

**DRT-15CE**  
**PORTABLE TURBIDIMETER**  
**OPERATING & MAINTENANCE MANUAL**





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OPERATING & MAINTENANCE  
MANUAL**

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## **FOREWORD**

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

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.



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**1.0 SPECIFICATIONS FOR DRT-15CE**

Ranges NTU	3 Ranges: 0-10, 0-100, 0-1000 NTU
Linearity	(+ or -) 1% /10, 5%/100, 10%/1000 of Full Scale
Repeatability	(+ or -) 1% of Full Scale on either range
Response	Virtually immediate in all ranges
Power Supply	6 Volt battery. 4.0 amp hours 120/240 VAC, 50/60 Battery Charger
Controls	Combination Range Switch for: ON/OFF and Range Selection. Reference Adjust
Recorder Output	0-1mA (user adjustable), 100 W maximum resistance
Reference Standard	0.02 NTU (Nominal)
Dimensions	11" x 9 1/4" x 5 1/2" (27 cm) x (22.7 cm) x (13.5 cm)
Weight	4.5 lbs.(2.05 kilograms)
Operating Temperature	0 - 50°C (32 - 122°F)

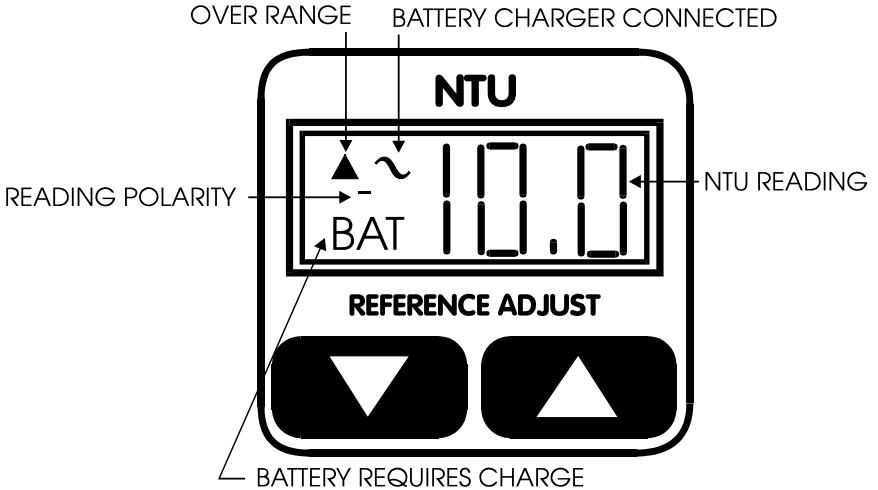
**2.0 PACKING LIST FOR THE DRT-15CE**

<u>QTY.</u>	<u>DESCRIPTION</u>
1	Instruction Manual
1	Calibration Standard 0.02 NTU (Nominal)
1	Battery Charger 120 V 60 Hz (US style) <u>OR</u> Battery Charger 240 V 50 Hz/60 Hz (European style)
1	Cuvettes complete with screw top (Reorder Cat. #50051)
1	Recorder Plug

A complete listing of spare parts is on page 11 of this manual.

### 3.0 PRE-OPERATION CHECKOUT

Extreme care should be taken when handling the Calibration Standard or sample cuvettes as surface scratches or finger smudges will cause analysis errors. Handle these items by the top only.



The battery, when new, usually requires several cycles of discharging and recharging in order to obtain optimum rated life between charges.

The turbidimeter provides up to 20 hours of continuous operation as a portable battery operated unit between recharges.

It is recommended that the unit be turned off between readings in order to obtain longer battery life between recharges. If used as a stationary unit leave the charger plugged in, but **TURN OFF INSTRUMENT WHEN NOT IN USE**. This will keep the battery at an optimum level at all times.

