DRT-200E TURBIDIMETER
RANGE 0-10 AND 0-100 NTU

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Catalog No. 21854 (9/99)

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FOREWORD

HF TURBIDIMETERS

HF turbidimeters are manufactured to meet design criteria for nephelometers as described in Standard Methods For Examination of Water and Wastewater. HF turbidimeters are approved by the U.S. EPA* as a means to measure the turbidity of potable water, waste water, and other liquids.

HF turbidimeters provide a linear display of turbidity, throughout all ranges, in Nephelometric Turbidity Units (NTU). HF turbidimeters use solid state electronic components because they resist thermal variation and are not affected by normal line voltage fluctuations.

HF turbidimeters can be calibrated using HF scientific factory certified Secondary Standards or Formazin. Factory calibration is accomplished using HF scientific Secondary Standards, which are factory certified traceable to formazin, therefore, this instruction manual describes the proper procedures for calibration of HF turbidimeters using Secondary Standards.

HF turbidimeter manuals are designed to assist the user in taking full advantage of the instrument in a majority of its applications. However, in the event that unusual circumstances or problems, not covered by this manual, arise please feel free to contact our local distributor or the manufacturer.

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Our engineering staff is available to help you with your specific needs.

CERTIFICATION

Congratulations! We at HF scientific are proud to present you with the DRT-200E turbidimeter. This instrument represents the very latest in integrated circuit and display technology. As a result, the product is a rugged and reliable instrument whose performance was tested thoroughly and found to meet its published specifications when it left the factory.

**EPA approved means the instrument meets or exceeds the design and performance criteria as specified in the United States Environmental Protection Agency method 180.1.*

SAFETY PRECAUTIONS

Before attempting to unpack, set-up, or operate this instrument, please read this entire manual. Pay particular attention to all warnings and notes. Failure to do so could result in serious injury to the operator or damage to the instrument.

This equipment can be affected by radio frequency radiation. This interference will cause the digital display to become very erratic. Proper installation and operation will help avoid such occurrences from happening in the field.

Disconnect the main electrical supply to the instrument and relay contacts before servicing. Refer installation and service to qualified service personnel only.

Operate instrument only with the front cover fastened in place. Do not operate or energize instrument with the cover opened for extended periods of time.

Precautionary Labels:
Please pay particular attention to the labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if they are not observed.

The sample system has been designed for measurement of water. Sample solutions other than water may be used, but care must be exercised. A list of materials used for wetted surfaces may be found in the specifications section of this manual. HF scientific assumes no liability for damage caused by the use of sample solutions other than water.

SPECIFICATIONS FOR THE DRT-200E

Specification	DRT-200E
Ranges:	0-10.00 NTU & 0-100.0 NTU
Method:	EPA approved* Nephelometric
Accuracy:	1% 0-10 NTU, 5% 0-100 NTU
Repeatability:	1%
Resolution:	.01
Digital Display:	3 1/2 digit LED
Response Time:	.3 to 8 seconds
Analog Output:	4-20 mA (Factory Set), 0-1 mA (Factory Set)
Alarms:	Selectable Alarm
Alarm Contact rating:	Max. 250 VAC @ 5 A
Operating Temperature:	32° - 122° F (0-50° C)
Storage Temperature:	-4° F to 140° F (-20° to +60° C)
Optical Cleaning for NTU Sensor:	Removable cuvette
Flow rate:	0-1.5 gpm (2000 ML/MIN - 6.0 L/m)
Positive System Pressure:	60 psi maximum
Wetted surfaces:	Nylon, C.A.B., PVC, Delrin-500, Borosilicate glass, neoprene
Lamp:	External, pre-focused module
Standard Cable Length:	6 feet (1.83 m)
Dimensions: Analyzer: NTU Sensor:	 11¾" x 9" x 6" (298.4 mm x 228.6 mm x 152.4 mm) 8 3/4" x 9 3/4" x 8" (222.2 x 247.6 x 203.2 mm)
Analyzer Case:	NEMA 4X
NTU Sensor Case:	NEMA 4X
Supply Voltage:	120 VAC ± 10% 50/60 Hz, 240 VAC ± 10% 50/60 Hz
Power Consumption:	30 VA (Nominal) Fuse - 0.5A (120V) Fuse - 0.25A (240V)
Shipping Weight:	Approximately 14 lbs. (6.35 kg.)
Shipping Size:	24" x 17" x 14" (610 mm x 432 mm x 355 mm)
Warranty:	One year from date of shipment

I. GENERAL INFORMATION

A. Instrument Description

1. Sensor and Optical assembly

The sensor optics (See Figure 1) are located inside the Sensor assembly, which is part of the two major subassemblies that comprise the DRT-200E turbidimeter. This configuration provides the optics with an area that can be environmentally controlled from humidity, dust and condensation.

A fan inside the sensor continuously circulates heated, dry air around the optical well and flow through cuvette creating a continuous vaporpurge system.

The Optical assembly consists of an optical block, tungsten filament light source, two photodiodes connected in parallel, lenses, and apertures. Light is beamed horizontally at the sample using a lens to direct the light path. Photodiodes (positioned at 90 degrees incident to the light beam, on each side of optical block), detect the light scattered by the turbidity of the sample. The optical signal which results is amplified and transmitted to the Analyzer where it is stabilized and amplified to drive the digital display.

The optical design characteristics of the DRT-200E allow the instrument to be used to measure a variety of liquids, both colored and colorless. It cannot be used with flammable samples or those containing hydrocarbons or concentrated acids because these materials can attack the flow though head or O-ring seal causing potentially dangerous situations.

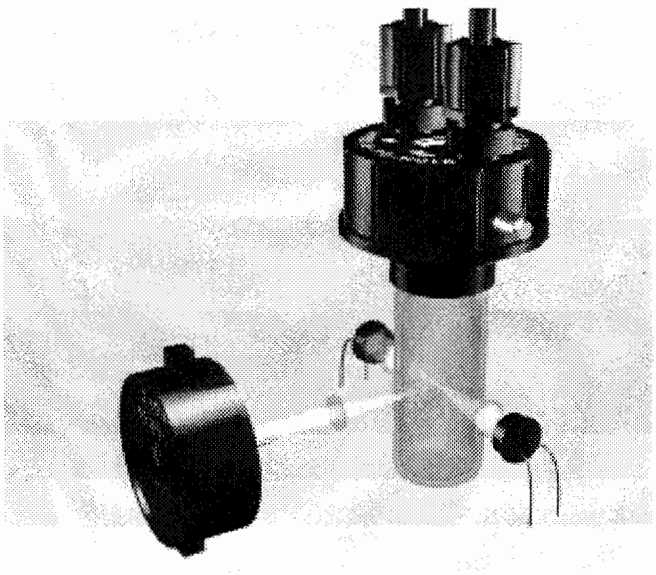

Figure 1
Sensor Optics

2. Analyzer Assembly

The Analyzer is the other major subassembly which comprises the DRT-200E turbidimeter. Operating controls are conveniently accessible by opening the front cover.

Either one of two ranges, 0-10, 0-100 NTU, can be selected manually using the range switch. Standardization adjustments are performed using the reference adjust potentiometer. Alarm setpoint, 4 - 20 mA, Hi/Lo, and Span calibration potentiometers can be adjusted. Interface connections are accessible through strain relief connectors located at the bottom of the Analyzer case.

The Analyzer assembly receives a signal from the sensor, which is then stabilized and amplified. The Analyzer then produces a measurement which is linear over a broad range of liquids and turbidities. The Analyzer functions as a transmitter when supplying a 4 to 20 mA output to peripheral equipment, such as, remote indicators, recorders, alarm modules, and control devices. The recorder load may be rated from 0 - 600 ohms maximum. The Analyzer case is constructed of glass reinforced plastic and is designed to meet NEMA 4X requirements for industrial dust-tight, drip-tight enclosures. It is designed to be wall mounted.

3. Output Connections

The DRT-200E turbidimeter provides two signal outputs. Output connections for a recorder, remote meter, process controller, etc., can be made to the terminal block located in the lower portion of the Analyzer Assembly Chassis (TB3) (See Figure 13). These outputs are factory set to provide accurate proportional signals over the full scale of each range.

For 0-1 milliampere (mA) output, connect to terminal 3 (common) and terminal 2 (+). For a 4-20 mA output connect to terminal 3 (common) and terminal 1 (+). The 4-20 mA output is adjustable over the range 0-50 mA by setting the trimming potentiometers labeled "HI" and LO" on the printed circuit board.

NOTE: Factory set 0 = 4 mA, 1 NTU = 20 mA.

A 0-1 volt output is obtained by placing the appropriate resistance in the holes on the PC Board labeled "R23".

The recommended cable is #22 AWG. twisted pair, shielded cable.

