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OPERATING
PROCEDURE
MANUAL

BULLETIN 76
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AQUA-GLO SERIES III WATER DETECTOR KIT

MODELS GTP-322 AND GTP-323

INTRODUCTION

The Aqua-Glo Series III Water Detector Kit is used to measure the amount of undissolved water in kerosene-type jet fuels. It can be used on other fuels by following special procedures in the section titled, "Other Fluids".

A measured sample of fuel is passed through a sodium fluorescein treated detector pad or "test pad". Undissolved (free) water in the fuel will react with the sodium fluorescein. When the pad is subsequently illuminated by ultraviolet light, the coating that was contacted by free water will fluoresce a bright yellow with the brightness increasing for increasing amounts of free water in the fuel sample. Water content is read out in parts per million by volume. By varying the fuel sample size, the range of the instrument of 1 to 12 ppm can be increased to as much as 60 ppm of free water.

METHOD DESCRIPTION

The primary method that is covered by this document is based on ASTM D3240. A copy can be obtained by writing to American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA. 19428-2959.

The following procedure is primarily applicable for **dynamic** line sampling; that is, taking the fuel sample directly from the fuel system and through the test pad without exposing the sample to the atmosphere or to a sample container. The use of sample containers such as bottles or cans for the temporary storage or transport of the sample will result in large errors due to changes in temperature, absorption of water on container walls, etc., and is not recommended. The amount of free water in a sample is very sensitive to temperature.

If there is absolutely no alternative and a test must be performed on a fuel sample that is in a container, the procedure in the section titled "Container Samples" can be used.

CALIBRATION

An encapsulated pad labeled "Calibrating Standard" is provided in an envelope in each kit. Note the "set" number on the back of this pad. Place the test pad in the window with the colored side facing the instrument. Turn on the ultraviolet lamp and then press the switch button on the photocell comparator or "Instrument Pack". This button is located within a cup on the instrument. Adjust the light modulating lever until the red pointer is steady at the zero "0" in the center of the meter. Always move the light modulating lever in the same direction when zeroing the photocell comparator, when calibrating or testing, to eliminate errors caused by clearance in the mechanical linkage. This may take 45 seconds. If the reading obtained does not agree with the "set" number on the calibrating standard, adjust the photocell comparator by removing the plug screw on the side (at the 45 deg. bend). Insert a small screwdriver, and adjust as necessary. Repeat the above procedure until the reading obtained agrees with the calibrating standard "set" number. **THE INSTRUMENT SHOULD BE CALIBRATED PRIOR TO EACH USE AND AFTER EACH HOUR OF USE.**

Return the Calibrating Standard to the envelope in the kit. Do not use a calibrating standard from another kit. Each calibrating standard is matched to a fluorescing standard which is secured under the panel labeled "Fluorescing Standard". The code number on the Fluorescing Standard must be the same as the code number on the Calibrating Standard **but the "set" points need not be the same.** Instruments that have been manufactured since 1998 have a small decal on the stationery face of the hinge providing the code number. NOTE: We urge our customers to label older instruments accordingly so that operators can easily determine if they are using the matching calibrating standard.

SAMPLE CONNECTION

It has been explained that this kit is designed for dynamic line samples. The sample connection must be planned so that the flow path to the test pad is as short as possible and so that there are no traps or pockets that may collect water. The quick disconnect coupler should be attached directly to the pipe.

FLUSHING

Attach the test pad holder assembly to the quick disconnect coupler. Open the toggle valve by lifting the handle. Allow at least 1 liter of fluid to pass through the assembly. Opening and closing the valve several times will insure better flushing. Remove the assembly after flushing.

TEST PROCEDURE **NOTE: An abbreviated test procedure is found in Figure 6**

Open the test pad holder assembly and insert a test pad using tweezers. Be sure that the orange colored side of the pad is facing upstream.

Do not remove the test pad from the hermetically sealed package until ready for use. Do not allow any discrete water droplets to come into contact with the pad (from rain, sneezing, coughing etc.). Exposure of the test pad to the atmosphere, especially on humid days, will also ruin the pad in a matter of minutes.

Pass 500 ml of fuel through the pad, accurately measuring the test sample quantity in the calibrated plastic bottle in the kit. Normal sample volume is 500 ml of test fuel, but if the reading is off scale (on high side), a sample volume as small as 100 ml in volume may be used in a repeat test by applying a correction factor, as explained below. In the latter case, a small graduated cylinder should be used to measure the sample volume accurately.

SPOILAGE OF WATER DETECTOR PADS

These pads are now heat sealed in aluminized composite envelopes to insure that moisture from the air will not reach the sodium fluorescein. Pads that were stored for 8 years were still in good condition, but statistical studies have proved that up to 4 or 5% of the envelopes have enough water permeability to spoil the pads. This occurs in the first six months. A spoiled pad is easily identified by its **yellow** color. The operator should inspect every pad before it is used. If it is not **orange** in color, it must not be used. Spoiled pads will cause a **high** reading, if used.