If for some reason the battery has been completely discharged, the display may not come "on" at all. If this happens turn the unit "off" and recharge the battery with the battery charger. To establish that the unit may be used while charging, turn the unit on periodically and observe the lower left corner of the display for the word "BAT". When it goes off, (can no longer be seen while the rest of the display is on), the instrument may be used while the charger "tops off" the battery. Depending on the state of discharge of the battery, it may take as long as 6 - 8 hrs. to fully charge. If the "BAT" indicator is "on", when the charger is not connected, the battery requires charging.

## 4.0 OPERATION AND DESCRIPTION

To operate the turbidimeter, it is first necessary to standardize the instrument. Switch to the "10" range and place the Calibration Standard (0.02 NTU) in the optical well.

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

When shipped, the white locator pin is installed in the collar ring around the optical well of your turbidimeter. The indexing ring is included in the accessory section of this instrument.

To index your Calibration Standard, slowly rotate the Calibration Standard, at least one complete revolution, while observing the reading, and locate the position of the lowest reading. Without moving the Calibration Standard, install the indexing ring over the ridged cap of the Calibration Standard such that the arrow on the o-ring aligns with the locator pin.

When indexing the Calibration Standard in the future, simply insert the Calibration Standard and rotate it until the arrow on the o-ring faces the locator pin. Please note that this Calibration Standard is only indexed to the turbidimeter for which it was aligned.

To standardize, first index the Calibration Standard as above. Then adjust the Reference Adjust in the appropriate direction to cause the display to read 0.02 NTU. The unit is now ready for use on any range.

To make a measurement of a sample, clean one of the cuvettes and fill it to within approximately 1/2" (12 mm) of the top with the sample to be measured. Place the cap on the cuvette and carefully clean the outside surface of the cuvette with a lint free wiper such as "Kimwipes". Place the sample in the well and take the NTU reading directly from display. Select the appropriate range for best resolution..

If the instrument has been subjected to cold (below 10 degrees Celsius) and then brought indoors, it should be allowed to warm up before use, since condensation may form on the various lenses. Warm up can be aided by leaving the case open and the instrument on for approximately a half hour.

## 5.0 RECORDER OUTPUT

The DRT-15CE has a 0-1 mA Recorder Output. The mA output jack is located on right side of the chassis (refer to Figure 2). To use, connect the 1/8" miniplug provided to your recorder. Adjust R17 (pot nearest jack) to obtain a full scale output compatible to a full scale reading on the DRT-15CE. Once this adjustment is made, the DRT-15CE will always be set up for this recorder. Use 10, 100 or 1000 NTU standard in appropriate range.

## 6.0 CRITICAL MEASURING AREA

The critical measuring area of the sample cuvette is a 3/4" wide band starting 5/8" above the bottom. Keep this area clean and free of scratches or abrasion. Handle by the top part only. (See Figure 1).

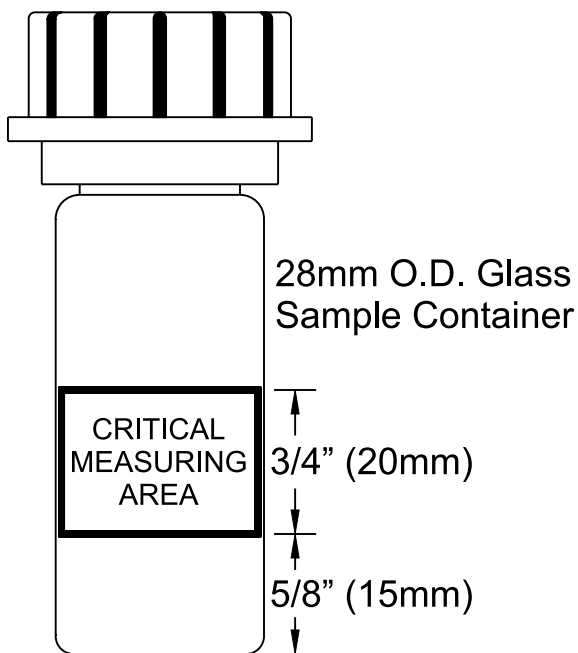


Figure 1

## **7.0 CALIBRATION PROCEDURES**

### **7.1 Calibration Standards**

#### **7.1.1 ProCal Standard Set (optional) Catalog No. 39071**

HF ProCal 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 the HF scientific Customer Service Department. HF ProCal 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.

