

Little Dipper™ In-Line Fluorometer



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P/N 998-2800

Version 1.5

TURNER DESIGNS

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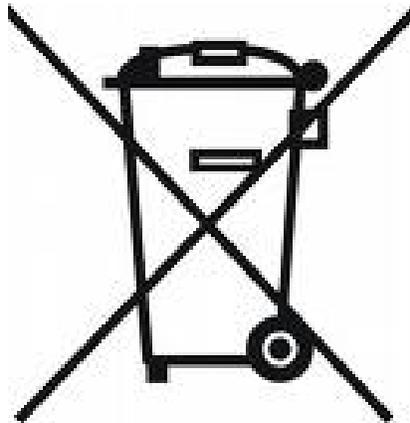
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Table of Contents

1. Introduction	
1.1 Introduction	4
1.2 Inspection and Setup	4
2. Installation and Operation	
2.1 Installation	5
2.2 Tee Installation	5
2.3 Operation	6
3. Calibration and Calculations	
3.1 Calibration	7
3.2 Calculating Calibration Coefficients	9
4. Recommended Measurement Practices	
4.1 Minimizing Variation in Signal	10
4.2 Temperature Considerations	10
5. Maintenance and Warranty	
5.1 Visual Inspection and Cleaning	12
5.2 Maintenance Check Using Standard Solutions	12
5.3 Warranty Terms	13
5.4 Warranty Service	13
5.5 Out of Warranty Service	14
Appendices	
A Fluorometer and Mounting Tee Specifications	16
B Wiring Guide	17



WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE) DIRECTIVE

Turner Designs is in the business of designing and selling products that benefit the well-being of our environment. Accordingly, we are concerned with preserving the surroundings wherever our instruments are used and happy to work with customers by complying with the WEEE Directive to reduce the environmental impact resulting from the use of our products.

WEEE Return Process:

To arrange the return of an end-of-life product, proceed as follows:

If you purchased your instrument through a Turner Designs Distributor please contact your local representative. They will instruct you where to return the end-of-life product.

If you purchased your instrument directly from Turner Designs please contact Turner Designs Customer Service:

By Phone: 1-408-212-4041 or Toll Free: (877) 316.8049

By Email: Customer Service at support@turnerdesigns.com

Turner Designs will provide a WEEE RMA Number, a Shipping Account Number, and a Ship to Address. Package and ship the product back to Turner Designs.

