



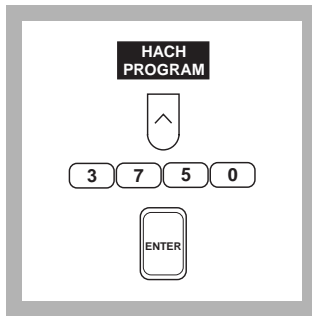
## Method 10047

## Attenuated Radiation Method (Direct Reading)

(0 to 5000 Formazin Attenuation Units\*)

**Scope and Application:** For testing turbidity in water, wastewater, estuary water, seawater and industrial process water. Results may not be used for compliance reporting. The estimated detection limit for program number 3750 is 14 Formazin Attenuation Units (FAUs).

\* A Formazin Attenuation Unit (FAU) is equivalent to a Nephelometric Turbidity Unit (NTU).



**1.** Press the soft key under **HACH PROGRAM**.

Select the stored program number for turbidity in FAUs by pressing **3750** with the numeric keys.

Press: **ENTER**

**Note:** If samples cannot be analyzed immediately, see *Sample Collection, Preservation and Storage* following these steps.

**Note:** The Flow Cell and Sipper Modules cannot be used with this procedure.

**Note:** Results are given in FAU (Formazin Attenuation Units), not Nephelometric Turbidity Units. An FAU is equivalent to a NTU when measuring formazin. They are not necessarily equivalent when measuring samples or other types of standards.



**2.** The display will show: **HACH PROGRAM: 3750 Turbidity, Absorb**

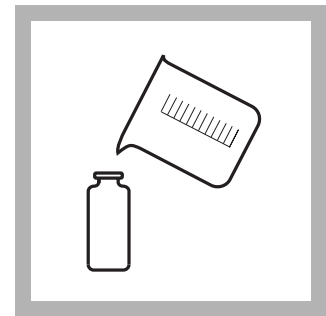
The wavelength ( $\lambda$ ), **860 nm**, is automatically selected.



**3.** Use a set of matched sample cells. Fill one of the clean stoppered sample cells to the 10-mL mark with deionized water (the blank). Stopper.

**Note:** For highly colored samples, filter a portion of the sample and use it in place of the deionized water. See *OPTIONAL EQUIPMENT AND SUPPLIES* for labware.

**Note:** For colored samples, see the *Interferences* section.



**4.** Rinse the other matched sample cell with sample. Then fill the sample cell to the 10-mL mark with sample. Stopper (this is the prepared sample).

# TURBIDITY, continued



**5.** Wipe the sides of both sample cells using a clean, soft cloth.

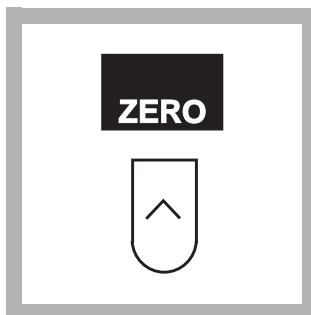
**Note:** Handle the sample cells by grasping the top of the cell.

**Note:** Apply a small amount of silicone oil to the outside of the sample cells. This minimizes the effects of surface defects on the measurement.



**6.** Place the blank into the cell holder. Close the light shield.

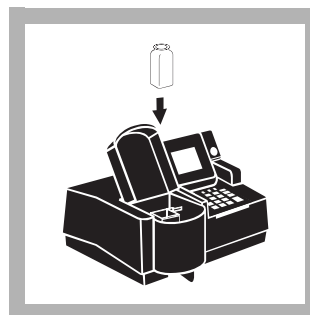
**Note:** Avoid disturbing the liquid in the sample cell.



**7.** Press the soft key under **ZERO**.

The display will show:

**0 FAU**



**8.** Gently invert the prepared sample several times. Immediately place it into the cell holder. Close the light shield. Results in FAU turbidity will be displayed.

**Note:** Do not shake the sample. Shaking causes air bubbles, which will cause falsely high turbidity readings.

## Interferences

Interfering Substance	Interference Levels and Treatments
Air bubbles	Interfere at all levels. Degass the sample using the optional Degassing Kit or Ultrasonic Bath listed under <i>REQUIRED EQUIPMENT AND SUPPLIES</i> at the end of this procedure.
Color	Interferes if the color absorbs light at 860 nm
Temperature extremes	May interfere by changing the turbidity of the sample. Analyze samples as soon as possible after collection. Analyze at the same temperature as the original sample.

## Sample Collection, Preservation and Storage

Collect samples in glass bottles. Analyze as soon as possible after collection. Changes in temperature can affect the constituents in the sample, which can influence turbidity readings. If immediate analysis is not possible, store the sample at 4 °C (39 °F) for up to 48 hours. Before analysis, warm the sample to room temperature or, preferably, to the temperature of the sample when it was collected.

## Accuracy Check

### Standard Solution Method

Prepare a 1000-FAU standard solution by pipetting 25.00 mL of a 4000-NTU Formazin Stock Solution into a 100-mL Class A volumetric flask. Dilute to the mark with deionized water. Stopper and invert several times to mix. Prepare this solution monthly. Perform the turbidity procedure as described above. The result should be 1000 FAU.

