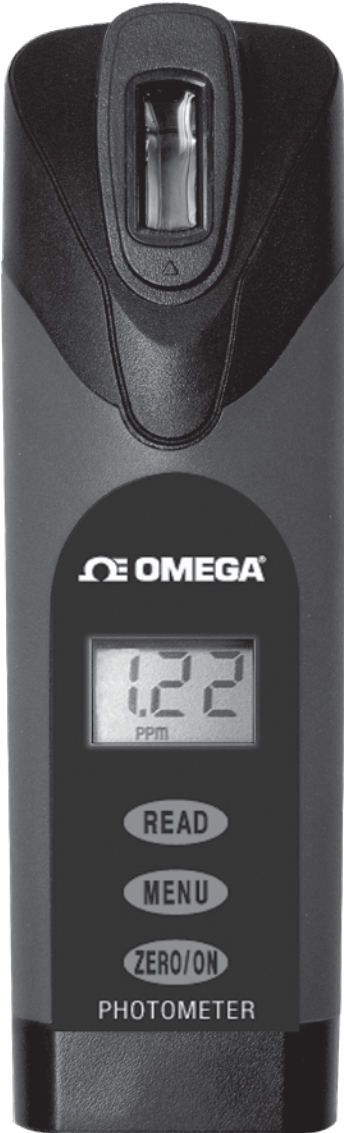


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HHWT-14

**Handheld Photometer for Lead,
Mercury, and Cadmium testing**



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It is the policy of OMEGA Engineering, Inc. to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

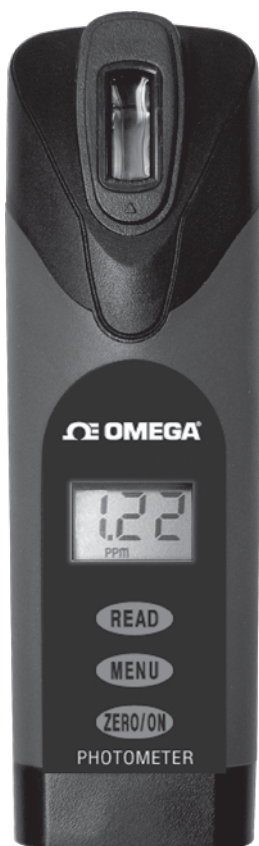
WARNING: These products are not designed for use in, and should not be used for, human applications.

Ω OMEGA®

HHWT-14

Advanced Photometer System Instruction Manual

**Ideal for Screening for Lead, Mercury,
and Cadmium in Potable Water**
(For Lead Soil Testing, see page 17)



<u>Parameter</u>	<u>Page</u>	<u>MENU</u>
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Mercury in Water	6	HG3
Cadmium in Water	7	CD4
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Spiked Recovery Method	8	
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For Your Safety:
Please read the entire manual
before using the test kit.

HHWT-14 Photometer



ITEM PICTURED LETTER	COMPONENT NAME
A	Mixing Cap
B	Cell (Built-in Plastic, 4mL)
C	LCD Display
D	READ Button
E	MENU Button
F	ZERO/ON Button
G	Battery Cover with loop for lanyard
H	AAA Batteries (x4) (INCLUDED)

HHWT-14 Meter Specifications

Measurement Method:	Photometric
Light Source:	Light Emitting Diode (LED)
Wavelength:	476 nm
ABS Range:	.001 - 2.00
Photometric Precision:	.001
Automatic Range Selection:	See Specifications below
Display:	3-digit customized liquid crystal display with annunciators
CELL Pathlength:	20mm

Cell Chamber:	Custom-molded, proprietary, PET plastic fused into chamber; non-removable
Sample Required:	4mL (0.13 oz)
Operating Temperature Range:	0 - 50°C (32° - 122°F)
Power Supply:	(4) AAA alkaline batteries (Included)
Battery Life:	2000 tests with alkaline batteries
Electromagnetic Compliance: (EMC)	Emitted Interference - EN 61326 Immunity to Interference - EN 61326
Waterproof Rating:	Exceeds IP67
Weight:	Instrument: 140 g (5 oz)
Dimensions:	Instrument: 5 (W) x 3.5 (D) x 16.5 (H) cm; (2 x 1.4 x 6.375 in)

We offer a “Green” Alternative

HHWT-14 has been designed to offer the user a more “Green” and cost-effective alternative to testing. Instead of using a 10mL water sample, HHWT-14 uses a 4mL water sample, which uses up to 60% less chemical per test. The accuracy of the meter is maintained by designing the photo cell with a 20mm pathlength.

HHWT-14 Specifications

Menu	Tests for	Range	Resolution	+/- Accuracy	Limit*
PA1	Diluted Homogenized Paint Lead	.000 to 1.99	.001	.003 or 6%	—
PB2	Lead in Water (auto-zero)	1 - 500 µg/L	1 µg/L	3 µg/L or 6%	3 µg/L
HG3	Mercury in Water (auto-zero)	10 - 600 µg/L	1 µg/L	6 µg/L or 6%	10 µg/L
CD4	Cadmium in Water (auto-zero)	0.01 - 0.80 mg/L	.01 mg/L	.06 mg/L or 6%	.02 mg/L
AB5	Future or Custom Tests (Absorbance)	.000 - 1.99 abs	.001 abs	.002 or 2% abs	—
PB6	Lead in Water	1 - 500 µg/L	1 µg/L	3 µg/L or 6%	3 µg/L
PB2	Modified Test for Lead in Soil	18 - 3000 mg/kg 200 - 300,000	1 mg/kg 200	+ - 25% + - 40%	18 mg/kg 200 mg/kg

*Limit is defined as the minimum reliable detection for that test. Any value below the limit should be considered inconclusive for that metal's presence.

