TD-550/560

OIL IN WATER ANALYZER

Operation Manual

PN 106737
REV H

Benchmark
Measurement Solutions

Table of Contents

1 INTRODUCTION

This manual is specific for analyzers with serial numbers greater than 55000224 (TD-550) and 55000284 (TD-560). Do not use this version of the manual for analyzers with serial numbers outside of this range.

The TD-550 and TD-560 oil in water analyzers are designed for quick, easy and reliable measurements of crude oil, fuel oil, lube oil, diesel, some gas condensates, and refined hydrocarbons in water or soil. When properly calibrated with a correlation method or a known standard, the TD-550/560 can be used to measure the hydrocarbon concentrations of water samples in less than 4 minutes.

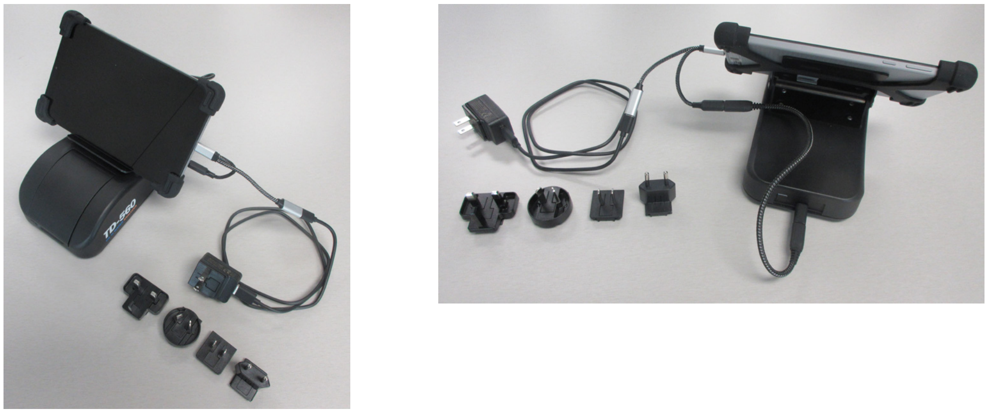
The TD-550 provides near ultraviolet (NUV) fluorescence detection for those applications where a wide concentration range is more important than high sensitivity. The TD-550 is ideal for the analysis of produced water samples where crude oil concentrations can vary from low levels to over one thousand parts-per-million.

The dual channel TD-560 offers the TD-550’s functionality in the NUV channel, as well as a deep ultraviolet (DUV) channel, which provides the extreme sensitivity required to monitor very low hydrocarbon concentrations and detect weakly fluorescent hydrocarbons, such as some gas condensates, diesel fuel, and refined petroleum products.

Both the TD-550 and TD-560 are normally used with a solvent-extraction method such as the Oil-in-water Analysis Procedure described in Section 4 fastHEX™ Analysis Method and the *Oil in Water Analysis Quick Reference Guide*. In this method, the target hydrocarbon is extracted into a suitable solvent. The TD-550/560 measures the hydrocarbon content of the extract, and calculates the hydrocarbon content in water.

NOTE: The TD-550 and TD-560 analyzers are not explosion-proof or intrinsically safe. They are not designed in any way to be used in an explosion-proof designated area.

1.1 COMPONENTS



Front and back views of the analyzer, showing sample well, touch-screen tablet, cables and power adapters.

1.2 PRINCIPLE OF OPERATION

The TD-550/560 Oil in Water Analyzer responds to the fluorescent aromatic compounds in the target hydrocarbon. The instrument must be calibrated by measuring the intensity of fluorescent light that is generated by a known concentration of hydrocarbon. Once calibrated, the instrument converts the fluorescent light intensity from an unknown sample into units of concentration.

The TD-550/560 must be operating in the linear range to display accurate results. To determine whether your calibration standard is in the linear range, first, select the NUV or DUV channel (TD-560) and proper cuvette size and calibrate the analyzer with a standard solution of known concentration. (See Section 3 General Considerations for Analysis for configuration guidelines.) Then prepare a new standard that is half the concentration of the standard solution by mixing equal volumes of the original calibration standard and pure blank. Place the diluted standard in a clean cuvette, place the cuvette in the sample well and tap Read on the Home screen (see Section 2.1 Touch Screen Interface). If the displayed result is greater than half the original standard concentration, allowing for some error due to dilution, the analyzer's calibration is beyond the linear range. The linear range is dependent upon the sample cuvette size and the optical channel of the analyzer; thus using a smaller cuvette size and/or changing the optical channel (TD-560) can extend the linear range.

1.3 SPECIFICATIONS

Common Target Oils	TD-550: crude oil, some diesels, fuel oils and some lubrication oils TD-560: all oils listed for the TD-550 plus gas condensates, BTEX, gasoline, styrene, phenol, jet fuel, kerosene, heat transfer fluids and hydraulic oils
Detection Range	5 ppb to 5000 ppm (dependent on target oil)
Power	External power supply: 90–240 VAC and 6–8 hours on battery
Data Output	USB and micro SD card
Calibration	Direct and raw
Display Units	ppm, ppb, mg/l, ug/l, raw
Approvals	CE
Data Logging and Graphing	Stores multiple calibrations and site locations Records each sample analyzed with time stamp, location and results for fast lookup Sort by date, location or calibration

1.4 REVISION HISTORY

Date	Revision	Section/Change	Description
1 June 2017	A		Initial version of operation manual.
12 Dec 2018	B	6 Troubleshooting Throughout	Additional procedures. Changes to touch screen software and interface.
11 March 2020	C	2 Operation	Changes to interface description, cuvette selection and calibration overview sections.
		6 Troubleshooting	Changes to section on diagnostics screen, including functionality check procedure.
14 Dec 2020	D	Throughout	Updated company addreess.
31 Jan 2022	E	Section 3.1 Analyzing a Sample	Updated instructions for proper use of cuvettes and adapters for sample measurements.
		Section 3.2 General Information and Precautions	Updated instructions for proper use of cuvettes and adapters for sample measurements.
		6 Troubleshooting	Updated instructions for proper use of cuvettes and adapters for sample measurements.
11 May 2022	F	Throughout	Updated instructions to reflect new tablet operations.

19 May 2022	G	Throughout	Updated instructions for new tablet operations..
12 Feb 2024	H	Throughout	Updated instructions for new tablet operations.

1.5 CONTACT INFORMATION

Benchmark International
5304 36 Street NW
Edmonton, Alberta
Canada T6B 3P3

sales@oilinwatermonitors.com
service@oilinwatermonitors.com
www.oilinwatermonitors.com

2 OPERATION

The TD-550/560 is powered by the touch screen tablet's battery and does not need to be connected to an AC outlet unless the battery requires charging. For initial operation connect the USB-C connector to the tablet, the USB-mini connector to the back of the analyzer, and the power connector to AC power. The round connector at the back of the analyzer is not used. Ignore the flashing red light on the back of the analyzer. To begin using the TD-550/560, press the power button, located on the top edge of the tablet.

If the tablet's charge falls below about 30%, the analyzer will not be able to properly communicate with the tablet. If the tablet will not properly communicate with the analyzer, allow the battery to charge to over 30% before using the analyzer. However, Benchmark does not recommend that the AC power should be continuously provided to the tablet through the charger.

The TD-550/560 is set up with tablet settings that are optimized for the application. Benchmark International does not recommend that the tablet settings be changed, except as directed in this manual.

2.1 TOUCH SCREEN INTERFACE

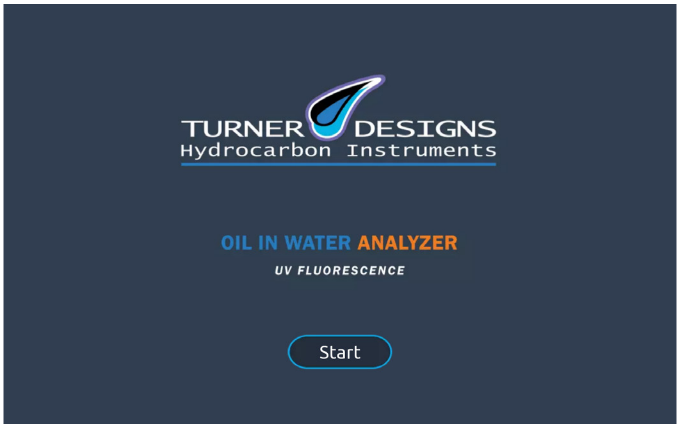
This section provides an overview of some key features of the TD-550/560 touch screen tablet. Other screens and functionality are described in detail in the following sections of this manual. In addition, video tutorials of calibration and analysis procedures are available in the Help & Settings pages on the tablet.

