DRT-200B TURBIDIMETER
O & M MANUAL

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FOREWORD

HF TURBIDIMETERS

HF turbidimeters are manufactured to meet design criteria for nephelometers as described in AWWA "Standard Methods", 17th Edition. 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 use Formazin as the primary standard for calibration. Therefore, this instruction manual describes the proper procedures for calibration of HF turbidimeters using Formazin 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.

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.

CERTIFICATION

Congratulations! We at HF scientific are proud to present you with the DRT-200B 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.

SPECIFICATIONS - DRT-200B

Ranges NTU	**0 - 1** **0 - 10** **0 - 100** **0 - 1000**
Repeatability and Linearity	**+/- 1% of full scale**
Supply Voltage	**120 VAC ± 10%, 50/60 Hz** **240 VAC ± 10%, 50/60 Hz**
Power Consumption	**30 watts (Nominal)** **Fuse - 0.5A (120V)** **Fuse - 0.25A (240V)**
Controls	**Range Switch, Reference Adjust, Alarm Control**
Reference Standard	**0.02 NTU**
Electrical Outputs	**4-20 mA (Factory Set)** **0-50 mA (Field Adjustable)** **0-10 V (With Appropriate Shunt)** **0-1 mA (Factory Set)** **0-1 V (With Appropriate Shunt)**
Alarm Contacts	**Max. 250 VAC @ 2.5 A** **30 VDC @ 2.5 A** **Min. 5 VDC @ 10 mA** **Resistive Load**
Dimensions	**Analyzer Assembly** **7 3/4" x 11 3/4" x 7 1/8"** **Sensor Assembly** **10 1/2" x 5 3/4" x 4 1/4"**
Shipping Weight	**19 pounds**
Operating Temperature	**0° - 50°C (32° - 122°F)**

I. GENERAL INFORMATION

A. Turbidity Measurement

Turbidity may generally be defined as the characteristics or property of a liquid that causes it to scatter or absorb light. This is due to very small particulate matter suspended in the liquid.

Turbidimeters do not measure turbidity directly, they measure the amount of light that is transmitted through or scattered by a sample.

The modern turbidimeter traces its origin to the "Jackson Candle Turbidimeter," which is read in Jackson Turbidity Units (JTU's). The JTU is a measure of light that is transmitted through a sample; it is seldom used today as more sensitive and effective methodology is available.

During the 1960's "Formazin" was accepted as a turbidity standard with turbidity expressed as Formazin Turbidity Units (FTU's). The FTU like the JTU is a measure of the light transmitted through a sample, the significant difference is that the JTU is a measure of turbidity as seen by a specific turbidimeter while the FTU, as a measure, relates to successive dilutions of a standard suspension (Formazin) against which turbidimeter must be calibrated.

Turbidity is not always reported in turbidity units, it is sometimes simply stated as a percentage of the light that is transmitted through a sample, i.e percent transmittance (%T). This format does not provide the accuracy that most turbidity monitoring requires and has limited but important applications.

The growing importance of turbidity monitoring in the potable water industry led to many refinements in turbidity measurement. Today the vast majority of turbidimeters sold utilize the technique of "nephelometry." This technique, instead of measuring the amount of light that is transmitted, measures the amount of light that is scattered through the sample. This measure, expressed as nephelometric turbidity units (NTU's), is accomplished by measuring the light scattered at a certain angle to the incident beam (usually 90°).

The United States Environmental Protection Agency Drinking Water Regulations specify that, Nephelometric Turbidimeters must be used for all monitoring of drinking water.

Nephelometry is now the universally accepted principle for turbidity measurement and NTU's are the accepted unit of measure.

B. Instrument Description

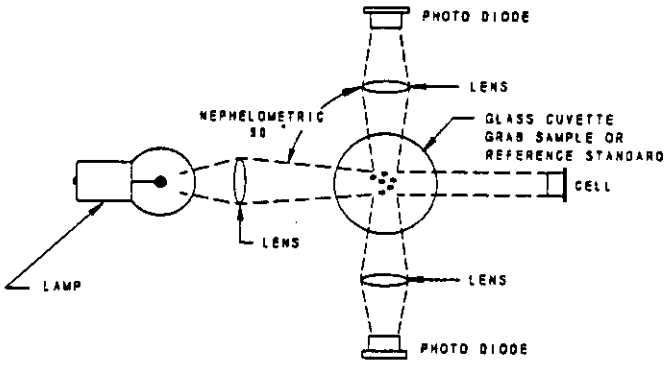
1. Sensor and Optical assembly

The Sensor optics (See Figure 1) are located inside the Sensor assembly, which is part of the two major sub-assemblies that comprise the DRT-200B turbidimeter. This configuration provides the optics with an area that can be environmentally controlled from humidity and dust. The Sensor housing can be air purged to prevent condensation within the compartment caused by high humidity or cold sample temperatures.

The Optical assembly consists of an optical block, tungsten filament light source, two photodiodes connected in parallel, a photoresistor, lenses, window glass and apertures. The Optical assembly operates using light from a tungsten lamp source. It 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. At the same time, the direct light beam is striking the photoresistor. The ratioed optical signal which results is transmitted to the Analyzer where it is stabilized and amplified to drive the digital display.

The optical design characteristics of the DRT-200B 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 they can attack the acetal head or elastomeric seal and O-ring. All parts of the optional teflon flow through optical assembly are constructed with F.D.A. approved materials to allow the instrument to be used in high temperature, food and beverage applications. This is available from HF, Catalog No. 50037. Please call HF Customer Service to order.

1. Sensor and Optical assembly cont.



SENSOR OPTICS

Figure 1

2. Analyzer Assembly

The Analyzer is the other major sub-assembly which comprises the DRT-200B turbidimeter. Most of the electronics are contained in the Analyzer assembly. Operating controls are conveniently accessible by opening the front cover.

Once inside, any one of four ranges, 0-1, 0-10, 0-100, 0-1000 NTU, can be selected manually using the range switch. Standardization can also be performed using the reference adjust potentiometer. In addition, alarm set-point, Hi/Lo, and Span/Lin calibration potentiometer can be adjusted. Interface connections are accessible through strain relief connectors located at the bottom of the Analyzer case.

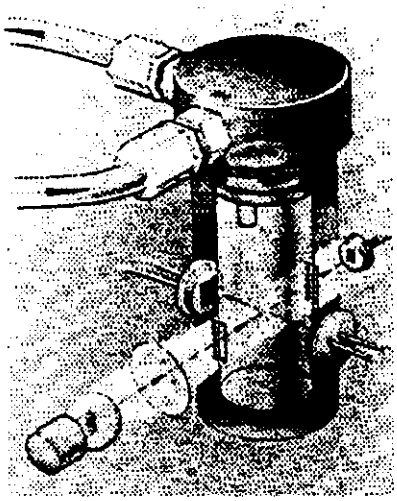
The Analyzer assembly operation consists of receiving a ratioed signal from the sensor, which is then stabilized and amplified. The Analyzer can then produce a measurement that is linear over a broad range of liquids and turbidities. The Analyzer functions as a transmitter when supplying a 4 to 20 mA output to peripheral equipment, such as, remote indicators, recorders, alarm modules, and control devices. The Analyzer case is constructed of ABS fiberglass and designed to meet NEMA 4X requirements for industrial dust-tight, drip-tight enclosures. It is designed to be wall mounted, but it may be flush mounted with the use of an optional flush mount kit.

3. Flow through Assembly

The standard flow through assembly supplied with the instrument, previous to June, 1991, is shown in Figure 2. It consists of an acetal head, 28mm x 70mm threaded glass cuvette, elastomeric & O-ring seals, PVC tubing, and nylon connectors. The entire flow through assembly is designed to operate up to a maximum pressure of 60 p.s.i., and withstand temperatures up to a maximum of 122°F fluid temperature. Flow rates through the unit can be adjusted from 1/10 G.P.M. to a maximum of approximately 1.5 G.P.M..

