Installation and Instruction Manual

# HC-404

# Oil-In Water

# Analyzer

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Buck Scientific Inc. Norwalk, CT U.S.A.

**Buck Scientific, Inc. Oil-In-Water Analyzer HC-4O4 instructions**

## Operation

1. Locate 404 on a level vibration free table.
2. Turn 404 on and let warm up for 30 minutes with the door open. (The door is a dust cover and only should be closed when the 404 is off.)
3. In **ABS 0-2 Mode** adjust the **COARSE** and **FINE** controls for .000 on the display (This is normally between 9 and 10 on the counting dial of the **COARSE** control).
4. In **%T MODE** use **%T Cal.** to get 100.0 on the display.
5. Block the beam and adjust the **0 %T** control for 00.0 on the display.
6. Change to **ABS 0-2 Mode** (.000 on display) and insert your BLANK (in a 10 mm. cell). (Average grade Freon will read about .150; the cell without Freon .070; if higher the Freon is contaminated. The better the Freon the better the sensitivity on low concentration).
7. Make a note of the Freon reading for your future reference.
8. Adjust **COARSE** and **FINE** controls for .000 on the display.
9. Empty the cell and fill with the 10 ppm standard, record the **ABS 0-2** reading; which should be 0.018 to 0.022 AU. Empty the cell, rinse with Freon blank and fill with the 100 ppm standard and record the **ABS 0-2** reading, which should be within the approximate range of 0.15 to 0.25 AU. These values will be used to create a linear calibration curve. If using **CONC x 1 MODE**; Zero out the Freon-113 blank, put in the cell with the 10 ppm standard and set display using the **DECIMAL** switch and **CONC CAL** knob, put in the cell with the 100 ppm standard and adjust the display using **CURVE CORRECT** knob. Recheck (and readjust if necessary) the 2 standards till values should read within 5 % of each other (9.5-10.5 and 95-l05).
10. Prepare the samples according to the recommended procedures (Examples - USEPA Methods #413.2 and 418.1; AOAC #973.47), and read the ABS of the sample solutions. Interpolate the concentration in the test solutions and correlate back to the concentration in the original sample using the preparation and dilution factor for that sample (Example - One (1) liter of water is extracted into 100 ml. of Freon-113, for a 10X enhancement in concentration. If this solution reads 25 PPM against a standard curve, then the TPH concentration in the water is actually 2.5 PPM). If using the **CONC X 1 MODE** insert cell with sample solution & read directly.
11. If the system produces similar levels to the readings mentioned above, its performance is validated and any problems in the analyses are related to improper preparation, handling or introduction of the sample.

## Notes

1. A l0 mm pathlength cell will do 5 ppm and above. Plot absorbance values versus ppm to make a working curve.
2. Each cell you use will have a slightly different absorbance reading with Freon; use the lowest absorber for the BLANK and higher ones for samples. Subtract the differences in the values to get a better curve.
3. HC samples are very linear in low concentration; for a larger working range read pages 11 and 12

to get your curve correct number.
4. To get direct readings in ppm, use the **CONC x 1** mode and adjust **CONC CAL** and **Curve Correct** as necessary (read pages 10 through 12)



**HC-404**

**Oil-In-Water Analyzer**

**Packing List**

| **Part Number** | **Description** |
|---|---|
| 999-1013 | Line Cord |
| 404-1032 | Drive Belts |
| BS-21-I-lO | l0 mm Quartz Cell |
| BS-5708 | Cell Holder |
| 404-9999 | Instruction Book |
| | Instrument Registration Card |

## Table of Contents

## Pre-Installation Requirements:

BUCK Model-404 Total Petroleum Hydrocarbon Analyzer

**Environment:**
110V, 60Hz, 10 Amp circuit
Approximately 2½' x 4' lab bench area
Solvent fume hood (for extracting samples)
Recommended temperature range = 60 to 85°F
Recommended (moisture condensation may occur below 50°F)
Recommended humidity range = 30 to 75 % R.H.
Recommended (noisy, slow response may occur outside this range)