The tablet is required for the system to operate properly and cannot be swapped. If the tablet is somehow damaged or lost, then the entire analyzer must be replaced. Do not attempt to separate the tablet from the analyzer.

Start Screen

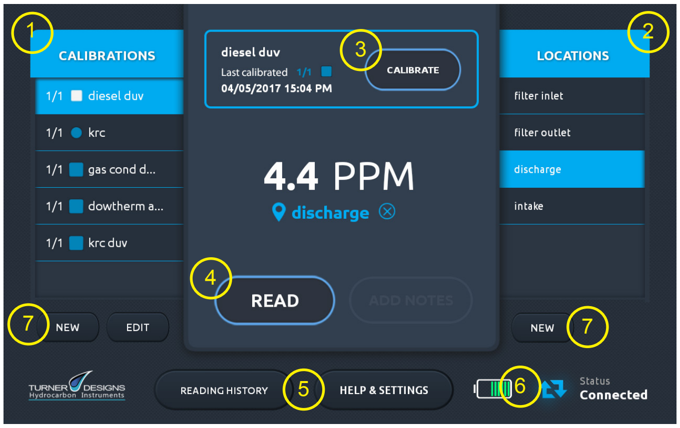
When first starting the touch screen tablet, press the Power button at the top-left corner of the tablet. The tablet desktop includes an icon for the TD-550/560 software. When you tap the icon, the Start screen appears. This screen will also appear when the program has been idle for 15 minutes or more. Tap the Start button. The Home screen will appear.

The TD-550/560 application does not automatically start upon power up of the analyzer, thus the application must be manually started as mentioned above each time you want to use the application.



Home Screen

The Home screen is central to the analyzer’s operation. From this screen you can create and save calibrations for your target hydrocarbons, create and save locations to associate with calibrations, or make a new sample reading. Other functionality includes navigation buttons to the Reading History screen and Help & Settings screen. Connection and battery status icons are displayed in the bottom-right corner of the screen.



1. Calibrations list
2. Locations list
3. Calibrate button
4. Read button
5. Navigation buttons
6. Battery and connection status icons
7. New (calibration and location) button

Calibration Screen

Use the Calibration screen when creating calibrations. Choose the measurement channel, concentration, c uvette type, and extraction ratio for your calibration on this screen. The software chooses cuvette type and extraction ratio when you select a measurement channel. You can change the defaults manually.

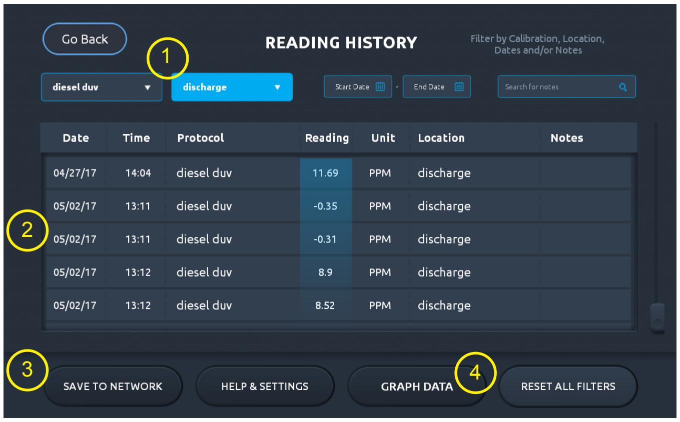
It is important to complete the calibration with both solutions within 5 minutes. The tablet’s screen times out after 5 minutes, and 1the calibration will not be properly recorded. If you find that the five minute time out period is too short, you can extend the display time out period in the tablet settings. Do not change to a time period shorter than five minutes.

1. Measurement Channel list
2. Concentration field
3. Units list
4. Cuvette types
5. Extraction ratios
6. Read Blank button
7. Read Standard button
8. Navigation buttons

Reading History Screen

Each sample analysis is recorded in the Reading History screen. Besides the sample concentration value (Reading), the date and time as well as the calibration and measurement units used are recorded. Any notes or location associated with the reading will also be included in the reading history.

Use this screen to search or filter the readings by calibration name, location, or date. Filtered data can then be saved to a connected network as a CSV file or displayed as a graph.

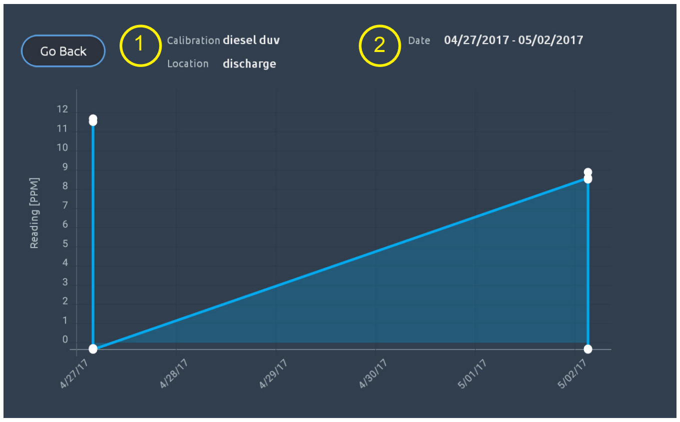


Date	Time	Protocol	Reading	Unit	Location	Notes
04/27/17	14:04	diesel duv	11.69	PPM	discharge	
05/02/17	13:11	diesel duv	-0.35	PPM	discharge	
05/02/17	13:11	diesel duv	-0.31	PPM	discharge	
05/02/17	13:12	diesel duv	8.9	PPM	discharge	
05/02/17	13:12	diesel duv	8.52	PPM	discharge	

1. Filters
2. Readings list
3. Save to Network button
4. Graph Data button

Graph Data Screen

After you have filtered the data in the Reading History screen, you can tap the Graph Data button to display a visual representation of the data.



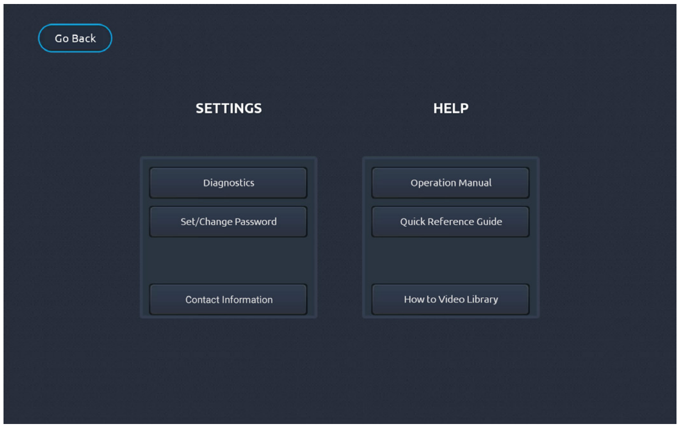
Calibration diesel duv
Location discharge
Date 04/27/2017 - 05/02/2017

1. Data filters chosen
2. Sample reading date range

Help & Settings Screen

The Help & Settings screen includes links to help resources such as the full TD-550/560 Operation Manual, the Quick Reference Guide, which includes instructions for solvent and no-solvent calibration and analysis, and the How to Video Library, which includes tutorials on calibration, analysis and standards preparation.

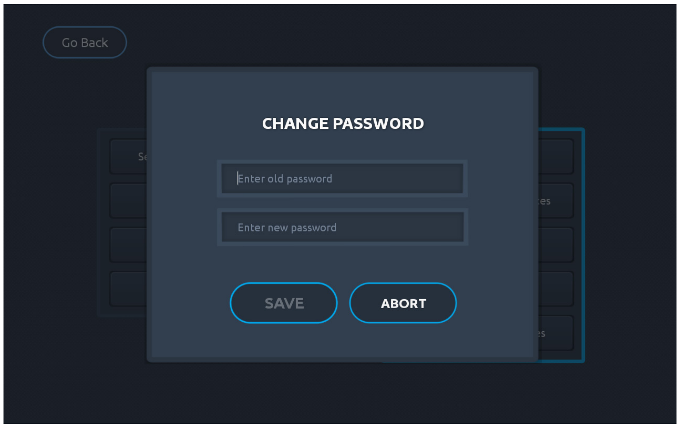
The Diagnostics screen is described in Section 6 Troubleshooting. The Set/Change Password screen is described in the following section.



Set/Change password

No default password is used for the TD-550/560, so leave the password section empty when first accessing the analyzer. You can set your own password if desired. To set a password of your preference, tap Set/Change password on the Help & Settings screen and enter new credentials.

NOTE: If you lose your password, you must contact the factory to regain access to the monitor. Benchmark International suggests that you manually record the password in a safe location if a password is used.



2.2 CHANNEL SELECTION GUIDELINES

The TD-550 is a single-channel crude oil analyzer with extended range and low detection limits for most crude oils.