3. Flow through Assembly cont.

Figure 2

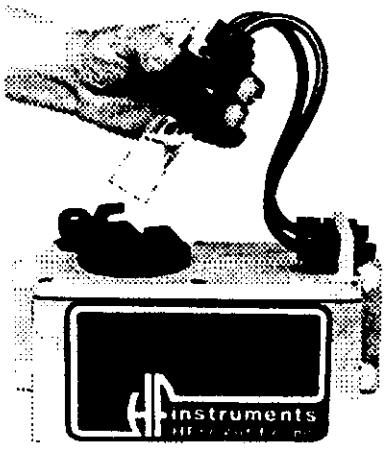


In order to allow indexing of the flow through cuvette for best accuracy and to make removal of the flow through assembly much easier, HF scientific has introduced the Rotational Flow Through Assembly with locking collar (see Figure 3). This is installed standard on all DRT-200 series turbidimeters manufactured after June, 1991. For those manufactured before June, 1991, this option is available in a retrofit kit, Catalog No. 19889. The new flow through assembly is designed to operate at the same pressure, temperature, and flow-rate as the flow through assembly previously described.

The 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 has been installed.

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

Figure 3



4. Output Connections

The DRT-200B 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 8). 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 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 potentiometer labeled "HI" and "LO" on the printed circuit board (See Figure 8).

A 0-1 volt output is obtained by placing the appropriate resistance in the holes on the PC Board labeled "R23" (see Figure 8). A 0-10 volt output is available by the appropriate resistance in the holes on the PC Board labeled "R34" (see Figure 8).

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

5. Principle of Operation

a. Operation of Continuous Monitor Flow through Assembly

There are three areas of concern to the operator when using the Continuous Monitor unit. They are speed of sensing turbidity changes, condensation, and pressure drop through the line. The following is a brief discussion of each area of concern.

First, 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 small input/output lines, (approximately 3/16" I.D.), of relatively short length, the response time is kept to a minimum.

Second, depending on the type of fluid being monitored, a pressure drop through the line can cause gas or air to escape into the fluid and form bubbles. These bubbles are, by definition, turbidity and will be interpreted accordingly, by the turbidimeter as a higher reading. It can be prevented by creating a slight back-pressure on the discharge side of the flow through unit using the stainless steel tube clamp supplied with the instrument (Catalog No. 50004). Another method to prevent this condition is to increase the size of the incoming line and reduce the flow-rate.

Third, during normal process operating conditions, when the flow through unit is inserted, it displaces all but a very small portion of the air in the optical well. Placing a desiccant on the bottom of the optical well, before inserting the flow through unit, will allow no opportunity for condensation to form even if there is a difference between the ambient air and the monitored liquid. However, if the monitored liquid is cold and the sensor is mounted in high temperature or high relative humidity conditions, condensation may form on the outside of the flow through cuvette when it is removed from the well. To prevent this situation, shut off the flow. Empty cuvette. Wipe the flow through unit and cuvette clean, place a new desiccant in the well, fill cuvette with warm tap water, re-install cuvette, seal the flow through unit in place. Re-start the flow to allow the cold fluid to flow through the system. In very severe conditions, where the above procedure does not work, the HF Anti-fog kit (Catalog No. 50091) will be needed.

b. Laboratory Grab Samples

Extreme care should be taken when handling grab sample cuvettes as surface scratches, dust, or finger smudges will cause analysis error. It is recommended that each cuvette be carefully examined and wiped clean with a lint free wiper before the sample is drawn and placed in the optical well. Grab Sample cuvettes should be indexed according to the instructions on page 10 of this manual. Reference Standard and cuvettes should be handled by the top portion only (See Figure 4).

b. Laboratory Grab Samples cont.

To take a reading of a grab sample:

1. Set the Range Switch at 1000

2. Remove the flow through unit and insert the grab sample cuvette in the Optical Well.

3. Place the Light Shield over the Optical Well.

4. Move the Range Switch until the display provides the desired resolution and note the reading.

NOTE: Settling particles or air in the sample may cause the digital reading to "hunt". Readings should be taken without delay before turbid particles settle when using grab samples. Air bubbles should be allowed to escape before taking a reading.

c. Alarm Contacts for External Control

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 when energized)
TB3-5 C (movable contact)
TB3-6 N.C. (is open when energized)

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 0° - 50°C range and be shielded from the direct sunlight and rain. Since this is not always possible, HF offers a weather resistant enclosure for the DRT-200B (Catalog No. 19802). Please refer to Section VII., Options and Accessories List, page 26 in this manual for more information.

B. Packing List of Contents for the DRT-200B, Cat. No's. 20028 and 20029

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 A HF APPROVED OR 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-200B. A removable check-list, for filing purposes, is provided in this manual (refer to Section VIII, Pre-installation Check-list on page 27).

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 needs to be mounted off the wall approximately ⅝ inches. This will allow room for removing the three screws, closest to the wall, from the sensor lid.

3. Sensor assembly must be mounted far enough from the Analyzer to allow easy access when removing/installing the flow through head assembly.

4. Sensor assembly must be mounted horizontally.

5. 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.

6. Interconnect cable must be securely fastened to the wall or run inside conduit.

7. Interconnect cable must not be field extended, but it can be shortened, if needed, for a neater installation. Recalibration is required, if shortened.

8. Water sample piping must not induce air into the system (check from origin to disposal).

9. Water flow/pressure must be sufficient to operate the flow through assembly.

10. Proper drainage from the flow through head output must be provided.

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, or if the shipment is incomplete, please contact the Quality Assurance Dept. at HF scientific for assistance and immediately notify the shipping company and arrange for an inspection.

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)
Details are shown in Figure 8

E. Mounting and Installation cont.

To provide the installer with enough information to pick the best location for installation, outline dimensions are shown in Figure 6. Installation details are shown in Figure 7. 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 7, Installation details, illustrates the flow through assembly hook-up to the Sensor assembly bulkhead fittings. 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. The inserts are shipped inside the bulkhead fittings on the Sensor assembly. A shut-off valve is provided on the inlet side of the flow-head assembly for flow control. A control valve, which is provided in the accessory kit, may be installed on the outlet side to apply back-pressure on the system, if needed.

*NOTE: For ease in servicing the DRT-200B metal lines should not be directly hooked up to the sensor. Run the metal line within a close proximity and then hook-up to sensor using plastic lines.

F. Electrical Connections

Power connections are made at terminal strip TB1 as shown in Figure 8. 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 perform the following steps:

1. 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.

Note: This change is shown on the schematic provided on page 33 in this manual.

G. Dry-air Connection (optional)

If a dry gas purge is to be connected to a DRT-200B manufactured after June, 1991, remove the Sensor Module Cover from the case and remove the sealing screw from the bottom of the Optical Block. Replace the cover on the Sensor Module. Remove the large O-Ring from the top of optical well and cut out a 3/8" section. Replace this O-ring. Remove the 1/8" pipe plug on the side of the Sensor Module case and make the dry gas connection.

If a dry gas purge is to be connected to a DRT-200B manufactured before June, 1991, remove the sealing screw from the bottom of the Optical Block. Replace the cover on the Sensor Module. Remove the large O-ring from the flow through head. Remove the 1/8" pipe plug on the side of the Sensor Module case and make the dry gas connection.

Recommended purge is dry nitrogen or instrument grade air per ANSI MC 11.1-1975 at 0.1 standard cubic feet per hour.

Figure 9 shows a typical arrangement for the Sensor Module for continuous purging with air. The dryer and filter are not needed with dry nitrogen.