**Chemical:**
High purity (low residue) Freon-113 (1, 1 ,2-trichloro-l, 2,2, -trifluoroethane)
Anhydrous crystalline (not powdered) Sodium Sulfate
Silica Gel, ~60-200 mesh granule size (larger is better), ~2 % hydration (Dry ~550 grams of Silica in a 1 liter Erlenmeyer Flask at 1500C for 24 hours, shake every 6 hours. Remove from oven and cool in dessicator. Add 10 ml. pure Water and stopper tightly. Let equilibrate for 24 hours, shake well every 6 hours. Store sealed.)
EPA-type Reference oil (BUCK Catalog #404-11)
Hydrochloric Acid; concentrated, Reagent-grade

**Glassware / Labware:**
BUCK I.R. Quartz Cell; 10 mm (for range of 10 to 500 PPM)
50 mm (for range of 5 to 10 PPM)
100 mm (for range of 1 to 5 PPM)
10 ml, 100 ml, 500 ml. Graduated Cylinders (for measuring liquid samples)
Top-loading electronic balance (for measuring solid samples)
8 ounce / 250m1. HDPE Disposable plastic bottles (for the preparation and extraction of water & soil samples)
**Or**
2 liter Separatory funnel
Disposable eye-droppers (for transferring solvent to the IR cell)

**Operation Suggestions:**
Turn system on approximately 30-60 minutes before running any samples to allow the system to

warm up and stabilize.

Do **not** place 404 system itself in a fume hood; since exposure to acid vapors will damage the internal components.



## Introduction

A. The BUCK Model HC-404 Oil-In-Water Analyzer operating characteristics are outlined below.

## Technical Data

| | |
|---|---|
| 1. Wavelength | 2924 cm-l (3.42 microns) |
| 2. Bandwidth | 30 cm-l (0.04 microns) |
| 3. Sample Space | Accommodates up to 100 mm cell |
| 4. Readout | %T, 0-2A, Conc. 0-1, X 0.1 |
| 5. Electrical Requirements | 120/240 VAC, 50/60 Hz, 80 watts |
| 6. Dimensions | 14" W, 11" D, 10" W |
| 7. Weight | 20 lbs. Approximately |
| 8. Detector | Cooled PbSe |
| 9. Source | Tungsten, Quartz - Halogen |

## Introduction

The HC-404 is a compact single beam, single wavelength spectrophotometer intended for quantitative measurement of hydrocarbons dissolved in a non-absorbing solvent, usually Freon. The optical and electronic organization is shown in the block diagram on page 8.
The optical path can accommodate a cell up to l00 mm in length, making it possible to use the HC-404 as a hydrocarbon gas monitor in the range 0.2-10% by weight.
Light Source - 10 watt 6 volt tungsten-halogen. Radiation is chopped at 91 Hz. An LED Phototransistor pair supplies a signal to synchronize the demodulator.
Filter - Nominally 3.42 microns or 2924 cm-l, 1% bandwidth 65 % Transmission at peak.
Detector - PbSe photoconductor cooled to -10 degrees Celsius by built in Peltier junction cooler. Total cooling power is dissipated by a small fan. Detector element temperature is sensed by a thermistor, which controls cooling power.

Electronics - Most of circuitry is on the P.C. Board.



# Installation

## Facilities Required

The oil-in-water Analyzer should be installed where it is isolated from mechanical shock, temperature variations, stray electrical fields and vibration. Do not obstruct the ventilation slots located at the rear or left side of the instrument. Always operate in a well ventilated room.

## Unpacking

Inspect all controls and the cabinet for evidence of damage during shipment. Report any damage to the carrier and BUCK Scientific immediately.

## Installation

A voltage selector slide switch is located at the rear of the instrument to enable alternate choice of 115v or 230v input potentials. To change from one to the other slide the switch so the desired input voltage is visible.

