4690 Series

Turbidity sensor



Introduction

The 4690 sensor is a rugged, reliable instrument designed to measure the turbidity content of water. The sensor also has additional features including dry standard verification and automatic cleaning. The sensor is designed for use with the ABB AWT420 dual-input transmitter.

For more information

Publications for the associated transmitters are available for free download from:
www.abb.com/measurement
or by scanning this code:

Search for or click on:	
AWT420 transmitter – Data Sheet	DS/AWT420
4690 Series Turbidity Sensor – Data Sheet	DS/ATS410
AWT420 transmitter – Operating Instruction	OI/AWT420

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Contents

1 Health and safety 3
1.1 Safety precautions 3
1.2 Potential safety hazards 3
1.3 Electrical safety 3
1.4 Product symbols 3
1.5 Product recycling and disposal (Europe only) 4
1.5.1 . . End-of-life battery disposal 4
1.6 Information on RoHS Directive 2011/65/EU (RoHS II) 4

2 Turbidity sensor components 5

3 Installation 6
3.1 Siting requirements 6
3.2 Install the turbidity sensor 6
3.2.1 . . Sample flow rate 7
3.2.2 . . Mounting the de-bubbler 8
3.2.3 . . Setup procedure for the de-bubbler 9

4 Turbidity sensor electrical connections 10

5 Calibration 11
5.1 Care and maintenance of secondary standards 11
5.2 Calibration verification with a secondary standard 12
5.3 Calibration with a primary standard 13

6 Maintenance 14
6.1 Cleaning the sensors without a wiper unit 14
6.2 Cleaning the sensors with a wiper unit 14

7 Fault-finding 14
7.1 Unstable or erratic readings 14
7.2 Intermittent short-term spikes in turbidity readings 14

1 Health and safety

Symbols that appear in this document are explained below:

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Note
'Note' indicates useful or important information about the product.

1.1 Safety precautions

Be sure to read, understand and follow the instructions contained within this manual before and during use of the equipment. Failure to do so could result in bodily harm or damage to the equipment.

1.2 Potential safety hazards

4690 turbidity sensor – electrical damage to the equipment.

⚠ WARNING

Bodily injury

To ensure safe use when operating this equipment, the following points must be observed:

- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.

Safety advice concerning the use of the equipment described in this manual or any relevant Material Safety Data Sheets (where applicable) can be obtained from the Company, together with servicing and spares information.

1.3 Electrical safety

This equipment complies with the requirements of CEI/IEC 61010-1 Edition 3.1 2017-01 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use' and complies with US NEC 500, NIST and OSHA.
If the equipment is used in a manner that is not specified by the Company, the protection provided by the equipment may be impaired.

1.4 Product symbols

Symbols that may appear on this product are shown below:


Protective earth (ground) terminal.


Functional earth (ground) terminal.


This symbol, when noted on a product, indicates a potential hazard which could cause serious personal injury and/or death. The user should reference this instruction manual for operation and/or safety information.


This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists and indicates that only individuals qualified to work with hazardous voltages should open the enclosure or remove the barrier.


Recycle separately from general waste under the WEEE directive.

Direct current supply only.

Alternating current supply only.


Both direct and alternating current supply.


The equipment is protected through double insulation.

...1 Health and safety

1.5 Product recycling and disposal (Europe only)



ABB is committed to ensuring that the risk of any environmental damage or pollution caused by any of its products is minimized as far as possible. The European Waste Electrical and Electronic Equipment (WEEE) Directive that initially came into force on 13th August 2005 aims to reduce the waste arising from electrical and electronic equipment; and improve the environmental performance of all those involved in the life cycle of electrical and electronic equipment. In conformity with European local and national regulations, electrical equipment marked with the above symbol may not be disposed of in European public disposal systems after 12th August 2005.

NOTICE

For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment for proper disposal.