H. Sensor Cable Extension

The standard multi-conductor cable inter-connecting the Sensor and Analyzer assemblies is 12 feet long. Other lengths are available by special order. Quite a few changes have to be preformed depending on the length required at your facility. For this reason cable extension should be installed at the factory.

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.

Standardization

Standardization is essentially a zeroing procedure. HF instruments only require the operator to standardize once, for all 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 10 in this manual).

Step 2: Rotate the range selector switch to the lowest NTU range.

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

Calibration

Calibration is a more elaborate procedure than Standardization because it requires the reference standard and at least two other known primary standards. 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, known values of Formazin solution must be prepared, on the day of calibration, using Formazin 4000 Stock Solution and Turbidity-free water (review Sections IV. A., Preparation of Formazin Turbidity Standards, on page 13 in this manual). Calibration is then carried out by comparing the known values of Formazin solution to the display/meter reading of the instrument. Adjustment, if required, is accomplished by using the calibration potentiometer, that are provided in the circuitry, to change the turbidimeter's operational characteristics (review Section IV. D., Calibration, on page 17 in this manual).

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 this reference standard.

The white locator pin may already be installed in the collar ring around the optical well of your turbidimeter. If not, please install the pin in either hole at this time.

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.*

D. Calibration Check

1. Prepare, on the day of the calibration check, standards of 8 and 800 NTU using the dilution chart in this manual under Section IV. A. 2., Formazin Dilutions Chart on page 14.

2. Clean, with a lint free wiper and glass cleaner, the reference standard and the 8 and 800 NTU standards.

3. Set the range selector switch to the 1 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 Standard Indexing, on page 10 in this manual).

4. Set the range selector switch to the 10 range. Insert the 8 NTU standard. Note the reading on the digital display.

5. Set the range selector switch to the 1000 range. Insert the 800 NTU standard. Note the reading on the digital display.

6. If the 8 NTU standard is not 8 NTU $\pm$.1 NTU or the 800 NTU standard is not 800 NTU $\pm$10 NTU, then refer to Section IV. D. 1, Turbidimeter Calibration, on page 17 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 DVMMM (Digital Volt Meter Milliamp Meter), which has a 2 mA scale, and a 800 NTU Formazin standard are required.

CONFIRM THE OUTPUT CHECK AS FOLLOWS:

1. Set the range selector switch to the 1000 range.
2. Remover the clear plastic high voltage protector from unit.
3. Connect the DVMMM (Red lead) to TB3-2 and common (Black lead) to TB3-3 on the 2 mA range.
4. Insert the 800 NTU standard.
5. Place the light shield over the optical well.
6. Note the reading on the digital display and DVMMM.
7. The readings should match. For example, if the DVMMM reads .802 then the digital display should read 802 NTU.

NOTE: If output does not match, refer to Section IV. D, 1. c. Display Adjustment, on page 18 in this manual for adjustment directions.

F. 4 - 20 mA Loop Output Check

NOTE: To perform a check of the 4 - 20 mA circuit, a DVMMM (Digital Volt Meter Milliamp Meter), which has a 20mA scale, and a 800 NTU Formazin standard are required.

CONFIRM THE OUTPUT CHECK AS FOLLOWS:

1. Set the range selector switch to the 1000 range.
2. Connect the DVMMM (Red lead) to TB3-1 and common (Black lead) to TB3-3 on the 20 mA range.
3. Place the light shield over the optical well (no cuvette should be in well).
4. Confirm that the DVMMM reads 4 mA +/-.04 mA (3.96-4.04 mA)
5. Insert the 800 NTU standard.
6. Place the light shield over optical well.
7. Confirm that the DVMMM reads 16.80 mA +/-.2 mA (16.6-17.00 mA)

NOTE: If output is not within specifications, refer to Section IV. D. 1. d., Output Adjustment, on page 18 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 O-ring 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.

Install one of the desiccants, provided in the accessory kit, into the optical well. NOTE: A new desiccant should be placed in the optical well each time the flow through assembly is re-inserted. Discard the old desiccant.

1. For the standard flow through manufactured previous to June, 1991 the flow through assembly is sealed into the well by inserting the unit so the O-ring seals the neck area of the well. In this way the air inside the well is sealed in and the desiccant is allowed to dry the air to a very low dew point.
2. For the standard flow through manufactured after June, 1991, 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 light shield, provided in the accessory kit, should be in place over the optical well to protect the optical well from debris, dust, etc.

H. Range Selection

The range selector switch located on the front panel of the Analyzer Assembly should be set to the 1000 range before applying power to the instrument. After initial setting, any range can be selected by manually turning the range switch to the desired range.

I. Alarm Set-point 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, with the instrument set to the 1000 range, the alarm set points for the other range settings are as follows:

100 Range = 2
10 Range = .2
1 Range = 0.02

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

IV. Maintenance

A. Preparation of Formazin Turbidity Standards

Calibration of this instrument is based on Formazin, a material which can be made by polymerization and reproduced repeatedly within one percent. When properly mixed, it is uniform in the number, size and shape of its particles, thus making it an ideal turbidity standard. The unit of measure, and thus the calibration of this instrument, is in Nephelometric Turbidity Units (NTU) based on Formazin.

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
1ml, 10ml, 25ml Pipettes, graduated	set	1

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.

1. Preparing Formazin Stock Suspension

WARNING: Some of the chemicals use 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 20° - 22° C (68° - 72° F). During this time the suspension will develop.

NOTE: Chemicals should be purity corrected before weighing.

2. 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	1.0ml	.25ml	of 4000 NTU	1000ml
8.0 NTU	10.0ml	2.0ml	of 4000 NTU	1000ml
40.0 NTU	10.0ml	2.0ml	of 4000 NTU	200ml
400.0 NTU	10.0ml	10.0ml	of 4000 NTU	100ml
800.0 NTU	10.0ml	20.0ml	of 4000 NTU	100ml

Recommended Calibration Values

HF Instrument	Formazin dilution values recommended			
DRT-200B	8.0 NTU			800.0 NTU

B. Cleaning

1. Optical lenses & windows

To clean the optical lenses and windows perform the following steps:

NOTE: Clean all lenses and windows with a glass cleaner and lint free wiper.

a. Remove the cover from the Sensor Assembly by removing the six screws holding the cover to case.

b. Lift the lid and rotate it to expose the optical block.

c. Remove the lamp bracket (See Figure 5) by loosening screw #3 and pull it forward off the barrel.

d. Loosen the 5/64" allen screw that prevents the barrel from rotating.

e. Using pliers, turn the barrel out of the block.

f. Remove the lens from the front of the barrel with a sharp pointed knife. Very carefully, insert the point behind the O-ring and pull it out. Clean and re-install lens.

g. Remove and clean the window located behind the barrel.

1. Optical lenses & windows cont.

h. Re-install the window and barrel. Tighten the allen screw.

i. Remove the four screws that hold the side-cells (photodiodes) in place. Very carefully, lift the photodiodes out. Remove the plastic sleeve and O-ring.

j. Remove and clean the lenses located behind the photodiodes.

k. Re-install the lenses, O-rings, plastic sleeves, and screws.

l. Remove the phillips screw that holds the back-cell (photocell) in place. Very carefully, lift the photocell out of the sleeve.

m. Loosen the 5/64" allen screw that prevents the back-plug sleeve from rotating and remove the back-plug sleeve.

n. Remove and clean the window located behind the photocell.

o. Re-install the window, back-plug sleeve, photocell, and phillips screw. Tighten the allen screw.

p. Re-install the lamp bracket.

q. Perform lamp alignment. See Section IV. C. Lamp Alignment on page 16, in this manual.