The TD-560 features two channels. The near ultraviolet (NUV) channel, provides the same functionality as the TD-550. In addition, the deep ultraviolet (DUV) channel can be used where high sensitivity is required. The DUV channel can detect all of the commonly used refined oils, crude oil, and gas condensates, with significant improvement over competing analyzers. The DUV channel is ideal for weakly fluorescent hydrocarbons or for very low concentrations of hydrocarbons.

NUV Channel (TD-550/560)

In most cases, use the NUV channel for measuring

- Crude Oil in Produced Water
- Heavy crude oils (higher concentrations)
- Heavy fuel oils (higher concentrations)

DUV Channel (TD-560)

In most cases, use the DUV channel for measuring the following hydrocarbons in water or soil

- Gas Condensate
- Diesel
- Marine Diesel
- Fuel Oil #6 (< 1 ppm)
- Lube Oil
- Crude Oil in Produced Water (< 1 ppm)

Use the above general suggestions regarding channel choices. If during the calibration you encounter low fluorescence values for the calibration solution or non-linear calibration, refer to Section 6 Troubleshooting for further suggestions. The linearity should always be checked for any calibration.

2.3 CUVETTE SELECTION GUIDELINES

The TD-550 includes an 8 mm adapter for the sample well and 8 mm diameter cuvettes (round). If you need to detect a lower linear range, purchase an optional 10 mm adapter kit and 10 mm cuvettes.

The TD-560 includes a 10 mm adapter for the sample well and 10 mm square cuvettes. The cuvettes can be used with either the NUV or DUV channel. An 8 mm adapter kit and cuvettes can be purchased separately for measuring crude and heavy oils in the NUV channel only. The 8 mm round cuvettes cannot be used with the DUV channel.

Use the 8 mm cuvettes (P/N 50957) for measuring heavy crude oil and other highly fluorescent oils in water. Use the 10 mm cuvettes (P/N 106686) for diesel, gas condensates, lube oil and other refined hydrocarbons in water or for very low concentrations of crude oil-in-water. The cuvette size is selected when the calibration concentration is entered on the Calibration screen. You must use the same cuvette type for the calibration and analysis. Changing the cuvette type for analysis will cause incorrect measurements.

If you encounter problems during calibration, refer to Section 6 Troubleshooting for cuvette type and measurement channel suggestions.

2.4 CALIBRATION OVERVIEW

Before the TD-550/560 can be used to analyze a sample, you must calibrate it with a blank and a calibration standard containing your target hydrocarbon. If you are following a solvent-extraction method, use the pure extraction solvent for the blank. Prepare the calibration standard by dissolving a known amount of hydrocarbon in a known volume of extraction solvent. The standard solution will then have a known concentration. You should also check the linearity and sensitivity as discussed in Section 6.1 Low Fluorescence During Calibration and Section 6.2 Linearity and Linearity Checking. Calibrations are saved to a list on the Calibration screen. Each calibration includes a name, date, cuvette type, and extraction ratio. On the Calibration screen, you can also associate a saved calibration with a location.

For *fastHEX*™ method calibration details, see Section 5 No-Solvent Analysis Method.
For No-Solvent method calibration details, see Section 5.2 Calibrating the Analyzer for 0-100 ppm Range.

NOTE: Make sure that you use the same size cuvette for blank, calibration solution, and sample analysis. For example, if you use the 8 mm cuvettes for blank and calibration solution, then you must use 8 mm cuvettes for sample analysis also. Using different size cuvettes for calibration and sample analysis will result in incorrect readings.

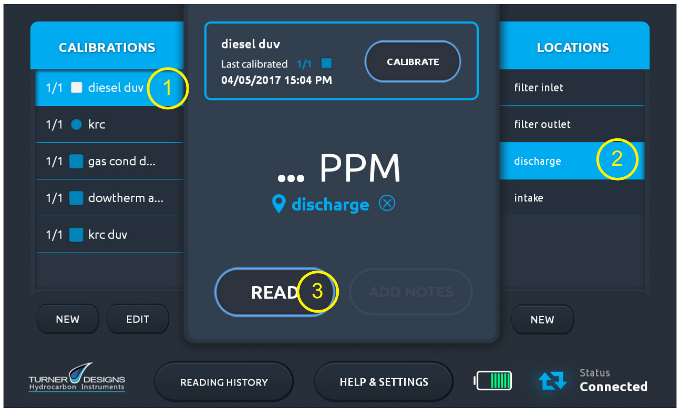
3 GENERAL CONSIDERATIONS FOR ANALYSIS

This section provides an overview of analyzing samples with the TD-550/560. For more details, see the Quick Reference cards as well as Section 4 fastHEX™ Analysis Method and Section 5 No-Solvent Analysis Method.

3.1 ANALYZING A SAMPLE

To analyze a sample

1. Turn on the analyzer tablet and tap Start on the Start screen.
2. On the Home screen select a saved calibration (1) in the Calibrations list.



NOTE: You cannot analyze a sample unless the TD-550/560 has at least one stored calibration. If you have not calibrated the analyzer, follow the calibration procedure in either Section 4 fastHEX™ Analysis Method or Section 5 No-Solvent Analysis Method.

3. If applicable, select a saved location (2) from the Locations list, or tap New to create a location.
4. Insert your sample in a clean cuvette. Be sure to wipe any oil or finger prints from the outside of the cuvette.
5. Open the sample well lid, insert the cuvette in the cuvette adapter, and close the lid. If using the 10 mm square cuvette, be sure to install in the cuvette adapter with the mark on the cuvette facing forward.
6. Tap Read (3). A new reading is stored in the Reading History screen.

For video tutorials on analyzing samples, see the How to Video Library on the Help & Settings screen.

3.2 GENERAL INFORMATION AND PRECAUTIONS

- The sample well is fitted with a cuvette adapter that accepts either 8 mm round cuvettes or 10 mm square cuvettes. See Section 2.3 Cuvette Selection Guidelines.
- Do not change the cuvette type once the calibration has been performed. If measurements are made with the wrong cuvette type relative to the cuvette used during the calibration, incorrect measurements will result.
- Make sure to complete the calibration with both the blank and calibration solution within the five minute timeout period, otherwise the calibration may not be properly recorded. The timeout period may be extended in the tablet settings if desired.
- Take care not to spill samples into the sample well. If a sample is spilled into the well, do not move or turn over the analyzer. Rather, use laboratory tissues to absorb the excess solvent. Clean around the optical surface with 99% or greater purity isopropyl alcohol and laboratory tissues. Do not attempt to disassemble the analyzer as this will cause incorrect measurements.
- Do not allow any liquids to spill around the analyzer as they can cause damage to the analyzer. The analyzer is not waterproof.
- The TD-550/560 is very sensitive and even small amounts of material from a previous sample may result in errors. Use a clean cuvette for each reading. Wipe the outside of the cuvette with a Kimwipe or similar laboratory tissue. Do not use paper towels or kitchen wipes because the optical brighteners in the paper may cause a false reading. Do not touch the optical surfaces where the cuvette adapter is located. If the optical surface has deposits, clean with 99% or greater purity isopropyl alcohol and laboratory tissues. Particles can be cleaned from the surface with optical grade canned gas dispensers.
- Fill the round or square cuvettes at least 75% full; significant error will result if the cuvette is not properly filled.
- The cuvette *must be clean and dry* on the outside when taking readings. Moisture and condensation or fingerprints on the outside can result in error. Use laboratory grade tissues or wipes for wiping the cuvettes.
- Avoid air bubbles in the cuvette. Bubbles in samples may cause drifting of the reading. Slight tapping on the outside cuvette wall should help remove any bubbles.
- Avoid getting water droplets and dissolved residue from water on the inside of the cuvette. These will interfere with the measurement.
- If using the 10 mm square cuvette, be sure to install in the cuvette adapter with the mark on the cuvette facing forward.
- Avoid transferring emulsions to the cuvette since bubbles of water in the extract will cause incorrect measurements.
- Always make sure to analyze the samples on the calibrated channel only (TD-560). Using a different channel for sample analysis will give incorrect readings.
- If using the *fast*HEX™ method, use the same solvent that was used for the calibration. Using a different solvent will result in incorrect measurements.
- If analyzing an unknown sample, always check for linearity of the sample extract as discussed in Section 6 Troubleshooting.
- If measuring samples with measured concentrations near zero, see Section 6.3 Measurement Of Samples Close To Zero.
- The measurements with both the square cuvette adapter and round cuvette adapter will be slightly sensitive to the cuvette adapter position. Make sure to install the cuvette adapter in a consistent position. We do not recommend changing the cuvette adapter position unless needed.