Lead in Water Test Procedure

Uses Reagent Set HHWT-486901.



1

1

PREPARE SAMPLE FOR TESTING

Collect water sample in 50mL conical tube to the 50mL line. Add three (3) drops of **PB-ACID Reagent HHWT-486999B**. Mix and allow to sit for at least five (5) minutes. After this time, TEST SAMPLE is ready for testing. **NOTE: If sample is tap water or is acidic, add 2 drops of PB-ACID.**



2

2

TURN METER ON

Press the **ZERO/ON** button to power the meter on; the display will show all annunciators, then the current MENU selection, followed by the last reading.



3

3

SELECT TEST: PB2

Press and re-press the **MENU** button until the display shows the parameter PB2.



4

4

ADD SAMPLE TO CELL

Using the TEST SAMPLE from above, fill and empty the **CELL** four (4) times. Finally, fill cell to capacity (4mL) with the TEST SAMPLE. Tilt meter forward to allow excess sample to flow out in order to make room for Pb-2 Reagent addition below.

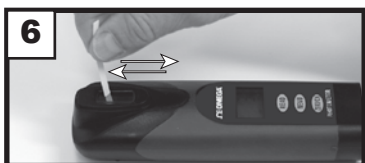


5

6

DIP STRIP AND PRESS "READ"

Dip the **Pb-3 HHWT-486997** strip into the **CELL** and immediately press **READ**. This starts the **20 SECOND** countdown timer. During this time move the strip in a gentle back and forth motion. **Remove and discard the strip after "1" on the display disappears***. The display will flash (- - -) and begin immediately counting up from **1 to 60**. After the 60 seconds, the meter automatically zeros. The cursor will move across the display followed by **0 µg (µg/L)**.

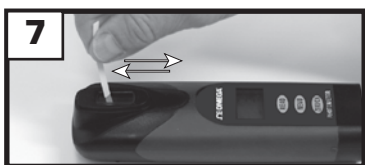


6

7

DIP STRIP AND PRESS "READ"

Dip the **Pb-4 HHWT-486995** strip into the **CELL** and immediately press **READ**. This starts the **20 SECOND** countdown timer. During this time move the strip in a gentle back and forth motion. **Remove and discard the strip after "1" on the display disappears***. The display will flash (- - -) and begin immediately counting up from **1 to 60**. After the 60 seconds, the cursor will move across the display, informing you that it is about to measure the sample as **µg (µg/L)**. Record result displayed (this result is automatically stored in **PB2**). After testing, discard sample and rinse cell at least three times with clean water.



7

*NOTE: When testing outdoors (sunlight), for best accuracy, use the Mixing Cap/Cell Cover when Zeroing and Reading the sample.

NOTE: For best results, the final pH of the sample should be between 9.5 and 10.

Uses Reagent Set HHWT-486901.



1 PREPARE SAMPLE FOR TESTING

Collect water sample in 50mL conical tube to the 50mL line. Add three (3) drops of **PB-ACID Reagent HHWT-486999B**. Mix and allow to sit for at least five (5) minutes. After this time, TEST SAMPLE is ready for testing.



2 TURN METER ON

Press the **ZERO/ON** button to power the meter on; the display will show all annunciators, then the current MENU selection, followed by the last reading.



3 SELECT TEST: HG3

Press and re-press the **MENU** button until the display shows the parameter **HG3**.



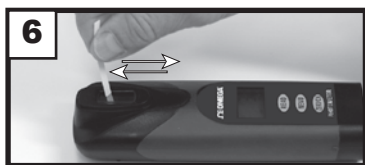
4 ADD SAMPLE TO CELL

Using the TEST SAMPLE from above, fill and empty the **CELL** four (4) times. Finally, fill cell to capacity (4mL) with the TEST SAMPLE. Tilt meter forward to allow excess sample to flow out in order to make room for Pb-2 Reagent addition below.



5 ADD REAGENT Pb-2

Add five (5) drops of **Reagent Pb-2 HHWT-488375B**.



6 DIP STRIP AND PRESS "READ"

Dip the **Pb-3 HHWT-486997** strip into the **CELL** and immediately press **READ**. This starts the **20 SECOND** countdown timer. During this time move the strip in a gentle back and forth motion. **Remove and discard the strip after "1" on the display disappears***. The display will flash (- - -) and begin immediately counting up from **1 to 60**. After the 60 seconds, the meter automatically zeros. The cursor will move across the display followed by **0 µg (µg/L)**.



7 DIP STRIP AND PRESS "READ"

Dip the **Pb-4 HHWT-486995** strip into the **CELL** and immediately press **READ**. This starts the **20 SECOND** countdown timer. During this time move the strip in a gentle back and forth motion. **Remove and discard the strip after "1" on the display disappears***. The display will flash (- - -) and begin immediately counting up from **1 to 60**. After the 60 seconds, the cursor will move across the display, informing you that it is about to measure the sample as **µg (µg/L)**. Record result displayed (this result is automatically stored in **HG3**). After testing, discard sample and rinse cell at least three times with clean water.

*NOTE: When testing outdoors (sunlight), for best accuracy, use the Mixing Cap/Cell Cover when Zeroing and Reading the sample.

Uses Reagent Set HHWT-486904.



