°F) per year

Logger

Real-time Clock	± 1 minute per month 0° to 50°C (32° to 122°F)
Battery	2/3 AA, 3.6 Volt lithium, factory-replaceable
Battery Life (Typical Use)	5 years with 1 minute or greater logging interval
Memory (Non-volatile)	64K bytes memory (approx. 21,700 pressure and temperature samples)
Weight	Stainless steel models: approximately 210 g (7.4 oz) Titanium models: approximately 140 g (4.8 oz)
Dimensions	2.46 cm (0.97 inches) diameter, 15 cm (5.9 inches) length; mounting hole 6.3 mm (0.25 inches) diameter
Wetted Materials	Stainless Steel models: 316 stainless steel, Viton® O-rings, acetal cap, ceramic sensor Titanium models: Titanium, Viton O-rings, acetal cap, ceramic sensor
Logging Interval	Fixed-rate or multiple logging intervals, with up to 8 user-defined logging intervals and durations; logging intervals from 1 second to 18 hours. Refer to the HOBOWare software manual.
Launch Modes	Immediate start and delayed start
Offload Modes	Offload while logging; stop and offload
Battery Indication	Battery voltage can be viewed in status screen and optionally logged in datafile. Low battery indication in datafile.
Environmental Rating	IP68

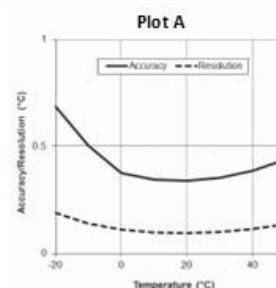


The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

* Water Level Accuracy: With accurate reference water level measurement, known water density, accurate Barometric Compensation Assistant data, and a stable temperature environment.

** Raw Pressure Accuracy: Absolute pressure sensor accuracy includes all sensor drift, temperature, and hysteresis-induced errors.

*** Changes in Temperature: Allow 10 minutes in water to achieve full temperature compensation of the pressure sensor. Maximum error due to rapid thermal changes is approximately 0.5%.



Software

HOBOWare Pro software is required for logger operation. Using a reference water level, HOBOWare Pro automatically converts the pressure readings into water level readings. The software also supports compensation for temperature, fluid density, and barometric pressure.

Communication

For launching and reading out the Water Level logger in the field, you can use a laptop computer with HOBOWare Pro and an Onset Optic USB Base Station (BASE-U-4), with a coupler (COUPLER2-B) or the HOB0 Waterproof Shuttle (U-DTW-1) with a coupler (COUPLER2-B).

The optical interface allows the logger to be offloaded without breaking the integrity of the seals. The USB compatibility allows for easy setup and fast downloads.

Barometric Compensation

The HOB0 Water Level Logger records absolute pressure, which is later converted to water level readings by the software. In this application, absolute pressure includes atmospheric pressure and water head. Atmospheric pressure is nominally 100 kPa (14.5 psi) at sea level, but changes with weather and altitude. Left uncompensated, barometric variations could result in errors of 0.6 m (2 ft) or more.

To compensate for barometric pressure changes, you can use the HOB0 U20 Water Level Logger as a barometric reference. The barometric reference is typically deployed in the same well or at the same location as the water level of interest, but rather than being placed in the water column, it is deployed above the water in air.

Barometric pressure readings are consistent across a region (except during fast-moving weather events), so you can generally use barometric pressure readings that are taken within 15 km (10 miles) of the logger or more, without significantly degrading the accuracy of the compensation.

Therefore, one U20 or weather station (HOB0 U30 or H21 recommended) can be used to compensate all of the water level loggers in an area. The U20-001-01 model with its 0–9 m (0–30 ft) range or the U20-001-04 with its 0–4 m (0–13 ft) range are both good barometric references due to their smaller range, temperature-compensated accuracy, and rugged stainless steel case. HOBOWare Pro includes a Barometric Compensation Assistant for easy and accurate barometric compensation.

LEDs

A light (LED) in the communications window of the logger confirms logger operation.

The following table explains when the logger blinks during logger operation:

When:	The Light
The logger is logging	Blinks once every one to four seconds (the shorter the logging interval, the faster the light blinks); blinks when logging a sample
The logger is awaiting a start because it was launched in Start At Interval or Delayed Start mode	Blinks once every eight seconds until logging begins

Calibration

The pressure sensor in each HOB0 Water Logger is individually calibrated. During calibration, raw pressure sensor data is collected at multiple pressures and temperatures over the calibrated range of the logger (see the specifications table). This data is used to generate calibration coefficients that are stored in the logger's non-volatile memory. The calibration coefficients are then checked to be sure that the logger meets its stated accuracy over the calibrated range.