4. Principle of Operation

a. Continuous Monitoring Flow Through Assembly

The standard flow through unit supplied with the instrument is designed to operate at pressures up to a maximum of 60 p.s.i. (414 kPa or 4.22 kg/cm^3) and temperatures to a maximum of 122° F (50° C) fluid temperature. Flow rates through the unit can be from zero (0) to a maximum of approximately 1.5 GPM (5.7 liters/minute). Any positive pressure allows flow through operation. The speed of sensing turbidity changes will depend on the length of the take-off line, the diameter of the take-off line, and the flow rate or velocity through the take-off line. By using a high flow rate and keeping the lines small, approximately 3/16 inch (4.8 mm) I.D. and relatively short length, the response time is kept to a minimum. Consult HF scientific, inc. when unusually long connections are required.

Depending on the type of fluid being monitored, a pressure drop through the line can cause gas or air to come out of solution and form bubbles which will create errors in the turbidity measurements. This can be prevented by creating a slight back pressure on the discharge side of the flow through unit using the stainless steel flow control valve (Catalog #50004) supplied. Increasing the size of the incoming line and reducing the flow rate will also help this condition. A plastic shut-off clamp is provided on the inlet side of the flow through unit in order to completely stop flow to facilitate changing the cuvette. See Section IV. B., on Cuvette Cleaning and Care, page 9 for more information.

The U.S. EPA recommends that cuvettes used for instrument calibration, standardization, or sample measurement be indexed. For quick indexing of the flow through cuvette, a rotational flow through assembly with locking collar is supplied.

To index your flow through cuvette, slowly rotate the flow through cuvette at least one revolution, while observing the reading, to locate the position of the lowest reading. Without moving the flow through head, press down on it and turn the locking collar until the flow through assembly is securely locked in place. See Figure 2.

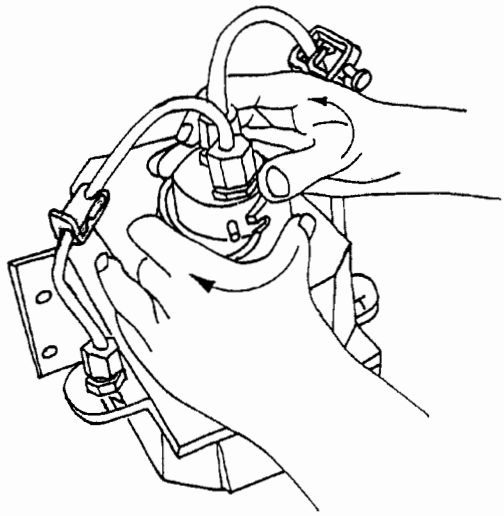

Figure **2**
Flow through cuvette

b. Grab Samples

Take extreme care when handling any sample cuvettes. Surface scratches, dust or finger smudges will cause analysis error. Examine each cuvette carefully before the sample is drawn and placed in the Optical Well. We recommend that the cuvette be wiped clean with a lint-free laboratory tissue after the sample is drawn. Handle Reference Standard and cuvettes by the top portion only.

To take a reading of a grab sample:

1. Remove the flow through unit and insert grab sample cuvette in Optical Well.
2 Select appropriate range.
3 The turbidity value of the grab sample will now be displayed on the readout.

NOTE: Settling particles or air in the sample may cause the digital reading to "hunt". For best results take readings before turbid particles settle but after air bubbles have been allowed to escape. Be consistent!

c. Alarm Contacts for External Control

NOTE: Disconnect the main electrical supply to the instrument and relay contacts before servicing. Refer installation and service to qualified service personnel only.

When Alarm/Control is required, connections can be made at TB3, terminal numbers 4, 5 and 6. Contact closures are described as follows in the Alarm condition:

TB3-4 N.O. (is closed with an alarm condition)
TB3-5 C (movable contact)
TB3-6 N.C. (is open with an alarm condition)

The relay is de-energized in the alarm condition to provide fail-safe operation.

During the "SET" procedure the relay contact circuit is open to prevent false alarms.

The center position "OFF" opens the relay contact circuit to prevent false alarms during calibration of the instrument or to eliminate the alarm function when it is not needed. The red L.E.D. in the center of the face plate panel is a visual indication of an alarm condition and will continue to operate when the SET/OFF/ NORM switch is in the "OFF" position.

II. INSTALLATION

A. Special Environmental Considerations

It is preferable that the location chosen for installation have an ambient temperature that does not exceed the specified 32° - 122° F (0°- 50° C) range and be shielded from direct sunlight and rain. Since this is not always possible, HF offers a weather resistant enclosure for the DRT-200E (Catalog No. 19802). Please refer to Section VII, Options and Accessories List, page 15 in this manual or call our office for more information.

B. Packing List of Contents for the DRT-200E

Contents	Units	Qty.
Analyzer Assembly	ea.	1
Sensor Assembly	ea.	1
Flow through Assembly	ea.	1
Instruction Manual	ea.	1
Accessory Kit	ea.	1
Warranty Card	ea.	1

C. Pre-installation Considerations

CAUTION: EQUIPMENT MUST NOT BE INSTALLED OUTSIDE WITHOUT USING AN HF APPROVED, VENTED WEATHER RESISTANT ENCLOSURE.

The following check list is provided to give the installer examples of possible areas of concern that need to be addressed before installing the DRT-200E. A removable check-list, for filing purposes, is provided in this manual (refer to Section VIII, Pre-installation Checklist on page 17).

1. Turbidimeter must be connected to a circuit which is properly rated, and preferably, have a disconnect switch installed in an area around the Analyzer.
2. Sensor assembly must be mounted far enough from the Analyzer to allow easy access when removing/ installing the flow through head assembly.
3. Sensor assembly must be mounted horizontally.
4. Interconnect cable from the Analyzer to the Sensor assemblies must not run in the same conduit or in close proximity with power lines or relay contact wires.
5. Water sample piping must not induce air into the system (check from origin to disposal).
6. Water flow/pressure must be sufficient to operate the flow through assembly.
7. Proper drainage from the flow through head output must be provided.
8. The entire system should be installed to permit easy access for routine maintenance. Sometimes it is best to bring the sample further and ensure easy access.

D. Unpacking the Instrument

When removing the instrument from its shipping carton, extreme care should be taken in unpacking and handling all assemblies. Inspect all assemblies for any damage that may have occurred during shipment. If damage is evident immediately notify the shipping company and arrange for an inspection. If the shipment is incomplete, please contact the Customer Service Dept. at HF scientific for assistance.

E. Mounting and Installation

CAUTION: Care must be taken during installation so the moisture integrity of the Sensor and Analyzer assemblies are not violated.

NOTE: For 240V applications no power cord is provided. A.C. power connections for 240V power cord or hard wire systems will be as follows:

TB1-1 = Live (Brown)
TB1-2 = Neutral (Blue)
Stand-off = Earth (Green and Yellow)

To provide the installer with enough information to pick the best location for installation, outline dimensions are shown in Figures 10 & 11. Installation details are shown in Figure 12. Avoid placing the Analyzer assembly in a position where glare from windows and lights will make reading the display difficult. Be sure it is mounted at a comfortable height so all adjustments can be accomplished without strain.

The Analyzer and Sensor assemblies are designed for surface mounting using 1/4" bolts. Figure 12, Installation Details, illustrates the flow through assembly hook-up to the Sensor assembly bulkhead fitting. When making these connections be sure not to overtighten the compression fitting nuts. Excessive force could cause damage to the bulkhead assembly. Additional tubing and fittings may be ordered from the factory, if needed, for your requirements. If metal tubing is to be used, 1/8" NPT compression fittings for 1/4" OD tubing are needed. The plastic inserts provided are intended for use with 5/16" OD x 3/16" ID flexible tubing used for sample and drain lines. A shut-off valve is provided on the inlet side of the flow-head assembly for flow control. A flow control clamp, which is provided in the accessory kit, may be installed on the outlet side to apply back-pressure on the system, if needed.

F. Electrical Connections

Power connections are made at terminal strip TB1 as shown in Figure 3. The instrument can be hard wired, using 1/2" conduit, into the holes provided in the bottom of the case. The power cord and strain relief supplied with the instrument can also be used.

The instrument is switched and fused for 120-volt operation when it leaves the factory. It can be easily changed at the factory when ordering. To convert it to the 240-voltage option in the field perform the following steps:

1. Disconnect primary power. Unsolder and remove jumper connections from the primary side of transformer T1. (For 120V operation pin 1 is jumpered to pin 4 and pin 2 is jumpered to pin 5).
2. Solder a new jumper connection between pins 2 and 4.
3. Change fuse F1 from 1/2 Amp to 1/4 Amp.

G. Vaporpurge

The DRT-200E sensor is equipped with a continuous vaporpurge system. A fan inside the sensor continuously circulates heated, dry air around the desiccant tray, optical well and the flow through cuvette. This feature eliminates the need for connection of a dry purge line. See Figure 4.

The desiccant beads are dark blue when dry and turn to a light pink when expended. Check the desiccant if after cleaning the cuvette readings appear erroneously high to ensure proper operation of the vaporpurge feature. It is important to keep a cover on the sample well if the flow through head is out for more than a few minutes, to avoid saturating the desiccant uselessly. A replacement desiccant tray complete with foot valve is available from HF scientific or your local representative HF part #21555. See figure 6 on page 8 when replacing the desiccant tray.