1 PREPARE SAMPLE FOR TESTING
Collect water sample in 50mL conical tube to the 50mL line. Add five (5) drops of **HCl-1 Reagent HHWT-486994**. Mix and allow to sit for five (5) minutes. After 5 minute wait, TEST SAMPLE is ready for testing.



2 TURN METER ON
Press the **ZERO/ON** button to power the meter on; the display will show all annunciators, then the current MENU selection, followed by the last reading.



3 SELECT TEST: CD4
Press and re-press the **MENU** button until the display shows the parameter CD4.

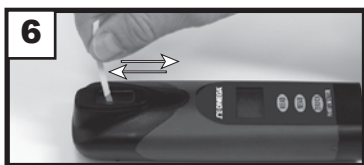


4 ADD SAMPLE TO CELL
Rinse the **CELL** at least 3 times with the TEST SAMPLE above. Finally, fill cell to capacity (4mL) with the TEST SAMPLE. Tilt meter forward to allow excess sample to flow out in order to make room for Pb-2 Reagent addition below.

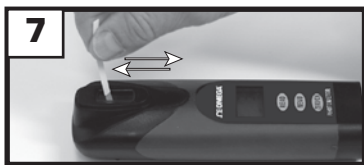
5 ADD REAGENT Pb-2
Add five (5) drops of **Reagent Pb-2 HHWT-488375B**.



6 DIP STRIP AND PRESS "READ"
Dip the **Pb-3 HHWT-486996** strip into the **CELL** and immediately press **READ**. This starts the **20 SECOND** countdown timer. During this time move the strip in a gentle back and forth motion. **Remove and discard the strip after "1" on the display disappears***. The display will flash [- -] and begin immediately counting up from **1 to 240**. After the 240 seconds, the meter automatically zeros. The cursor will move across the display followed by **0.00 mg** (mg/L).



7 DIP STRIP AND PRESS "READ"
Dip the **Pb-4 HHWT-486995** strip into the **CELL** and immediately press **READ**. This starts the **20 SECOND** countdown timer. During this time move the strip in a gentle back and forth motion. **Remove and discard the strip after "1" on the display disappears***. The display will flash [- -] and begin immediately counting up from **1 to 240**. After the 240 seconds, the cursor will move across the display, informing you that it is about to measure the sample as **mg** (mg/L). Record result displayed (this result is automatically stored in CD4). After testing discard sample and rinse cell immediately.



*NOTE: When testing outdoors (sunlight), for best accuracy, use the Mixing Cap/Cell Cover when Zeroing and Reading the sample.

Spiked Recovery Test Method for Interferences:

The Spiked Recovery Test Method (also referred to as Standard Additions Method) is used to verify that HHWT-14 gives accurate results for your water sample. If you find an unexplained difference in results when compared to another test method it is reasonable that you should resolve the issue. A good way to resolve the issue is by a technique commonly used by analytical chemists every day. This technique is often referred to as Spiked Recovery Test Method for Interferences. The following information explains how to perform the test method. You will need a Lead standard solution. The idea behind this method is as follows:

1. Add a known amount or concentration of Lead standard solution to the questionable sample. This is now the "spiked sample." It is recommended to add a Standard Solution amount that is at least equivalent to three times the minimum detectable limit of the test (10 µg/L or ppb).
2. Test the spiked and un-spiked (original) samples using the same reagents, instrument and technique or test method. The spiked sample should show an increase equal to the amount of standard added. The value obtained is called the **Recovery**. Ideally the % recovery is 100%. Results are acceptable if the % recovery is +/- 10%. The formula for calculating percent Recovery is below.
3. If the percent recovery is not in the acceptable range there may be interferences. You can consider diluting the sample with lead free water past the point of interference, within the detection limit of the test kit. You can also consider calculating the actual lead in the sample (see below) as long as the % Recovery is above a reasonable level such as 40%.

The percent recovery formula is as follows:

$$\% \text{ Recovery} = \frac{100(cs-cu)}{k}$$

Where:

cs = concentration found through testing of the spiked sample

cu = concentration found through testing of the un-spiked sample

(NOTE: result should be adjusted for the dilution of the spike volume if volume change is more than 5%)

k = concentration of the spike added to the sample

Example 1: An un-spiked questionable sample measures 10 ppb Lead. A separate 10mL portion of the questionable sample was spiked by adding 20 µL of a 10 ppm Lead standard solution. This is the equivalent of adding 20 ppb Lead to the water sample. The spiked solution was measured by the same method as the original sample. The Spiked result was 28 ppb (Cs)

cs = 28 ppb

cu = 10 ppb

k = 20 ppb

$$\% \text{ Recovery} = \frac{100(28-10)}{20} = 90\% \quad (\text{Recovery result acceptable})$$

Example 2: In another water sample using a similar spiked method as in Example 1 the results were

cs = 30 ppb

cu = 18 ppb

k = 20 ppb

$$\% \text{ Recovery} = \frac{100(30-18)}{20} = 60\% \quad (\text{Recovery result unacceptable})$$

Calculating the Lead: In this example the percent recovery value is low and suggests that, with this test, the water sample gives lead results that are 60% of the actual concentration. To calculate the concentration of lead in this sample divide the expected recovery (100%) by the observed recovery (60%) to get the interference correction factor (100% / 60% = 1.67). Multiply the interference correction factor by the un-spiked sample result (cu) for the actual concentration of lead in the sample (1.67 x 18 ppb = 30 ppb).