4 *FASTHEX*™ ANALYSIS METHOD

The *fastHEX*™ method for the TD-550/560 was developed to provide a simple, rapid, accurate, safe and environmentally friendly field procedure for the analysis of oil and grease in water. The TD-550/560 measures the oil content of a water sample by measuring the fluorescent light emitted by oil that has been extracted into hexane. Hexane is an inexpensive, non-fluorescent, organic solvent that efficiently extracts all types of crude oil, and separates out quickly on top of the water sample.

The *fastHEX*™ method has been in use for several years, and has been field-proven to give results that correlate well to US EPA Method 1664 and other official oil and grease methods. The entire procedure, from taking a water sample to recording results, takes less than 4 minutes. Because the method uses inexpensive, disposable bottles and cuvettes, solvent waste is reduced to a minimum. Also, unlike Freon and other halogenated or chlorinated solvents, hexane can be disposed of in most oil and gas facilities without worrying about physical exposure.

4.1 ALTERNATIVE SOLVENTS

Although the *fastHEX*™ method was originally intended to use hexane, its solvent extraction and measurement procedures can also be applied to other lighter-than-water solvents (xylene, petroleum ether, etc.). In addition, the procedure can be modified allowing use of a variety of heavier-than-water solvents (Vertrel MCA, Ashikleen AK-225, perchloroethylene, etc.). Analysis procedures for lighter-than-water solvents and heavier-than-water solvents are given in Section 4.2, and Section 4.3, respectively.

4.2 IMPORTANT NOTE REGARDING SOLVENTS

Some solvents, especially Vertrel MCA, Ashikleen AK-225, and chloroform, can damage the TD-550/560 if left in contact with the plastic parts. If you spill solvents on the case or inside the sample well, flush the contacted area immediately with isopropyl alcohol and dry the area with a non-abrasive lab tissue.

Xylenes, toluene, and other aromatic solvents cannot be used as solvents when using the DUV channel because of interference from fluorescence of these solvents.

Always follow safety rules for handling and disposing of solvents.

4.3 CALIBRATING THE ANALYZER FOR *FASTHEX*™ METHOD

NOTE: Some solvents may not be able to dissolve certain oils and hydrocarbons at a 10,000 ppm concentration. Should this happen, either choose another solvent or choose a lower stock calibration solution concentration.

The TD-550/560 can be calibrated with a standard solution of oil in extraction solvent. The standard solution (known oil concentration) is prepared by dissolving a known amount of oil in a known volume of extraction solvent. The instrument is calibrated by relating measured fluorescence response to the concentration of oil in the standard. This procedure can be used for all extraction solvents.

To prepare a calibration standard

Part 1—Preparing a 10,000 ppm Stock Standard

1. Pipette 1 mL (1000 μL) of oil into a 100 mL volumetric flask that is approximately half full of clean extraction solvent.
2. Cap the flask and shake it to dissolve the oil.
3. Fill the 100 mL volumetric flask to the mark with clean extraction solvent.
4. Cap and shake the flask to mix.

Part 2—Preparing a Calibration Standard

The following table values apply to a 10:1 (water to oil) extraction ratio.

Select a concentration that is equal to the maximum anticipated in your water samples. Prepare a Calibration Standard by diluting the Stock Standard with clean solvent. Recipes for preparing several typical concentrations are given in Table 1. To prepare the Calibration Standard shown in column 1, pipette the Stock Standard volume given in column 3 into a 100 mL volumetric flask, then fill the flask to the 100 mL mark with clean solvent.

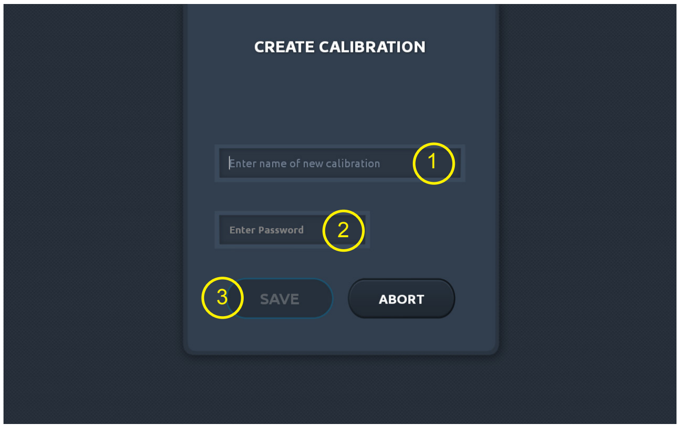
Calibration Standard, ppm	**Oil-in-water Equivalent., ppm** (assuming 10:1 extraction ratio)	**Stock Standard Volume**
5,000	500	50 mL
2,500	250	25 mL
1,000	100	10 mL
500	50	5.0 mL
250	25	2.5 mL
100	10	1.0 mL

Table 1. Calibration Standards

For video tutorials on preparing calibration standards, see the How to Video Library on the Help & Settings screen.

To calibrate the analyzer for fastHEX™ method

1. Turn on the analyzer tablet and tap Start.
2. On the Home screen, at the bottom of the Calibrations list, tap New. The Create Calibration screen appears.



3. On the Create Calibration screen, tap the Name field (1) and enter a name for your calibration.
4. If you wish to use a password, which is not recommended, tap the Password field (2) and enter your password. Otherwise, leave the field blank and proceed. See Section 2.1 Touch Screen Interface.
5. Tap Save (3). The Calibration screen appears.

6. On the Calibration screen, choose a channel (1) from the drop-down menu (TD-560 only).
7. In the Standard Concentration field (2), enter the concentration of oil in solvent (not the corresponding oil in water concentration).
8. The cuvette type and extraction ratio settings are chosen by default but can be changed (3).
9. Select a unit of measurement from the Units drop-down list (4).
10. Prepare a blank by filling a cuvette with clean extraction solvent. Wipe the outside of the cuvette with a clean laboratory grade tissue to remove any liquid, dirt or oil that might be present.
11. Open the sample well lid, insert the blank cuvette into the cuvette adapter, and close the lid.
12. Tap Read Blank to have the analyzer record the fluorescence reading of the blank (5). Do not tap Read Blank again.
13. Remove the blank cuvette from the sample well.
14. Fill a new cuvette with the calibration standard. Wipe the outside of the cuvette with a clean laboratory grade tissue to remove any liquid, dirt or oil that might be present.
15. Insert the calibration standard cuvette into the cuvette adapter and close the lid.
16. Tap Read Standard to have the analyzer record the fluorescence reading of the standard solution (6). Do not tap Read Standard again.
17. Check that the fluorescence response is at least 200 fluorescence units greater than the blank. Calibrations with fluorescence response differences less than 200 indicates insufficient sensitivity. If this occurs, consult Section 6 Troubleshooting.
18. A value appears in the New field (7). To store the calibration (8) tap Save, or tap Abort to try again. Tapping Save returns you to the Home screen. Do not attempt to save values more than once.
19. On the Home screen tap and hold a calibration in the list if you want to delete it.

The calibration is now complete. However, the calibration should be checked for linearity as discussed in Section 6 Troubleshooting. The calibration will be stored and maintained when the analyzer is turned off.

For video tutorials on calibrating the analyzer, see the How to Video Library on the Help & Settings screen.

4.4 EXTRACTION AND CALIBRATION PROCEDURE METHOD SUPPLIES

The TD-550/560 can be purchased with the extraction kits for heavier and lighter than water solvents. These extraction kits have enough supplies for approximately 96 sample analyses each and they include necessary laboratory supplies and glassware required for the extraction procedure. Extraction solvent, hydrochloric acid, 2-propanol (also called isopropanol or isopropyl alcohol), and detergents and liquids are not provided in the extraction kit. To purchase kits and supplies, contact a Benchmark International service representative.

4.5 ANALYSIS USING LIGHTER THAN WATER EXTRACTION SOLVENTS

This procedure is for use with lighter than water extraction solvents such as:

- Hexane
- Cyclohexane
- Heptane
- Octane
- Xylenes (cannot use with the DUV channel and might give high blank reading on NUV channel)
- Toluene (cannot use with the DUV channel and might give high blank reading on NUV channel)

For the calibration procedure, see Section 5 No-Solvent Analysis Method.

NOTE: Please use this procedure even if your solvent is not listed above and you are using lighter than water extraction solvent.

NOTE: If you are using heavier than water extraction solvent then refer to Section 4.3 of this manual for heavier than water extraction solvent analysis procedure.