H. Ground Isolation

Isolation of either recorder output may be achieved by removing or cutting the jumper between TP1 (GND) and earth GND.

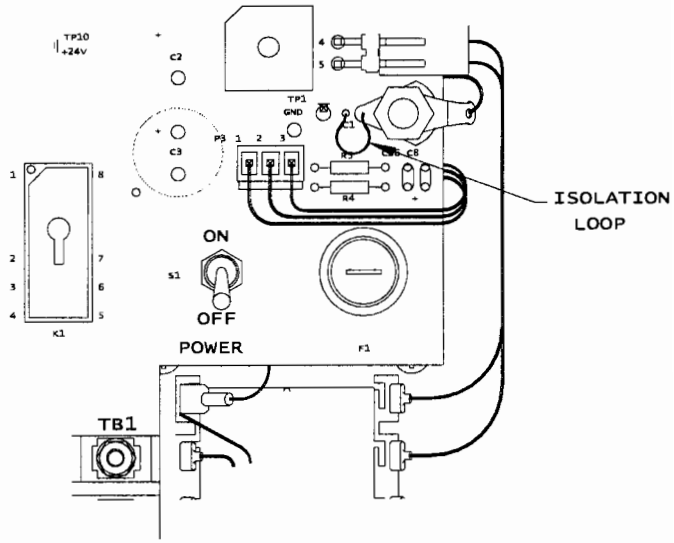

Figure 3
Isolation Jumper Removal

WARNING: **While the chance is slight, there are fault conditions under which a hazardous voltage could be exposed on the analog output wires when the isolation jumper is removed. To preclude this possibility HF scientific strongly recommends, for personal protection, that a Ground Fault Circuit Interrupter (GFCI), such as LEVITON part number 6599 or 5299, be used at the power connection.**

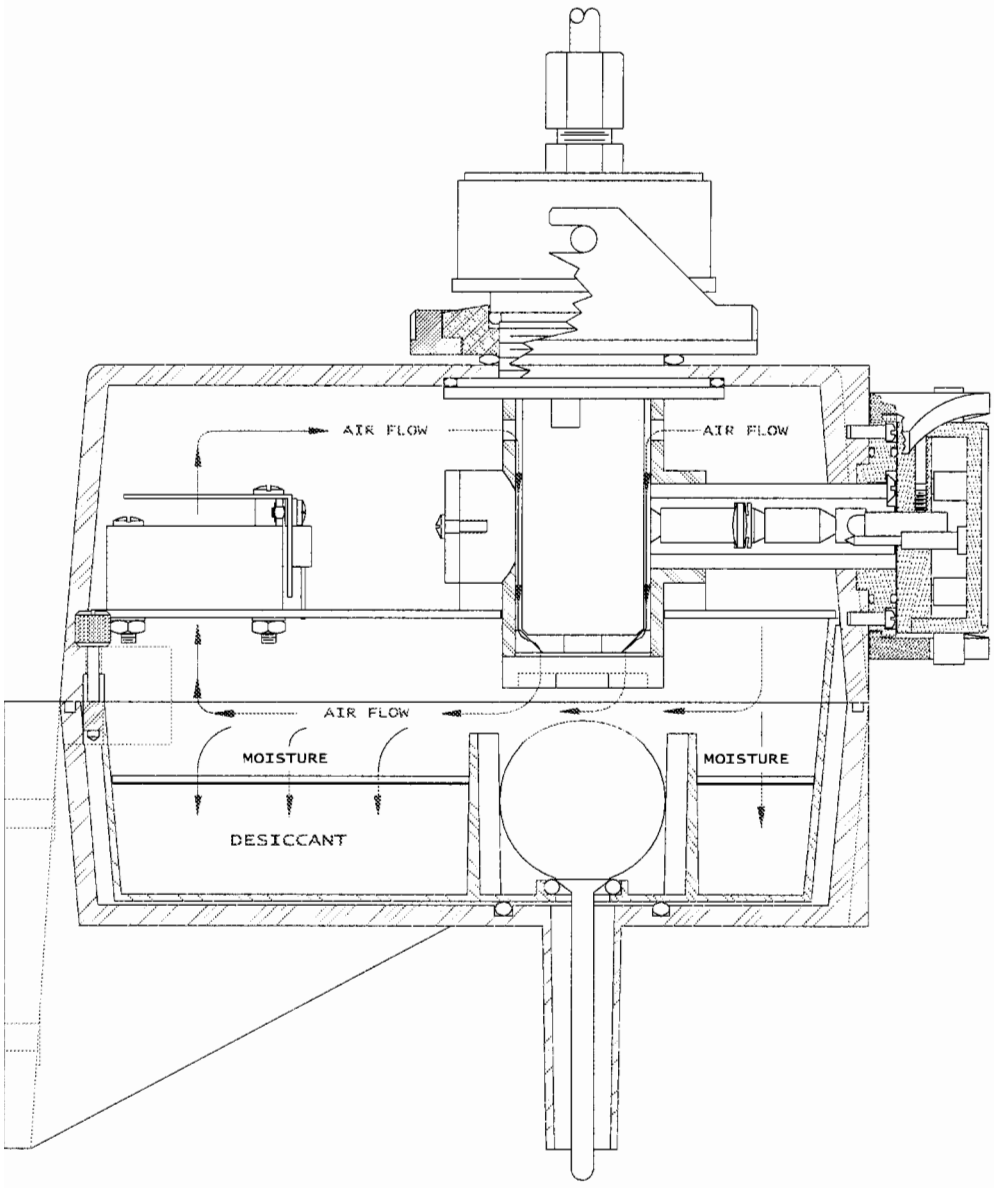

Figure 4
Vaporpurge

III. START-UP

A. Standardization and Calibration

Standardization and Calibration are two terms that are often used interchangeably, when using a turbidimeter. However, these terms are really significantly different procedures that must be performed by qualified personnel, with various frequency, during the lifetime of the instrument. Below is a brief description of both procedures.

1. Standardization

Standardization is essentially a zeroing procedure. HF instruments only require the operator to standardize once, for both ranges, using the supplied Reference Standard. The frequency that this procedure is required will vary with the application. HF recommends standardization be checked on a scheduled basis. For the best accuracy, the instrument should be standardized at least weekly for on-line applications, and just before each grab sample measurement. Adjustment, if necessary, is easily performed by the operator in three steps, which are described below:

Step 1: Place the reference standard in the optical well and rotate to its indexed position (review Section III. C., Reference Standard Indexing, on page 6 in this manual).

Step 2: Rotate the range selector switch to the 0 - 10 NTU range.

Step 3: Adjust the reference adjust potentiometer, as necessary, to cause the display to read the same value as marked on the reference standard.

2. Calibration

Calibration is a more elaborate procedure than Standardization because it requires the reference standard and a least one other known standard. The EPA and HF recommend that a qualified operator or instrument service technician check a turbidimeters linearity, after every four months of use, using a specified calibration procedure for their particular instrument. If calibration is necessary, factory certified Secondary Standards are available (Cat. No. 19833) or Formazin Solution may be prepared. Calibration is then carried out by comparing the known standard solution to the display reading of the instrument. Adjustment, if required, is accomplished by using the **Cal** switch and reference adjustment knob.

B. Reference Standard

The NTU value of the HF scientific, inc. Reference Standard is 0.02 NTU. This value has been determined based on an EPA method for producing Turbidity-free water. HF scientific, inc. certifies that this 0.02 NTU standard, is a pure water standard manufactured to meet or exceed the EPA requirements for Turbidity-free water. The value of the water has now been defined by EPA, therefore, we can state with certainty that this standard, when used according to instructions is 0.02 NTU.

EPA approved means this standard meets or exceeds the performance criteria as specified in the United States Standard Method 2130 B., 3. **The reference standard should be replaced at least once a year**.

C. Reference Standard Indexing

The EPA recommends that cuvettes used for instrument calibration, standardization or sample measurement be indexed. For quick and repeatable indexing of the reference standard, an indexing ring and locator pin are included with the reference standard and grab sample cuvettes.

The white locator pin is already installed in the collar ring around the optical well of your turbidimeter.

To index your reference standard, slowly rotate the reference standard, at least one complete revolution, while observing the reading, to locate the position of the lowest reading. Without moving the reference standard, install the indexing ring over the ridged cap of the reference standard such that the notch on the ring aligns with the locator pin.