The pressure sensor can be used at pressures and temperatures that are outside of the calibrated range, but the accuracy cannot be guaranteed.

Important: Never exceed the burst pressure of the sensor!

Sleep Mode

The logger consumes significantly more power when it is "awake" and connected to a base station or shuttle. To conserve power, the logger will go into a low-power (sleep) mode if there has been no communication with your computer for 30 minutes. To wake up the logger, remove the logger from the coupler, wait a moment, then re-insert the logger.

Sample and Event Logging

The logger can record two types of data: samples and events. Samples are the sensor measurements recorded at each logging interval (for example, the pressure every minute). Events are independent occurrences triggered by a logger activity, such as Bad Battery or Host Connected. Events help you determine what was happening while the logger was logging.

The logger stores 64K of data, and can record over 21,700 samples of pressure and temperature.

Setup

Before you deploy the HOB0 U20 Water Level Logger in the field, perform the following steps in the office:

1. Start HOBOWare.
2. Connect the logger to the computer. See the next section.
3. Verify the status. Click Status on the toolbar and observe that the absolute pressure is near barometric pressure for the location and the temperature is near the actual temperature.

4. Launch the logger. See the *HOBOWare User's Guide* for details.

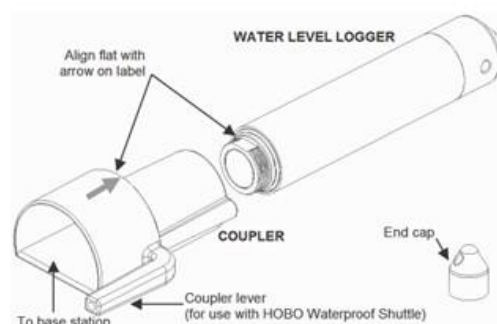
- Make sure both *Abs. Pressure* and *Temperature* are selected (temperature is required for temperature compensation of pressure).
- *Logging Battery Voltage* is not essential since you can check the battery voltage using the Status screen at launch or readout of logger.

Connecting the Logger to a Computer

The HOB0 Water Level Logger requires a coupler (COUPLER2-B) and USB Optic Base Station (BASE-U-4) or HOB0 Waterproof Shuttle (U-DTW-1) to connect to the computer.

1. Follow the instructions that came with your base station or shuttle to attach the base station or shuttle to a USB port on the computer.
2. Unscrew the black plastic end cap from the logger by turning it counter-clockwise.
3. Attach the coupler to the base station or shuttle.
4. Insert the logger into the coupler with the flat edge on the logger aligned with the arrow on the coupler label. Gently twist the logger to be sure that it is properly seated in the coupler (it should not turn).

NOTE: If you are using the Waterproof Shuttle, briefly press the coupler lever to put the shuttle into base station mode.

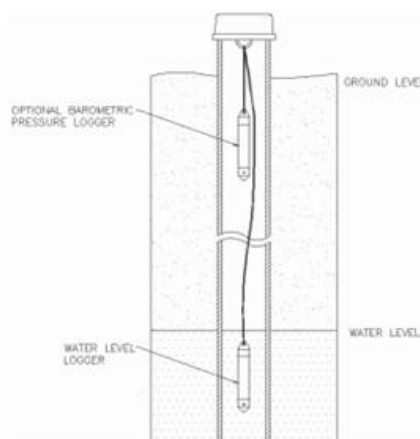


If the logger has never been connected to the computer before, it may take a few seconds for the new hardware to be detected by the computer.

Important: USB communications may not function properly at temperatures below 0°C (32°F) or above 50°C (122°F).

Deploying the Logger

The HOB0 Water Level Logger is designed to be easy to deploy in many environments. The logger uses an absolute pressure sensor, so no vent tube is required. The small size of the logger is convenient for use in small wells and allows the logger to be mounted and/or hidden in the field.



Deployment Guidelines

Full Temperature Equilibrium

The pressure sensor is temperature compensated over the range of 0° to 40°C (32° to 104°F). To obtain the highest level of accuracy, the logger should be allowed to come to full temperature equilibrium (approximately 20 minutes) before the reference level is recorded.