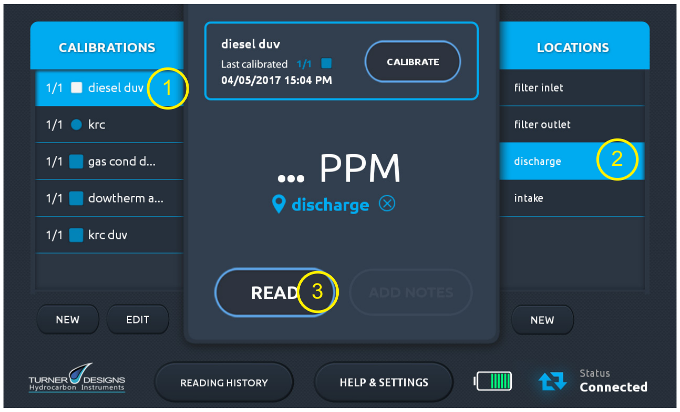
NOTE: The following procedure describes a 10:1 water to oil extraction ratio. If a different extraction ratio is used, the volumes of water sample and/or extraction solvent will be different.

To analyze a sample using a lighter than water extraction solvent

1. Collect 100 mL of contaminated water in a clean, graduated prescription bottle or suitable graduated glass container.
2. Add 6 **N** hydrochloric acid until the pH of the water sample is < 2. Check the pH with pH paper.

NOTE: Depending on the method philosophy of the facility, the sample can be measured at normal pH.

3. Add 10 mL of extraction solvent and securely cap the bottle.
4. Extract oil from the water by vigorously shaking the bottle for 2 minutes.
5. Allow the extraction solvent to separate from the water for approximately 1 minute. If the extraction solvent is trapped in an emulsion; break the emulsion by agitating with a clean pipette. Allow the extract to sit for several minutes after agitating the emulsion. This will allow the solvent to separate from the water. The solvent extract will be floating on top of the water.
6. Carefully release the pressure from the bottle.
7. Fill the appropriate cuvette (8 mm round or 10 mm square) ¾ full with the solvent extract. Wipe the outside of the cuvette with a clean laboratory grade tissue or cloth to remove any liquid, dirt or oil that might be present.
8. Open the sample well lid, insert the cuvette into the cuvette adapter, and close the lid.
9. Turn on the analyzer tablet and tap Start on the Start screen.



10. On the Home screen select a saved calibration in the Calibrations list (1).

    NOTE: If you have not calibrated the analyzer, follow the calibration procedure in Section 5 No-Solvent Analysis Method.

11. If applicable, select a saved location from the Locations list (2), or tap New to create a location.
12. Tap Read (3). A new reading is stored in the Reading History screen.
13. If measuring an unknown sample, you should always check for linearity as discussed in Section 6 Troubleshooting. This is especially important when measuring clear oils as you cannot visually determine whether the extract is in the linear range relative to the standard solution.
14. Dispose of the water, extraction solvent, cuvette and prescription bottle in a safe, environmentally responsible manner, in accordance with your company's procedures.

NOTE: For measurement of samples with expected concentrations near zero, see Section 6 Troubleshooting for suggestions on how to express the results.

For video tutorials on analyzing samples, see the How to Video Library on the Help & Settings screen.

4.6 ANALYSIS USING HEAVIER THAN WATER EXTRACTION SOLVENTS

This procedure is for use with heavier than water extraction solvents such as:

- Vertrel MCA
- Freon
- Ashikleen AK-225
- Chloroform
- Carbon Tetrachloride
- Horiba S-316
- Methylene Chloride

For the calibration procedure, see Section 5 No-Solvent Analysis Method.

NOTE: Please use this procedure even if your solvent is not listed above and you are using heavier than water extraction solvent.

NOTE: If you are using lighter than water extraction solvent then refer to Section 4.2 of this manual for lighter than water extraction solvent analysis procedure.

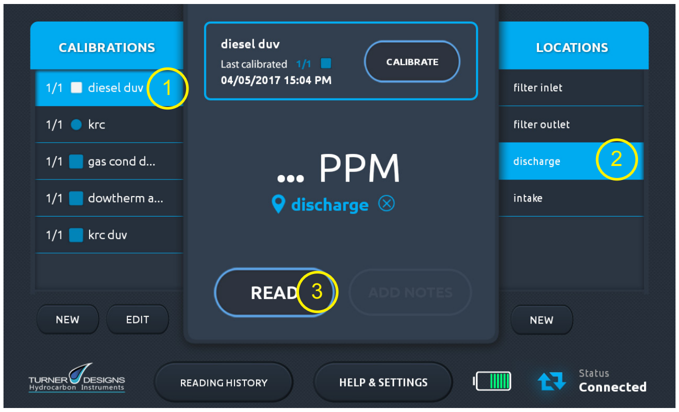
NOTE: The following procedure describes a 10:1 water to oil extraction ratio. If a different extraction ratio is used, the volumes of water sample and/or extraction solvent will be different.

To analyze a sample using a heavier than water extraction solvent

1. Collect 100 mL of produced water in a clean, graduated prescription bottle.
2. Add 6 **N** hydrochloric acid until the pH of the water sample is < 2. Check the pH with pH paper.

NOTE: Depending on the method philosophy of the facility, the sample can be measured at normal pH.

3. Add 10 mL of extraction solvent and securely cap the prescription bottle with a clean, Teflon-lined septum cap.
4. Extract oil from the water by vigorously shaking the prescription bottle for 2 minutes.
5. Allow the extraction solvent to separate from the water for approximately 1 minute. If the extraction solvent is trapped in an emulsion; break the emulsion by agitating with a clean pipette. Allow the extract to sit for several minutes after agitating the emulsion. This will allow the solvent to separate from the water. The solvent extract will be on the bottom of the bottle, underneath the water.
6. Place a blunt needle on the end of a 3 mL plastic syringe. Push the syringe plunger all the way in.
7. Turn the prescription bottle upside down and allow the solvent extract to settle on top of the Teflon-lined septum cap.
8. While holding the prescription bottle upside down, insert the needle through the Teflon-lined septum cap far enough for the end of the needle to be in the solvent extract.
9. By pulling the syringe plunger out, withdraw 1-1.5 mL of solvent extract.
10. Inject the solvent extract into the cuvette (8 mm or 10 mm cuvette, the same type used for calibration) until the cuvette is ¾ full.
11. Wipe the outside of the cuvette with a clean tissue or cloth to remove any liquid, dirt or oil that might be present.
12. Open the sample well lid, insert the cuvette into the cuvette adapter, and close the lid.
13. Turn on the analyzer tablet and tap Start on the Start screen.



14. On the Home screen select a saved calibration in the Calibrations list (1).

    NOTE: If you have not calibrated the analyzer, follow the calibration procedure in Section 5 No-Solvent Analysis Method.

15. If applicable, select a saved location from the Locations list (2), or tap New to create a location.
16. Tap Read (3). A new reading is stored in the Reading History screen.
17. Check that the fluorescence response is at least 200 fluorescence units greater than the blank. Calibrations with fluorescence response differences less than 200 indicate insufficient sensitivity. If this occurs, consult Section 6 Troubleshooting.
18. Dispose of the water, extraction solvent, cuvette and prescription bottle in a safe, environmentally responsible manner, in accordance with your company's procedures.

NOTE: For measurement of samples with expected concentrations near zero, see Section 6 Troubleshooting for suggestions on how to express the results.

For video tutorials on analyzing samples, see the How to Video Library on the Help & Settings screen.

5 NO-SOLVENT ANALYSIS METHOD

NOTE: This analysis method requires special accessories currently under development and not available for the TD-550/560 at time of manual publication.

The *No-Solvent Method* makes it possible to perform oil-in-water analyses by making fluorescence measurements directly on the produced water sample. No organic solvents are required. The method is based upon the addition of a proprietary surfactant (OIW Surfactant) to a produced water sample to determine the dispersed oil content of the sample. It also provides a measure of the fluorescent water-soluble organic (WSO) compounds.

The analysis is based upon two samples taken from the same water stream. The first, called the *OIW* sample, is a sample of water that has been treated with the OIW Surfactant and filtered into a measurement cuvette. The OIW sample contains dispersed oil that has been solubilized by the OIW Surfactant, as well as the WSO present in the water. The second sample, called the *WSO* (or background) sample, contains no surfactant. It is simply filtered into a measurement cuvette to remove dispersed oil, leaving only WSO. Both the OIW and WSO cuvettes are then measured by the TD-550/560. The dispersed oil concentration is calculated by subtracting the WSO measurement from the OIW measurement. Dispersed oil is reported in units of parts-per-million (ppm). WSO is reported in units of dispersed-oil-equivalents. One dispersed-oil-equivalent is the fluorescence intensity emitted by 1 ppm of dispersed oil.

5.1 EQUIPMENT NEEDED

The No-Solvent Method requires a TD-550/560 Oil-in-Water Analyzer and auxiliary equipment available from Benchmark International. Other common laboratory items can be purchased from a variety of sources (e.g., VWR International, LLC, www.vwr.com).