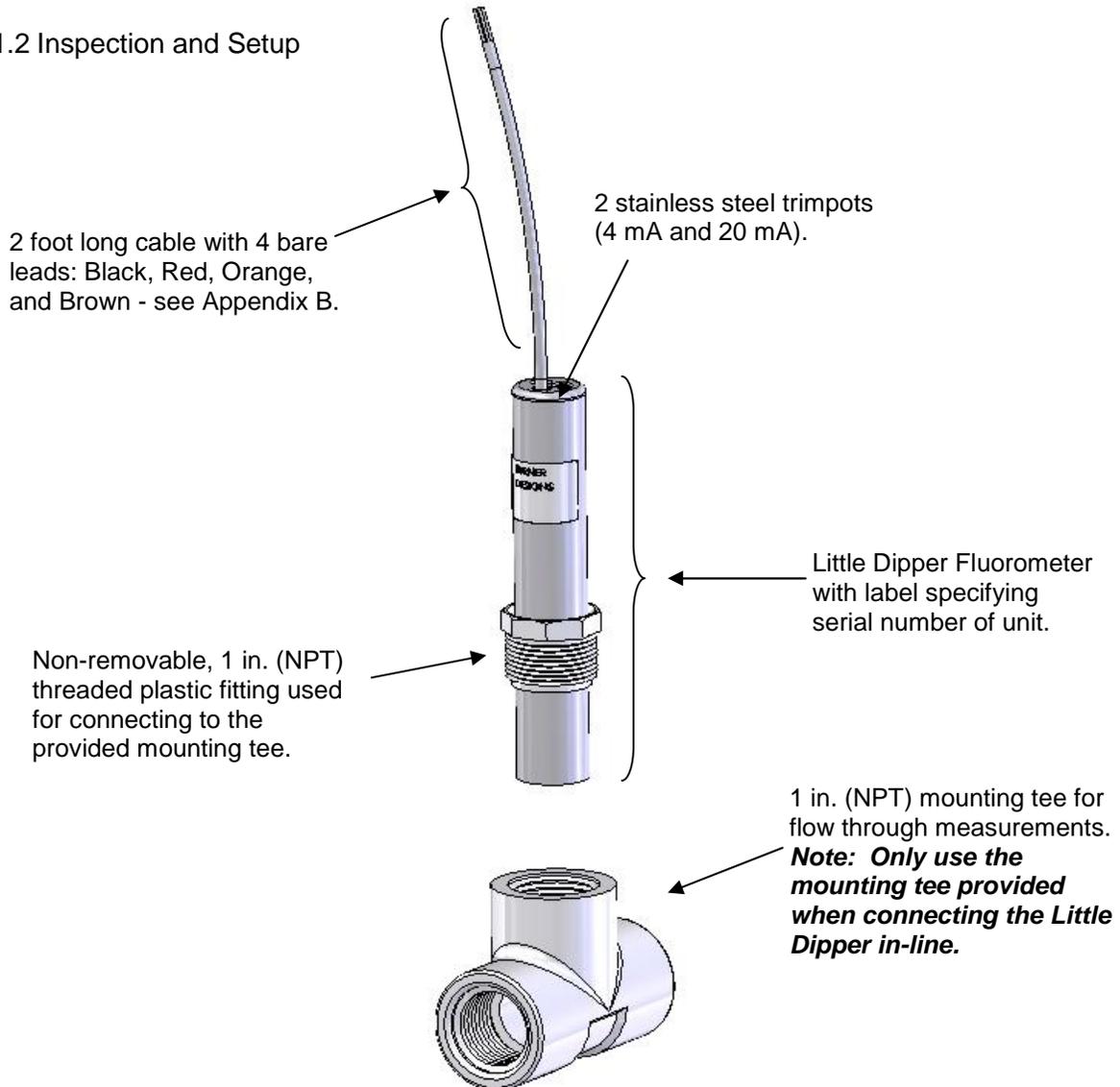
The product will be dealt with per Turner Designs' end-of-life recycling program in an environmentally friendly way.

1. Introduction

1.1 Description

Turner Designs' Little Dipper is an accurate, single-channel fluorometer designed to measure the concentration of your fluorophore of interest. The Little Dipper provides 4 - 20 mA output signal proportional to the concentration of the fluorophore in the sample or source water. In a representative application, the Little Dipper can be used with a data collection system to monitor and control the level of treatment chemicals in industrial applications. The sample water's fluorescence intensity is measured by passing the sample water, containing the fluorophore of interest, past the Little Dipper's optical window. An excitation light source illuminates the solution and excites the fluorophore in the solution which fluoresces at a different wavelength. The intensity of the emitted light is proportional to the concentration of the fluorophore in the sample or source water. Turner Designs' Little Dipper has a low maintenance design that will provide trouble-free performance.

1.2 Inspection and Setup



2. Installation and Operation

2.1 Installation

Turner Designs' Little Dipper is rated for light industrial environments.

Do not install the Little Dipper:

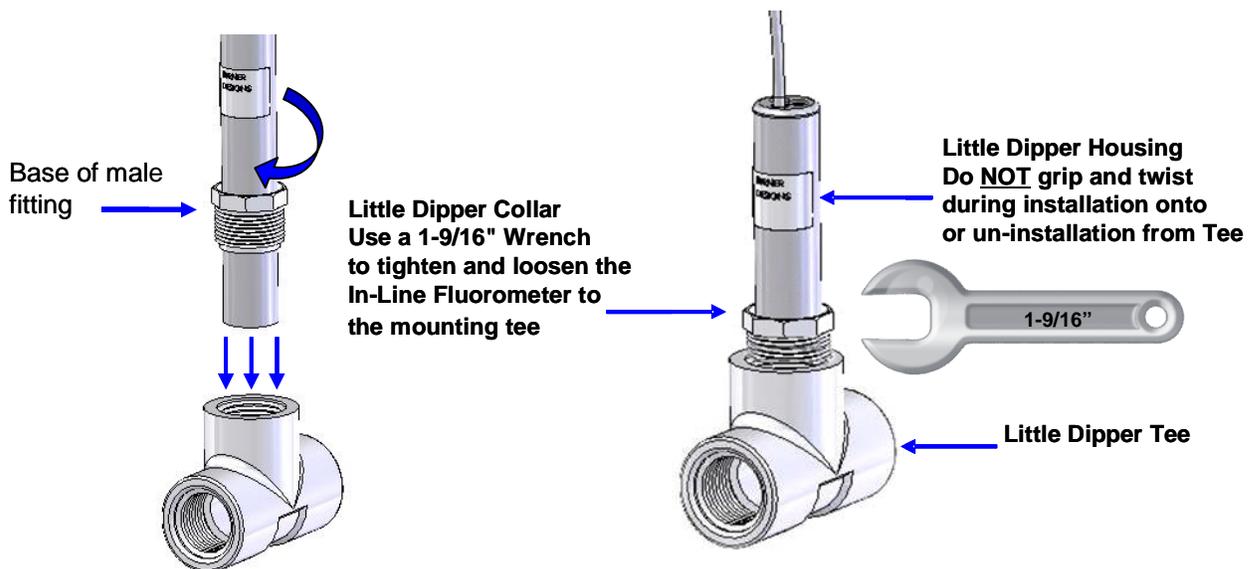
- In direct sunlight or near heat sources - operating temperature 0-50 °C.
- On vibrating walls or surfaces that affect the flow.
- Near devices that produce a strong electromagnetic field, such as large generators.

It is recommended that the Little Dipper be installed in such a way that the flow is directed upward to expel any trapped air bubbles or air trapped on the optical window will influence signal and cause erratic readings - see Section 4.0.

2.2 Tee Installation

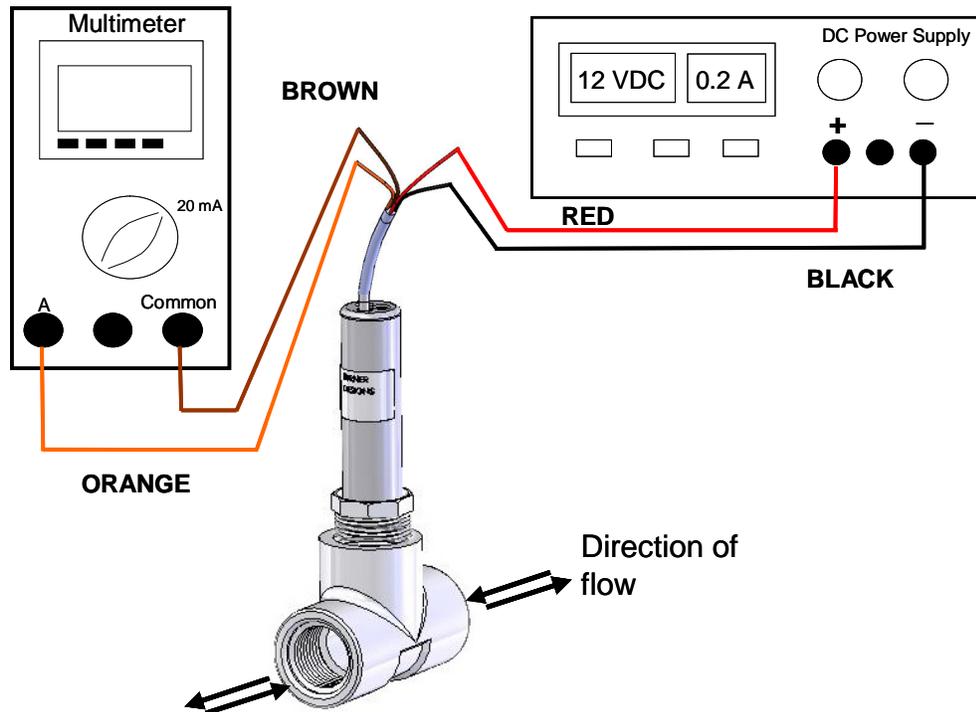
We recommend the following installation procedure for installing the Little Dipper onto the mounting tee provided for flow through applications:

- 1) Wrap Teflon tape around the threaded male fitting which is bonded to the fluorometer's housing.
Note: Turner Designs applies Teflon tape prior to shipping. For re-applications, do not wrap Teflon tape more than 3 – 4 full turns.
- 2) Connect the Little Dipper Fluorometer to the mounting tee provided.
Always use a 1-9/16" Wrench to tighten and loosen the Little Dipper to the mounting tee. Tightening and loosening by hand can cause damage to the Little Dipper.