## Theory of Operation

The BUCK Model HC-404 Analyzer system is a complete system for determination of Hydrocarbons in water.

Either saline or fresh water samples can be examined for contamination by petroleum Hydrocarbons. Calibration of the instrument is performed with standard solutions of only water taken from the same source so that the specific gravity is approximately the same as subsequent samples. If this is not possible, make up a series of standard solutions in accordance with E.P.A. Method #735-58, 1958.

Measurement of extracted Hydrocarbons is executed by containment in a 1, 5 or 10 cm cell placed in the light source path which has been properly calibrated in advance. The energy passes through the sample then through a narrow band I.R. optical filter and finally illuminates the cooled detector. The signal is then transformed and de-modulated to produce a reading on the digital display.

## Controls & Indicators

| | |
|---|---|
| 1. Curve Correct | Controls the upper end of the linear portion of the working curve. |
| 2. Damping Lo, Hi | Provides low or high noise suppression to stabilize the DPM. |
| 3. Mode | Enables instrument operation in four different protocols i.e. % Transmission, Absorbance, Concentration 0-1 and Concentration x 0.1. |
| 4. 0 %T | Controls the zero setting of the DPM. |
| 5. Decimal | A three position switch controls the decimal point position on the DPM. Operates in the concentration mode only. |
| 6. Coarse & Fine | Adjusts the DPM to 100 in the Transmission mode or zero (.000) in the Absorbance mode. |
| 7. Conc. Cal. | Enables adjustment of the standard solution concentration in units per sample volume. (i.e. µl, or mg/l etc.) |
| 8. Main | AC power to the instrument primary system. |
| 9. DPM | Provides a digital readout of instrument measurements. |
| 10. %T Cal. | Enables adjustment of instrument readout for transmission standards. (i.e. 100%T - .000 ABS) |

## Operation

The following outlined method describes an orderly protocol for reliable usage of the HC-404 Oil-in-Water Analyzer.

1. Locate the instrument in the environment outlined under "Installation" on page 6.

2. Turn instrument on and allow a 30 minute warm-up to stabilize.

3. Prepare working standards as per EPA - method No. 418.1.

4. Prepare a working curve in accordance with working ranges and cell pathlengths desired.

5. Operate the instrument as follows:

    5.1 Insert selected cell in cell holder containing a blank solvent.

    5.2 Set control to transmission mode then block the beam. Meter should read zero. Adjust zero control to produce zero %T on DPM.

    5.3 Unblock the beam and adjust 100 % control to 100.

    5.4 Switch to absorbance mode; meter should now read zero (.000). If not, adjust coarse and fine controls for .000.

    5.5 Remove the blank from the cell holder.

    5.6 Insert the working standards and plot the absorbance values observed on graph paper. (Note: Adjust Conc. Cal. control as required to linearize curve)

    5.7 Proceed with sample measurements by comparing their response readings against the

calibration plot. (i.e. absorbance vs. concentration)

5.8 Calculate mg/liter of samples as per EPA 418.1, Step 8.



## Preparing Working Curves of Standards as: Absorbance vs. Concentration

1. Insert selected cell, containing blank solvent, in cell holder.

2. Set **MODE** switch to **ABS 0-2**.

3. Adjust **0 ABS / 100 % T COARSE** and **FINE** controls so that DPM reads zero (.000).

4. Remove cell containing blank and replace with same cell containing first (preferably the lowest) concentration of hydrocarbon standard. Read DPM ABSORBANCE value and record.

**Note:** I.R. quartz cells may exhibit two values of blank absorbance differing by as much as .030, depending on which direction the light passes through the cell. The cell or cells should be suitably marked so they can be placed in the cell holder with the same orientation each time.