1.5.1 End-of-life battery disposal

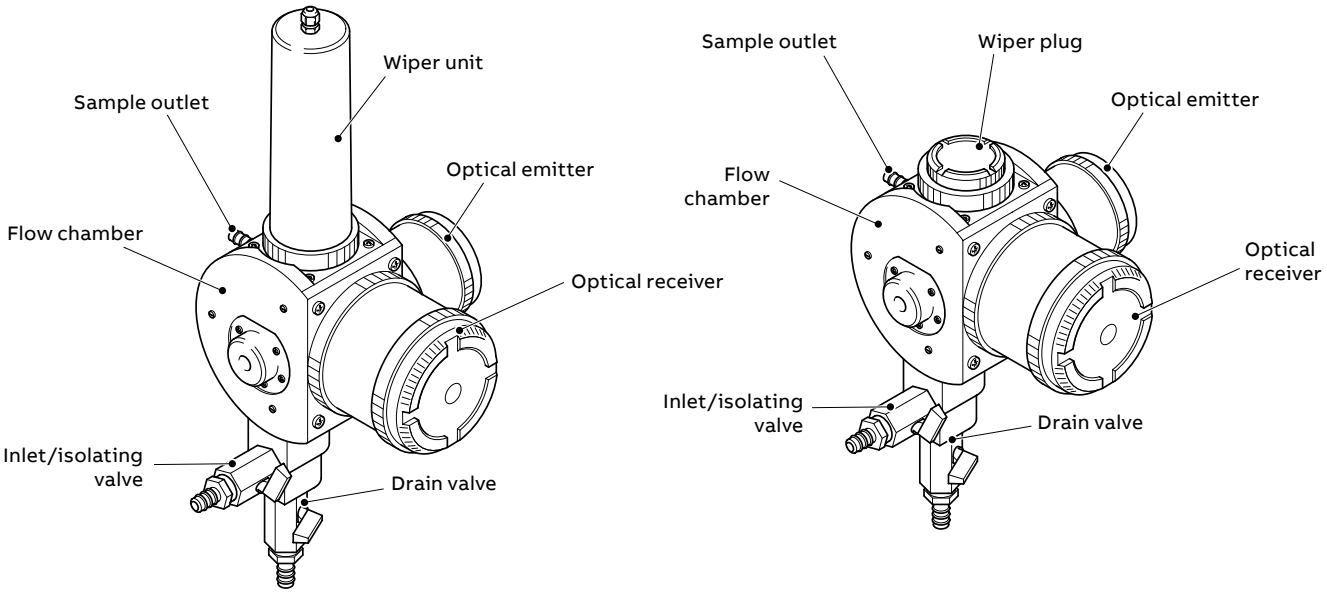
The transmitter contains a small lithium battery (located on the processor/display board) that must be removed and disposed of responsibly in accordance with local environmental regulations.

1.6 Information on RoHS Directive 2011/65/EU (RoHS II)



ABB, Industrial Automation, Measurement & Analytics, UK, fully supports the objectives of the RoHS II directive. All in-scope products placed on the market by IAMA UK on and following the 22nd of July 2017 and without any specific exemption, will be compliant to the RoHS II directive, 2011/65/EU.

2 Turbidity sensor components



O1 Primary components of the turbidity sensor

3 Installation

3.1 Siting requirements

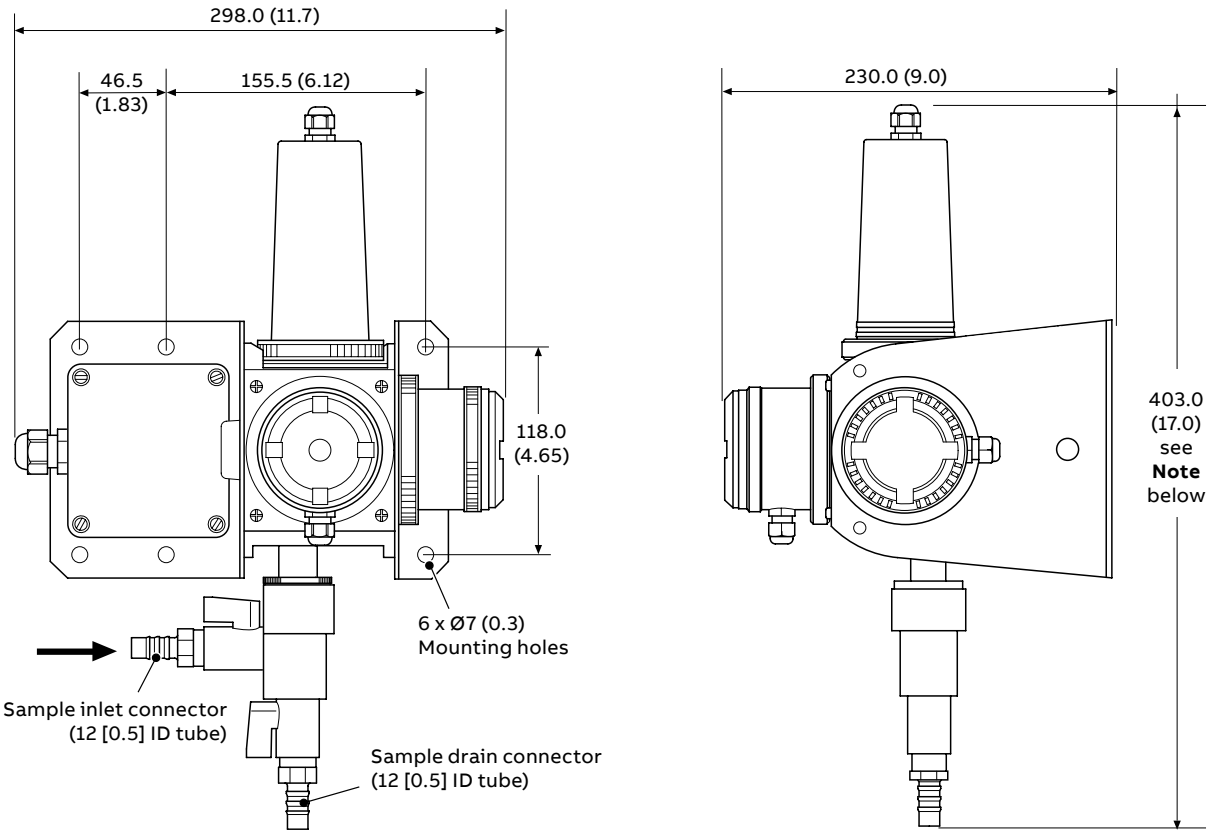
Make sure that there is a clearance of 200 mm (7.9 in) all around the sensor, to let the turbidity sensor be easily removed for maintenance. Refer to Install the turbidity sensor for the dimensions of the sensor.