2. Cuvettes

Cuvettes and vials must be clean and free of marks or scratches in the critical area (See Figure 4). Cleaning is accomplished by washing in a detergent solution then rinsing thoroughly 8 to 10 rinses in clean, preferably distilled water, to remove all streaks. A sample of HF scientific cuvette cleaning/conditioning solution (Catalog No. 70900) is provided. This solution is specially formulated to remove hard water deposits. To use, fill cuvette with cleaning/conditioning solution and let stand until clear (approximately 5-15 minutes). Discard solution and rinse cuvette. As some separation of this solution is normal, it is suggested that this product be shaken before using.

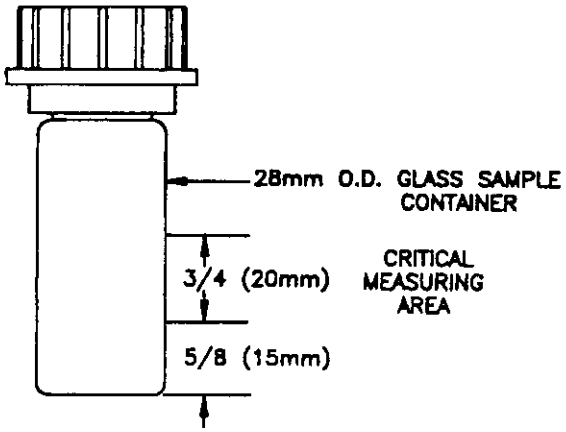
The sample flow can be stopped with the shut-off valve on the inlet side of the flexible tubing when the vial in the flow through assembly is to be cleaned or changed.

The cuvette or vial should be replaced if scratches or marks in the critical area affect readings.

Reusable cuvettes (Catalog No. 50051, pkg. of 3) and the flow through vial (Catalog No. 50036, pkg. of 3) should be stored in a clean dust-free environment.

NOTE: Extreme care should be taken when handling the Reference Standard or sample cuvettes as surface scratches or finger smudges will cause analysis errors. Handle these items by the top only (see Figure 4).

2. Cuvettes cont.



(not to scale)

Figure 4

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 abrasion.

C. Lamp Alignment

Perform lamp alignment as follows:

NOTE: The lamp alignment tool, provided in the accessory kit, is required for this procedure.

a. Remove the cover from the Sensor Assembly by removing the six screws holding the cover to the case.

b. Turn the power on.

c. Insert the lamp alignment tool into the optical block and lift off the lid.

d. Loosen screw #1 (See Figure 5). Position the lamp so its filament is parallel to the front side of the black lamp bracket.

e. Look down into the optical block at the cross-tee or box target located on the alignment tool and position the lamp so the light is centered vertically on the target of the alignment tool.

f. Tighten screw #1 snugly.*

g. Loosen screw #2 (See Figure 5). Look down into the optical block at the cross-tee or box target located on the alignment tool and position the lamp so the light is centered horizontally on the vertical cross or box target on the alignment tool.

h. Tighten screw #2.

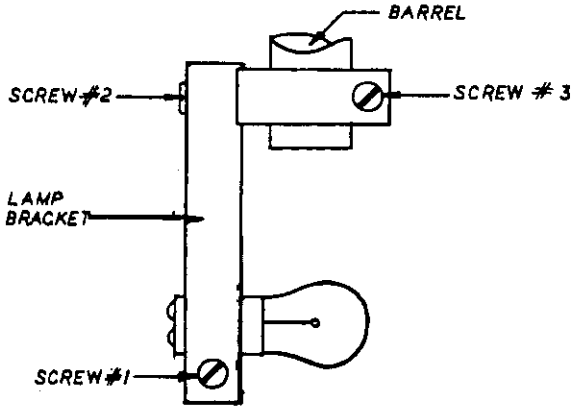
C. Lamp Alignment cont.

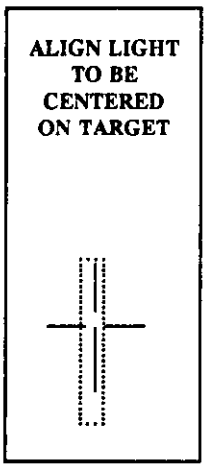
i. Loosen screw #3 (See Figure 5). Slide the lamp bracket assembly along the barrel, while looking at the alignment tool, until the narrowest image of the light is observed.

j. Tighten screw #3.

k. Position the Sensor cover, with its gasket, over the mounting holes in the Sensor Assembly and tighten the screws back in place.

*IMPORTANT - Do not tighten Screw #1 too much, as it may crush the base of the lamp.





↑
Front
Figure 5

D. Calibration

The DRT-200B 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 indicate a need for recalibration, this may be easily accomplished in your facility. Refer to Figure 8 for location of calibration potentiometers.

1. Turbidimeter Calibration Using Freshly Prepared Formazin Solutions

a. Preliminary

1. Clean the optical lenses and windows (Refer to Section IV. B. 1, Cleaning, on page 14 in this manual).

2. Perform lamp alignment. (Refer to Section IV. C, Lamp Alignment on page 16 in this manual).

3. Perform 0 - 1 mA Output Check (refer to Section III. E., 0 - 1mA Loop Check on page 11 in this manual). NOTE: If output does not match, then proceed to step c., Display Adjustment, below in this section, for adjustment directions.

4. Perform 4 - 20 mA Loop Check (refer to Section III. F., 4 - 20mA Loop Check on page 11 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 -10.

1. Measure and verify the following voltages using a DVM (Digital Volt Meter). Connect the common (black lead) to the ground test point, TP1 (Refer to DWG.#88009-C-06, Sheet 1, on page 33 in this manual).

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 = +15.0 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 1000 range.
2. Connect DVMMM (Digital Volt Meter Amp Meter) (Red lead) to TB3-2 and the common (Black lead) to TB3-3 on the 2 mA range.
3. Insert the 800 NTU standard.
4. Place the light shield over the optical well.
5. 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 DVMMM.

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

Refer to DRT-200B Schematic DWG.#88009-C-06, on page 33 in this manual.

d. Output adjustment

1. Set the range selector switch to the 1000 range.
2. Connect DVMMM (Red lead) to TB3-1 and the common (Black lead) to TB3-3 on the 20 mA range.
3. Place the light shield over the optical well.
4. Adjust R28 (lo) to read 4 mA +/-.04 mA (3.96-4.04 mA)
5. Insert the 800 NTU standard.
6. Adjust R24 (hi) to read 16.80 mA +/-.2 mA (16.6-17.00 mA)

Refer to DRT-200B Schematic DWG.#88009-C-06, on page 33 in this manual.

To carry out a complete calibration the following Formazin suspension values are required:

800 NTU & 8.0 NTU	-	Fill, cap, and label a separate cuvette with a sample of each.
	-	Always mix the contents of each cuvette by inverting several times before placing it in the Optical Well for a reading.
	-	Keep the outside surface of cuvettes clean.
	-	When placing any standards in the well, always use the Light Shield to cover the well in order to keep out ambient light.

Carry out the following steps:

Before calibration is attempted, it is important to note that all the calibration potentiometer (reference adjust, linearity, span) are inter-related. That is, adjusting one will also affect the value of the other ranges slightly.

1. Prepare, on the day of calibration, standards of 8 and 800 NTU using the dilution chart in this manual under Section IV. A. 2., Formazin Dilutions Chart, on page 14 in this manual.

2. Clean, with a lint-free wiper and glass cleaner, the reference standard and the 8 and 800 NTU. standards.

3. Set the range selector switch to the 1 range. Standardize the instrument as described in this manual under Section III., Start-Up, on page 9 in this manual. 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 Standard Indexing on page 10 in this manual).

4. Set the range selector switch to the 10 range. Insert the 8 NTU standard. Note the reading on the digital display.

5. Set the range selector switch to the 1000 range. Insert the 800 NTU standard. Note the reading on the digital display.