Using several cells, each containing a known standard, requires that all cells be first calibrated as to their individual Clean absorbance values which may have a spread of .015. Again, the cells should be suitably marked with an identifying number, and the absorbance of each when filled with FREON blank should be recorded against the respective number.

A 10 mm pathlength cell will typically have, when filled with Clean FREON, an absorbance of 0.150. When using multiple cells which have been calibrated, the excess or deficiency of each cell absorbance over that of the cell designated as the blank should be subtracted or added respectively, to e absorbance reading given by the standard.

5. Make a plot of the observed absorbance values vs. concentration. For low concentrations giving less than 0.65 ABS ,the line should be almost straight; at concentrations where the slope of the curve is less than 1/2 of the slope at 0.65 ABS, accuracy and reproducibility will start to surfer, and more accurate concentration values for unknown solutions will be obtained by dilution of the unknown.

Any pronounced departure of the curve from smoothness of monotonisity will indicate an error in preparation of standards.

*Determination of unknowns can be made by back-plotting against the standard curve.

## Direct Concentration Mode

In the direct concentration mode, the number of milli-absorbance units given by any sample can be expanded by a variable factor selected by the **CONC CAL** control and the **DECIMAL** point is selectable so that the readout may be in any conventional units.

Typical operation for use with 10 mm cells is illustrated as follows:

If a 50 ppm solution of oil-in-Freon gave you a net absorbance of .090, you could change the DPM to read 50.0. The **CONC CAL** dial has reading of 0 to 1000. At a dial reading of near 325 the concentration and absorbance readings are the same. When the dial reading is at zero, the concentration number is about one third of the reading at 325. The setting of dial to 1000 will give a reading of over three times the reading at 325. After the **CONC CAL** knob is set correctly, the decimal place can be moved to the correct position with the **DECIMAL** slide switch.

The next part of the calibration procedure deals with the problem of non-linearity. As seen from a plot of absorbance vs. concentration, the region above 0.65 ABS is curved downward. Most of the curvature in the scaled absorbance (Concentration) mode can be removed by the curvature control.

The degree of curve correction applied varies from zero at **CURVE CORRECT** dial setting of 000 to over 3 X at maximum (1000) setting. At any setting, the zero absorbance condition is not affected but the initial slope of the curve is increased, and the proportional increase becomes greater at progressively higher absorbances.

Note that when we speak of absorbance, an absolute photometric condition is compiled, we can scale an absorbance by multiplying it by the proper factor, to make the product equal the true concentration but the optical condition remains constant.

$$\text{ABS} = \text{Log } 10 \quad \frac{1}{\text{Transmission}}$$

is also, of course, an absolute photometric condition. Curvature correction is the electrical process by which the scaling factor for absorbance is continually adjusted to make the concentration reading accurate.

The quick and direct way to determine the proper setting of the curve control, is to use the standards,

one twice the concentration of the other. The more concentrated standard should not give an absorbance greater than 0.5 (31.6 %T). Place the **MODE** switch to **%T** and measure the transmissions of the standards (but only after setting the Transmission of a blank, to 100.0%.



Record the standard Transmissions thus:

T1 = Transmission of weaker standard

T2 = Transmission of stronger standard

T1> T2

Also note that transmission is a number between zero and one and equals %T - 100.

Division of dial setting of curvature control

$$3100 \times \frac{(T1)\text{squared} - (T2)}{2T1 - T2 - 1}$$

In this calculation, both numerator and denominator will be negative. If the fraction comes out between ±0.02, the curvature is almost negligible. Any value more negative than -0.05 indicates an error on the proportional strengths of the standards; the formula will only work for concentrations in the ratio of 2:1.

## Maintenance

Factory service is recommended for all instrument failures with a few exceptions:

1. Minor problems related to contamination of sample are due to spillage of solution.

2. Line voltage fluctuations exceeding ± 10%.

3. Drive Belt change.

4. Lamp change recommended for advance users only, ( 23 steps ) because of the small space and electronic changes normally needed.