Install the sensor at a height that gives easy access during calibration and cleaning.

NOTICE

Do not install the sensor in direct sunlight.

Dimensions in mm (in)



O2 Sensor dimensions (with the optional wiper unit)

Note:
Leave an additional clearance of approximately 30 mm (1.2 in) above the wiper unit for the bend in the wiper unit cable.

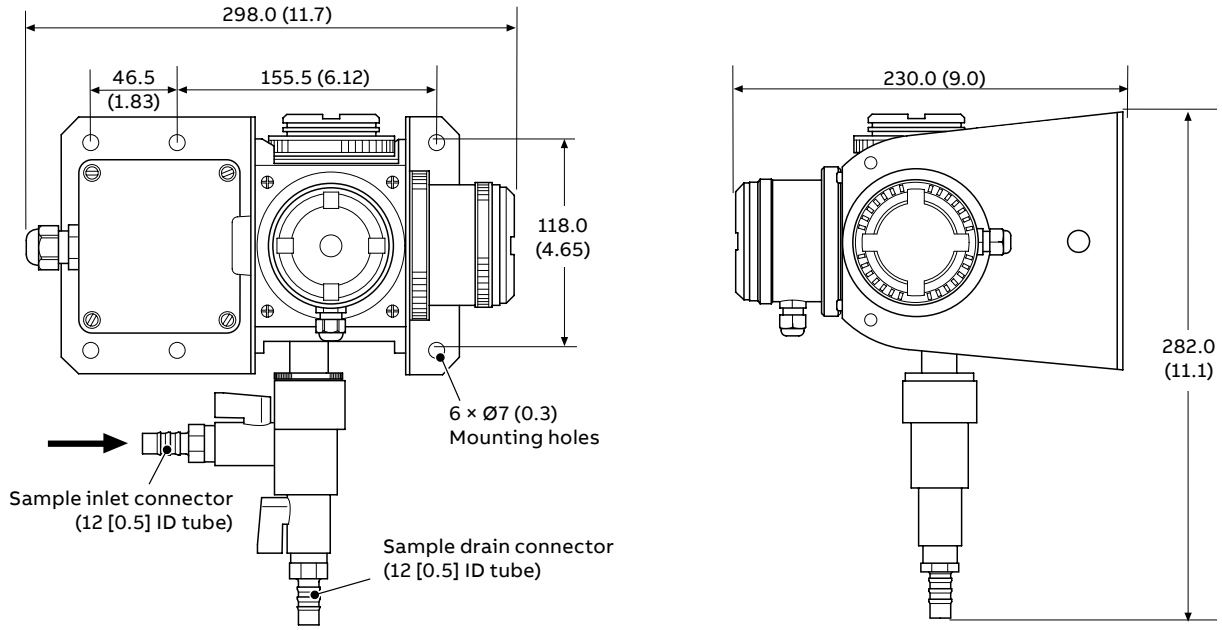
3.2 Install the turbidity sensor

01 identifies the main components of each sensor.

Referring to Figure 02 or 03:

1. Install the sensor in the position shown with the brackets that are provided. Make sure that the sensor is installed within 5° of its vertical axis.
2. Connect the sample inlet tube and the sample drain tube.
3. Connect the sample outlet tube. Refer to Figure 04.