Sudden Temperature Changes

Sudden temperature changes should be avoided. When deploying a HOB0 Water Level Logger for barometric pressure reference, some consideration should be made to minimize the rate of temperature fluctuations. Ideally, the barometric pressure reference logger should be hung several feet below ground level in an observation well where ground temperatures are stable (while making sure the logger remains above the water level). If that is not possible (or if a well is not used), try to put the logger in a location where it will not be subject to rapid daily temperature cycles.

Venting

When deploying a HOB0 Water Level logger in a well, make sure the well is vented to the atmosphere. Typically, a small hole can be drilled in the well cap to ensure that the pressure inside and outside the well is at equilibrium. If this is not possible, the barometric pressure reference logger should be used inside the same well.

Wire

Use a no-stretch wire to hang the water level logger. Any change in length of the wire will result in a 1-to-1 corresponding error in the depth measurement. Always pull-test a cable prior to deploying a logger in a well to make sure it does not stretch.

Stilling Well

If you are deploying the logger in a lake, river, or stream, you must first build a stilling well to protect the logger from vibration, shock, and movement.

A simple stilling well can be constructed with PVC or ABS pipe. A properly constructed stilling well helps to protect the logger from currents, wave action, and debris. Suspend the logger in the stilling well so it is always underwater, but not on the bottom to be buried by silt.

For more information, see the Technical Application Note for Constructing a Stilling Well at:
http://www.onsetcomp.com/water_level_stilling_well.html

Burst Pressure

Be very careful not to exceed the burst pressure for the logger. The pressure sensor will burst if the maximum depth is exceeded (see specifications table). The logger should be positioned at a depth where the logger will remain in the water for the duration of the deployment, but not exceed the rated bursting depth.

Deployment Procedure

1. Cut wire to suspend logger.
 - a. Measure the physical depth to the surface of the water from the suspension point.
 - b. Cut a piece of stranded, stainless steel wire (Teflon coated is best) so that the logger will be deep enough to always be in the water. Estimate the low water level and make the cable length such that the logger will be about 2 feet below that level.
2. Attach the wire to the suspension point and to the logger cap.
3. Relaunch the logger if desired (if a PC or a HOB0 U-Shuttle is available).
4. Lower the logger into the well or stilling well.
5. Measure the water depth from the desired reference point (top of pipe, ground level, or sea level).
 - To maximize accuracy, allow 20 minutes after deploying the logger before measuring water depth to allow the logger to reach temperature equilibrium with the water.
 - If the well is too small in diameter to measure the water depth after deployment, measure the water depth before deployment, then deploy the logger immediately and record deployment time.
 - For well deployments: If the water level surface is below the reference point (such as referencing groundwater measurements to the top of the well), record the water level as a negative number. If the water level surface is above the reference point (such as height above sea level), record the water level as a positive number.
 - For lake, stream, and river deployments: If the water level is being referenced to some point above the logger (such as the top of the stilling well), record the water level as a negative number. If the water depth is being

referenced to a point below the water surface such as the bottom of the stream, record the water level as a positive number.

6. Record the reference measurement date and time.

Deploying a U20 Logger for Barometric Pressure Data (Optional)

If you are using a U20 logger to record barometric pressure data, install one logger in one of the wells as follows:

1. Cut wire for suspending the logger.
 - a. Measure the physical depth to the surface of the water from the suspension point.
 - b. Cut a piece of stranded, stainless steel wire (Teflon coated is best) so that the logger will hang about 2 feet below the ground surface but always above the water surface.
2. Attach the wire to the suspension point and to the logger cap.
3. Relaunch the logger if desired (if a PC or a HOB0 U-Shuttle is available).
4. Lower the logger into the well or stilling well. Make sure the logger does not go below the water surface.
5. Record the deployment time.

Collecting Data

For reading out the Water Level logger in the field, you can use either of the following:

- Laptop computer with HOB0ware Pro and an Optic USB Base Station (BASE-U-4), with a coupler (COUPLER2-B)
- HOB0 Waterproof Shuttle (U-DTW-1) with a coupler (COUPLER2-B)

1. Measure the water depth using the original reference point with the correct sign.
2. Record depth and date and time.
3. Pull the logger out of the well.
4. Remove the logger from its cap, leaving the suspension undisturbed.
5. Readout the data using one of the options listed above.
6. Save the data in a test folder location.
7. Redeploy the logger (optional). See below.