## Replacement Components

| Parts | Description |
|---|---|
| 205-1035 | Printed circuit Board Assembly |
| 404-1004 | Quartz - Halogen Lamp (2 package) |
| 999-1607 | Digital Meter with RS232 |
| 999-1041 | Fuse - 1 Amp |
| 999-1013 | Line cord |
| 404-1017 | Chopper Motor |
| 404-1032 | Drive Belt (six package) |

## PETROLEUM HYDROCARBONS, TOTAL RECOVERABLE

### Method 418.1 (Spectrophotometeric, Infrared)

1. **Scope and Application**

1.1 This method is for the measurement of fluorooarbon-113 extractable petroleum hydrocarbons from surface and saline waters, industrial and domestic wastes.
1.2 The method is applicable to measurement of light fuels, although loss of about half of any gasoline present during the extraction manipulations can be expected.
1.3 The method is sensitive to levels of 1 mg/l and less, and may be extended to ambient monitoring.

2. **Summary of Method**

2.1 The sample is acidified to a low pH(<2) and serially extracted with fluorocarbon -113 in a Separatory funnel. Interference's are removed with silica gel absorbent. Infrared analysis of the extract is performed by direct comparison with standards.

3. **Definitions**

3.1 As in the case of oil and Grease, the parameter of Petroleum Hydrocarbons is defined by the method. The measurement may be subject to interferences and the results should be evaluated accordingly.
3.2 Oil and Grease is a measure of biodegradable animal greases and vegetable oils along with the relative non-biodegradable mineral oils. Petroleum hydrocarbons is the measure of only the mineral oils. Maximum information may be obtained using both methods to measure and characterize oil and grease of all sources.

4. **Sampling and Storage**

4.1 A representative sample of 1 liter volume should be collected in a glass bottle. Because losses of grease will occur on sampling equipment, the collection of a composite sample is impractical. The entire sample is consumed by this test; no other analyses may be performed using aliquots of the sample.
4.2 A delay between sampling and analysis of greater than 4 hours requires sample preservation by the addition of 5 ml of HCl (6.1). A delay of greater than 48 hours also requires refrigeration for sample preservation.

5. **Apparatus**

5.1 Separatory funnel, 2000 ml, with Teflon stopcock.
5.2 Filter paper, Whatman No. 40, 11cm.

5.3 Infrared spectrophotometer, scanning or fixed wavelength for measurement around 2950 cm-l.



5.4 Cells, 10 mm, 50 mm, and 100 mm pathlength, sodium chloride or infrared grade glass.
5.5 Magnetic stirrer, with Teflon coated stirring bars.

6. **Reagents**

6.1 Hydrochloric acid, 1:1, Mix equal volumes of conc HCl and distilled water.
6.2 Fluorocarbon-113, (1,1, 2-trichloro-l, 2 ,2-trifluroethane), b.p.48 degrees Celsius.
6.3 Sodium sulfate, anhydrous crystal.
6.4 Silica gel, 60-200 mesh, Davidson Grade 950 or equivalent. Should contain 1-2 % water as defined by residue test at 130 degrees Celsius. Adjust by overnight equilibrium if needed.
6.5 **Calibration mixtures:**

6.5.1. Reference oil: Pipet 15.0 ml n-hexadecane, 15.0 ml isooctane, and 10.0 ml chlorobenzene into a 50 ml glass stoppered bottle. Maintain the integrity of the mixture by keeping stoppered except when withdrawing aliquots.
6.5.2.Stock standard: Pipet 1.0 ml reference oil(6.5.1) into a tared 200 ml volumetric flask and immediately stopper. Weigh and dilute to volume with fluorocarbon-113.
6.5.3.Working standards: Pipet appropriate volumes of stock standard (6.5.2) into 100 ml volumetric flasks according to the cell pathlength to be used. Dilute to volume with fluorodarbon-113. Calculate concentration of standards from the stock standard.