- 3) Connect the mounting tee in line with your flow and start flowing water.
- 4) Inspect for leaks.
- 5) If a leak occurs, continue tightening $\frac{1}{4}$ inch at a time until the leaking stops.
Note: The base of the male fitting should not be flush with the mounting tee; the male fitting's threads should be visible after securing the connection using a wrench.
- 6) Connect the Little Dipper to the power supply and digital multimeter as shown below.

Note: The power ground (Black Wire) and the 4-20 mA return (Brown Wire) are not common. These wires should not be connected to the same point. Do not allow the bare wires to touch each other or conductive surfaces. Use standard electrical connection and insulation materials. Failure to properly connect the Little Dipper may result in damaged equipment.



2.3 Operation

Turner Designs' Little Dipper uses a Light Emitting Diode (LED) at a specific wavelength to excite the fluorophore of interest in samples or source water. Upon excitation, the fluorophore emits a different wavelength of light (fluorescence) that will be detected by the fluorometer's photodiode.

After power (8 - 30 VDC) is applied to the Little Dipper allow 5 seconds for the LED to stabilize. After 5 seconds measurements can be taken continuously as current output (4 – 20 mA).

3. Calibration and Calculations

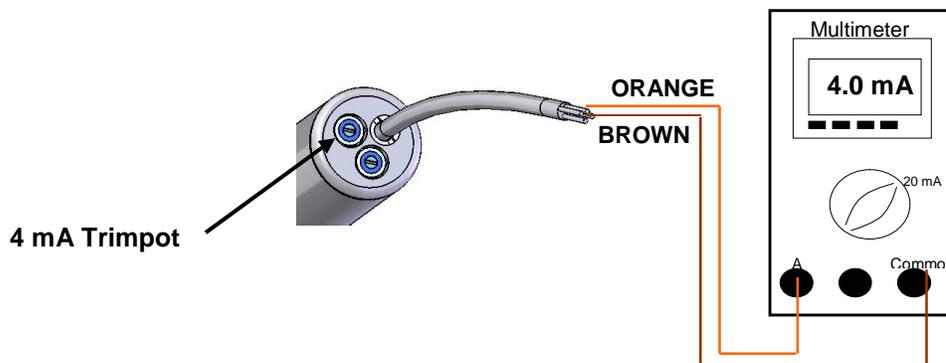
3.1 Calibration

The Little Dipper does NOT come calibrated from the factory. In order to specify a particular concentration for the Little Dipper to detect within the dynamic range of the instrument calibration of the sensor is required.

- 1) Connect the Little Dipper to the mounting tee provided - see Section 2.2, steps 1-6.
- 2) Connect the Little Dipper to the power supply and digital multimeter - see Section 2.2, Step 7.
- 3) Obtain a bucket with a known volume of the source water you will be measuring. **Note: This water should represent the signal you intend to set as zero, make sure that it does not contain any fluorophore.**
- 4) Fully submerge the mounting tee into the bucket with water and allow water to fill the mounting tee.

IMPORTANT NOTE: MAKE SURE TO REMOVE ALL BUBBLES FROM THE MOUNTING TEE BY TILTING THE LITTLE DIPPER AND GENTLY SHAKING WHILE FULLY SUBMERGED IN THE WATER AS AIR BUBBLES TRAPPED NEAR OR ON THE OPTICAL HEAD WILL INFLUENCE RESULTS.