Barometric Pressure Data

To read out a U20 logger used for barometric pressure data:

1. Remove the logger from the well.
2. Readout the data using one of the options listed above.
3. Save the data in a test folder location.
4. Redeploy the logger (optional). See the next section.

Redeploying the Logger

If you are redeploying the logger, you must first make sure that it is launched. If you used the HOBOWaterproof Shuttle to offload data, the shuttle automatically performs a synchronized relaunch of the logger so that data is logged on the same measurement intervals. If you wish to change the launch settings, you must launch the logger using HOBOWare Pro.

The existing suspension can be reused as long as the water level logger remained in the water and the barometric logger remained out of the water for the entire test interval. Take a reference reading with the date and time as described in *Collecting Data*. Record this information in your field notebook to use later to calibrate your data, which will zero out any drift error.

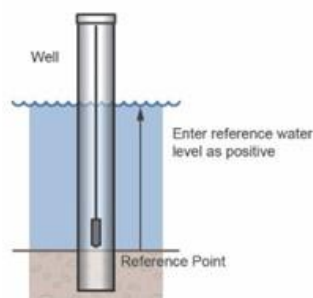
Processing Data using Barometric Pressure Data

To determine water level using barometric pressure data, use the **Barometric Compensation Assistant** in HOBOWare Pro, as described below.

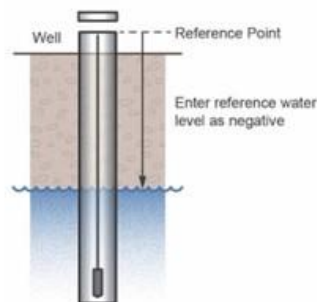
If you are using barometric pressure data from a HOBOWeather station, you can use the data file as if it were U20 barometric data. For data from sources other than Onset products, see *Barometric Data from Other Sources* below.

1. In HOBOWare Pro, open the water depth data file. The **Plot Setup** window appears.
2. Uncheck all boxes except *Abs. Pressure*.
3. Run the Barometric Compensation Assistant.
 - a. Click the **Process** button.
 - b. Select the water density box that best describes the water that you are measuring or enter the actual water density.
 - c. Check the *Use a Reference Water Level* box and enter the reference water level that you measured at the beginning of the deployment.

Enter the water level as a positive number if it is measured upward from a reference point below the water's surface, such as the water's height above sea level. This illustration shows an example of when to enter the water level as a positive number.



Enter the water level as a negative number if it is measured downward from a reference point above the water's surface, such as the top of the well. This illustration shows an example of when to enter the water level as a negative number.



- d. Select the date and time from the pull-down menu that is closest to the recorded date/time for the measurement. If you measured the depth before deployment because of pipe size, then select a date/time after the start of the deployment.
- e. Check *Use Barometric Data file*.
- f. Click the **Choose** button. This will allow you to select the data file to use for barometric pressure compensation.
- g. Select and open the data file.
- h. Click the **Create New Series** button. A new Plot Setup window appears.
4. Select the *Water Level* box and any other series that you want plotted. Click the **Plot** button to obtain a plot of the resulting water level data.

Measurement Error

Measurement error can be caused by manual measurement error, sensor drift, or change in the suspension cable length.

To quantify measurement error (which is ideally zero), compare the calculated water level at the end of the plot with the water level measured just before you removed the water level logger.

Barometric Data from Other Sources

Third Party Weather Station or Barometric Logger

If you choose to use barometric pressure from a third party weather station or barometric logger, you need to convert the date, time, and pressure data to a text file with special header requirements. For information on how to set up the text file, see the HOBOWare Help or User Guide. It is easiest to do this work in EXCEL and then save it as a text file.

Online Weather Station

If you choose to use barometric pressure from an online weather station, such as the National Weather Service, the measured barometric pressure is modified to be at sea level. This sea level pressure is useable since all pressure offsets are zeroed when you enter the reference measurement.

In the Barometric Compensation Assistant, when you select the Barometric Data File, select the text file that you generated. HOB0ware Pro will ask for the data format and data separation characters (tab or comma) and then import the barometric data.