To adjust the calibration curve using the reading obtained with the 1000-FAU standard solution, press the soft keys under **OPTIONS, MORE** then **STD: OFF**. Press **ENTER** to accept the displayed concentration, the value of which depends on the selected units. If an alternate concentration is used, enter the actual concentration and press **ENTER** to return to the read screen. See Section 1.5.5 *Adjusting the Standard Curve* for more information.

## Method Performance

### Precision

Standard 1000 FAU

Program	95% Confidence Limits
3750	976–1024 FAU

For more information on determining precision data and method detection limits, refer to Section 1.5.

### Estimated Detection Limit

Program	EDL
3750	14 FAU

For more information on derivation and use of Hach’s estimated detection limit, see Section 1.5.2. To determine a method detection limit (MDL) as defined by 40 CFR part 136, appendix B, see Section 1.5.1.

### Sensitivity

Program Number: 3750

Portion of Curve	$\Delta$ Abs	$\Delta$ Concentration
0.010 Abs	0.010	6.1 FAU
2500 FAU	0.010	24.5 FAU
4500 FAU	0.010	51.0 FAU

See Section 1.5.3 *Sensitivity Explained* for more information.

## Calibration Standard Preparation

To perform a turbidity calibration using the attenuated radiation procedure, prepare turbidity calibration standards containing 40, 200, 1000, 2000, and 4000 FAU as follows:

- a. Pipet 1.00, 5.00, 25.00, and 50.00 mL of well mixed 4000-NTU Formazin Stock Solution into four different 100-mL Class A volumetric flasks, using Class A pipets.
- b. Immediately dilute each flask to volume with turbidity free deionized water. Stopper and invert each flask to mix. (The 4000-NTU standard is not diluted).
- c. Using the Attenuated Radiation method, and the calibration procedure described in the *User-Entered Programs* section of the *DR/4000 Spectrophotometer Instrument Manual*, generate a calibration curve from the standards prepared above.

## Summary Of Method

This test measures turbidity, which is an optical property of the sample that results from the scattering and absorption of light by particles in the sample. The amount of turbidity measured depends on the size, shape, color and refractive properties of the particles.

# TURBIDITY, continued

Formazin standards are used for calibration and readings are taken using Formazin Attenuation Units (FAU). A 400-NTU Formazin stock standard is also defined as 400 FAU. The optical measurement method for FAUs is very different than the NTU method. Color interference is minimized by taking measurements at 860 nm.

This test cannot be used for USEPA reporting purposes, but it may be used for daily in-plant monitoring and is best suited for measuring turbidity levels greater than 20 NTU. A turbidimeter should be used for accurately monitoring low levels of turbidity and for reporting purposes.

## Safety

Good safety habits and laboratory techniques should be used throughout the procedure. Consult the *Material Safety Data Sheet* for information specific to the reagents used. For additional information, refer to *Section 1*.

## Pollution Prevention and Waste Management

For information on pollution prevention and waste management, refer to *Section 1*.

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## REQUIRED REAGENTS AND STANDARDS

Description	Quantity Required		Cat. No.
	Per Test	Unit	
Water, deionized .....	10 mL .....	4 L .....	272-56

## REQUIRED EQUIPMENT AND SUPPLIES

DR/4000 1-Inch Cell Adapter .....	1 .....	each .....	48190-00
Sample Cells, 10 mL, 1-inch, matched pair, with stoppers .....	2 .....	2/pkg .....	20950-00

## OPTIONAL EQUIPMENT AND SUPPLIES

Bath, ultrasonic .....		each .....	24895-00
Beaker, 50-mL .....		each .....	500-41
DR/4000 Carousel Module .....		each .....	48070-02
Flask, volumetric, Class A, 100- mL .....		each .....	14574-42
Filter, membrane, 47-mm .....	200/pkg .....		13530-01
Filter Disks, 0.2- $\mu$ m .....	10/pkg .....		23238-10
Filter Holder, magnetic .....		each .....	13529-00
Filter Paper, glass fiber, 47-mm .....	100/pkg .....		2530-00
Formazin Stock Solution, 4000-NTU .....	500 mL .....		2461-49
Oiling Cloth, for applying silicone oil .....		each .....	47076-00
Pipet, TenSette®, 0.1- to 1.0-mL .....		each .....	19700-01
Pipet Tips, for 19700-01 TenSette Pipet .....	50/pkg .....		21856-96
Pipet, volumetric, Class A, 1.00-mL .....		each .....	14515-35
Pipet, volumetric, Class A, 5.00-mL .....		each .....	14515-37
Pipet, volumetric, Class A, 25.00-mL .....		each .....	14515-40
Pipet, volumetric, Class A, 50.00-mL .....		each .....	14515-41
Pump, vacuum, hand-operated .....		each .....	14283-00
Sample Degassing Kit .....		each .....	43975-00
Sample Degassing and Filtration Kit .....		each .....	43975-10
Silicone Oil .....	15 mL DB .....		1269-36



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