- 5) Once bubbles have been removed, allow the multimeter signal to stabilize, and then use a flathead screwdriver to rotate the marked 4 mA trimpot so that the multimeter reads a minimum of 4 mA. **Note: Allow the multimeter reading to stabilize before adjusting the trimpot between readings; do not adjust the trimpot more than 1 full turn at a time before allowing signal to stabilize.**

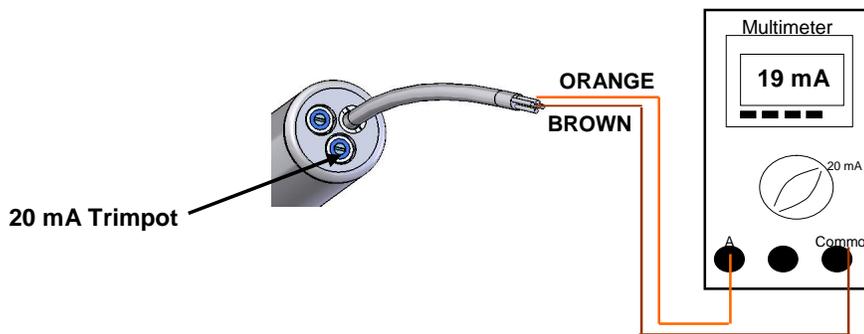


- 6) Make sure to log the reading - see Table 1 for example.
- 7) Remove the Little Dipper from the bucket.

- 8) In the same bucket which contains a known volume of your source water, make a solution using your fluorophore of interest that represents the maximum concentration you intend to measure, or use Turner Designs prepared calibration standards. Contact [Accessory Sales](#) to purchase.
- 9) Ensure the solution is well mixed, submerge the Little Dipper with mounting tee into the solution and allow the solution to fill the mounting tee.

IMPORTANT NOTE: MAKE SURE TO REMOVE ALL BUBBLES FROM THE MOUNTING TEE BY TILTING THE LITTLE DIPPER AND GENTLY SHAKING WHILE FULLY SUBMERGED IN THE SOLUTION AS AIR BUBBLES TRAPPED NEAR OR ON THE OPTICAL HEAD WILL INFLUENCE RESULTS.

- 10) Once bubbles have been removed, allow the multimeter signal to stabilize, and then use a screwdriver to rotate the marked 20 mA trimpot so that the multimeter reads 19mA.
Note: Allow the multimeter reading to stabilize before adjusting the trimpot between readings; do not adjust the trimpot more than 1 full turn at a time before allowing signal to stabilize.



- 11) Make sure to log the reading - see Table 1 for example.
- 12) You can now install the Little Dipper in line with the system you intend to monitor following installation instructions provided - see Section 2.1.

Data collected upon completing these calibration steps can be put into a table similar to the table below.

Table 1: Example of data collected from calibration Steps 1-10.

Solution Measured	Concentration	Multimeter current output
Blank Solution	C_b (0 ppb)	R_b (4 mA)
Sample Solution	C_s (30 ppb)	R_s (19 mA)

3.2 Calculating Calibration Coefficients

With the data collected you can find the coefficients required for calculating concentrations using the equation:

$$\text{Equation 1: } y = mx + c$$

Where:

y = the sample concentration,

m = the slope of your equation,

x = the sensor output in mA,

c = the x intercept (offset) when y = 0.

Finding the slope of your equation using example data from Table 1:

$$\begin{aligned} \text{Equation 2: } m &= [(C_s - C_b) / (R_s - R_b)] \\ m &= [(30 - 0) / (19 - 4)] = 30/15 = 2 \end{aligned}$$

Finding the c constant using example data from Table 1:

$$\begin{aligned} \text{Equation 3: } 0 &= [(m * R_b) - C] \\ 0 &= [(m * 4) - C] \\ c &= -8 \end{aligned}$$

Substitute m and c from Equation 1 with end values from Equations 2 and 3:

$$\text{Equation 4: } y = 2x - 8$$

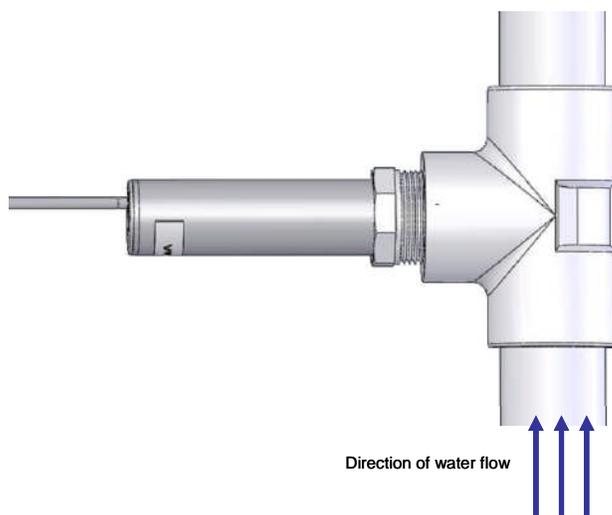
You can now calculate y (ppb) concentrations simply by substituting sensor output (mA) values for x in Equation 4.