To prepare for calibration

1. Label four (4) clean, dry sample bottles *1000 ppm*, *BLANK*, *BKG (WSO)*, and *OIW*.
2. Label four (4) 8 mm cuvettes *1000 ppm*, *BLANK*, *BKG (WSO)* and *OIW*. Confine the labels to the top 0.5 inch (13 mm) of the cuvette to keep the mark out of the measurement zone.
3. Place 250 mL of tap water in a 600 mL beaker. Place the beaker on a hot plate. Turn on the hot plate and heat the water until it is near boiling (~180°F, 82°C).

For more details, see the How to Video Library on the Help & Settings screen.

5.2 CALIBRATING THE ANALYZER FOR 0-100 PPM RANGE

To prepare the blank

1. Place 3 mL of OIW surfactant into a 180 mL volumetric flask labeled BLANK.
2. Fill to 100 mL with distilled water and mix until surfactant is completely dissolved.
3. Fill an 8 mm cuvette marked BLANK ½ to ¾ full with the BLANK solution.
4. Make sure the appropriate cuvette adapter is installed in the sample well.

To prepare the 1000 ppm standard

1. Place 3 mL of OIW Surfactant into the bottle marked 1000 ppm.
2. Pipette 100 µL of oil directly into the OIW Surfactant. Swirl the bottle until the oil is fully dispersed in the OIW Surfactant.

NOTE: It may be necessary to heat viscous oils for accurate pipetting. A temperature of 120 °F (49 °C) to 150 °F (66 °C) is usually sufficient. If you must heat the oil in order to pipette it, you should also warm the OIW Surfactant in the 1000 ppm bottle before you add the oil. This will help the OIW Surfactant fully disperse the oil.

3. Add distilled water to the 1000 ppm bottle until the liquid level reaches the 100 mL mark.
4. Cap the bottle and shake it vigorously for at least 15 seconds.
5. Place the bottle in the hot water bath and heat it until the contents are uniformly milky-white in appearance.
6. Put on heat-resistant gloves suitable for handling glass bottles at boiling water temperature (212 °F, 100 °C).
7. Remove the bottle from the hot water and, while the contents are still milky-white, shake the bottle vigorously for at least 30 seconds.
8. Allow the 1000 ppm standard to cool to room temperature.

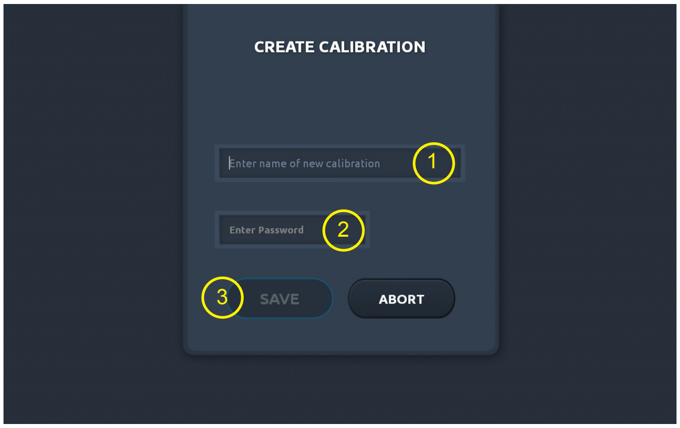
NOTE: You may accelerate cooling by placing the 1000 ppm standard in a refrigerator or a container of cold water.

9. Fill a 3 mL syringe with the 100 ppm standard.
10. Attach an unused syringe filter to the end of the syringe.
11. Press the syringe plunger to filter the liquid into the 8 mm cuvette marked 1000 ppm. Continue until the cuvette is ½ to ¾ full.

For video tutorials on preparing blanks and standards, see the How to Video Library on the Help & Settings screen.

To calibrate the analyzer for No-Solvent method

1. Turn on the analyzer tablet and tap Start.
2. On the Home screen, at the bottom of the Calibrations list, tap New. The Create Calibration screen appears.



3. On the Create Calibration screen, tap the Name field (1) and enter a name for your calibration.
4. Tap the Password field (2) and enter your password.
5. Tap Save (3). The Calibration screen appears.

test123

Deep UV

Enter standard concentration: 100 PPB

New	Saved
19.547	18.605
N/A	9324.8

Status Connected

6. On the Calibration screen, choose Near UV from the drop-down menu (TD-560 only).

NOTE: The Deep UV channel is not compatible with the No Solvent Method because of surfactant interference. You will not be able to save calibrations conducted by the No Solvent Method when the Deep UV channel is selected.

7. In the Standard Concentration field (2), enter 1000.
8. The cuvette type and extraction ratio settings are chosen by default. Make sure to select No Solvent (NS) rather than one of the extraction ratios (3).
9. Both the NUV and DUV channels (TD-560) default to PPM in the Units drop-down list. Select a different unit of measurement if necessary (4).
10. Wipe the outside of the blank cuvette with a clean laboratory grade tissue to remove any liquid, dirt or oil that might be present.
11. Open the sample well lid, insert the blank cuvette into the cuvette adapter, and close the lid.
12. Tap Read Blank (5) to make a reading. Do not tap Read Blank more than once.
13. Remove the blank cuvette from the sample well.
14. Fill a new cuvette with the 1000 ppm calibration standard. Wipe the outside of the cuvette with a clean laboratory grade tissue to remove any liquid, dirt or oil that might be present.
15. Insert the 1000 ppm calibration standard cuvette into the cuvette adapter and close the lid.
16. Tap Read Standard (6) to have the analyzer record the fluorescence response of the calibration solution. Do not tap Read Standard more than once.
17. Check that the fluorescence response is at least 200 fluorescence units greater than the blank. Calibrations with fluorescence response differences less than 200 indicate insufficient sensitivity. If this occurs, consult Section 6 Troubleshooting.
18. A value appears in the New field (7). To store the calibration (8) tap Save, or tap Abort to try again. Do not attempt to read blank or standard more than once.
19. On the Home screen tap and hold a calibration in the list if you want to delete it.

NOTE: For measurement of samples with expected concentrations near zero, see Section 6 Troubleshooting for suggestions on how to express the results.

The calibration is now complete. The calibration will be stored and maintained when the analyzer is turned off.

For video tutorials on calibrating the analyzer, see the How to Video Library on the Help & Settings screen.

5.3 ANALYZING 0-100 PPM OIL-IN-WATER SAMPLES

To prepare the background (WSO) sample

1. Open the process sample valve and allow water to run for at least 15 seconds.
2. Fill the bottle labeled BKG to the neck with process water.

NOTE: Make sure that the BKG bottle is clean and dry and that no OIW Surfactant has been added.

3. Cap the bottle and allow it to cool to room temperature.
4. Fill a 3 mL syringe with BKG water.
5. Attach a syringe filter to the end of the syringe.
6. Press the syringe plunger to force liquid through the filter and into the BKG cuvette. Continue until the cuvette is ½ to ¾ full.

To prepare the OIW sample

1. Add 3 mL of OIW Surfactant to the OIW bottle.
2. Open the process valve and purge the sample valve by allowing the water to flow at a high rate for at least 1 minute.
3. Adjust the sample valve until the water is flowing at a rate of ~10 mL per second. Allow the water to flow at this rate for at least 15 seconds.
4. Allow water to flow into the OIW bottle until the liquid level reaches the 100 mL mark.
5. Cap the bottle and shake it vigorously for at least 15 seconds.
6. If the contents of the bottle are uniformly milky-white, it is not necessary to perform Steps 7 through 9. You may skip to Step 10.
7. Place the OIW bottle in the hot water bath and heat it until the contents of the bottle are uniformly milky-white.
8. Put on heat-resistant gloves suitable for handling glass bottles at boiling water temperature (212 °F, 100 °C).
9. Remove the bottle from the hot water.
10. While the contents are still milky-white, shake the bottle vigorously for at least 30 seconds.
11. Allow the OIW sample to cool until the contents change from milky-white to clear.

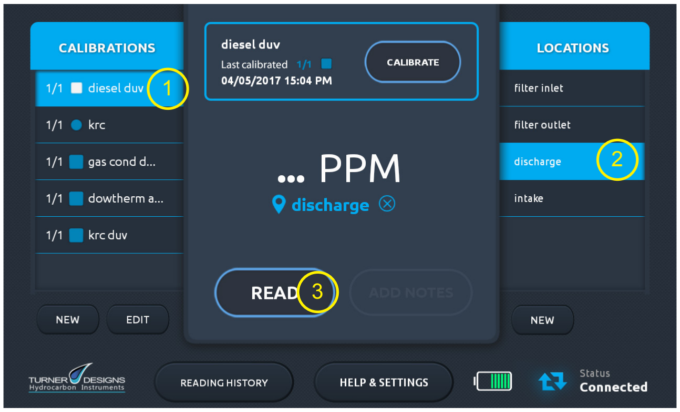
NOTE: You may accelerate cooling by placing the OIW bottle in a refrigerator or a container of cold water. You may also mix the sample thoroughly and immediately pour ~5 mL into a small disposable beaker. The small volume will cool more quickly than the original sample bottle.