6. Before making any adjustments remember that the calibration potentiometer affect each other slightly. Here is a sample calibration:

   a) If your instrument reads the following values in steps 4 and 5:

Standard	Reading
8 NTU	7.1 NTU
800 NTU	831 NTU

   b) Then set the range selector switch to the 10 range. Insert the 8 NTU standard. Adjust linearity (10 range, 8 NTU standard) to make the 8 NTU standard read approximately 8.50 NTU on the digital display. NOTE: This adjustment was over compensated to account for interaction of span adjustment in the following step.

c) Set range selector switch to the 1000 range. Insert the 800 NTU standard. Adjust the span potentiometer (1000 range, 800 NTU standard) until the digital display reads 800 NTU $\pm$10 NTU.

d) Re-standardize the instrument.

e) Repeat steps 4 & 5. If the 8 NTU standard is not 8 NTU $\pm$.1 NTU or the 800 NTU standard is not 800 NTU $\pm$10 NTU then repeat step 6, a through d, until the instrument reads the correct value for all standards with no additional adjustment required.

In the event that interaction between the controls becomes excessive, set each control at its midpoint with respect to its total number of turns, and then proceed to calibrate as directed above.

* LIN (Linearity) and Span are two (2) potentiometer on the printed circuit board inside of the DRT-200B. After opening the front cover of the DRT-200B, the potentiometer can be located by looking to the left of TB2 (see Analyzer Assembly, Figure 8).

Formazin standards, values of 400, 40, and 1 NTU may be used to check for linearity.

E. Component Replacement

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

1. Source Lamp Replacement

The Lamp Indicator shown in Figure 6 will indicate when the Lamp needs replacing.

Turn off the power. Remove the cover from the Sensor Module by removing the six screws holding the cover to the case. The bulb may now be removed by loosening Screw #1 and removing the electrical leads from the Lamp Bracket. Insert the new bulb, reconnect the electrical leads, and tighten screw # 1 snugly*. Perform lamp alignment (refer to Section IV. C, Lamp Alignment on page 16 in this manual). Perform calibration check (refer to Section III. D. on page 10 in this manual).

*IMPORTANT - Do not tighten Screw #1 too much as it may crush the base of the lamp.

2. Photocell Replacement

Turn-off the power. Remove the cover from the Sensor Module by removing the six screws holding the cover to the case. Remove the screw that connects the solder lug to the photocell. Carefully remove the photocell from the back-plug sleeve. Un-solder the two leads, coming from the photocell, that are attached to the terminal strip. When replacing the photocell, it must be oriented so that its two leads are parallel with the sensor lid. Re-use the PVC sleeves from the old photocell leads. Solder the leads back onto the terminal strip. Re-install the photocell into the back-cell sleeve. Re-install the solderlug and screw. Perform calibration check (refer to Section III. D. on page 10 in this manual.)

3. Photodiode Replacement

Turn-off the power. Remove the cover from the Sensor Module by removing the six screws holding the cover to the case. Remove the two screws that hold the photodiode in its sleeve. Carefully remove the photodiode. Un-solder the two leads, coming from the photodiode, that are attached to the terminal strip. The replacement photodiode has three leads, so before replacing the photodiode the right lead must be removed. Orient the photodiode so that when you are facing it, the middle lead is on top. Then remove the right lead. Re-insert the photodiode into its sleeve. Orient it so the middle lead will be soldered to the terminal strip with the black wire attached to it. The left lead will be soldered where the red wire is attached. Tighten screws. Re-use the PVC sleeves from the old photodiode leads. Re-solder the leads to the terminal strips. Perform calibration check (refer to Section III. D. on page 10 in this manual.)

4. 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.

5. Lamp Regulator Replacement

Open the door on the Analyzer Assembly. Turn-off power. Loosen the 1/16" allen screw in the range selector knob and remove the knob. Remove the four screws from the corners of the red faceplate. Remove the faceplate. Remove the wires, coming from the sensor, terminated at TB2-1 through 6. Remove the wires, coming from the power cord, terminated at TB1-1 and 2 and the common stand-off. Un-plug the Molex connector J3 from P3. Remove the one screw and five stand-offs that secure the circuit card. Start to pull the board out of the case slowly. Un-plug the Molex connector J1 from P1. Un-plug the crimp connectors on the transformer. The circuit board will come completely out now. Remove the screw that secures VR4. Remove VR4. Cut the old shrink tube off with a small knife. Unsolder the wires off the regulator. Replace new shrink tubing on the wires and re-attach them to the new regulator. Replace the regulator and all other parts in reverse order.

V. TROUBLESHOOTING

A. DRT-200B Troubleshooting Guide

PROBLEM	CAUSE	SOLUTION
Analyzer display reads reference set-point regardless of sample.	Lamp burned out or not receiving power.	Check lamp and lamp wiring visually. Verify +10.55V +/-.25V across lamp connections. Replace lamp if defective.
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. Verify voltages per schematic. 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 +17Vdc 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 section.	Consult HF Customer Service for replacement circuit card.
	Defective photocell.	Check photocell for cracks or pit marks. Replace as necessary.

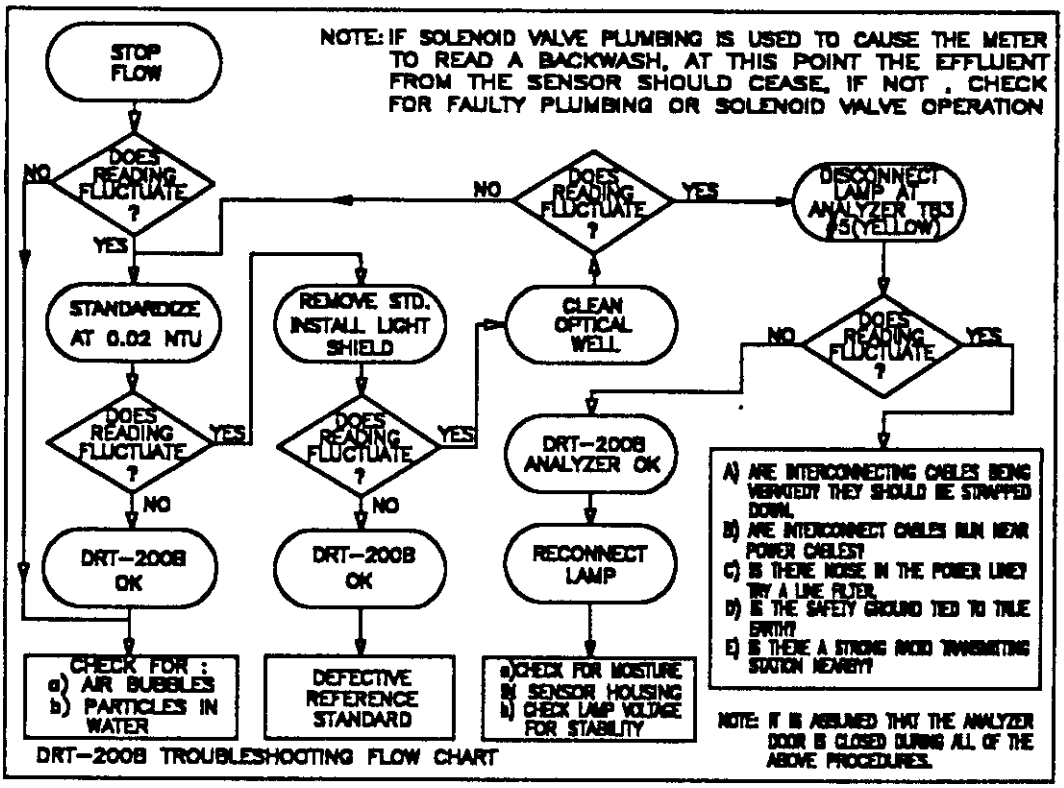
A. DRT-200B Troubleshooting Guide cont.