HHWT-14 Tips For Best Accuracy

1. Become familiar with the meter and the different tests by reading the instructions carefully.
2. Observe the dip time (*as required for the test*) for accurate results.
3. Be sure the **CELL** is filled to capacity (4mL). Then, tilt meter forward to discard about 0.2mL of the cell volume. This allows for the Pb-2 addition to be performed without overfilling the **CELL**.
4. Rinse the **CELL** with clean water immediately after completing the test. (*Some test reagents will stain or coat the CELL*)
5. It is recommended that the sample be allowed to sit for 5 minutes or longer in Step 1 to facilitate Acid reaction. Additional time would be recommended if the detection of solid Lead or Cadmium, containing particles, are of interest.
6. Store the meter and all test materials out of direct sunlight and away from chemical storage areas.
7. Minimize exposure of meter and test reagents to heat. Storage below 80°F (27°C) is recommended. **DO NOT REFRIGERATE TEST REAGENTS.**
8. Dry the outside of the meter when testing is complete or before storage of the meter.
9. Each strip is valid for **ONLY** one test. Discard strip after single use in regular trash that is inaccessible to children and pets.
10. Each bottle of strips contains the quantity of strips notated on the bottle. Due to the manufacturing process, you may find one or two strips that are noticeably smaller or larger in width than the normal strips in the bottle. These should be discarded. Using these strips may give unreliable results.
11. If conversion table(s) are supplied, they have a unique revision number. It is recommended that you visit www.sensafe.com to check for any updated revisions and details.
12. Tests are calibrated at 75°F +/- 2°F (24°C +/- 1°C). It is recommended that the water sample be warmed before testing if sample temperature is below 60°F / 16°C.
13. Our lab testing with the HHWT-14 meter has shown that zeroing and measuring of the sample does not require any cell cover for accurate results, even in full sunlight.
14. Remove batteries when meter is not used for more than a month.
15. **CELL** cleaning procedure: Fill cell with clean water and add two drops of Acid-1 or HCl-1. Leave meter undisturbed for 5 minutes. Afterwards, rinse the cell and the meter is ready for use again. Cleaning the cell regularly will not be necessary if you rinse the **CELL** immediately after the test.

Lead in Water Recommendation for "First Draw Sample"

The EPA 2007 Lead and Copper Rule Revision has a heavy lead testing focus on schools. The sampling is tiered:




1. "First draw sample" - sample a line unused for at least 8 to 18 hours. Draw the first 250mL to test. This measures the lead contribution from fixtures.
2. "Flushed sample" - before any water is used in the morning allow the line to run for 30 seconds, and then collect a 250mL sample. This measures the lead contribution from internal piping

The June 1991 Lead and Copper Rule Fact Sheet recommended 1 liter of water from a tap unused for 6 hours. This is not mentioned in the 2007 revisions to the rule.

The amount of flushing determines what part of the system is being evaluated for lead. If the volume of water in the system can be determined (e.g. gallons of water/linear ft. of pipe) the amount of flushing can help isolate the source of the lead contamination. It appears that this approach is used by some cities as they do mandated lead testing of their water systems.


Instrument Operation Summary

Key Functions

Key	Description	Function
	ZERO/ON	While meter is off, when pressed, this turns meter on. When meter is on, when pressed, this zeros meter.
	READ	When pressed, this initiates countdown timing and count up timing as appropriate for the MENU test.
	MENU	When pressed and re-pressed, this advances the display to the next MENU test. When pressed and held down for two seconds (continue holding down), the instrument automatically retrieves the last 20 measurements in the MENU displayed. Beginning with the most recent measurement stored (20) through the oldest measurement stored (1). This recall is available for each MENU test.

HHWT-14 Meter Messages

The following are some common messages that may be displayed, including error messages. If an error message other than those listed below is displayed, please contact technical support in the USA at (800) 872-9436.

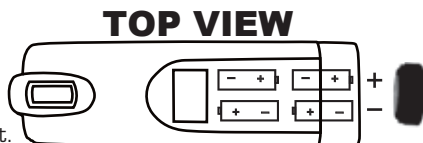
LCD Message	Description	Corrective Action
HI	In READ mode: test sample concentration is above the measurement range (test specific).	Dilute and retest.
LO	In READ mode: test sample concentration is below the measurement range (test specific).	Sample value is below measurement range.
LO	In ZERO mode: sample absorbance (due to a cloudy or colored sample or a dirty cell) is too high to zero, the meter will read "LO".	Dilute sample, filter sample, or clean cell. Testing cannot proceed until a valid ZERO is achieved.
ER	Excessive stray light detected. Normally this does not occur, even when testing in sunlight.	Place the LIGHT BLOCKING CAP over the CELL for zeroing and for reading result. Moving to a shaded area can also fix this problem.
	Low battery indication.	Replace the batteries.

About The Built-In Cell

The built-in **CELL** is transparent plastic and, when filled to the top, contains 4mL. The sturdy **CELL** design will last for over 20,000 readings. Scratches on the **CELL** will not interfere or compromise the accuracy of the readings because of its fixed position. For best accuracy, rinse cell with clean water immediately after a test is completed. Do not use solvents, such as acetone, to clean the cell. When the **CELL** becomes stained or cloudy from repeated testing, or when the meter does not blank when you press the **ZERO/ON** button, the cell needs to be cleaned.

To Install/Replace "AAA" Batteries:

1. Unscrew the O-ring sealed battery cover counter-clockwise. Use proper sized pliers if necessary. Do not disturb the sealing O-ring. Batteries are not included.
2. Remove the used batteries and install 4 new AAA batteries following the diagram for correct polarity (see diagram). We recommend high quality AAA alkaline batteries be used.
4. Replace the battery cover. Be sure to tighten the cover securely. This is necessary for meter to be waterproof.
5. Dispose of the used batteries in accordance with your local regulations.
6. Press ZERO/ON button to confirm the meter turns on. The meter is now ready for operation.
7. Meter will not work if battery orientation is incorrect.