Each ProCal Standard Kit contains:

- 0.02 Calibration Standard
- Certified ProCal Standards 10.00, 100.0, 1000 NTU  
Standards are contained in preselected cuvettes with light shield caps.
- A sturdy storage case

#### **7.1.2 Standard Formazin Solutions**

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

Calibration samples may be obtained by diluting Formazin stock suspension using "Turbidity-Free" water. Formazin stock suspension can be prepared by the user (Reference Standard Methods For Examination of Water and Wastewater) or a kit can be purchased from, HF scientific, inc., Catalog No. 50040.

Each kit contains:

- Instruction manual
- 1 liter of 4000 NTU Stock Suspension
- 1 Gallon (3.79 liters) turbidity-free water
- 4 Sample cuvettes (28 mm)
- 4 Light Shield Caps
- Graduated Pipettes 1 ea. in 1 ml, 10 ml, & 25 ml
- 1 Calibration Standard

The following table gives the recommended dilutions of the stock suspension. Be sure to adequately mix the stock suspension prior to removing a portion for dilution.

#### PROCEDURE

NTU Value	Pipette	Amount	Base Formazin	Volumetric Flask
10.0 NTU	10.0ml	2.5ml	of 4000 NTU	1000ml
100.0 NTU	10.0ml	5.0ml	of 4000 NTU	200ml
1000.0 NTU	25.0ml	25.0ml	of 4000 NTU	100ml

**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. Prepare 40 NTU and lower standards daily.

#### **7.2 ELECTRONIC CALIBRATION USING FACTORY CERTIFIED PROCAL STANDARDS (CAT. NO. 39071)**

The DRT Turbidimeters have been carefully calibrated at the factory. However, should the Electronic P.C. Board, the Photo Detectors, or the Light Source be replaced recalibration may be easily accomplished at your facility.

To carry out a complete calibration the following ProCal Standard values are required:

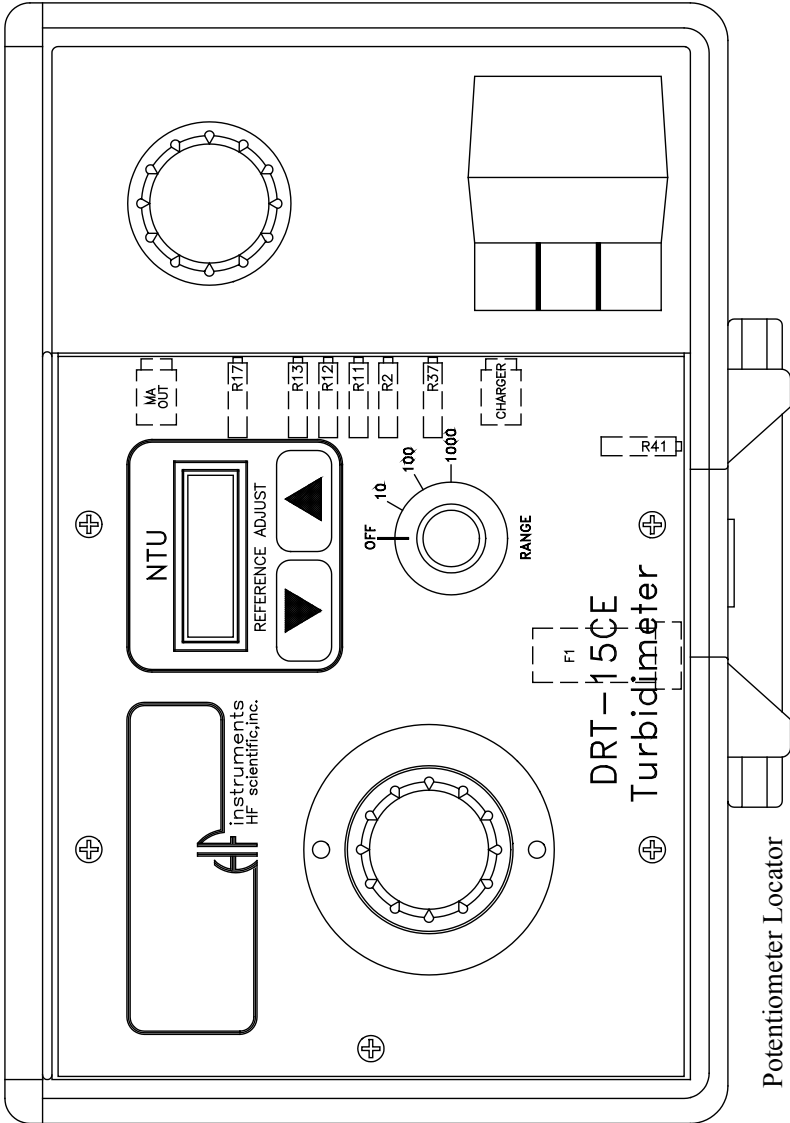
- 1000 NTU,  
100 NTU  
& 10 NTU
- Keep the outside surface of cuvettes clean.
  - When placing any standards in the well, always use the screw cap/shield to cover the well in order to keep out ambient light.