PROBLEM	CAUSE	SOLUTION
Analyzer digital display drifts.	Extreme environmental conditions causing condensation on sample cuvette or optics.	Provide a controlled environment. Refer to Section I. B. 5. a on page 5 in this manual.
	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. D. 1. b on page 18 in this manual.
	Problem with amplifier circuitry.	Consult HF Customer Service for replacement circuit card.
Analyzer digital display gives erratic indications.	Bubbles in sample.	Refer to DRT-200B Troubleshooting Flow Chart, Section V. B on page 25 in this manual for a corrective action procedure.
	Fogged optics.	
	Dusty optics.	
	Inter-connect cable not securely fastened when not in conduit.	
	Inter-connect cable installed with, or in close proximity to, power cables.	
Analyzer digital display always reads over-range indication.	Turbidity sample higher than instrument range setting.	Select higher range.
	Out of Calibration.	Re-calibrate. Refer to Section IV. D. 1. on page 17 in this manual.
	Shorted photodiode light detector.	Check wiring and operation. Replace, if defective.
	Defective range switch S34.	Check solder connections and operation. Replace if necessary.
	Problem with amplifier circuitry.	Consult with HF Customer Service for replacement circuit card

A. DRT-200B Troubleshooting Guide cont.

PROBLEM	CAUSE	SOLUTION
Turbidity samples and standards read low.	Out of calibration.	Re-calibrate. Refer to Section IV. D. 1. on page 17 in this manual.
	Samples or Standards too old.	Prepare new samples or standards as required.
	Lamp aging.	Replace lamp.
	Problem with amplifier circuitry.	Consult with HF Customer Service for replacement circuit card.
Turbidity samples and standards read high.	Out of calibration.	Re-calibrate. Refer to Section IV. D. 1. on page 17 in this manual.
	Environmental conditions causing condensation on sample cuvette or optics.	Provide controlled environment. Refer to Section I. B. 5. a. on page 5 in this manual.
	Scratches,smudges or fingerprints on sample cuvette.	Verify condition of sample cuvette. Replace if necessary.
	Problem with amplifier circuitry.	Consult HF Customer Service for replacement circuit card.
Recorder does not track known reading.	Improper mA output.	Perform 0-1mA or 4-20mA loop check. Refer to Section III. E. or F. on page 11 in this manual.
	Loop open.	Check continuity of series loop with ohmmeter.
	Defective circuit card.	Consult HF Customer Service for a replacement circuit card.
	Defective recorder.	Consult HF Customer Service for a replacement recorder.

B. DRT-200B Flow Chart



VI. REPLACEMENT PARTS LIST

CAT. NO.	DESCRIPTION	CAT. NO.	DESCRIPTION
60002	Reference Standard 0.02 NTU	50089	O-ring for Flow Through Unit 3/pk. (old style)
50004	Stainless Steel Tube Clamp	20702	Reference Adjust Potentiometer
50096	Lamp Source with Leads, 2/pk.	20850	Photodiode
50010	Flexible Tubing, 5/16" OD, 3/16" ID, Long	21023	Photocell
50008	Instruction Manual	70821	Shut-off Valve
50016	Fuse, 1/2 Amp SLO-BLO (120 VAC) or	21001	Lamp Bracket Assembly
50017	Fuse, 1/4 Amp SLO-BLO (240 VAC)	20467	P.C. Board Assembly
50018	Desiccant (pkg. of 45)	50120	Locking Flow Through Assembly
50036	Flow through Vial only (Screw-in type) 3/pk.	70900	Cuvette Cleaning/Condition Solution, 16 oz.
50040	Formazin Stock Solution Kit (4000 FTU)	19886	EPA Certification Kit
50051	Cuvette, 28mm 3/pk. or	70820	Lamp Alignment Tool
50052	Cuvette, 28mm 10/pk.	21116	Accessory Case
21148	Nylon Bulkhead Fitting Assembly 2/pk.	21115	Accessory Case Insert
50009	Light Shield	50128	Thick O-ring for Locking Collar Flow Through Unit (new style)
50133	O-Ring Washer	50127	Thin O-ring for Locking Collar Flow through unit (nwe style)

VII. Options and Accessories List

CAT. NO.	DESCRIPTION	CAT. NO.	DESCRIPTION
50081	Relative Attenuation Option	20106	Stilling chamber
50099	RS-232 Serial Port	50317	Isolated 4-20mA
50037	Teflon Flow Through Head	20087	Rustrak Recorder
19886	EPA Certification Low Range Calibration Kit	19802	Fiberglass Enclosure

HF scientific, inc.
3170 Metro Parkway
Ft. Myers, FL 33916-7597
Phone: (941) 337-2116
Fax: (941) 332-7643

VIII. PRE-INSTALLATION CHECK LIST

EQUIPMENT IS NOT 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 head. ☐
5. On/Off closure is mounted on inlet side of flow head (plastic clamp). ☐
6. Stainless Steel back pressure clamp is installed on effluent side of flow 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. ☐
9. Lamp has not been knocked out of alignment (use lamp alignment tool). ☐

Analyzer

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

WARRANTY

HF scientific, inc., as vendor, warrants to the original purchaser of the instrument to be free of defects in material and workmanship, in normal use and service, for a period of one year from date of delivery 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, and fuses are excluded. Also excluded are accessories and supply type items.