Lead Recovery in Various Water Samples:

Our laboratory has performed numerous Spiked Recovery tests using water samples from around the world. The water samples were obtained in the locations as identified below. The water was collected in clean plastic bottles and shipped to our lab. The samples were not preserved by acid and not refrigerated.

Each sample was spiked in duplicate at two different spiked concentrations (20µg/L and 50µg/L) giving a total of four spiked tests. Except for two water samples the % recovery of spiked water samples had an acceptable average for the four spiked water tests (within +/- 10%). The Highland, NC well water averaged a 74% Recovery and the Seattle, WA municipal water averaged 83.5% Recovery.

Water sample lead (Pb⁺²) concentrations found for all samples were below 3ppb, and reported as 0, except for Rock Hill, SC water (exposed to lead).

		Water	Spiked		Spiked	
Water Origin	Water Type	Sample µg/L	20ppb ppb (µg/L)	% Recovery	50ppb ppb (µg/L)	% Recovery
Vienna, Austria	M	0	21	105	52	104
repeated		0	19	95	51	102
Munich, Germany	M	0	21	105	54	108
repeated		0	19	95	46	92
Kusnacht, Switzerland	M	0	20	100	51	102
repeated		0	19	95	54	108
Paris, France	M	0	19	95	50	100
repeated		0	20	100	45	90
Washington, DC	M	0	23	119	52	104
repeated		0	20	100	49	98
Philadelphia, PA	M	0	17	85	45	90
repeated		0	23	119	43	86
Phoenix, AZ	M	0	20	100	47	94
repeated		0	21	105	47	94
Edgewater, MD	W	0	22	110	50	100
repeated		0	16	80	46	92
Highland, NC	W	0	15	75	36	72
repeated		0	15	75	37	74
Rockwell, NC	W	0	22	110	51	102
repeated		0	23	119	50	100
Las Vegas, NV	M	0	19	95	52	104
repeated		0	17	85	49	98
Chicago, IL	M	0	21	105	51	102
repeated		0	16	80	52	104
Rock Hill, SC	W	0	18	90	47	94
repeated		0	17	85	46	92
Melbourne, Australia	M	0	20	100	47	94
repeated		0	19	95	45	90
Rock Hill, SC (exposed to lead)	M	5	25	100	56	102
repeated		5	26	104	52	95
Weaverville, NC	M	0	16	80	52	104
repeated		0	20	100	46	92
Anaheim, CA	M	0	19	95	53	106
repeated		0	21	105	47	94
Seattle, WA	M	0	16	80	45	90
repeated		0	16	80	42	84
Kilowna, BC, Canada	M	0	19	95	51	102
repeated		0	21	105	53	106

*M = Municipal, W = Well

Summary of HHWT-14 Chemistry for Lead (Pb⁺²) Detection:

Lead in the water sample is first solubilized to Pb⁺² by the addition of the Nitric Acid reagent. Pb-2 Buffer is then added to make the solution alkali. The Strip Pb-3 is dipped for 20 seconds with gentle motion, which adds the porphyrin indicator, and mixes the solution. After a one minute wait, which allows for the porphyrin and Pb⁺² to form a colorimetric complex, the HHWT-14 Colorimeter automatically zeros. The Strip Pb-4 is dipped into the cell sample for twenty seconds with gentle motion. This motion releases EDTA into the sample which then breaks up the colorimetric porphyrin-Pb²⁺ complex. After a one minute wait, the result is displayed in µg (µg/L) as Lead. The Mercury test uses a similar chemistry. Cadmium uses Hydrochloric Acid for solubilization of the Cadmium ion, and this test requires more indicator reagent.

A procedure using the porphyrin 5,10,15,20-tetakis(1-methylpyridinium-4-yl)porphine as indicator is described in *Mirochim Acta* volume 157, page 87-91 published in 2007 K. Kawamura, et al. For convenience the indicator is referred to as TMPYP. Our modified test procedure is patented. In combination with the Strip reagent delivery device, and by not removing the cell from the meter between the zeroing and reading steps; HHWT-14 delivers optimum accuracy and sensitivity. Please refer to the Lead Test Interference chart (Table 1) for details as to the highest concentration of ions the test can tolerate. From our lab and contract lab studies with HHWT-14 we find that over 90% of the typical potable, municipally treated water samples experience no interference. Before you start using the HHWT-14 with potable water samples in your area use the "Standard Additions" method to determine if there are any interferences in your water that may require consideration.

Interfering ions listed, except for Mercury and Cadmium, inhibit the TMPYP-Pb⁺² complex formation above the concentrations given. Mercury and Cadmium give similar color reaction with TMPYP. Mercury is rarely found in tap water above 0.005 mg/L. A procedure modification is not yet available to remove Mercury interference. Typical Cadmium levels in tap water will not interfere in the Lead and Mercury procedures using Nitric Acid. Hardness ions such as Calcium and Magnesium are tolerated as noted in Table 1. When the water sample has Total Hardness minerals above 400 mg/L, the Pb-4 addition of EDTA may be inadequate; and the TMPYP-Pb⁺² complex may not be completely destroyed and the lead reading will be low. If you suspect this, do a Spiked Recovery Test (page 8).