4. Recommended Measurement Practices

4.1 Minimizing Variations in Signal

Turner Designs' Little Dipper has a flat surfaced optical window that might trap air bubbles when positioned vertically. For this reason we recommend:

- 1) Installing the Little Dipper horizontally so that the mounting tee is in a vertical position.



- 2) That the flow direction is upward through the mounting tee.

This will ensure that any trapped air bubbles will be released and will not interfere with sample measurement.

4.2 Temperature Considerations

Fluorescence is temperature dependant. The fluorescence signal from most fluorophores will decrease as sample temperature increases. However, fluorescence values can be corrected for temperature effects if the temperature correction coefficient of the fluorophore being measured is known. Table 2 lists known temperature correction coefficients. These coefficients can be used with recorded temperatures in the following equation to correct temperature effects on fluorescence values:

$$F_r = F_s * e^{[n (T_s - T_r)]}$$

Where:

F_r = the calculated fluorescence at the reference temperature, T_r

T_r = the reference temperature

T_s = the sample temperature at time of reading F_s

F_s = the sample's fluorescence at the time the temperature of the sample is measured, T_s .

e = the base of natural log

n = a temperature coefficient for whatever dye is used - see Table 2.

For greatest accuracy, determine, if possible, the temperature correction coefficient of the dye or fluorophore being used, record the sample temperature, and correct the sensor output for changes in temperature. Additional information on how to apply these corrections

is included in the Turner Designs Application Note: [A Practical Guide to Flow Measurements](#).

Table 2: Temperature correction coefficients for specific dyes.

Dye	Coefficient
Rhodamine WT	0.026 / °C Exponential
Rhodamine B	0.027 / °C Exponential
Pontacyl Brilliant Pink B	0.029 / °C Exponential
PTSA	-0.00126 / °C Exponential
Fluorescein	0.0036 / °C Exponential

5. Maintenance and Warranty

The Little Dipper fluorometer is designed for light industrial monitoring applications that require continuous measurements. It provides maximum performance and solid state reliability with minimal maintenance.

A maintenance check should be made once per month to ensure the optical window is free from any chemical or biological fouling. Frequency of maintenance checks are dependant on the fouling rate of the system being monitored. Systems that have a higher fouling rate might require more frequent maintenance checks.

5.1 Visual Inspection and Cleaning

To visually check if the optical window has been fouled:

- 1) Remove the Little Dipper from the mounting tee.
- 2) If there is any noticeable fouling, use a soft bristle brush or non-abrasive cloth material and soapy water to clean the optical window. Be sure to rinse thoroughly.
- 3) If the fouled window is unable to be cleaned with soapy water and the soft bristle brush, make a 10% HCL solution and use that solution, in place of the soapy water, with the soft bristle brush to clean the window.

Note: Hydrochloric acid is a hazardous material and should only be handled by qualified personnel.

- 4) Once the optical window has been cleaned, re-install the mounting tee back onto the Little Dipper.

Note: See Section 2.2 on how to properly install the mounting tee.

Note: In the event the In-Line Fluorometer must be removed for service, the mounting tee opening can be plugged with a 1" PVC Hex-Head Plug, schedule 80, McMaster.com P/N 4596K75 or equivalent.



5.2 Maintenance Check Using Standard Solutions

You may also check if the unit is responding correctly simply by running standard solutions past the optical window.

- 1) Make a standard solution (solution of known concentration of the fluorophore being measured) that is less than the maximum concentration set for the Little Dipper.
- 2) Flow this solution past the optical window and record the mA reading
- 3) Calculate the solution concentration using your equation determined via calibration from Section 3.2 and compare to the actual solution concentration.
- 4) If the calculated concentration varies by more than 5% of the actual solution's concentration, see Section 5.1 for visual inspection and cleaning.