12. Fill a 3 mL syringe with the OIW sample.
13. Attach an unused syringe filter to the end of the syringe.
14. Press the syringe plunger to filter the liquid into the 8 mm cuvette marked OIW. Continue until the cuvette is ½ to ¾ full.

For video tutorials on preparing samples, see the How to Video Library on the Help & Settings screen.

To take the sample measurement

1. Turn on the analyzer tablet and tap Start on the Start screen.
2. On the Home screen select a saved calibration (1) in the Calibrations list.



3. Make sure that the 8 mm cuvette adapter that is in the sample well is the same one that was used for calibration.
4. Wipe the OIW and BKG cuvettes with a Kimwipe to remove any fingerprints, dirt or liquid droplets that might be present.
5. Place the OIW cuvette in the sample well and close the lid.
6. Tap Read Standard.
7. Record the OIW Reading.
8. Place the BKG cuvette in the sample well and close the lid.
9. Tap Read Standard.
10. Record the BKG Reading.
11. Calculate the oil concentration by subtracting the BKG reading from the OIW reading, as shown in the following equation: Cdispersed = OIW Reading – BKG Reading.

    Example:
    OIW reading = 35.5
    BKG reading = 10.0
    Oil concentration = 25.5 ppm (dispersed oil)

For video tutorials on analyzing samples, see the How to Video Library on the Help & Settings screen.

6 TROUBLESHOOTING

The diagnostic screen is accessed from the Help & Settings screen. The screen displays the serial number, firmware version, and software version.

Diagnostics Screen

DIAGNOSTICS

Instrument S/N: 12345678
FW Version: 0.181009_2
FW Checksum: 0xAC6A9778
SW Version: 0.181126_1

Channel	Factory
NUV	Pass
Tx	Pass
DUV	Pass

Status
Connected

Also, in the Diagnostics screen, the operation of the TD-550/560 can be checked at any time by using the Functional Check Solution (PN 106424). Do not perform the check with any solution other than PN 106424, which must be within the validity period stated on the label.

NOTE: **If you have a TD-550, you must perform the functionality check with the 8 mm cuvette adapter and 8 mm cuvette. Do not use the square cuvette and square cuvette adapter.**

NOTE: **If you have a TD-560, you must perform the functionality check with the square cuvette adapter and square cuvette. Do not use the 8 mm round cuvette and adapter.**

NOTE: The PN 106424 Functional Check Solution is a water-based solution. Make sure the cuvette is completely dry and does not have any solvent residue. Never pour the solution back into the container.

NOTE: The functionality check is dependent upon the cuvette adapter mounting position and cuvette position. Failure to correctly position these can cause apparent functionality test failures.

To check the functionality of the TD-550/560

1. Fill a clean, appropriate cuvette with the PN 106424 Functional Check Solution.
2. Wipe the outside of the cuvette with a clean tissue and insert into the analyzer.
3. Close the lid and press Read Sample.

   After a delay period, the current measurement results are reported as either Pass or Fail.

The evaluation is based upon the factory calibration, not the customer calibration. A pass result indicates that the measurement channel is working properly. A fail result indicates that maintenance or repair of the analyzer could be necessary.

A fail result does not necessarily mean the analyzer is damaged. You should assess if the correct cuvette type is being used, the check solution is valid, and that the cuvette is clean. Another source of failure is a dirty optical surface or the cuvette adapter not being properly seated. Remove the cuvette adapter carefully from the analyzer. Particles can be cleaned from the optical surface with canned gas suitable for cleaning sensitive optical components. If a residue is present, gently clean the circular optical surface with a lint-free laboratory tissue moistened with a small volume of 99% purity 2-propanol (isopropanol or isopropyl alcohol). Do not use any other solvents or water. Do not spill liquid. Dry with a second lint-free laboratory tissue. Repeat the test. If fail is still reported, please contact the appropriate service representative for suggestions. There are no user-repairable components within the analyzer.

6.1 LOW FLUORESCENCE DURING CALIBRATION

The TD-550/560 does not impose a lower limit to the fluorescence response of the calibration solution as long as it is greater than the blank response. Benchmark International suggests that the minimum fluorescence response of the calibration solution should be 200 fluorescence units greater than the blank. Calibration that results in a calibration solution response difference less than 200 fluorescence units will cause excessive variation in the measurements. Should this happen, you should try calibrating with a more sensitive channel (TD-560 only), a larger size cuvette, and/or higher calibration concentration. The Deep UV channel on the TD-560 will be more sensitive than the Near UV channel for most applications.

6.2 LINEARITY AND LINEARITY CHECKING

The linear range is the concentration range within which the readout of the TD-550/560 is directly proportional to the concentration of the hydrocarbon. You must make sure the instrument is calibrated in the linear range.

The linear range is dependent upon the sample cuvette size and the optical channel of the analyzer; thus using a smaller cuvette size and/or changing the optical channel (TD-560) can extend the linear range. See Section 2.2 Channel Selection guidelines and Section 2.3 Cuvette Selection Guidelines.

After performing a calibration, the linearity should always be checked to insure the calibration is within the linear range. The linearity is checked by diluting the calibration solution exactly to half of its original concentration with clean solvent in a clean container and then measuring the concentration. If the measured concentration is much higher than the expected half concentration or even higher than the original calibration solution concentration, this indicates non-linearity. Should non-linearity occur during calibration, you should try using a less sensitive channel (TD-560 only), a smaller size cuvette, and/or lower calibration concentration.

When measuring unknown samples, the sample extract should be checked for linearity by diluting by a known volume with clean extraction solvent and then checking that the concentration reduction corresponds to the dilution factor. If the reduction does not correspond to the dilution factor, then dilute the extract with clean solvent until linearity is observed and then multiply the results by the final dilution factor.

6.3 MEASUREMENT OF SAMPLES CLOSE TO ZERO

For critical measurements, it may not be appropriate to report measurements close to zero without taking into account minimum reporting concentrations. For approximate determination of the minimum reporting concentration, Benchmark International recommends the following:

1. A calibration must first be conducted and linearity validated.
2. Fill a cuvette ¾ full with clean solvent (FastHEX Method) or blank (No-Solvent Method).
3. Wipe the sides of the cuvette with a laboratory tissue and insert into the analyzer. Close the lid.
4. Press Read.
5. Remove the cuvette from the analyzer and then re-insert it. Close the lid.

6. Repeat Steps 4 and 5, taking care to remove and re-insert the cuvette at least ten times.
7. Using a statistical program, calculate the standard deviation of the ten or more blank measurements.
8. Multiply the standard deviation by 10.
9. The value in Step 8 provides an approximate recommendation of the minimum reportable concentration.

6.4 ERROR MESSAGES

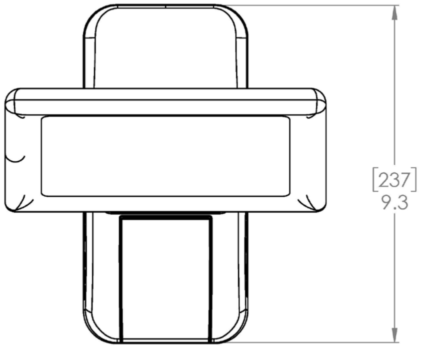
The TD-550/560 has various messages and controls that do not allow certain features to be chosen for situations where a configuration choice is not applicable.

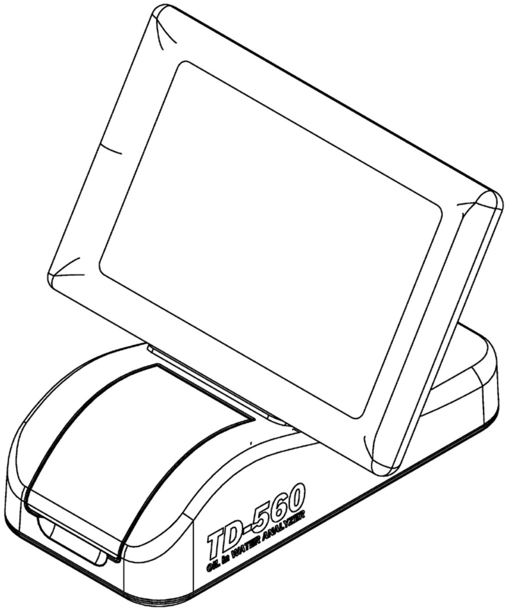
If the analyzer is not connected to the tablet, a not connected message will appear. Connect the tablet and the analyzer with the provided cable and restart the power. Note that disconnecting the power supply from the AC source while the power cable is connected to the analyzer can cause a disconnection message. If this happens, either plug the power supply back into the AC source or restart the power on the tablet.