When standardizing this instrument in the future, simply insert the reference standard and rotate it until the notch on the indexing ring faces the locator pin. Standardize as per the instruction manual. *Please note that this reference standard is only indexed to the turbidimeter for which it was aligned.*

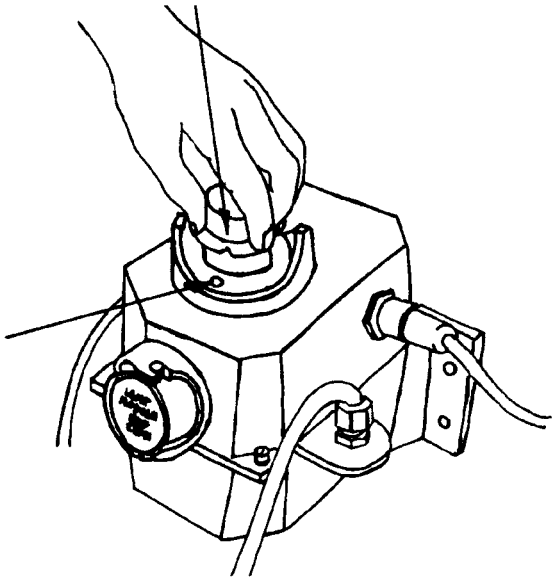

Figure 5
Reference Standard Indexing

D. Calibration Check

1. Have available on the day of the calibration check, standards of .02, 10 and 100 NTU (Secondary Standard Set, Cat. No. 19833, is available).
2. Clean, with a lint free wiper and glass cleaner, the reference standard and the 10 and 100 NTU standards.
3. Set the range selector switch to the 10 range. Standardize the instrument as described in this manual under Section III. If your reference standard has never been indexed or if it is a new reference standard, index it at this time (review Section III. C., Reference Standards Indexing, on page 6 in this manual.).
4. Set the range selector switch to the 10 range. Insert the 10 NTU standard. Note the reading on the digital display.
5. Set the range selector switch to the 100 range. Insert the 100 NTU standard. Note the reading on the digital display.
6. If the 10 NTU standard is not 10 NTU ± .1 NTU or the 100 NTU standard is not 100 NTU ± 5 NTU, then refer to Section IV, Turbidimeter Calibration, on page 10 in this manual for a complete calibration procedure.

E. 0-1 mA Loop Output Check

NOTE: To perform a check of the 0-1 mA circuit a DmAMETER (Digital mA Meter), which has a 2 mA scale, and an 10 NTU standard are required.

CONFIRM THE OUTPUT CHECK AS FOLLOWS:

1. Set the range selector switch to the 10 range.
2. Remove the clear plastic high voltage protector from unit.
3. Connect the DmAMETER (Red lead) to TB3-2 and common (Black lead) to TB3-3 on the 2 mA range.
4. Insert the 10 NTU standard.
5. Note the reading on the digital display and DmAMETER.
6. The readings should match. For example, if the DmAMETER reads 1.000 mA, then the digital display should read 10.00 NTU.

NOTE: If output does not match, refer to Section IV. C., 1. c., Display Adjustment, on page 10 in this manual for adjustment directions.

F. 4-20 mA Loop Output Check

NOTE: 4-20 mA loop is factory set to provide 4 mA @ 0 NTU and 20 mA @ 1.00 NTU.

NOTE: To perform a check of the 4-20 mA circuit, a DmAMETER (Digital mA Meter), which has a 20 mA scale, and a 10 or 100 NTU standard are required.

CONFIRM THE OUTPUT CHECK AS FOLLOWS:

1. Set the range selector switch to the range of interest.
2. Connect the DmAMETER (Red lead) to TB3-1 and common (Black lead) to TB3-3 on the 20 mA range.
3. Place the 0.02 NTU reference standard in the well. Use the reference adjust potentiometer to set display at 0.00 NTU.
4. Confirm that the DmAMETER reads 4 mA ± .04 mA (3.96-4.04 mA).
5. Insert the full scale standard for the range selected in step 1.
6. Confirm that the DmAMETER reads 20.00 mA ± .2 mA (19.8-20.2 mA).

NOTE: If output is not within specifications, refer to Section IV. C. 1. c., Output Adjustment, on page 10 in this manual for adjustment directions.

G. Flow through assembly turn-on

With the flow through assembly outside the Sensor assembly, check to insure that the O-ring is around the neck of the optical block and the washer is installed in the flow-head. Install cuvette. Start the flow and check

for any leaks due to a loose cuvette. Also check for proper flow rate and for the presence of sediment or bubbles in the sample. To minimize bubbles, apply back-pressure on outlet side of the flow through assembly.

Install the desiccant tray into the bottom section of the sensor housing. Insert the flow through assembly into the well and turn the flow through unit to obtain the lowest reading, then twist the lock to secure it in place.

NOTE: When the flow through assembly is not in place, the cuvette cap, provided in the accessory kit, should be placed over the optical well to protect the optical well from debris, dust, etc.

H. Installing Desiccant Tray

Before operating for the first time the desiccant tray and foot valve must be installed in the sensor housing. The desiccant tray and foot valve are shipped in a moisture resistant foil pouch. Use care when opening so as not to damage the contents. Refer to Figure 6.

NOTE TO CONTRACTORS: The desiccant tray should not be installed until the system is to be left powered continually.

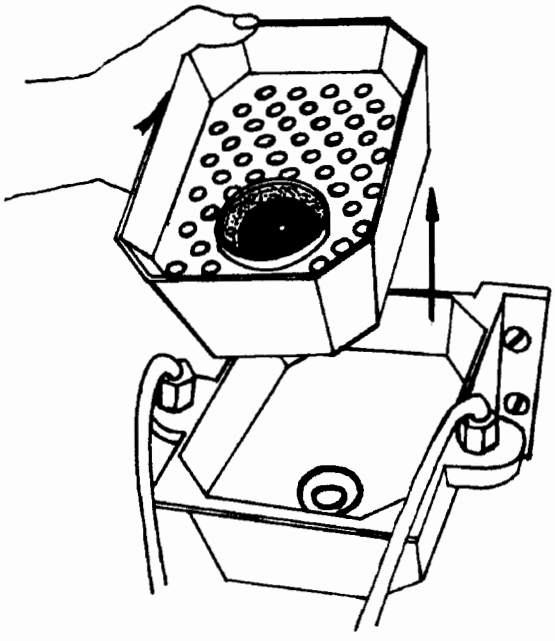

Figure 6
Desiccant Tray Installation

I. Range Selection

The range selector switch located on the front panel of the Analyzer Assembly should be set to the 100 range before applying power to the instrument. After initial setting, either range can be selected by manually turning the range switch to the desired range.

J. Alarm Setpoint Adjust

To set the Alarm Set Point:

1. Open the cover of the Analyzer assembly.
2. Move the SET/OFF/NORMAL switch to the "SET" position.
3. Use a suitable screwdriver to make the adjustment through the 1/4" hole next to the SET/OFF/ NORMAL switch.
4. Adjust screw until the desired Alarm Set Point Value appears on the Digital Display.
5. Return SET/OFF/NORMAL switch to the "NORMAL" position.

NOTE: If the alarm is set at 20.0 with the instrument set to the 100 range, the alarm set point for the other range is as follows:

10 range = 2.00

The alarm circuit will now respond at the set point value.

IV. ROUTINE MAINTENANCE

A. Calibration Standards

1. Secondary Standard Set (optional) Catalog No. 19833

HF Secondary Standards are recommended and certified by HF scientific. They are traceable to freshly prepared Formazin primary standards. These standards are very easy to use off the shelf anytime without preparation making them an ideal turbidity standard. A Certificate of Traceability is available on request to HF scientific Customer Service Department. HF Secondary Standards may be used for calibration of HF turbidimeters. Order from HF scientific, inc.

NOTE: Do not freeze standards.
Do not leave standards in the measuring well for extended periods.
Do not shake standards.

Specific instructions for using certified Secondary Standards are included with the kit.

Each Secondary Standard Kit contains:
- Instructions
- 0.02 Reference Standard
- Certified Secondary Standards 10.00 and 100.00

NTU Standards are contained in preselected cuvettes with light shield caps.
- A sturdy storage case

2. Preparation of Formazin Turbidity Standards

Calibration of this instrument is based on Formazin, a material which can be made by polymerization.

Calibration samples may be obtained by diluting Formazin stock suspension using "Turbidity-free" water. Formazin stock suspension may be prepared by the user (Reference A.W.W.A. "Standard Methods", 17th Edition) or it may be purchased in kit form, Catalog No. 50040.

Each kit contains:

Contents	Units	Qty.
Instruction Manual	ea.	1
Formazin 4000 NTU Stock Solution	500 ml	2
Turbidity-free 0.02 NTU water	gal/4L	1
Selected Cuvettes	ea.	4
Light shield caps	ea.	4
Reference Standard	ea.	1
1 ml, 10 ml, 25 ml Pipettes, graduated	set	1

NOTE: When the prepared samples start to flocculate, they are unreliable and fresh ones must be made. This will occur more rapidly for the lower value diluted suspensions.

a. Preparing Formazin Stock Suspension

WARNING: Some of the chemicals used in this procedure are hazardous. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to proceeding. Read all warnings on labels and on the MSDS provided by the chemical supplier.