RATING PROCEDURE

Remove the test pad from the holder using tweezers and press between dry paper blotters or absorbent towels to remove excess fuel. To blot, press firmly (about 5 lb. force) 3 or 4 times with heel of hand, moving the pad with tweezers each time.

For maximum accuracy, the test pad should be read within 3 minutes after sampling is initiated. If the test pad is not read immediately after sampling, it must be placed in a desiccator to prevent moisture pick up from the air. However, readings made on dried test pads, that is, not damp with fuel, should be avoided if possible since they will give high and erroneous results. Conversely, rating a pad which has not been well blotted will give a low reading as the excess fuel will absorb part of the ultraviolet light and decrease fluorescence.

The ultraviolet light must be on to get a reading. This can be verified when the selector switch is turned on. The center of the **white indicator button** will glow a light green if the ultraviolet tube is operating.

Using tweezers, put the pad into the test pad window. Turn on the lamp and press the photocell button. Continuously zero the photocell comparator by adjusting the light modulating lever until there is a steady reading at zero for 10 to 15 seconds. Always move the light modulating lever in the same direction when zeroing the photocell comparator to eliminate errors caused by backlash. This may take 45 seconds or longer. Turn off the instrument light immediately after use to conserve battery power.

Record the instrument reading where the lever crosses the scale (estimated to the nearest tenth). Record the sample volume and the fuel temperature at the time of the test. See section titled "Comments".

Visual observation of the used test pad is often of value. This is easily accomplished by removing the photocell comparator assembly and viewing the test pad in a darkened room with the ultraviolet light turned on. Free water in fuel is normally well dispersed and will form an even distribution of many small points of yellow fluorescence on the test pad when illuminated.

Large water drops, however, will form a few large spots of yellow fluorescence on the pad. These large spots usually are indicative of a separator element failure, rather than a coalescer element failure if the test is performed downstream of a filter separator.

CALCULATION

Correct the reading if the sample volume is other than 500 ml.

$$\text{PPM free water} = \frac{\text{scale reading} \times 500}{\text{sample volume, ml.}}$$

NOTE: The velocity of the fuel through the pad will have an influence on accuracy if the flow rate is not between 600 and 800 ml/min. The 1 mm diameter orifice upstream of the test pad serves to control velocity over a wide pressure range but onsite controls may be required. The orifice also serves to break up water droplets and promote uniformity of distribution on the test pad.

CARE OF BATTERY (GTP-2324)

Do not leave the battery on recharge for more than 2 days without use.

Unlike the battery in the Aqua-Glo Series II Water Detector, the GTP-2324 battery is built-in and is considered a semi-permanent component. If it is ever necessary to replace it, the entire side cover of the light unit must be removed (7 screws). Then separate the wire connector having the black and red wires. The battery clamp can now be removed by first removing 2 screws, one at each end.

Position 3 of the selector switch allows you to operate from an external battery using a wire connector, GTP-2403. Order separately. This feature is especially useful if you plan to run many tests in the field and are concerned that the internal battery may not have the life you need. An external battery is not supplied with the kit but may be ordered as Model GTP-2404.

To recharge the internal battery, simply connect the power cord in the kit to the fitting marked "Off-Charge". A full charge requires from 14 - 16 hours. The external battery will be charged at the same time if connected.

CONTAINER SAMPLES

Although we do not recommend bottle or bucket sampling, if accuracy is to be achieved, it is sometimes impractical to obtain pressure to force the fuel sample through the detector pad. For this reason, we offer as an option, the model GTP-165 syringe with an attachment nipple GTP-3614 (adapter). When this nipple is screwed into the outlet of the detector pad holder, the tapered fitting on the syringe will seal in the small end of the nipple. To pull a sample through the detector pad, place the entire detector pad housing in the fuel sample container and pull the syringe handle all the way out. Expel the fuel from the syringe after disconnecting it from the nipple fitting. Then push the handle all the way in while holding the syringe fitting over the polyethylene bottle in the kit. Repeat this procedure until the required fuel volume has been passed through the detector pad.

CARE OF THE PHOTOCCELL COMPARATOR (INSTRUMENT PACK)

Heavy use will eventually deplete the battery. If very frequent recalibration is necessary, this can mean that the battery is weak. If the meter responds sluggishly, this also indicates a weak battery. Replace with any good quality 9 v transistor radio battery or order our Model GTP-892. Remove the 4 battery cover screws to reach the battery.