7. **Procedure**

7.1 Mark the sample bottle at the water meniscus for later determination of sample volume. If sample was not acidified at time of collection, add 5 ml hydrochloric acid (6.1) to the sample bottle. After mixing the sample, check the pH by touching pH-sensitive paper to the cap to insure that the pH is 2 or lower. Add more acid if necessary.
7.2 Pour the sample into a Separatory funnel.
7.3 Add 30 ml fluorocarbon-113 (6.2) to the sample bottle and rotate the bottle to rinse the sides. Transfer the solvent into the Separatory funnel. Extract by shaking vigorously for 2 minutes. Allow the layers to separate.
7.4 Filter the solvent layer through a funnel containing solvent-moistened filter paper into a 100 ml volumetric flask.
**Note 1:** An emulsion that fails to dissipate can be broken by pouring about 1 g sodium sulfate (6.3) into the filter paper cone and slowly draining the emulsion through the salt. Additional 1 g portions can be added to the cone as required.
7.5 Repeat (7.3 and 7.4) twice more with 30 ml portions of fresh solvent, combining all solvent into the volumetric flask.
7.6 Rinse the tip of the Separatory funnel, filter paper, and the funnel with a total of 5-10 ml solvent and collect the rinsings in the flask. Dilute the extract to 100 ml. If the extract is

known to contain greater than 100 mg of non-hydrocarbon organic material, pipet an appropriate portion of the sample to a 100 ml volumetric and dilute to volume.
7.7 Discard about 5-10 ml solution from the volumetric flask. Add 3 g silica gel (6.4) and a stirring bar; stopper the volumetric flask, and stir the solution for a minimum of 5 minutes on a magnetic stirrer.



7.8 Select appropriate working standards and cell pathlength according to the following table of approximate working ranges:

| **Pathlength** | **Range** |
|---|---|
| 10 mm | 2-40 mg |
| 50 mm | 0.5-8 mg |
| 100 mm | 0.1-4 mg |

Calibrate the instrument for the appropriate cells using a series of working standards (6.5.3.). It is not necessary to add silica gel to the standards. Determine absorbance directly for each solution at the absorbance maximum at about 2930 cm-l. Prepare a calibration plot of absorbance vs. mg petroleum hydrocarbons per 100 ml solution.

7.9 After the silica gel has settled in the sample extract, fill a clean cell with solution and determine the absorbance of the extract. If the absorbance exceeds 0.8 prepare an appropriate dilution.

**Note 2:** The possibility that absorptive capacity of the silica gel has been exceeded can be tested at this point by adding another 3.0 g silica gel to the extract and repeating the treatment and determination.

7.10 Determine the concentration of petroleum hydrocarbons in the extract by comparing the response against the calibration plot.

8. **Calculations**

8.1 Calculate the petroleum hydrocarbons in the sample using the formula:

$$\text{mg/l Petroleum Hydrocarbons} = \frac{R \times D}{V}$$

where:

R = mg of Petroleum Hydrocarbons as determined from the calibration plot (7.10).
D = extract dilution factor, if used.
V= volume of sample, in liters.

9. **Precision and Accuracy**

9.1 Precision and accuracy data are not available at this time.



## Appendix B-3

## Quantitative Determination of Hydrocarbons in Soil (Extraction-Infrared Absorption Method) by D. DeAngelis Mobil Oil Corporation Technical Service Laboratories New Jersey

### Introduction

This method employs an extraction which quantitatively removes volatile and non-volatile petroleum hydrocarbons from soil. It is a modification of EPA Test Method 418.1, Total Recoverable Petroleum Hydrocarbons.

The action of weathering, namely evaporation, oxidation and biodegradation can change the physical and chemicals characteristics of the hydrocarbons to be measured. Consequently, it is important to choose a comparative reference material that closely resembles the unknown in order to obtain accurate results.