Original purchaser is responsible for return of the instruments, 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 the 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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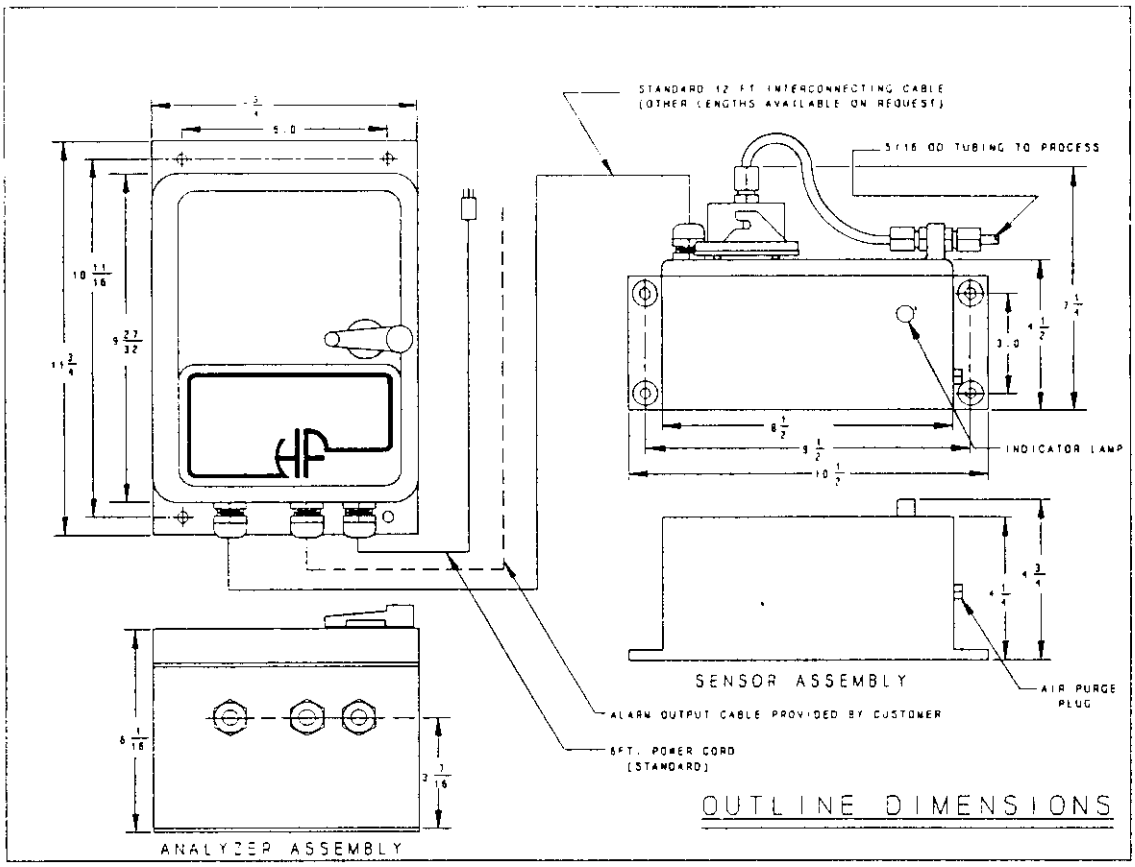
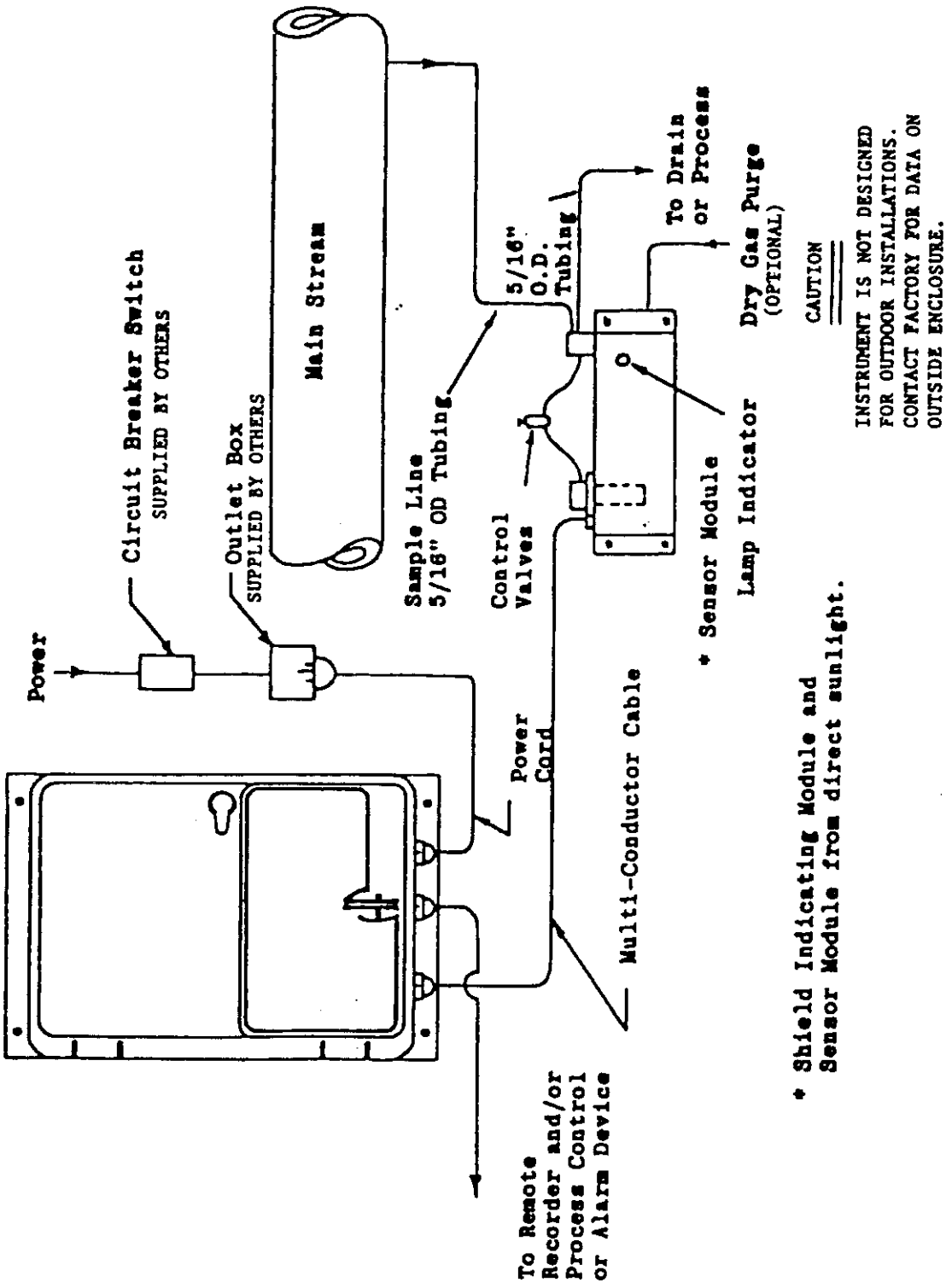
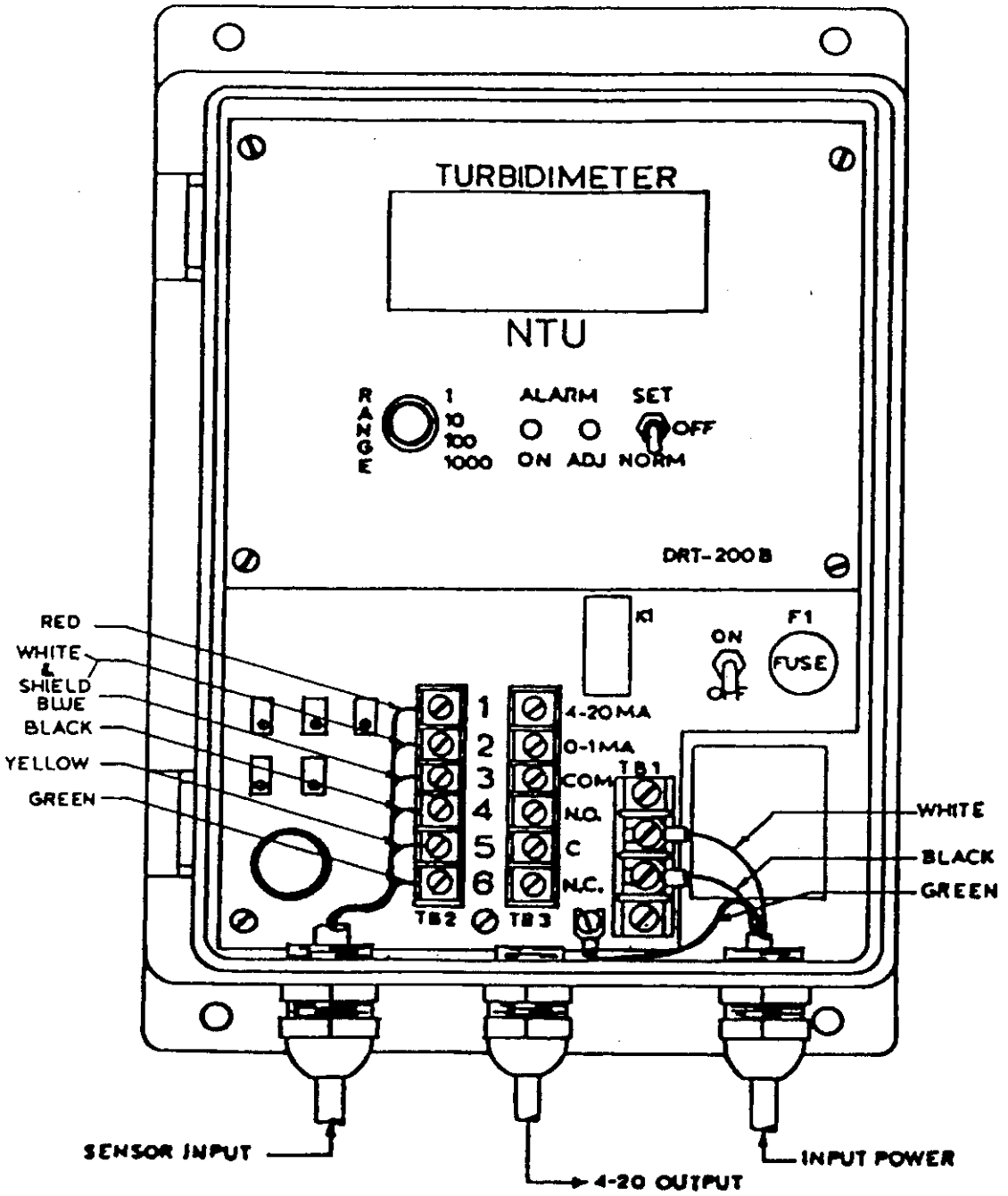