It is recommended that for best results this test be done on unpreserved, freshly drawn water samples. Water samples that have been preserved with strong Nitric Acid for lead testing will require alkali neutralization of excess acid to a pH of about 2.5; and the Acid-1 addition can be skipped. After the Pb-2 addition step the pH should be verified if pH issue is a concern; and ideally should be between 9.5 and 10.0 pH.

Table 1:

Lead Test (PB2 & PB6 MENU) Interferences (Similar interferences can be expected for Mercury and Cadmium Tests.)			
Ion	Interference Level	Ion	Interference Level
Aluminum, Al ³⁺	2 mg/L	Magnesium, Mg ²⁺	200 mg/L
Barium, Ba ²⁺	3 mg/L	Manganese, Mn ²⁺	0.5 mg/L
Bromide, Br ⁻	20 mg/L	Mercury, Hg ²⁺	0.01 mg/L
Cadmium, Cd ²⁺	0.07 mg/L	Nickel, Ni ²⁺	1 mg/L
Calcium, Ca ²⁺	500 mg/L	Nitrogen, Ammonium, NH ₄ ⁺	40 mg/L
Chloride, Cl ⁻	150 mg/L	Nitrogen, Nitrate, NO ₃ ⁻	20 mg/L
Chromium, Cr ³⁺	0.1 mg/L	Nitrogen, Nitrite, NO ₂ ⁻	300mg/L
Cobalt, Co ²⁺	1 mg/L	Phosphate, PO ₄ ³⁻	100 mg/L
Copper, Cu ²⁺	5 mg/L	Sulfate, SO ₄ ²⁻	200 mg/L
Fluoride, F ⁻	40 mg/L	Tin, Sn ²⁺	0.2 mg/L
Iron, Fe ²⁺	0.2 mg/L	Zinc, Zn ²⁺	2 mg/L
Iron, Fe ³⁺	0.1 mg/L		Rev. 07/03/07

About your Water Sample:

If the water sample you are testing has a pH of 6.5 to 8.5, then the HHWT-14 Reagent System will give valid results. If your water sample is below pH 6.5 or above pH 8.5, or has a Total Alkalinity above 200 PPM; then the pH of the water needs to be adjusted to between pH 7 and 8 before testing begins. Use 1.0N HCl or 1.0N NaOH to adjust the pH of your water sample. Iron above 0.1 ppm can be present in well water samples. It is recommended that the absence of iron be confirmed by the Iron Check Test (HHWT-480025). If your results are different from what you expect, then after the test is completed, check the pH of the reacted sample. The chemistry, to work properly, should have a final pH of 9.5 to 10.0. If your pH is below 9.5, then add six drops of PB-2 in step 5. If pH is above 10.0, then add four drops of PB-2 in step 5.

Specifications:

The test detects from 0 to 500 µg/L or ppb levels of Lead as Pb²⁺. The most accurate test range will be 3 to 200 µg/L. For this range, the Test resolution is 1 ppb, minimum detection is 3 µg/L, and accuracy is +/-3 µg/L or +/-6% (whichever is higher), when used with an HHWT-14 Photometer. If lead level is above 500 µg/L (ppb), dilute sample with lead-free water before retesting.

The MCL (**M**aximum **C**ontaminant **L**evels allowed) for drinking water as set by the USEPA for Pb²⁺ is 15 µg/L (WHO is 10 µg/L); Mercury (Hg⁺²) is 2 µg/L; and Cadmium (Cd⁺²) is 5 µg/L.

MSDS 1

Material Safety Data Sheet

Section 1
Catalog # / Description: Part Number HHWT-486999B
Name: Reagent PB-Acid (17mL)

Section 2
CAS #: 7697-37-2 Nitric Acid 18%
CAS#: 7732-18-5 Demineralized Water 82%
Caution: CORROSIVE ingredient

Section 3 Hazards Identification

Clear colorless liquid causes BURNS:

Eye contact: Causes eye burn

Skin Contact : Causes burn

Ingestion: Can cause acid burn including nausea, abdominal pain. Wear safety glasses with top and side shields and latex gloves when handling. Irritating to nose and throat. Avoid inhalation. Remove and wash contaminated clothing before reuse.

Section 4 First-Aid Measures

- If swallowed, give 1-2 glasses of water. Call a physician or the Poison Control Center as a precaution.
- In case of skin contact, flush with copious amounts of water for at least 2 minutes. Remove contaminated clothing and shoes.
- In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Call physician.
- If inhaled, remove to fresh air. If breathing is difficult, give oxygen and seek medical advice.

Section 5 Fire Fighting Measures

Not Flammable, but reacts with many metals forming hydrogen gas, which is flammable. Because of small volume in bottle, use media appropriate for surrounding fire conditions.

Section 6 Exposure Controls / Personal Protection

Have an eyewash station nearby. Do not expose to eyes, skin, or clothing. Keep away from children and pets. Wash hands thoroughly after handling. Maintain general hygienic practices when using this product.

Section 7 Physical and Chemical Properties

Appearance and Odor:

- Clear, colorless liquid with no odor

Physical Properties:

- Melting Point: Not Applicable
- Vapor Pressure: Not Applicable
- Specific Gravity: about 1.2
- Vapor Density: Not Available
- pH: < 0.6
- Stable when stored at room temperature.

Hazardous Polymerization:

- Will not occur.

Section 8 Toxicological Information

- Ingredient toxicological data:
- Nitric acid oral Human LD₅₀=430mg/kg
- Each bottle contains about 17mL liquid
- HMIS and NFPA classification for Health: 3 and Reactivity: 1
- Wash hands after use and avoid skin, eye contact.
- This product may be shipped as part of a chemical test kit composed of various compatible components because of it's small volume.