Prepare the 4000 NTU stock solution as follows:

a. Dissolve 5.000 grams of reagent grade Hydrazine Sulfate ($N_2H_4 \cdot H_2SO_4$), in 400 mL of demineralized water.
b. Dissolve 50.00 grams of hexamethylenetetramine in 400 mL of demineralized water.
c. Pour the two solutions quantitatively into a 1-liter volumetric flask, and dilute to volume with demineralized water.
d. Allow the solution to stand undisturbed for 48 hours at 68° - 72° F (20° - 22° C). During this time the suspension will develop.

NOTE: Chemicals should be purity corrected before weighing.

b. Formazin Dilutions Chart

The following table gives the relationship between dilutions of the stock suspension and NTU's. Be sure to adequately mix the stock suspension prior to removing a portion for dilution.

NTU Value	Pipette	Amount	Base Formazin	Volumetric Flask
1.0 NTU	1.0 ml	.25ml	of 4000 NTU	1000 ml
10.0 NTU	1.0 ml	.50 ml	of 4000 NTU	200 ml
100.0 NTU	10.0 ml	5 ml	of 4000 NTU	200 ml

Recommended Calibration Values

HF instruments	Formazin Dilution values recommended			
DRT-200E	10.00 NTU			100.0 NTU

B. Cuvette Cleaning & Care

Cuvettes must be clean and free of marks or scratches in the critical area (see figure 7 on page 10). Cleaning is accomplished by washing the interior and exterior of the cuvette in a detergent solution, then rinsing thoroughly 8 to 10 rinses in clean, distilled water, to remove all streaks. HF scientific cuvette cleaning/conditioning solution (Catalog No. 70900) is available. This solution is specially formulated to remove hard water deposits. To use, fill cuvette with cleaning/conditioning solution and let stand (approximately 5-15 minutes). Discard solution and rinse cuvette. Some settling of this solution is normal, so shake well before using.

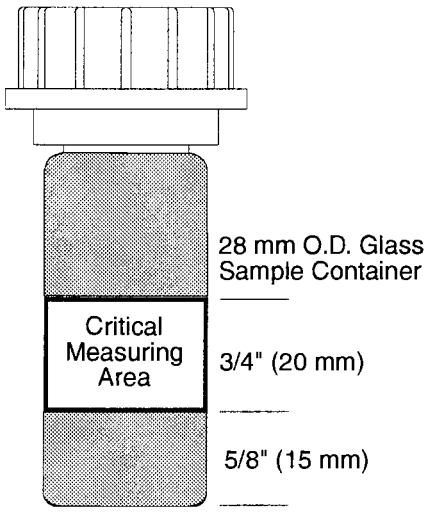

Figure 7
Cuvette Critical Measuring Area

The turbidimeter's optical system measures the liquid sample through this section of the reference standard, grab sample cuvette or flow through vial. Therefore, it is important that this 3/4" wide band of glass container be kept clean and free of scratches or abrasions.

C. Calibration

The DRT-200E has been carefully calibrated at the factory. However, should the Electronic P.C. Board, the Photo Detectors, or the Light Source be replaced or if very carefully prepared Formazin suspensions or HF standards indicate a need for recalibration, this may be easily accomplished in your facility.

1. Turbidimeter Calibration Using Factory Certified Secondary Standards

a. Preliminary

1. Perform 0-1 mA Output Check (refer to Section III. E., 0-1 mA Loop Check on page 7 in this manual).

NOTE: If output does not match, then proceed to step c., Display Adjustment, below in this section, for adjustment directions.

2. Perform 4-20 mA Loop Check (refer to Section III. F., 20 mA Loop Check on page 7 in this manual). **NOTE**: If the output is not within the stated spec, perform Calibration and then proceed to step d., Output Adjustment, below in this section, for adjustment directions.

b. Confirm voltages (as follows):

NOTE: Remove red face cover to access TP1- TP10

1. Measure and verify the following voltages using a DVM (Digital Volt Meter). Connect the common (black lead) to the ground test point, TP1.

TP-2 - Positive Op-Amp Supply Voltage = +15.0 Vdc ± 0.5V
TP-3 - Negative Op-Amp Supply Voltage = -15.0 Vdc ± 0.5V
TP-4 - 4 - 20 mA Supply Voltage = +18.0 Vdc ± 0.5V
TP-5 - Digital Display Supply Voltage = +5.0 Vdc ± 1.0V
TP-6 - Digital Display Supply Voltage = -5.0 Vdc ± 0.5V
TP-7 - Regulator Supply Voltage = +17.0 Vdc ± 1.0V
TP-8 - Lamp Source Voltage = +10.55 Vdc ± 0.25V
TP-10 - Regulator Supply Voltage = +24.0 Vdc ± 2.0V

c. Display adjustment

1. Set the range selector switch to the 10 range.
2. Connect DmAMETER (Digital mA Meter) (Red lead) to TB3-2 and the common (Black lead) to TB3-3 on the 2 mA range.
3. Insert the 10 NTU standard.
4. Adjust the DPM potentiometer, R35 located on the left hand side of the circuit card underneath the red face plate, until the digital display perfectly matches the mA reading on the DmAMETER.

NOTE: The hole in the face plate is provided for adjustment tool access.

d. Output adjustment

NOTE: 4-20 mA loop is factory set to provide 4 mA @ 0 NTU and 20 mA @ 1.00 NTU.

1. Set the range selector switch to the range of interest.
2. Connect DmAMETER (Red lead) to TB3-1 and the common (Black lead) to TB3-3 on the 20 mA range.
3. Place the 0.02 NTU reference standard in the well. Use the reference adjust potentiometer to set the display at exactly 0.00 NTU.
4. Adjust R28 (lo) to read 4 mA ± .04 mA (3.96-4.04 mA).
5. Insert the full scale standard for the range selected in step 1.
6. Adjust R24 (hi) to read 20.00 mA ± .2 mA (19.8-20.2 mA).

Calibration Steps 0-10 NTU Range

To meet stated accuracy it is advisable to allow both the analyzer and sensor to come to its ultimate operating temperature, which can take approximately one hour. After this point your can proceed with the following procedure.

Standardization should be performed after Sensor Calibration, although it is possible to standardize at any time without performing a complete calibration. Read these instructions in entirety prior to calibration.

1. Insert the 10 NTU Standard.
2. Rotate the standard while observing the digital display until the lowest reading is noted.
3. Push the "CAL" switch and hold it on for approximately one second.

NOTE: The CAL switch should only be used when a 10 NTU standard is in the well on this range.

4. Insert the .02 NTU Reference Standard.
5. Rotate the Reference Standard to its index point. If the standard has not been indexed, see page 6.
6. Rotate the reference adjust potentiometer until the display reads 0.02 NTU.
7. Repeat steps 1 through 6 until no further change is required.

Calibration Steps 0-100 NTU Range

To meet stated accuracy it is advisable to allow both the analyzer and sensor to come to its ultimate operating temperature, which can take approximately one hour. After this point you can proceed with the following procedure.

Standardization should be performed after Sensor Calibration although it is possible to standardize at any time without performing a complete calibration.

Read these instructions in entirety prior to calibration.

1. Insert 100 NTU Standard.
2. Rotate the standard while observing the digital display.
3. Push the "CAL" switch and hold it on for approximately one second.

NOTE: The CAL switch should only be used when a 100 NTU standard is in the well on this range.

4. Insert the Reference Standard.
5. Rotate the Reference Standard to its index point. If the standard has not been indexed, see page 6.
6. Rotate the reference adjust potentiometer until the display reads 0.02 NTU.
7. Repeat steps 1 through 6 until no further change is required.

NOTE: If the current calibration settings are fairly close to being correct, the display will change very little when the CAL switch is pushed. If the calibration settings are not close (For example: The lamp source was just replaced. Then the display will change when the sensor calibrate button is pushed.

D. Component Replacement

WARNING: Before performing any of these procedures, ensure that the power is disconnected from the DRT-200E Analyzer either by unplugging or turning off the power to the instrument at the circuit breaker panel or disconnect switch.

1. Source Lamp Replacement

Periodically the LAMP MODULE, Cat. #21541, in the sensor will require replacement. It is recommended that one spare lamp for each DRT-200E be kept on hand at all times. A burned out lamp is indicated by an over-range indication on the analyzer display. TO CHANGE THE LAMP MODULE SIMPLY TURN THE OUTSIDE LOCKING RING COUNTER CLOCKWISE (DO NOT TURN THE LAMP MODULE!!), AND PULL THE MODULE STRAIGHT OUT. Reverse the procedure to install the replacement module. For accurate operation a calibration is recommended after a lamp module replacement. The sensor calibration adjusts for lamp-to-lamp variations and must be done prior to standardization. See page 8 for calibration instructions. Refer to Figure 8.