Maintenance checks are important and will ensure the Little Dipper is continuing to provide maximum performance and measurement reliability.

5.3 Warranty Terms

Turner Designs warrants the Little Dipper and accessories to be free from defects in materials and workmanship under normal use and service for a period of 12 months from the date of shipment from Turner Designs with the following restrictions:

- Turner Designs is not responsible for replacing parts damaged by accident or neglect. Your instrument must be installed according to instructions in the User's Manual. Damage from corrosion is not covered. Damage caused by customer modification of the instrument is not covered.
- This warranty covers only Turner Designs products and is not extended to equipment used with our products. We are not responsible for accidental or consequential damages, except in those states where this limitation is not allowed. This warranty gives you specific legal rights and you may have other rights which vary from state to state.
- Damage incurred in shipping is not covered.

5.4 Warranty Service

To obtain service during the warranty period, the owner shall take the following steps:

1. Write, email or call the Turner Designs Technical Support department and describe as precisely as possible the nature of the problem.

Phone: 1 (877) 316-8049

Email: support@turnerdesigns.com

2. Carry out any adjustments or tests as suggested by the Technical Support Department.
3. If proper performance is not obtained you will be issued a Return Materials Authorization number (RMA) to reference. Package the unit, write the RMA number on the outside of the shipping carton, and ship the instrument, prepaid, to Turner Designs. If the failure is covered under the warranty terms, the instrument will be repaired and returned free of charge, for all customers in the contiguous continental United States.

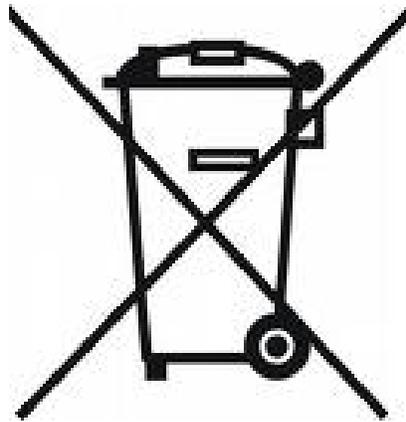
For customers outside of the contiguous continental United States who purchased equipment from one of our authorized distributors, contact the distributor. If you purchased directly, contact us. We will repair the instrument at no charge. Customer pays for shipping duties and documentation to Turner Designs. Turner Designs pays for return shipment (custom duties, taxes and fees are the responsibility of the customer).

5.5 Out of Warranty Service

Follow steps for Warranty Service as listed above. If our Technical Support department can assist you by phone or correspondence, we will be glad to, at no charge. Repair service will be billed on a fixed price basis, plus any applicable duties and/or taxes. Shipment to Turner Designs should be prepaid. Your bill will include return shipment freight charges.

Address for Shipment:

Turner Designs, Inc.
845 W. Maude Avenue
Sunnyvale, CA 94085



Equipment Specified as Electrical and Electronic Waste

Appendix A: Fluorometer and Mounting Tee Specifications

Parameter	Specification
Linearity (over dynamic range)	0.99 r ²
Power Draw	0.96 W @ 12 VDC (1.2 W max.)
Input Voltage	8 – 30 VDC
Signal Output	4 – 20 mA
Light Source	Light Emitting Diode
Detector	Photodiode
Warm up time	5 seconds
Dimensions	Length: 5.92 in. (15.04 cm) Diameter (housing): 1.05 in. (2.67 cm) Diameter (Max.): 1.54 in. (3.91 cm)
Weight	3.35 oz. (95 g)
Material	PVC – Type I, machined plastic

Mounting Tee Specifications

Parameter	Specification
Material	PVC – Type I, molded plastic
Threading	1 inch (NPT)
Length	3.44 in. (8.74 cm)
Dynamic Pressure Rating	100 PSI
Fitting	Schedule 80

Appendix B: Wiring Guide

Wire Color	Function	Connection
Red	Supply Voltage 8 – 30 VDC	PSU – Positive Connection
Black	Supply Ground 0 VDC	PSU – Ground Connection
Orange	Signal out to data logger, “A”, 4 – 20 mA DC	Multimeter “A” Connection
Green/Brown	Signal out to data logger, “Common”, 4 – 20 mA DC	Multimeter “Common” Connection