To gain access to the trim pots, remove the accessories from the foam holder. Refer to figure 2 for trim pot identification during the next few steps.

1. Turn the DRT-15CE to the 0 - 10 Range.
2. Insert the calibration standard and index it as described in "Operation and Description".
3. Set the Reference Adjust to the maximum "up" position.
4. Adjust R2, Ref. Offset trim pot, until the display reads 0.18 NTU.
5. Set the Reference Adjust to 0.02 NTU.
6. Insert the 10 NTU standard and index. Adjust R11 (0 - 10 NTU gain) to obtain a reading of 10.00 NTU.
7. Rotate the range switch to the 100 NTU range. Replace the 10 NTU standard with the 100 NTU standard and index it.
8. Adjust R12 (0 - 100 gain) to obtain a reading of 100.0 NTU.
9. Rotate the range switch to the 1000 NTU range. Replace the 100 NTU standard with the 1000 NTU standard and index it.
10. Adjust R13 (0 - 1000 gain) to obtain a reading of 1000 NTU.
11. It is not necessary to adjust R37 (low battery indicator). This is factory set to indicate a low battery condition when the battery voltage is below 5.6 V.
12. **WARNING:** R41 is factory set. Adjustment of this trim pot could cause damage to battery and/or DRT-15CE.

This completes the calibration of the DRT-15CE.

- R17 - Recorder Output
  - R13 - 0 - 1000 Gain
  - R12 - 0 - 100 Gain
  - R11 - 0 - 10 Gain
  - R2 - Ref. Offset
  - R37 - Low Battery
  - R41 - Charge Volts.\*
- \*Factory set, do not adjust.



Potentiometer Locator  
Figure 2

## 8.0 TROUBLE SHOOTING

### Symptom

Meter does not respond when a sample is set into the well.

### Possible Cause

1. Lamp is burned out. Replace the lamp and recalibrate.
2. Printed Circuit Board failure. Replace Printed Circuit Board.
3. Battery is low. Charge battery.

In the case of 1 or 2 the instrument should be recalibrated. The lamp has an extraordinary long life and therefore replacement is infrequent.

### Symptom

Reference Adjust does not have enough travel to adjust for the calibration standard value.

### Possible Cause

1. Scratched or rubbed calibration standard container or aged calibration standard. Replace the standard.
2. Optics have aged. Recalibrate.
3. Faulty lamp. Replace the lamp and recalibrate.