Dimensions in mm (in)

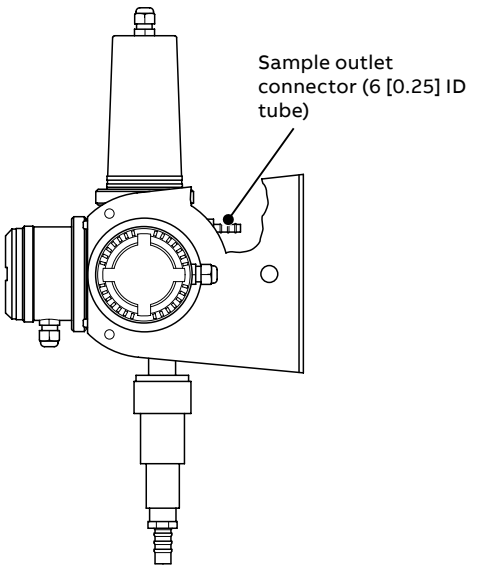


O3 Sensor dimensions (without the optional wiper unit)

3.2.1 Sample flow rate

Set a minimum flow rate of 0.5 L/min to prevent solids settling in the pipework. Increase the flow rate if it is necessary, but do not exceed the maximum flow rate of 1.5 L/min.

When measuring turbidity, it is important to eliminate additional sources of light scattering, such as gas bubbles in the sample. An optional de-bubbler (part number 7997 500) is available to eliminate gas bubbles. Refer to 3.2 Install the optional de-bubbler on page 8.



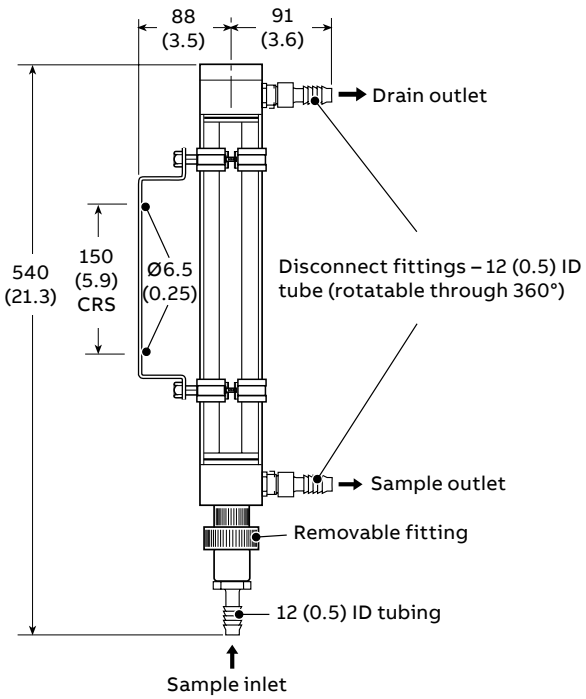
O4 Sample outlet connector location on 4960 series

…3 Calibration

…3.2 Install the optional de-bubbler

3.2.2 Mounting the de-bubbler

Mount the de-bubbler vertically with the flow upwards.



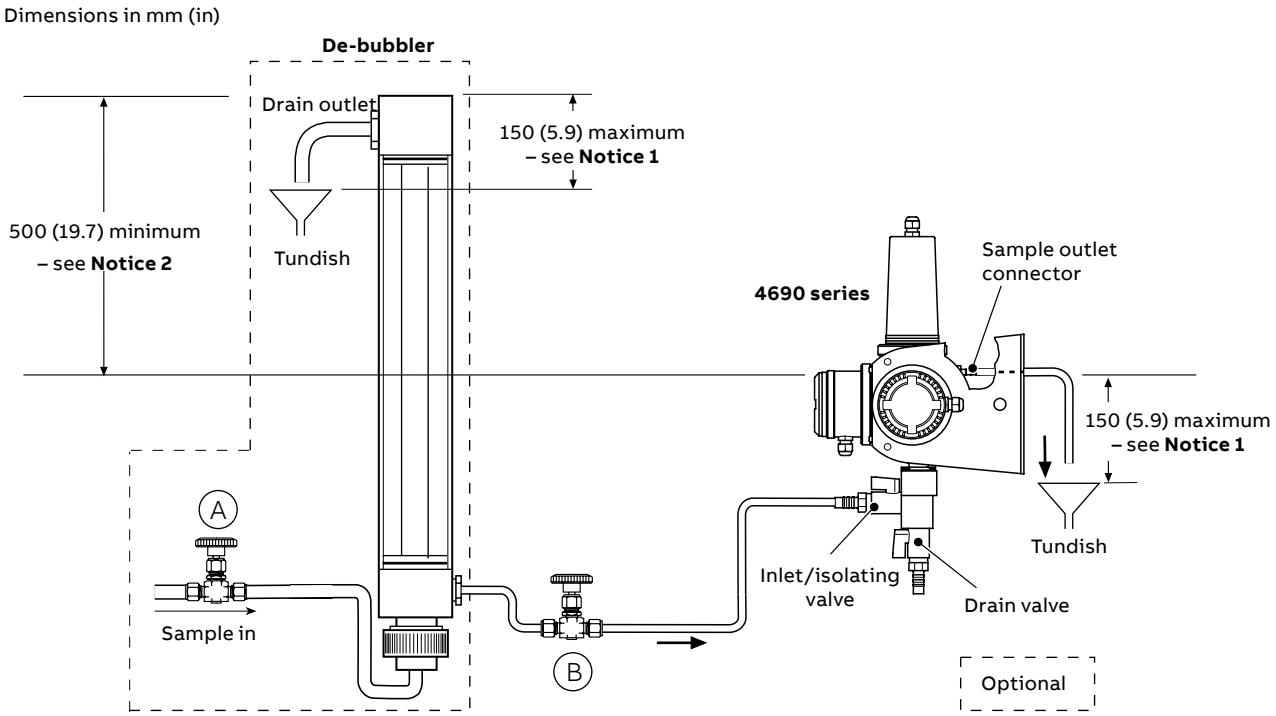
05 De-bubbler mounting information
(de-bubbler part number 7997 500)