Section 9 Other Information

The above information is believed to be correct but does not purport to be all-inclusive and shall be used ONLY as a guide. Keep away from children and pets.

MSDS 2

Material Safety Data Sheet

Section 1
Catalog # / Description: Part Number HHWT-488375B
Name: Reagent Pb-2 (15mL)

Section 2
CAS#: 115-69-5 2-Amino-2-Methyl-1,3-Propanediol (AMP) 7%
CAS# 77-86-1 Tris(hydroxymethyl)-aminomethane (TRIS) 15%
CAS# 7732-18-5 Demineralized water 78%

Section 3 Hazards Identification

- Physical Appearance: Clear, colorless liquid
- Immediate Concerns: DANGER. Alkali pH of around 10.8. Causes skin and eye burns. Wear safety glasses with top and side shields and latex gloves when handling. Irritating to nose and throat. Avoid inhalation. Remove and wash contaminated clothing before reuse.

Section 4 First-Aid Measures

EYES: If contact with eyes occurs: Immediately flush eyes with water for 15 minutes. Call Physician.

SKIN: If contact with skin: Rinse off excess chemical and flush skin with soap and plenty of water. If skin irritation develops, seek medical attention.

INGESTION: If swallowed: Give 1-2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. Call a physician immediately.

Section 5 Fire Fighting Measures

- This product is not flammable or combustible.
- Extinguishing Media: Use media appropriate for surrounding fire conditions

Section 6 Exposure Controls / Personal Protection

Do not expose to eyes, skin, or clothing. Keep away from children and pets. Wash hands thoroughly after handling. Maintain general hygienic practices when using this product.

Section 7 Physical and Chemical Properties

Appearance and Odor:

- Clear liquid.
- Odorless

Physical Properties:

- Melting Point: Not Applicable
- Vapor Pressure: Not Volatile
- Specific Gravity: about 1.4
- Vapor Density: Not determined

Stability:

- Stable when stored under proper conditions.

Hazardous Polymerization:

- Will not occur.

Incompatibilities:

- Incompatible with strong acids.

Section 8 Toxicological Information

Acute Effects of ingredients:

- TRIS Oral LD₅₀: 5,900 mg/kg (rat)
- AMP Oral LD₅₀: 17,000 mg/kg (rats)

Section 9 Other Information

The above information is believed to be correct but does not purport to be all-inclusive and shall be used ONLY as a guide. Keep away from children and pets.

MSDS 3

Material Safety Data Sheet

Section 1

Chemical Identification
Catalog # / Description: Part Number HHWT-486997
Name: Strip Pb-3 (50)

Section 2

Composition / Information on Ingredients
CAS #: 36951-72-1
Chemical: meso-Tetra(N-methyl-4-pyridyl)prophine tetratosylate salt
Trade name: TMPYP

- Purple powder; Brown appearance on strip pad

Section 3

Hazards Identification

Precautionary Statements:

May be harmful by inhalation, ingestion and skin absorption. Causes eye and skin irritation.

Section 4

First-Aid Measures

- Immediately flush eyes with plenty of water for 15 minutes. Call a physician.
- If inhaled, remove to fresh air. If breathing is difficult, give oxygen and seek medical advice.
- In case of contact, immediately wash skin with soap and water thoroughly.

Section 5

Fire Fighting Measures

Fire/Explosion Hazard:

- Fire may produce irritating or poisonous gases in small quantity
- Extinguishing Media:
- Foam and water, Carbon Dioxide or dry chemical.

Section 6

Exposure Controls / Personal Protection

Do not get in eyes, on skin, on clothing. Keep away from children and pets. Wash hands thoroughly after handling. Maintain general hygienic practices when using this product.

Section 7

Physical and Chemical Properties

Appearance and Odor:

- Solid bluish-gray powder

Physical Properties:

- Melting Point: >400°C
- Vapor Pressure: Not Applicable
- Specific Gravity: 1.98
- Vapor Density: Not Applicable

Stability:

- Stable when stored dried and at room temperature.

Hazardous Polymerization:

- Will not occur.

Section 8

Toxicological Information

- Skin and eye irritation.
- LD50: None reported

Section 9

Other Information

The above information is believed to be correct but does not purport to be all-inclusive and shall be used ONLY as a guide. Dispose of empty bottle and used test strip as normal trash. Keep away from children and pets. Store in a dry, cool place. Keep container tightly closed.

MSDS 4

Material Safety Data Sheet

Section 1

Chemical Identification
Catalog # / Description: Part Number HHWT-486995
Name: Strip Pb-4 (50)

Section 2

Composition / Information on Ingredients
CAS#: 64-02-8
Chemical: EDTA Tetrasodium salt impregnated on strip pad pH adjusted to 10.5

Section 3

Hazards Identification

Precautionary Statements:

- May be irritating to eyes and nasal passages.
- Low toxicity orally due to small amount in test pad
- LD50: None reported.

Section 4

First-Aid Measures

- If swallowed, give large quantities of water and call a physician or the Poison Control Center as a precaution.
- In case of skin contact, flush with copious amounts of water.
- In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Call physician.

Section 5

Fire Fighting Measures

Not Applicable since the amount of Reagent in pad and kit is negligible.

Section 6

Exposure Controls / Personal Protection

Do not expose to eyes, skin, or clothing. Keep away from children and pets. Wash hands thoroughly after handling. Maintain general hygienic practices when using this product.