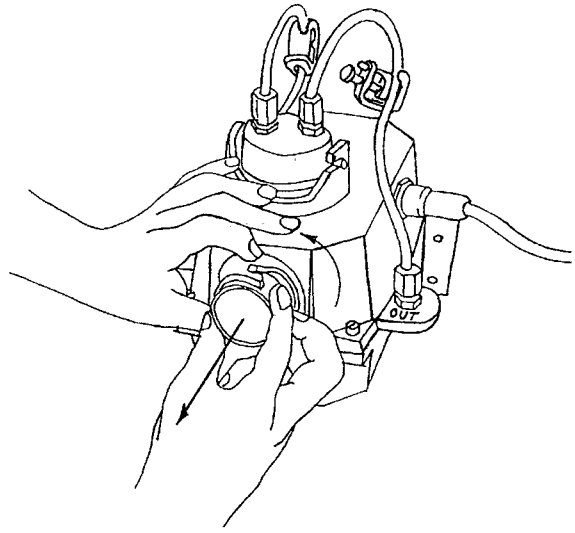

Figure **8**
Lamp Replacement

2. Fuse Replacement

Open the door on the Analyzer Assembly. Turn-off the power. Locate the fuse holder installed next to the on/off switch on the right hand side of the circuit card. Use a screwdriver to remove the gray section from the fuse holder by turning it counter-clockwise. Insert a BUSS 250V 1/2A MDL fuse for 120V systems or a BUSS 250V 1/4A MDL fuse for 240V systems into the gray section. Insert the gray section back into the fuse holder by turning it clockwise with a screwdriver.

V. TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
Analyzer display indicates an over-range condition regardless of sample.	Lamp burned out or not receiving power.	Check lamp and lamp wiring visually.
	Cal switch pressed with no standard in the well.	Insert full scale standard and re-cal.
Lamp and Digital display indicators are off.	No operating power.	Check fuse, power switch position, and power cord connection.
	Problem with CR1 power supply.	Check transformer T1 connections. Replace if defective.
		Check diode bridge CR1 for faulty connections, open, or shorted diodes. Replace CR1 if defective.
		Check filter capacitor C6 for proper operation.
		Verify +17dc at TP7 on circuit card. If +17V is not attainable replace circuit card.
Instrument will not standardize	Switch S4 (Set/Off/Norm) in set position.	Set switch S4 to Norm position.
	Loose connection on terminal strip TB2.	Check for faulty connection. Tighten as necessary.
	Broken wire in inter-connect cable.	Verify continuity of all wires in cable from Analyzer to Sensor.
	Ref. Adj. Potentiometer has faulty connections or is defective.	Check connections. Perform continuity check on potentiometer.
	Defective amplifier.	Consult HF Customer Service for replacement circuit card.
Analyzer digital display drifts.	Lamp aging.	Replace lamp.
	Faulty connections.	Visually check for cold solder joints and cracked traces.
	Problem with either CR1 or CR2 power supply.	Verify all voltages are steady and within spec. Refer to Section IV. C. 1.b. on page 10 in this manual.
	Problem with amplifier circuitry	Consult HF Customer Service for replacement circuit card.

PROBLEM	CAUSE	SOLUTION
Analyzer digital display gives erratic indications	Bubbles in sample. Dusty optics. Inter-connect cable installed with, or in close proximity to, power cables.	Refer to DRT-200E Troubleshooting Flow Chart, Section V. B. on page 14 in this manual for a corrective action procedure.
Analyzer digital display always reads over-range indication.	Turbidity sample higher than instrument range setting. Shorted photodiode light detector. Defective range switch S3. Problem with amplifier circuitry.	Select higher range. Check wiring and operation. Replace, if defective. Check solder connections and operation. Replace if necessary. Consult with HF Customer Service for replacement circuit card.
Turbidity samples and standards read low.	Out of calibration. Samples or Standards too old. Lamp aging. Problem with amplifier circuitry.	Re-calibrate. Refer to Section IV. C. 1., on page 10 in this manual. Prepare new samples or standards as required. Sensor calibrate or replace lamp. Consult with HF Customer Service for replacement circuit card.
Turbidity samples and standards read high.	Out of calibration. Scratches, smudges or fingerprints on sample cuvette. Problem with amplifier circuitry.	Re-calibrate. Refer to Section IV. C. 1, on page 10 in this manual. Verify condition of sample cuvette. Replace if necessary. Consult HF Customer Service for replacement circuit card.
Recorder does not track known reading.	Improper mA output. Loop open. Defective circuit card. Defective recorder.	Perform 0-1 mA or 4-20 mA loop check. Refer to Section III or on page 7 in this manual. Check continuity of series loop with ohmmeter. Consult HF Customer Service for a replacement circuit card. Consult HF Customer Service for a replacement recorder.

B. DRT-200E Flow Chart

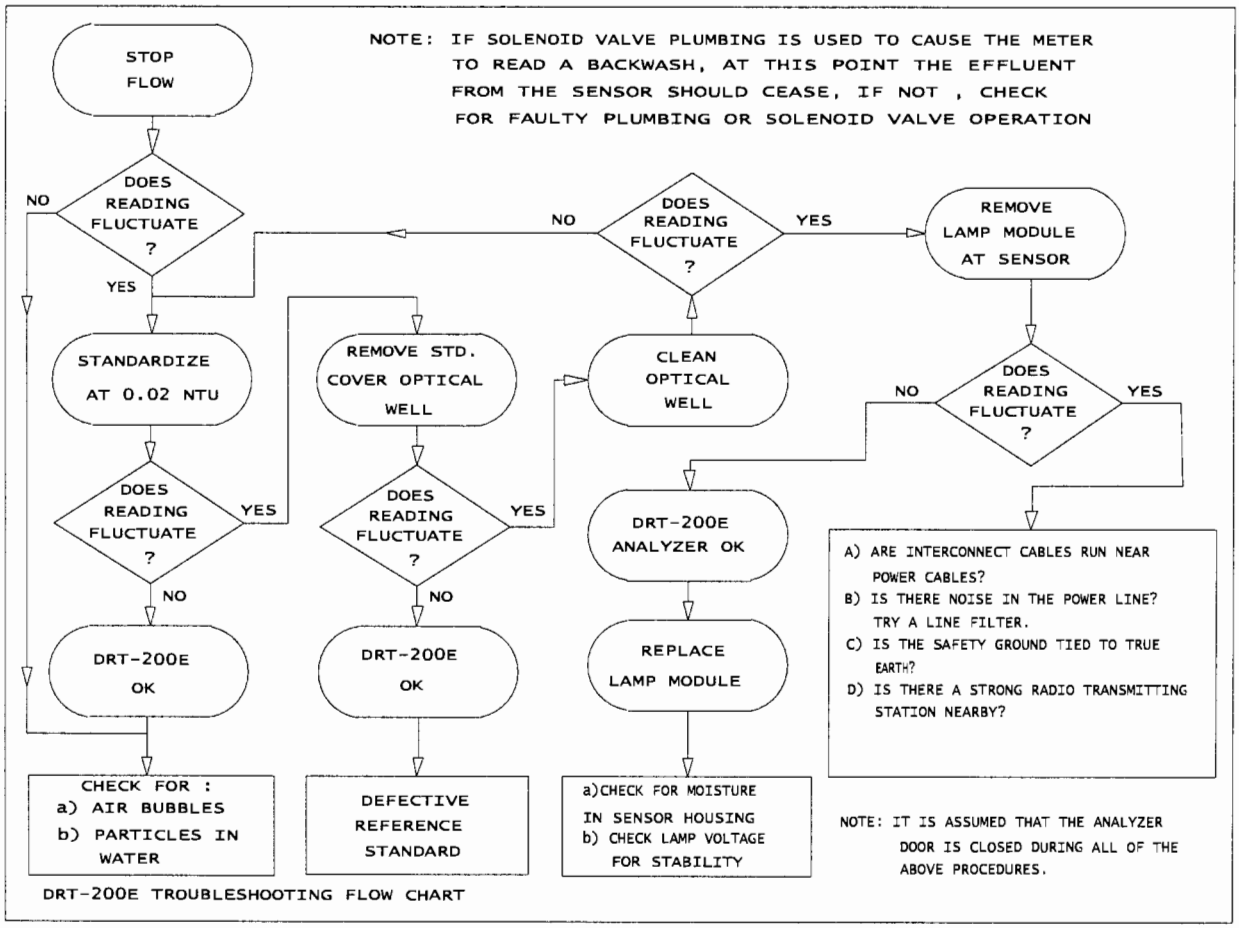

Figure 9
Flow Chart

VI. REPLACEMENT PARTS LIST

Cat. No.	Description
19816	Sensor (Electronic Portion Only)
20421	P.C. Board Assembly
20702	Reference Adjust Potentiometer
21148	Nylon Bulkhead Fitting Assembly 2/pk.
21541	Lamp Module, plug in source lamp
21555	Desiccant Tray Complete w/Foot Valve & 0-Rings
50004	Stainless Steel Tube Clamp (Back pressure)
21854	Instruction Manual
50010	Flexible Tubing, 5/16" OD, 3/16" ID, 6 ft. long
50016	Fuse, 1/2 Amp SLO-BLO (120 VAC)
50017	Fuse, 1/4 Amp SLO-BLO (240 VAC)
50036	Flow through cuvette only (Screw-in type) 3/pk.
50051	Cuvette, 28 mm 3/pk. (grab sample) or
50052	Cuvette, 28 mm 10/pk. (grab sample)
50125	Locking Flow Through Assembly
50136	O-Ring Kit Rotational Flow-Head 3 pk.
60002	Reference Standard 0.02 NTU
70721	Accessory Kit
70821	Shut-off Valve
70900	Cuvette Cleaning/Condition Solution, 16 oz.