### Scope

The method measures a wide range of petroleum hydrocarbons which are extractable with Freon 113 (Trichlorotrifluoroethane). The use of silica gel absorbent eliminates polar organics such as fats, soaps, and acidic soil organics. The concentration range is 5 mg/kg (ppm) to about 1%.

### Analytical Procedure

#### Extraction

Place approximately 20 g of soil in a 16 oz. french square bottle with minimum exposure, along with 50 ml of distilled water and adjust pH to 3 with HCl. Cap the bottle tightly using a Teflon lined cap and shake mildly to disperse the soil for 1 to 2 minutes.

After shaking, pipet 25 ml of Freon into the bottle and shake well again for 15 minutes using a paint or lateral shaker. At the end of the shaking period, let stand to permit contents of bottle to separate into distinct layers.

Caution: Vent the bottles at the beginning of this procedure to avoid pressure buildup.

Note: If the Freon forms an emulsion that fails to dissipate, it can be broken by centrifugation or by adding 1 g of sodium sulfate into a filter paper cone and slowly draining the emulsion through the salt.

## Infrared Analysis

Using a pipet, remove about 10 ml of Freon from the appropriate layer and filter it through a column of 5 grams of activated silica gel directly into a 1 cm pathlength fused silica cell. Fill a matched reference cell with clean Freon 113.



Place the cells in the appropriate beams of the instrument and scan from 3200 to 2700 cm using medium scan speed. Drawing a horizontal from the baseline, measure the net absorbance of the CH2 frequency at 2930 cm (3.42 microns). If the absorbance exceeds 0.80, dilute as needed and re-analyze.

## Calibration

Prepare the standards of a known hydrocarbon in Freon in the concentration range of approximately 50 to 500 mg/L. It is important to choose a standard that most closey resembles the scan of the unknown in the 2700 to 3200 cm region, specifically the absorbances at about 2880, 2930, 2990, and 3040 cm. Appropriate standards may include:

1. EPA standards of reference chlorobenzene, isooctane and hexadecane.

2. Reference gasoline that is known to be involved in the spill and which has been weathered (evaporated) to between 25 and 50% by volume.

3. Distillate fuel oil, fresh or weathered.

4. Heavier products such as oils and residual fuels.

Analyze the standards in a similar fashion as the samples. Prepare a calibration curve by plotting the net absorbance values versus the concentration in mg oil/ml Freon on linear graph paper and drawing a straight line of best fit.

## Calculation

Calculate the concentration of hydrocarbons in the sample as follows:

$$\text{mg of hydrocarbons/kg soil} = \frac{C \times V \times D \times 1000}{W}$$

where:
C= concentration of hydrocarbon obtained from the calibration curve (mg oil/mL Freon)
V= volume of Freon 113 used for extraction (mL).
D = dilution factor, if any, and
W = weight of soil sample (g).

## Precision

A statistically signification number of test (25) were performed on each of two types of soils contaminated with weathered gasoline (40% evaporated) and No. 2 grade fuel oil in the range of 100 to 500 mg/kg. The results are summarized below:

| Soil 5 % Moisture | Hydrocarbon | % Recovery | Standard Deviation (mg) | 95% Confidence Level (mg) |
|---|---|---|---|---|
| Fine grained clayey loam | Gasoline | 82 | 0.3 | ± 0.07 |
| Medium sand | Gasoline | 87 | 0.3 | ± 0.07 |
| Medium sand | No. 2 fuel oil | 95 | 0.1 | ± 0.02 |

## RS-232 Section

The RS232 cable for the HC-404 is a double female 9-Pin D connector. On one side the 1,4 and 6 pin are connected as well as pin 7 and 8. The connections from one 9-Pin to another are 2 goes to 2, 3 goes to 3 and 5 goes to 5.

The "#(CR)" is used to get a response from the meters.

Transmitted data is standard ASCII form.

Baud Rate is 1200

Stop Bits 1

Data Bits 7

Parity Even