DRT-200B
Outline Dimensions
Figure 6

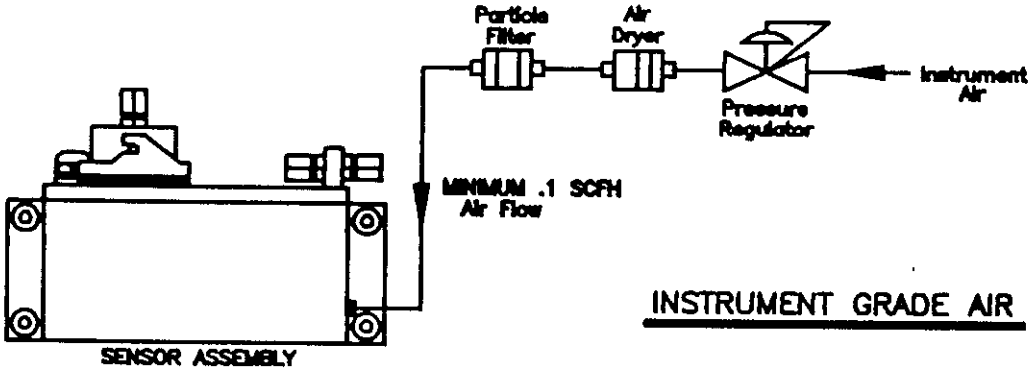


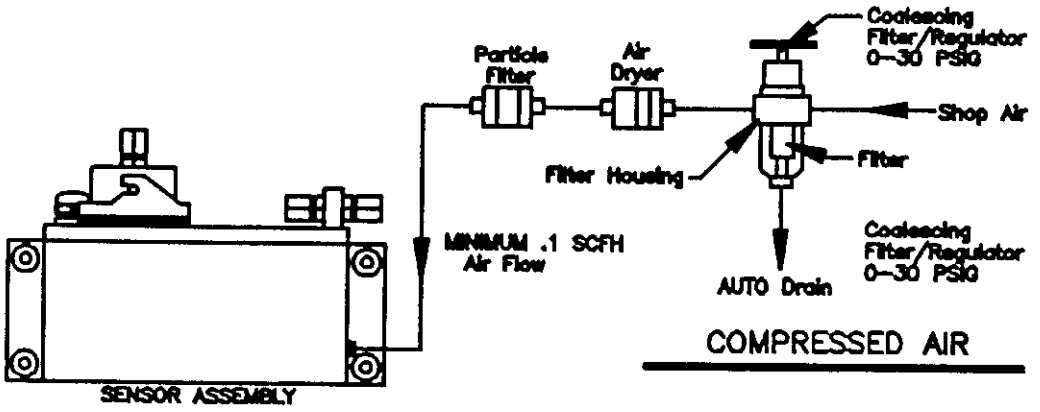
DRT-200B
Installation Details
Figure 7



*See Page 8 for European 240V wiring.

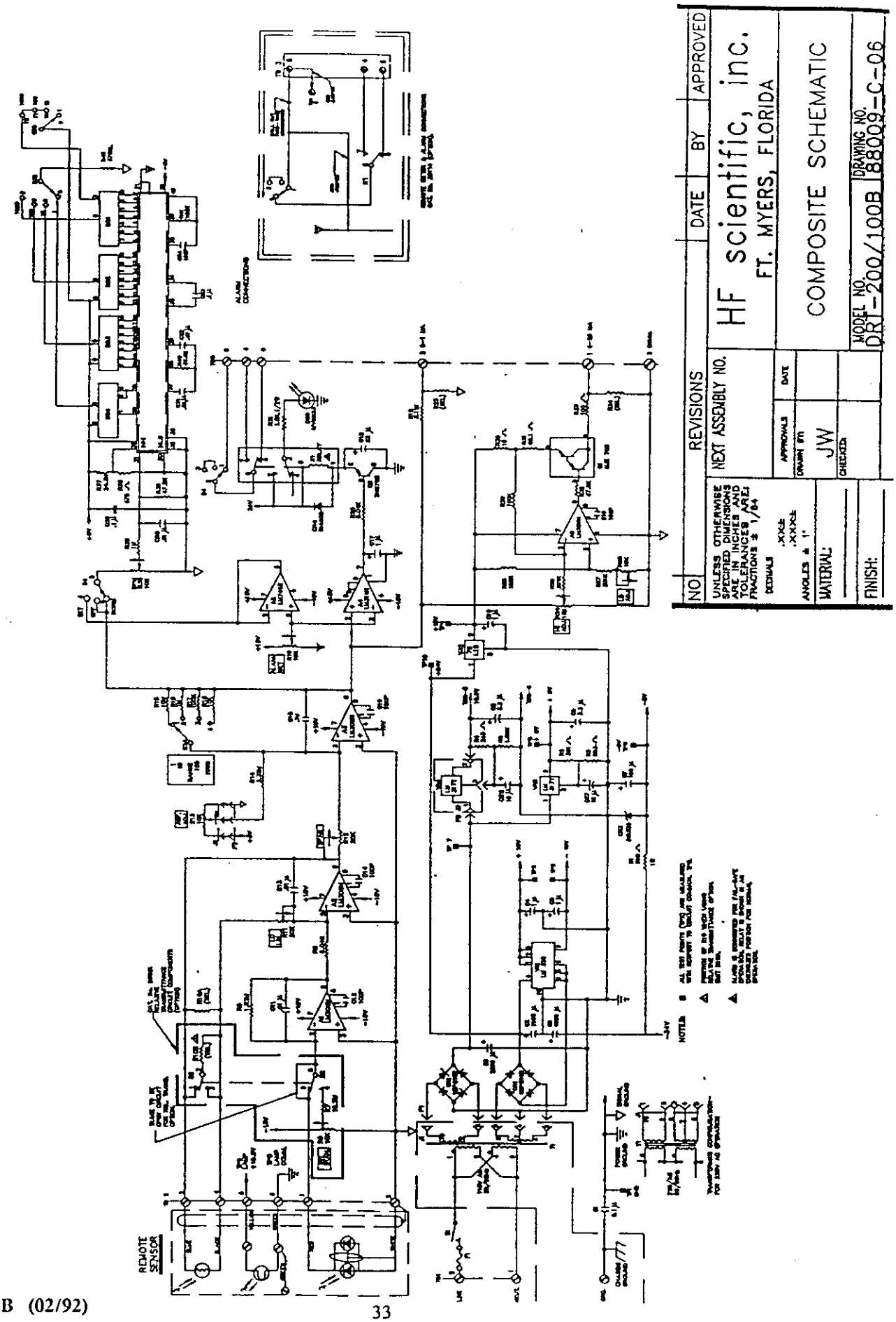
Analyzer Assembly
Figure 8





OPTIONAL AIR PURGE

DRT-200B
Air Purge
Figure 9


NO
REVISIONS
DATE
BY
APPROVED
HF scientific, inc.
FT. MYERS, FLORIDA
COMPOSITE SCHEMATIC
MODEL NO.
DRT-200/100B
DRAWING NO.
88009-C-06
NEXT ASSEMBLY NO.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE: FRACTIONS ± 1/64
DECIMALS .XX± .XXX±
ANGLES ± 1°
MATERIAL:
FINISH:
APPROVALS
DRAWN BY
JW
CHECKED
DATE
REMOTE SENSOR