3.2.3 Setup procedure for the de-bubbler

For systems that include a de-bubbler, refer to Figure 06:

1 Open the 'sample in' isolating valve (A) to keep the overflow from the de-bubbler at a minimum.

2 Adjust the sample flow through the turbidity system with the flow regulating valve (B).



Note.
It is recommended to use the sample regulating valves together with a flow indicator to ensure easy maintenance and consistent performance. These devices are not supplied with the 4690 turbidity systems.

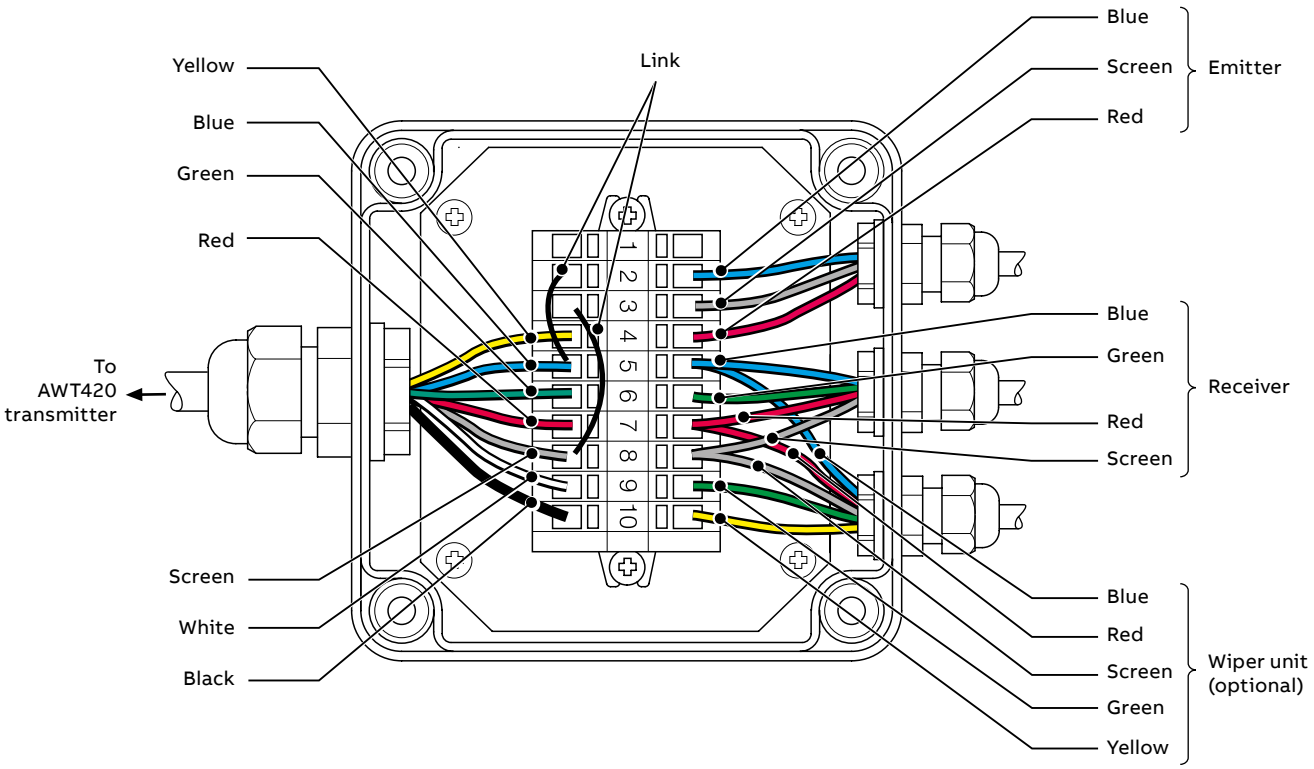
06 Typical system installation for 4690 series turbidity systems

NOTICE

1 To prevent degassing of the sample, which can cause very erratic readings, do not exceed this measurement.

2 This is the minimum installation distance that ensures adequate flow rate through the sensor. Increase this distance if you use long tubing or small-bore tubing.