### Symptom

The display will not stabilize with the calibration standard in the well.

### Possible Cause

1. Battery voltage too low. "BAT" indicator is "ON" when the battery requires recharging. When the battery is discharged, the voltage will drop off causing the meter display to drift. Recharge battery.
2. Cold sample can cause condensation on the cuvette. Clean and dry cuvette.
3. Unit has not been given sufficient time to stabilize at ambient temperature. Allow time for instrument to stabilize.

## **Symptom**

No display on instrument at all.

## **Possible Cause**

1. Battery is dead. Recharge battery.
2. Fuse has blown. Check battery connections and replace fuse with 1A fast acting 5x 20 mm.

## **Symptom**

Low battery indicator on after 8 hour charge.

## **Possible Cause**

1. Battery is defective. Replace battery.
2. Charger is defective or is not connected to a valid power source. Check for "~" indication on display.

## **9.0      MAINTENANCE**

The DRT-15CE is not designed for field servicing. It should be returned to your local distributor or to HF scientific for any service requirements. Be sure to obtain a return authorization number prior to return. This will facilitate prompt servicing of the unit. The exceptions are Battery and Lamp Assembly replacement. This can be done in the field provided the new battery is installed in the same manner as the battery being replaced.

### **9.1      BATTERY REPLACEMENT**

Should the battery (HF catalog #70008) fail, it can be user replaced. Make certain the instrument is turned off. Remove all the accessories in the foam holder. Next, remove the foam insert by placing a finger in the cuvette hole and pulling the rear of the foam forward, then up. The five Phillips head chassis screws should be removed. Remove the chassis from the case by sliding the chassis all the way to the right then pulling up. The two screws under the right side of the chassis need to be removed now. This will allow for the removal of the battery clamp and the old battery. Replace the battery by reversing the procedures described above. When connecting the battery, be certain that you connect the red wire to the terminal marked (+) and the black wire to the terminal marked (-). If these wires are inadvertently reversed the fuse will blow and must be replaced (see Figure 2).

## 9.2 LAMP REPLACEMENT

The lamp source (HF catalog #21084) used in the DRT-15CE has an extremely long life. Before replacing the lamp, make certain that the battery is not in need of a charge and is not defective. Prior to replacing the lamp, remove the battery as described in battery replacement. Remove the lamp wires at terminal block. To remove the lamp, loosen the two set screws on the outermost barrel with a 5/64" hex wrench and pull the lamp straight out. Replace the lamp in the reverse order. Make sure the lamp is pushed all the way in. The set screws should be snugged up; excess pressure could damage the lamp. Replace the battery. Replace the chassis in the case and recalibrate as described in **CALIBRATION PROCEDURES SECTION 7.0**, page 5 in this manual.

## 10.0 PARTS & ACCESSORIES

HF scientific  
PARTS AND ACCESSORIES  
FOR  
DRT-15CE

<u>CAT. NO.</u>	<u>DESCRIPTION</u>
60013	ProCal Calibration Standard 0.02 NTU (replace annually)
21805	Instruction Manual DRT-15CE
50051	Cuvettes - Screw Top, 3/pk.
21084	Lamp Source Assembly 2/pk.
70008	Battery - 6 volt
70050	Battery Charger - 120 volt (US style)
20850	Photo Diode
19046	Battery Charger, 240 Volt (European style)
21904	LCD Display
20495	Printed Circuit Board Complete
50040	Formazin Stock Solution Kit
20956	Fuse, 1A, 5 x 20 mm
39071	ProCal Calibration Standards -1 ea.10, 100, 1000 NTU, (Replace annually)
19045	Auto Adapter 12V
50091	Anti-fog kit

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## **11.0 WARRANTY**

HF scientific, inc., as vendor, warrants to the original purchaser of the instruments 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, reagents, desiccant, sensors, electrodes 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 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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