Maintenance

Protecting the Logger

Important: Do not attempt to open the logger housing! Unscrewing the metal nose cone of the logger will cause serious damage to the pressure sensor and logger electronics. There are no user serviceable parts inside the case. Contact Onset technical support if your logger requires servicing.

This logger can be damaged by shock. Always handle the logger with care. The logger may lose its calibrated accuracy or be damaged if it is dropped. Use proper packaging when transporting or shipping the logger.

Biofouling

Periodically inspect the logger for fouling. Biological growth on the face of the pressure sensor will throw off the pressure sensor's accuracy. Organisms that grow inside the sensor nose cone and on the sensor itself can interfere with the sensor's operation and eventually make the sensor unusable. If the deployment area is prone to biofouling, check the logger periodically for marine growth.

Solvents

Check a materials-compatibility chart before deploying the logger in locations where untested solvents are present.

The logger is shipped with Viton O-rings installed. Viton has an excellent resistance to most solvents and is suitable for deployments in water that contain a mixture of most fuels, solvents and lubricants. However, the Viton O-rings are sensitive to polar solvents (acetone, ketone), ammonia, and brake fluids.

The black acetal cap is provided to help protect the communications window. Acetal is resistant to most solvents, fuels, and lubricants.

The polycarbonate communications window is sealed as an additional barrier to water and dirt entering the logger housing.

Compensating for Drift

All pressure sensors drift over time. The drift for the pressure sensor and electronics in the HOB0 Water Level logger is less than 0.3% FS (worst case) per year. In most applications, drift is not a significant source of error, because the offset created by any drift is zeroed out when you take a manual reference level measurement and use the logger software to automatically calculate the level readings relative to the reference measurement. In effect, you are re-zeroing the sensor each time you apply a reference reading to the data file.

Pressure sensor drift matters only when absolute pressure values are needed, or if there are no recent reference level or depth measurements available. For example, if the logger is deployed for one year and no new reference level readings are taken during the deployment, it is possible that the sensor

could have drifted as much as 0.3% FS by the end of the deployment.

It is possible to determine the actual amount of drift during a deployment if a reference level is taken at the beginning and the end of a long-term deployment. The results of applying the two different reference levels (once at the beginning of the data file, and again at the end of the data file) can be compared. Any difference between the files indicates the amount of sensor drift (assuming accurate reference levels).

Verifying Accuracy

You can check the *differential accuracy* of your loggers for water level measurements by deploying the loggers at two depths and comparing the difference in level readings. When verifying the accuracy this way, be sure to allow the loggers' temperature to stabilize at each depth. Use the logger software to convert the readings from pressure to level. The level readings should be taken close enough together that the barometric pressure does not change.

You can check the *absolute pressure accuracy* of your HOB0 Water Level Logger by comparing its ambient pressure readings to a second HOB0 logger. Their readings should be within each other's specified accuracy. Alternatively, you can check the pressure reading against an accurate local barometer. If you use a non-local source of barometric information, such as the NOAA website, adjust for altitude.

Recalibration

If you would like to have your logger's absolute accuracy verified against a NIST standard, or to have your logger recalibrated, contact Onset or your place of purchase for pricing and return arrangements.

The Battery

The battery in the HOB0 Water Level Logger is a 3.6 Volt lithium battery.

Battery Life

The battery life of the logger should be about five years or more. Actual battery life is a function of the number of deployments, logging interval, and operation/storage temperature of the logger. Frequent deployments with logging intervals of less than one minute, and continuous storage/operation at temperatures above 35°C will result in significantly lower battery life. For example, continuous logging at a one-second logging interval will result in a battery life of approximately one month.

To obtain a five-year battery life, a logging interval of one minute or greater should be used and the logger should be operated and stored at temperatures between 0° and 25°C (32° and 77°F).

Voltage

The logger can report and log its battery voltage. If the battery falls below 3.1 V, the logger will record a "bad battery" event in the datafile. If the datafile contains "bad battery" events, or if logged battery voltage repeatedly falls below 3.3 V, the battery is failing and the logger should be returned to Onset for battery replacement.

Replacing the Battery

To have your logger's battery replaced, contact Onset or your place of purchase for return arrangements. Do not attempt to replace the battery yourself. Severe damage to the logger will result if the case is opened without special tools, and the warranty will be voided.

 **WARNING:** Do not cut open, incinerate, heat above 100°C (212°F), or recharge the lithium battery. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations for lithium batteries.