VII. Options and Accessories List

Cat. No.	Description
19802	Fiberglass Enclosure
19833	Secondary Standards Kit (.02, 10 and 100 NTU)
20087	Rustrak Recorder
20106	Stilling chamber
50037	Teflon Flow Through Head
50099	RS-232 Serial Port
50040	Formazin Stock Solution Kit (4000 FTU)

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VIII. PRE-INSTALLATION CHECK LIST

EQUIPMENT SHOULD NOT BE INSTALLED OUTSIDE UNLESS IN AN HF APPROVED ENCLOSURE.

SENSOR

1. Interconnect cable is not field extended. ☐
2. Interconnect cable is not run in conduit with power supply. ☐
3. Interconnect cable is securely fastened to the wall or in conduit. ☐
4. Sensor is mounted to allow easy access to flow through head. ☐
5. On/Off closure is mounted on inlet side of flow head (white plastic clamp). ☐
6. Stainless Steel back pressure clamp is installed on effluent side of flow through head (if needed). ☐
7. Water sample piping cannot induce air into the system (check from origin to disposal). Check for pumps that could induce air. ☐
8. Water flow sufficient to operate flow through assembly. Minimum one foot of head. ☐

ANALYZER

1. AC Power connected and properly grounded. ☐
2. 4-20 mA output from DRT-200E (if used) is correct. ☐
3. 0-1 mA output from DRT-200E (if used) is correct. ☐
4. Alarm contacts (if used) are correctly connected. ☐
5. Alarm set is in Off or Normal position. ☐

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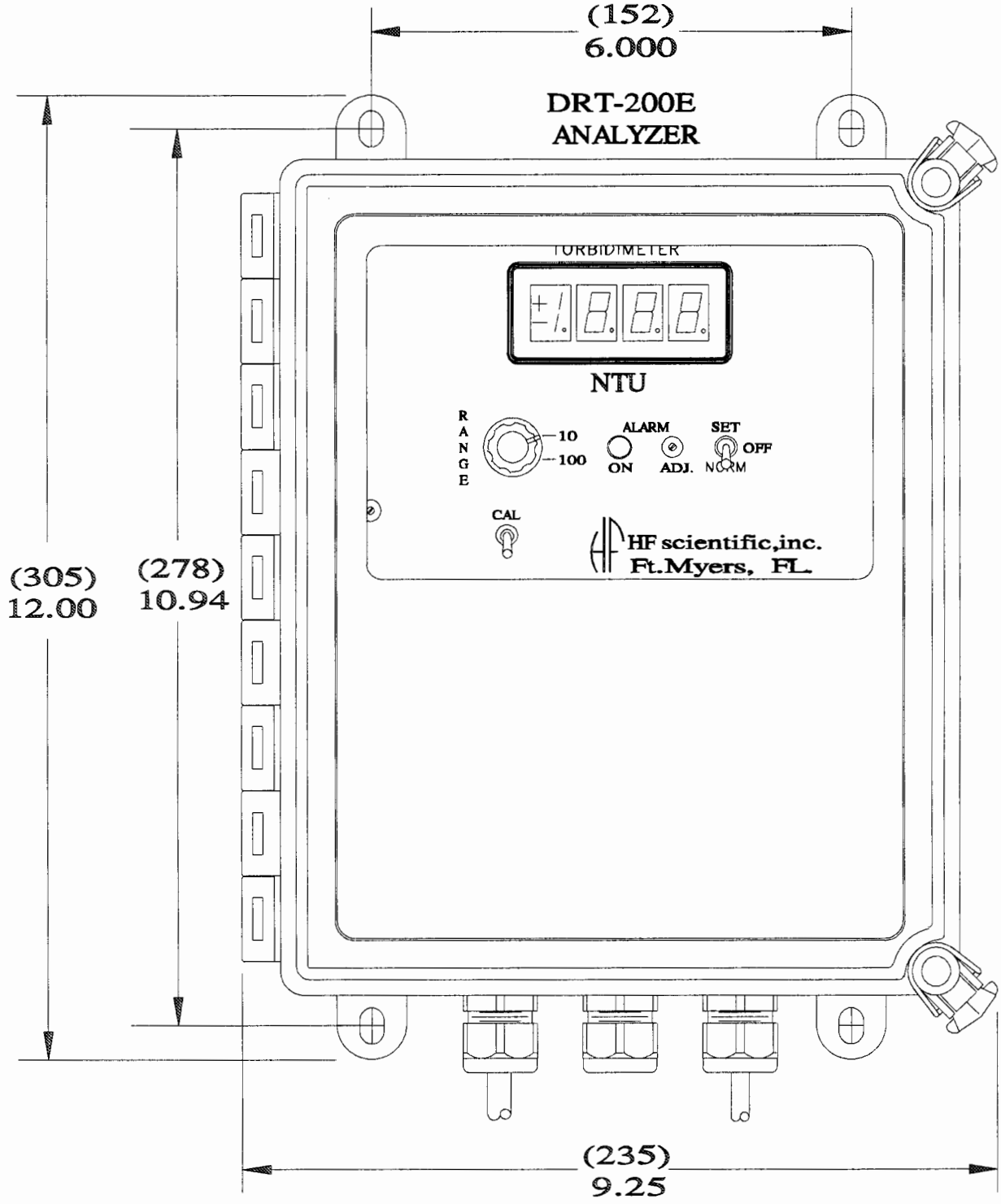
CAUTION

INSTRUMENT IS NOT DESIGNED FOR OUTDOOR INSTALLATIONS. CONTACT FACTORY FOR DATA ON OUTSIDE ENCLOUSURE.

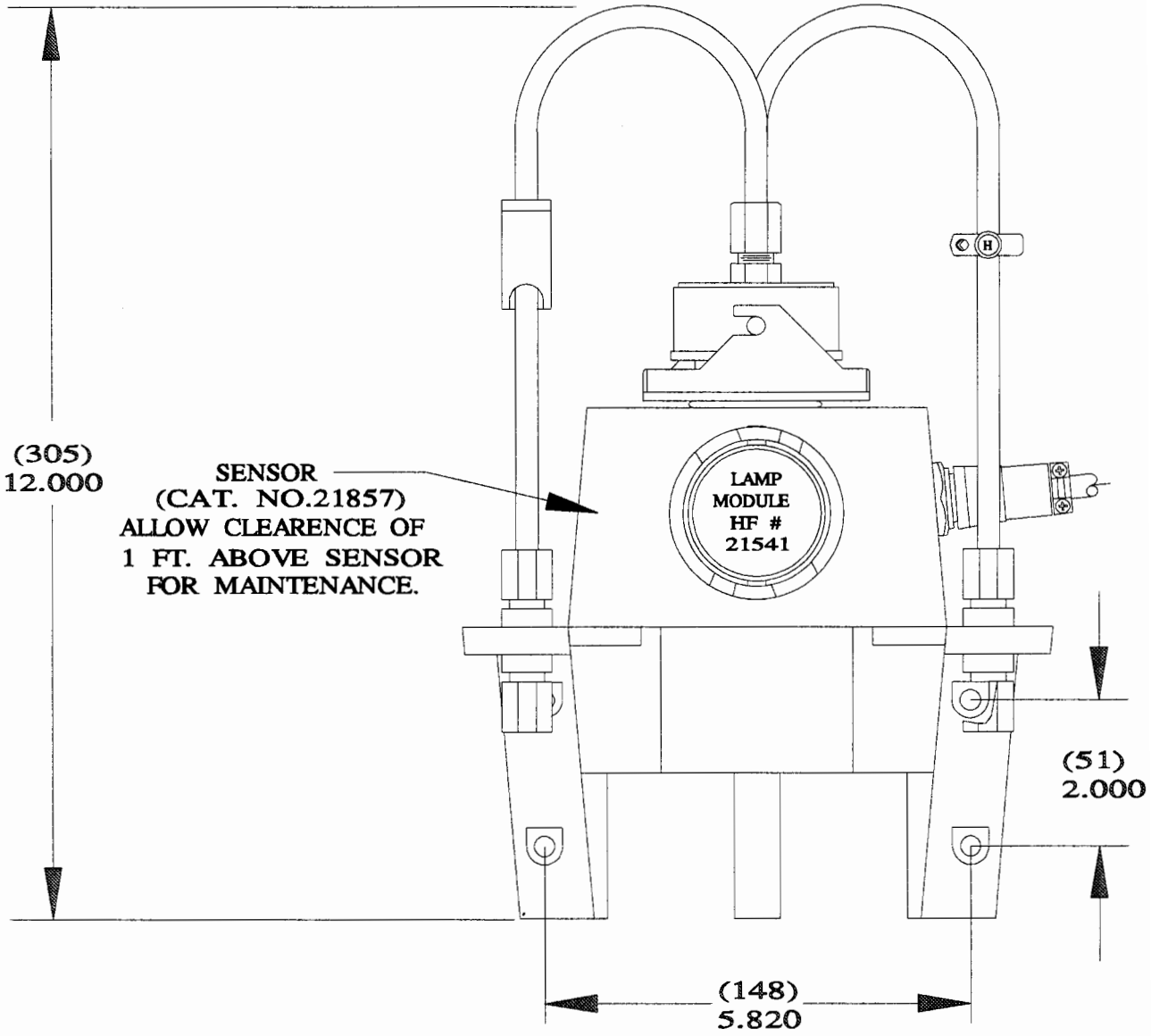


(XX)=mm
XX.XX=INCHES

Figure 10
Analyzer Outline Dimensions

CAUTION

INSTRUMENT IS NOT DESIGNED FOR OUTDOOR INSTALLATIONS. CONTACT FACTORY FOR DATA ON OUTSIDE ENCLOUSURE.