4 Turbidity sensor electrical connections



07 Turbidity sensor junction box connections

5 Calibration

A key feature of the 4690 Series Turbidity system is the dry secondary calibration standard. This is designed to simplify routine calibration verification and minimizes the need for chemical standards.

Each dry calibration standard is verified against a primary formazine standard before delivery, and the nominal turbidity value is indicated on the label.

For regulatory monitoring, use the secondary calibration standard for monthly calibration verification and periodically monitor it for deterioration using a primary standard.

Definitions

- **Primary standards**
  Turbidity standards that are traceable and equivalent to the reference turbidity standard, within statistical errors. Formazine is the most commonly acceptable form of primary standard. The other is a commercially manufactured liquid suspension of styrene divinylbenzene polymer beads (SDB). Primary standards are used to calibrate a turbidity analyzer directly or to calibrate a secondary standard.

- **Secondary standards**
  Standards that the manufacturer (or an independent testing organization) has certified give analyzer calibration results equivalent (within certain limits) to the results obtained when the analyzer is calibrated with a primary standard.

- **Calibration**
  A procedure that checks or adjusts an analyzer's accuracy by comparison with a defined standard or reference.

- **Calibration verification**
  A procedure used to check whether or not the calibration of the analyzer is within certain limits.

5.1 Care and maintenance of secondary standards

ABB's secondary standards may be used repeatedly but must be monitored for deterioration.

All secondary standards can change gradually with time. Deterioration can be detected by measuring the turbidity value of the secondary standard after calibration of the analyzer with a primary calibration standard.

It is recommended that secondary standards are checked every 12 months against a primary standard on the analyzer they are intended to be used with.

If the comparison with a primary standard shows that the turbidity value of the secondary standard has changed, the secondary standard can be assigned a new turbidity value for use in future calibration verification.

Included with each sensor is a calibration record card kit for recording the value of the secondary standard compared to the primary calibration data for each individual analyzer with which the secondary standard is used.

Additional calibration record card kits can be purchased from ABB (part no. 7998 190 for pack of 3).

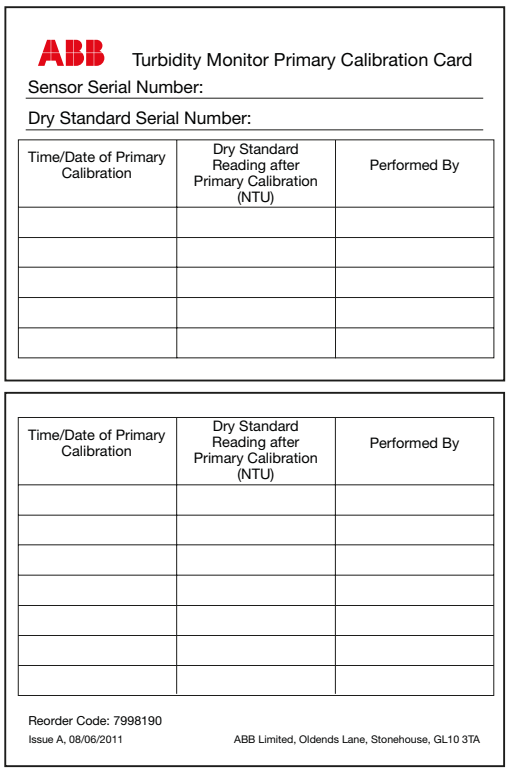


ABB Turbidity Monitor Primary Calibration Card

Sensor Serial Number:

Dry Standard Serial Number:

Time/Date of Primary Calibration	Dry Standard Reading after Primary Calibration (NTU)	Performed By

Time/Date of Primary Calibration	Dry Standard Reading after Primary Calibration (NTU)	Performed By

Reorder Code: 7998190

Issue A, 08/06/2011 ABB Limited, Oldends Lane, Stonehouse, GL10 3TA

08 Example of calibration record card

To minimize deterioration of the secondary standard:

- Carefully clean any residual moisture after use.
- Clean the prism with a cloth that has no lint.
- Do not touch the dry standard rod. Fingerprints on the surface can have an effect on its stated value.
- Keep it in the container provided when not in use, and keep it in a dry place.

...5 Calibration

5.2 Calibration verification with a secondary standard

To check the calibration:

1 Close the isolating valve that is installed upstream of the sensor.

2 Close the sensor inlet valve.

3 Open the drain valve. Let the sensor drain.

NOTICE

When you remove the wiper unit, do not put too much force on the wiper because it can bend the wiper arm out of 90°. When you remove the wiper, make sure that the wiper arm is not bent.