Section 7

Physical and Chemical Properties

Appearance and Odor:

- White powder. Soluble in water.

Physical Properties:

- Melting Point: >300°C
- Vapor Pressure: Not Applicable
- Specific Gravity: Not Applicable
- Vapor Density: Not Applicable

Stability:

- Stable when stored under proper conditions.

Hazardous Polymerization:

- Will not occur.
- Incompatibilities:*
- None reported.

Section 8

Toxicological Information:

- LD50: None reported

Section 9

Other Information

The above information is believed to be correct but does not purport to be all-inclusive and shall be used ONLY as a guide. Keep away from children and pets. Store in a dry, cool place. Keep container tightly closed.

HHWT-14 Method for Lead in Soil:

Uses Reagent Set HHWT-486902.

Extraction Method (Pb-1P, 0.1mL scoop, and 50mL Plastic Conical tube are not supplied, but required to perform this test)

Add one level scoop (0.1mL volume scoop, which holds approximately 0.14 grams) of soil sample to a clean 50mL, graduated, plastic conical tube. Add Twenty (20) drops of Pb-1P HHWT-487925-P15 to the conical tube. Swirl the mixture for a few seconds or until all soil is suspended and mixed well. After five minutes, bring the volume of the sample to 50mL using deionized, distilled, or lead free tap water. Cap and mix this solution. This solution is now identified as the Soil Extraction Solution (SES). Wait one (1) minute, or more, for suspended solids to settle, then perform the test as follows:

- 1 Add 1.0mL (1000 µl) of SES sample to a clean 50mL conical tube. Do not add **Pb-1P HHWT-487925-P15** to the conical tube. Adjust the volume of the cell to 50mL using lead free tap water. Mix sample. Test Sample is ready for testing.
- 2 Press the **ZERO/ON** button to power the meter on; the display will show all annunciators, then the current **MENU** selection, followed by the last reading.
- 3 Press and re-press the **MENU** button until the display shows the parameter **PB2**.
- 4 Rinse the **CELL** at least 3 times with the Test Sample above. Finally, fill cell to capacity (4mL) with the Test Sample. Tilt meter forward to allow excess sample to flow out in order to make room for **Pb-2** Reagent addition below.
- 5 Add five (5) drops of **Reagent Pb-2 HHWT-488375B**.
- 6 Dip the **Pb-3 HHWT-486997** strip into the **CELL** and immediately press **READ**. This starts the **20 SECOND** countdown timer. During this time move the strip in a gentle back and forth motion. **Remove and discard the strip after "1" on the display disappears.** The display will flash (- -) and begin immediately counting up from 1 to 60. After the 60 seconds, the meter automatically zeros. The cursor will move across the display followed by 0 µg (µg/L).
- 7 Dip the **Pb-4 HHWT-486995** strip into the **CELL** and immediately press **READ**. This starts the **20 SECOND** countdown timer. During this time move the strip in a gentle back and forth motion. **Remove and discard the strip after "1" on the display disappears.** The display will flash (- -) and begin immediately counting up from 1 to 60. After the 60 seconds, the cursor will move across the display, informing you that it is about to measure the sample as µg (µg/L). Record result displayed (this result is automatically stored in **PB2**). After testing is complete discard sample and rinse cell immediately.
- 8 To convert the value in step 7 from µg/L to mg/kg use **17.86** as the multiplication factor:
(For example: $65 \mu\text{g/L} \times 17.86 = 1161 \text{ mg/kg}$)

NOTE: If no Lead is found when 1.0mL SES sample is used in Step 1, then try 2mL of the SES for lower detection. If the result reads "HI", then the SES sample should be retested using a 0.01mL sample in Step 1. Pb-1P and Pb-2 drops required for these SES volume variations are listed in the chart below.

SES Volume	Pb-1P Drops	Pb-2 Drops	Multiplication Factor	Range (mg/Kg)	Accuracy (%)
0.01mL	0	5	1786	up to 300,000	± 40
1mL	0	5	17.86	18 to 3000	± 25
2mL	0	5	8.93	18 to 1500	± 25

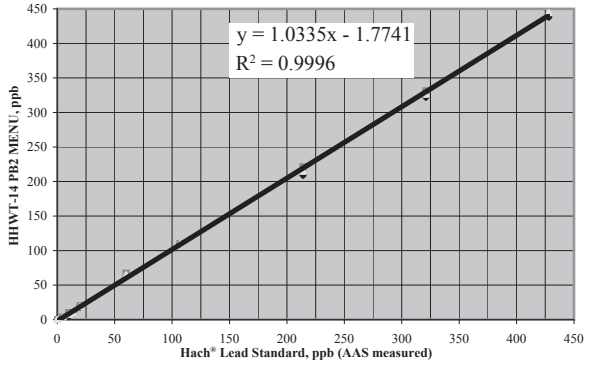
HHWT-14 Accuracy

Hach® Lead Standard Solution, 10 mg/L as Pb²⁺ (Cat. 23748-20) was verified by Atomic Absorption and used with the HHWT-14 Meter, PB2 MENU to confirm precision and accuracy.

Hach® AAS, Lead Std, ppb	Meter 1 PB2 MENU ppb	Meter 2 PB2 MENU ppb	Average PB2 MENU ppb
0	0	0	0
5	4	4	4
10	6	10	8
10.7	6	10	8
14	10	10	10
20	18	20	19
60	63	67	65
107	110	110	110
214	209	221	215
321	322	331	326.5
428	438	451	444.5

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Detection of Lead in Water





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OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

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RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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