(XX)=mm
XX.XX=INCHES

Figure 11
Sensor Outline Dimensions

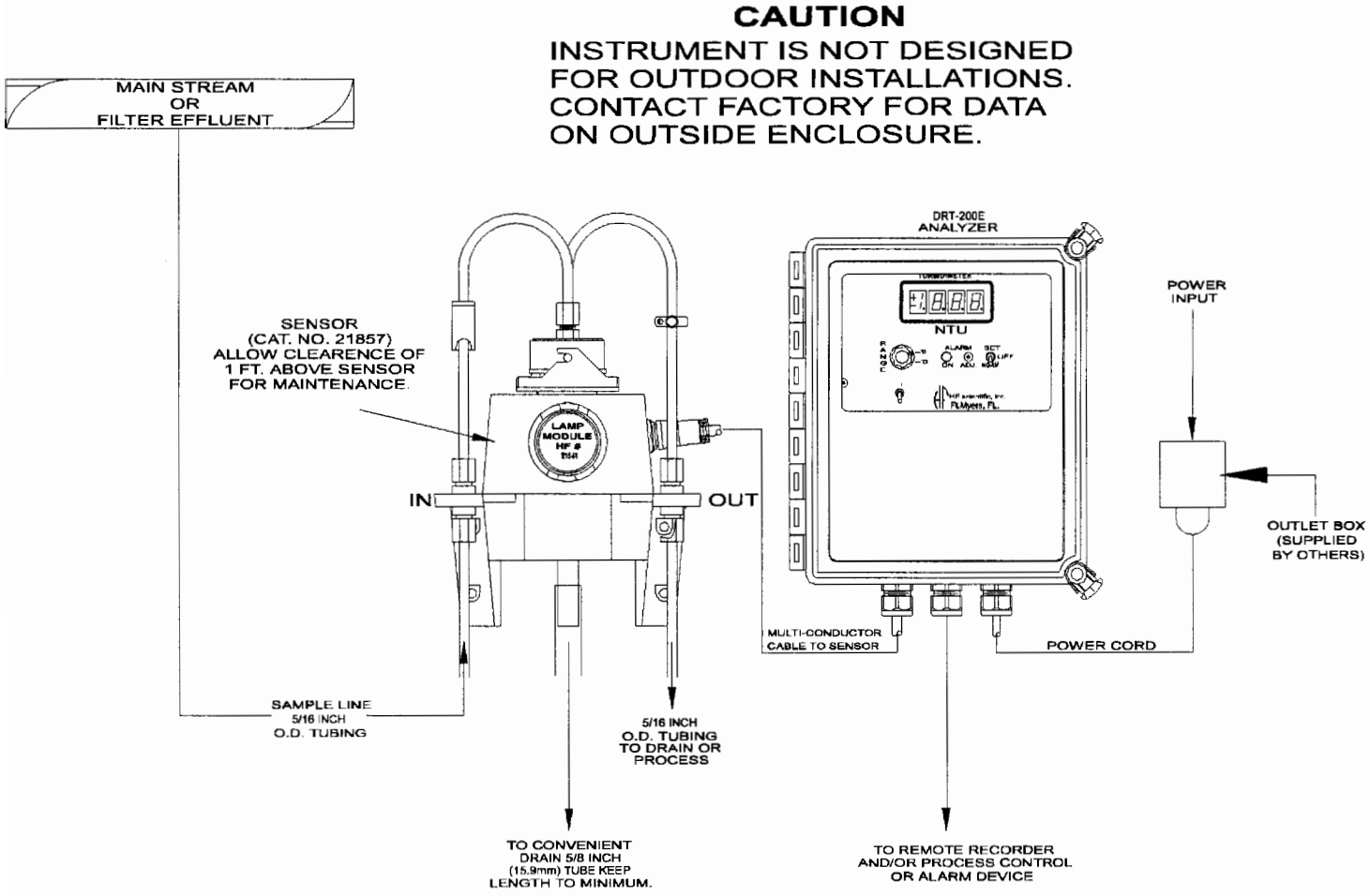


Figure 12
Installation Details

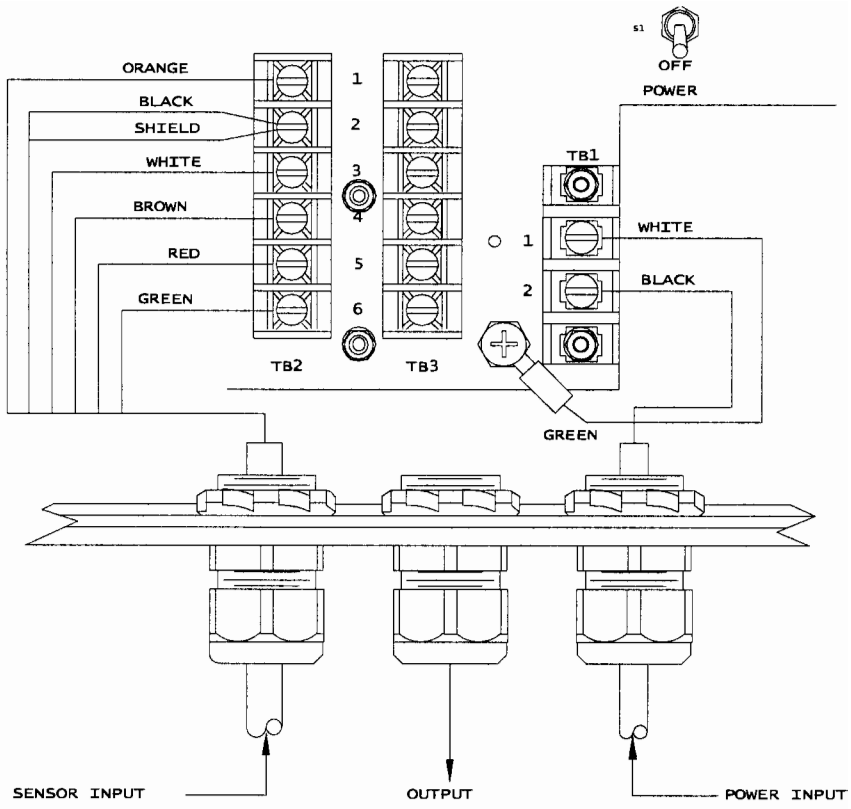


Figure 13
Analyzer Wiring Diagram

WARRANTY

HF scientific, inc., as vendor, warrants to the original purchaser of a new instrument that it be free of defects in material and workmanship, in normal use and service, for a period of one year from date of delivery (90 days for 200B upgrade) to the original purchaser. HF scientific, inc.'s, obligation under this warranty is limited to replacing, at its factory, the instrument or any part thereof. Parts which by their nature are normally required to be replaced periodically, consistent with normal maintenance, specifically lamps, reagent, desiccant, sensors, electrodes and fuses are excluded. Also excluded are accessories and supply type items.

Original purchaser is responsible for return of the instrument, or parts thereof, to HF scientific, inc.'s factory. This includes all freight charges incurred in shipping to and from HF scientific, inc.'s factory.

HF scientific, inc. is not responsible for damage to the instrument, or parts thereof, resulting from misuse, negligence or accident, or defects resulting from repairs, alterations or installation made by any person or company not authorized by HF scientific, inc.

HF scientific, inc. assumes no liability for consequential damage of any kind, and the original purchaser, by placement of any order for the instrument, or parts thereof, shall be deemed liable for any and all damages incurred by the use or misuse of the instruments, or parts thereof, by the purchaser, its employees, or others, following receipt thereof.

Carefully inspect this product for shipping damage, if damaged immediately notify the shipping company and arrange an on-site inspection. HF scientific, inc. cannot be responsible for damage in shipment and cannot assist with claims without an on-site inspection of the damage.

This warranty is given expressly and in lieu of all other warranties, expressed or implied. Purchaser agrees that there is no warranty on merchantability and that there are no other warranties, expressed or implied. No agent is authorized to assume for HF scientific, inc. any liability except as above set forth.

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