4 Carefully remove the wiper unit (7998 011 and 012) or the wiper plug (7998 016 and 017) to aid complete drainage of the system.

5 When the system is empty, close the drain valve.

6 Thoroughly dry the flow chamber internally using clean tissue.

7 Thoroughly clean and dry the emitter and receiver lenses using clean tissue.

8 If there is condensation on the emitter and receiver lenses:
- **a** Leave the sensor open to let the lenses reach ambient temperature before you do the calibration.

9 Insert the dry calibration standard with the zero NTU indication (see Figure 09 or 10) facing the optical receiver, ensuring the locating lug engages correctly. Refer to Figure 11.

10 Note the reading on the display.

11 Remove the dry standard, turn it through 180° and refit it, ensuring that the NTU value indication (refer to Figure 09 or 10) faces the receiver and the locating lug engages correctly. Refer to Figure 11.

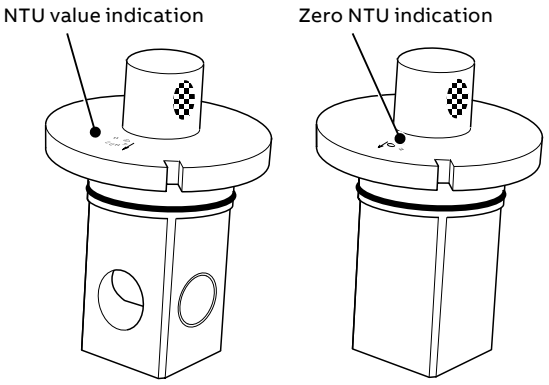
12 Note the reading on the display.

13 If the readings noted at steps 9 and 10 exceed ±5 % of dry standard value:
- **a** Repeat the procedure from step 7.
- **b** If the readings are still outside this range, calibrate the sensor.

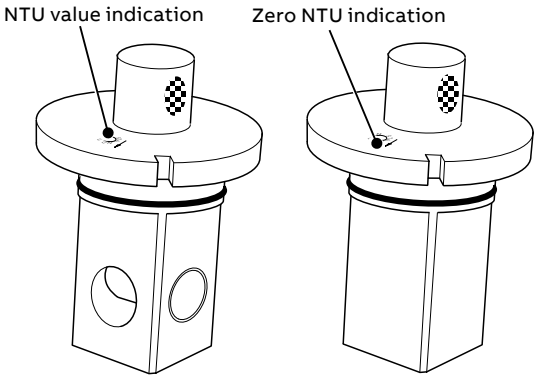
14 Remove the dry standard and put it in its storage container.

15 Refit the wiper unit (7998 011 and 012) or wiper plug (7998 016 and 017).

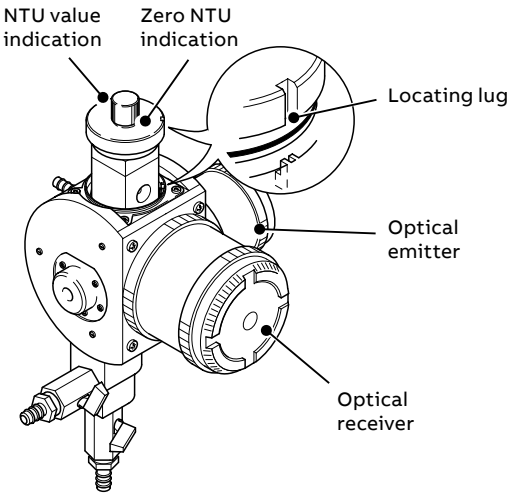
16 Open the inlet valve and ensure that the flow through the sensor is 0.5 to 1.5 L/min^{-1}.



09 Dry calibration standard for low-range sensors



10 Dry calibration standard for high range sensors



11 Inserting dry standard

5.3 Calibration with a primary standard

Before you do a wet standard calibration, make sure that a stock formazine solution is available. If a stock solution is not available, 24 hours must elapse before a freshly prepared solution can be used.

To prepare the sensor assembly for wet (formazine) calibration:

1 Close the isolating valve installed upstream of the sensor.

2 Close the sensor inlet valve.

3 Open the drain valve. Let the sensor drain.

NOTICE

When you remove the wiper unit, do not put too much force on the wiper because it can bend the wiper arm out of 90°. When you remove the wiper, make sure that the wiper arm is not bent.

4 Carefully remove the wiper unit (7998 011 and 012) or the wiper plug (7998 016 and 017) to aid complete drainage of the system.