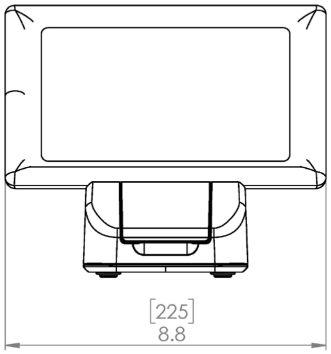
In rare cases that a solution with excessive light absorption is caused by either hydrocarbons or other materials in the solvent is evaluated, a “Bad Tx” message appears. If this happens, it may be necessary to calibrate at a lower concentration, calibration with a different solvent, or measure a diluted extract.

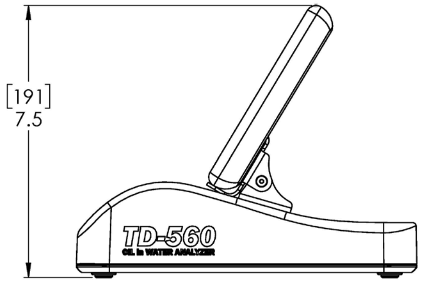
In some cases it may be desireable to retrieve the data from the analyzer for reporting or troubleshooting. To do this, connect the tablet to a computer with a user-provided cable. Go to the tablet settings and then to the Connected devices section. Tap the USB section. Under “Use USB for”, select File Transfer. Then use the computer to navigate to the Benchmark International_Datalog folder. Here you can find calibrations in the Calibration_History file and a list of readings in the Readings file. When the analyzer to tablet cable is reconnected, it will automatically configure the USB communication.

7 GENERAL ARRANGEMENT DRAWINGS









8 WARRANTY

This section details warranty services and legal provisions regarding the product and its documentation.

8.1 COPYRIGHTS

All rights reserved. This document contains proprietary information of Benchmark International, Edmonton, Alberta, Canada, embodying confidential information, ideas, and expressions. No part of this document may be reproduced or transmitted in any form or by any means, electronic, mechanical, or otherwise, without prior written permission from Benchmark International.

8.2 TRADEMARKS

TD-550, TD-560, TD-120, E09 TD-4100XD, E09 TD-4100XDC, TD-4100XD, TD-4100XDC and TD-107 are trademarks of Benchmark International.

Other brand and product names are trademarks and/or registered trademarks of their respective holders.

8.3 RIGHT OF CHANGE

Information in this document is subject to change without notice and does not represent a commitment on the part of Benchmark International.

For questions or comments about this manual, please contact:

Benchmark International, Inc.
Service Department
5304 36 Street NW, Edmonton, AB, Canada T6B 3P3

Email: service@oilinwatermonitors.com
Website: www.oilinwatermonitors.com

8.4 LIMITED WARRANTY

All Benchmark International products are manufactured under strict quality control to the highest standards available. It is our intention to provide the fastest response to any potential warranty service requirement.

What We Cover

Benchmark International warrants its monitors and accessories to be free from manufacturing defects under normal use and with proper installation and maintenance as defined in the Operation and Maintenance Manual and as advised by Benchmark International, for a period of one year (12 months) from the date of shipment. An extended warranty is available at an additional cost for a total not to exceed 3 years (36 months) from date of shipment. The extended warranty must be purchased prior to shipment.

If your monitor or monitor component becomes defective due to a manufacturing defect within one year of shipment, Benchmark International will repair or replace at our sole option your monitor or component free of charge at our factory, Edmonton, Alberta, Canada. All freight charges, insurance, customs duties and clearance fees, inland freight and handling fees from third parties to and from the factory are not covered by this warranty.

All costs for removal, re-installation and for re-calibration of the monitor are not covered under warranty and are the responsibility of the purchaser or customer.

All warranty return items will be assessed for malfunction and you will be notified regarding status. If the malfunction is determined not to be covered under warranty, an explanation will be sent to you with an estimate for repair.

What We Do Not Cover

Benchmark International is not responsible for replacing limited life parts, such as light sources, or for replacing parts damaged by accident or neglect. (The sensors—photomultipliers and diode arrays—are covered by the warranty.) Additionally, the following damages are not covered.

- Damage incurred in shipping.
- Damage caused by installation not in compliance with instructions in this manual and recommendations from Benchmark International.
- Damage resulting from measurement of samples found incompatible with the materials used in the sampling system is not covered.
- Damage resulting from contact with corrosive materials, corrosive atmosphere, or solvents not compatible with the monitor materials are not covered.
- Damage caused by modification of the equipment by the user is not covered.

This warranty covers only Benchmark International products, and is not extended to special equipment not normally supplied with our products.

Shipping

Although our monitors are built to withstand hard use, we are not responsible for damage incurred during shipment to and from the factory. To avoid cosmetic and structural damage in your return shipping, we recommend saving the original packing material. If a monitor returned under warranty is not properly packaged or if the packaging is not reusable, we will advise you of the cost for repackaging.

8.5 OBTAINING WARRANTY SERVICE

Components potentially covered by warranty must be shipped freight pre-paid to Benchmark International. Benchmark International will make a determination upon inspection of the inoperable or damaged component to determine if the component is covered by warranty. In the event the component is covered by warranty, Benchmark International, at its sole option, will repair or replace the item at no cost. In the event the damage is not covered by warranty, an explanation will be sent to you with an estimate of the repair. Benchmark International will not begin the repair in this case until a purchase order is received. All costs for removal, re-installation, and re-calibration of the monitor are not covered under warranty and are the responsibility of the customer. All costs associated with return of the monitor from the factory are the responsibility of the customer.

NOTE: Under no conditions should the monitor or accessory be returned without notice. Prior correspondence is needed for the following reasons.

- Many problems may be rectified on site.
- The nature of the problem must be defined in detail to speed the repair of the monitor.
- A RMA number must accompany the monitor. This number is used to track the repair cycle.

Warranty Service Within the United States/Canada

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

1. Follow the instructions in Troubleshooting and Maintenance Sections.
2. Email a Benchmark International representative: service@oilinwatermonitors.com
3. Describe, as precisely as possible, the nature of the problem.

4. Carry out minor adjustments or tests as instructed by the Benchmark International service representative.
5. If proper performance is not obtained after consultation with Benchmark International's service representative, obtain a RMA number from Benchmark International, and ship the monitor, prepaid, to

   Benchmark International, Inc.
   Attention RMA # ____________________
   5304 36 Street NW
   Edmonton, AB, Canada T6B 3P3
6. The monitor will be repaired free of charge, less shipping, if the damage is covered by the warranty. This warranty service is provided to Benchmark International's customers in the contiguous continental United States.

Warranty Service Outside the United States/Canada

Benchmark International features a worldwide network of trained service technicians. For customers outside of the contiguous continental United States and who have purchased the equipment from a Benchmark International distributor, contact the Benchmark International distributor. The Benchmark International distributor will advise you on warranty coverage and the use of a RMA number.

If the purchase was direct from Benchmark International, contact the Benchmark International service department. The monitor will be repaired free of charge, less shipping, if the damage is covered by the warranty, as described in Section 8.4 Limited Warranty

8.6 OUT-OF-WARRANTY SERVICE

Proceed exactly as for Warranty Service. Verbal or written support from Benchmark International's representative is free.

Repair Service will be billed for time, materials, and custom clearance (if any). Shipment to Benchmark International must be prepaid. We strongly suggest you insure the monitor during shipment. Return shipment will be the responsibility of the customer unless otherwise negotiated. If the repair service is not obtained, there is a minimum service charge for the inspection in addition to return shipping.

8.7 INTERNATIONAL DEALERS & REPRESENTATIVES

Contact Benchmark International for your regional representative.

5304 36 Street NW, Edmonton, AB, Canada T6B 3P3
Sales & Marketing E: sales@oilinwatermonitors.com
Application Support E: service@oilinwatermonitors.com
Website: www.oilinwatermonitors.com

8.8 DOMESTIC DEALERS AND REPRESENTATIVES

Contact Benchmark International for your local representative.

5304 36 Street NW, Edmonton, AB, Canada T6B 3P3
Sales & Marketing E: sales@oilinwatermonitors.com
Application Support E: service@oilinwatermonitors.com
Website: www.oilinwatermonitors.com