5 When the system is empty, close the drain valve.

6 Thoroughly dry the flow chamber internally using clean tissue.

7 Thoroughly clean and dry the emitter and receiver lenses using clean tissue.

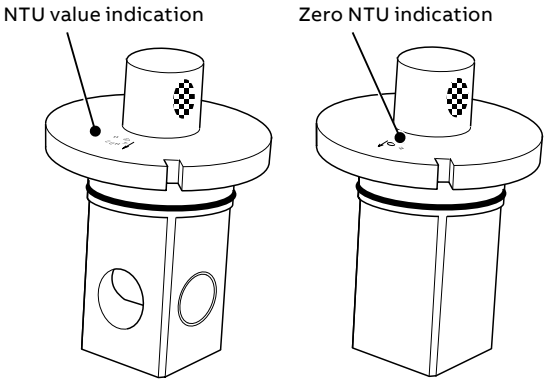
8 If there is condensation on the emitter and receiver lenses:

a Leave the sensor open to let the lenses reach ambient temperature before you do the calibration.

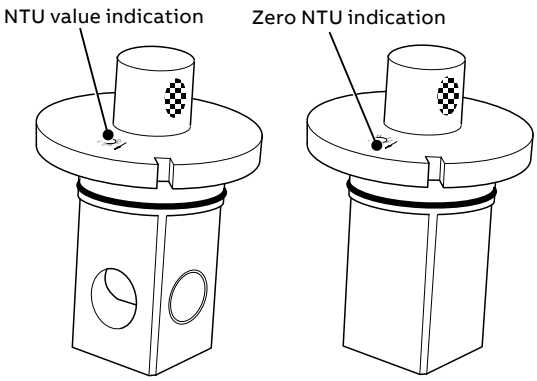
9 Insert the dry calibration standard with the zero NTU indication (refer to 12 or 13) facing the optical receiver, ensuring the locating lug engages correctly. Refer to Figure 14.

NOTICE

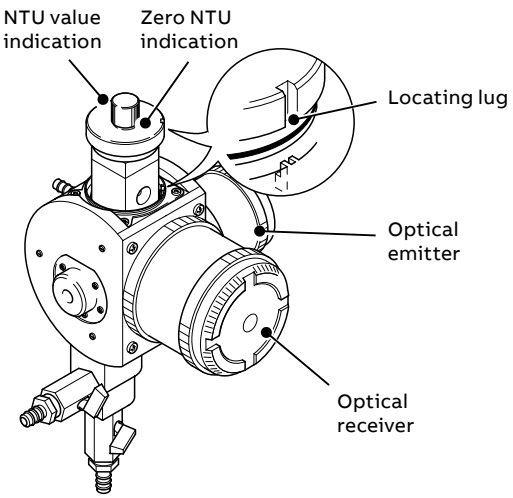
Do not touch the light-reflecting parts of the standard.



12 Dry calibration standard for low range sensors



13 Dry calibration standard for high range sensors



14 Inserting dry standard

6 Maintenance

The servicing schedule in Table 1 is a guide only. Because the turbidity systems are designed for a wide range of applications, and the nature of the sample can vary considerably, it might be necessary to change the schedule to apply to the particular installation and sample conditions.

Table 1 Suggested maintenance schedule

Task	Recommended frequency
Wiper blade replacement	Quarterly
LED light source (ISO 7027) replacement kit	Every 5 years

6.1 Cleaning the sensors without a wiper unit

These sensors are normally used on clean water samples. Under normal conditions, they may only require manual monthly cleaning of the flow chamber.

However, if a high turbidity breakthrough occurs, clean the flow chamber immediately to make sure that the readings are accurate.

6.2 Cleaning the sensors with a wiper unit

The required automatic cleaning frequency of the flow chamber and optical windows of the sensors can be determined only by plant experience.

It is recommended to do checks at appropriate intervals.

7 Fault-finding

7.1 Unstable or erratic readings

There are a number of possible causes of unstable or erratic readings. Look for air bubbles in the sample. The bubbles might be due to degassing of the sample, caused by either a drop in sample pressure, or a rise in temperature.

Frequent cleaning of the optical windows helps prevent the accumulation of bubbles. If you see bubbles, it is recommended to install the optional de-bubbler unit. Refer to 3.2 Install the optional de-bubbler on page 8.

Where the noise level gradually worsens over time, this usually indicates that solids accumulated in the flow cell. An increase in the flow rate through the flow cell might reduce this build up. The flow cell must be cleaned manually.

7.2 Intermittent short-term spikes in turbidity readings

This is usually caused by bubbles that go through the light path in the flow cell. The bubbles are a result of degassing. Degassing is not an instantaneous process, and it is possible that it occurs after the sample has gone through the de-bubbler. The bubbles start to form in the sample pipework and the flow cell. As the bubbles grow gradually, the bubbles finally release and flow through the light path. This causes a spike in the turbidity reading.

The analyzer can be programmed for bubble rejection to remove short-term spikes from the readings. For optimum operation, operate the wiper unit frequently to prevent bubbles accumulating on the windows.

Notes

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