Frequently wipe dust and finger marks from the green glass filters. Use a soft cloth or a bit of cotton wool. This assembly is easily damaged if it is dropped. Generally, the damage is one or more of 3 problems. Therefore, if it is dropped, the operator should inspect as follows: Frequently wipe dust and finger marks from the green glass filters. Use a soft cloth or a bit of cotton wool. This assembly is easily damaged if it is dropped. Generally, frequently wipe dust and finger marks from the green glass filters. Use a soft cloth or a bit of cotton wool. This assembly is easily damaged if it is dropped. Generally, the damage is one or more of 3 problems. Therefore, if it is dropped, the operator should inspect as follows: the damage is one or more of 3 problems. Therefore, if it is dropped, the operator should inspect as follows:

CARE OF PHOTOCCELL COMPARATOR (INSTRUMENT PACK) Continued

1. Attachment flange bent - This can be straightened, but any black paint that is scratched must be replaced to prevent errors due to reflection. Use dull, flat black paint.
2. Green glass filters broken - Return the instrument pack to the factory for replacement.
3. Meter pivots broken or disengaged - Return the instrument pack to the factory for repair or replacement, depending upon extent of damage. To determine whether this type of damage has occurred, observe the exact position of the tip end of the pointer as the instrument is moved slowly in various positions around an orbit. If the tip of the pointer moves up and down, the pivots have been damaged.

OTHER FLUIDS

The Aqua-Glo Water Detector Kit can be used to determine the undissolved water content of fluids that are not in the jet fuel category but there are several factors that must be considered. First of all, material compatibility of the detector pad holder and its various components must be studied. The quick disconnect nipple is made of Type 303 stainless steel. The detector pad holder itself and the toggle valve are anodized aluminum. Tubing fitting is brass. Seals are Buna N. Tubing is urethane. Components made of other materials are available and will be quoted on request. Another consideration is the detector pad itself. Certain alcohols may remove the fluorescein coating. Strong chemicals may damage the filter paper pad itself.

Low boiling point fluids, such as LNG, butane, etc., create special problems that require consideration. First of all, the volume of a fluid that evaporates rapidly cannot be determined in the open bottle that is provided in the kit. Several methods can be used, depending on the test fluid. One method is to use a sample bomb. Another is to place a graduated cylinder in a refrigerated bath. Precautions must also be taken to prevent condensation of moisture on the cold detector pad after the pad has been removed from its holder. An effective way to handle this is to immediately drop the pad in a beaker containing clean, dry kerosene. The use of kerosene as a "conditioner" is required whenever a test is to be performed on a non-jet fuel fluid. The reason is that the calibration of the Aqua-Glo scale is based on a jet fuel damp detector pad.

GASOLINE - No special procedure is required when testing gasoline, except that the pad must be placed in clean, dry kerosene (jet fuel) briefly before blotting it between paper towels. See Rating Procedure. This is a necessary step to prevent moisture from humid air from condensing on the pad as it cools during evaporation of the gasoline. Also, the Aqua Glo instrument is calibrated with a kerosene-damp pad and this procedure will insure that condition.

Heating oil and diesel fuels have a natural fluorescence that causes high readings. Accuracy can be obtained if the residual oil on the test pad is rinsed off by flushing dry kerosene through the pad after the test. See the procedure under "Container Samples". Adequate rinsing will result if the capacity of the syringe is drawn through the detector pad one or two times. Do not be concerned that this flushing operation will influence accuracy by reversing the chemical reaction between water and the sodium fluorescein. It will not. Another procedure that can be used with fuels that fluoresce naturally is to determine the scale reading for a pad that is wetted with the fuel but has not been subject to any water. The procedure is to dip a new pad in the test fuel and blot it as described above. Take a reading by following the steps that are described in the section titled "Rating Procedure". Then put the pad in the holder and allow 500 ml of the test fuel to pass through the pad. Take a new reading in the instrument and the difference in readings will be the water content in ppm.

Additives in fuels, including jet fuel, have variable effects on readings. Generally, heating oil additives tend to mask the presence of water, but experience to date indicates that additives in jet fuel tend to cause slightly high readings.

CARE OF THE COMPARATOR CHAMBER

The inside surfaces of the chamber must be kept clean. Dust and dirt often glows brilliantly in ultraviolet light and this will cause a reading error. To test for such dirt, turn on the light in a dark room with the instrument pack removed. Remove all glowing particles inside of the comparator chamber, being careful not to scratch off the black paint. Do not move or remove the iris diaphragm from its installed position because it has been carefully positioned at the factory and cannot be reset in the field without a special gauging tool.

COMMENT

The measurement of water in jet fuel has occupied our staff for more than 50 years. We have learned from this experience that the variables are infinite and that no device or procedure has ever been developed that can be called a "referee" method.

The water content of jet fuel is constantly changing as the humidity of the air above it changes. Temperature has a substantial influence. As a general rule, 1 ppm of water will come out of solution in the fuel that is saturated for every degree of temperature reduction if the fuel sample is water saturated. The average jet fuel will have about 70 ppm of water in solution at 70°F. At 60°F, the dissolved content is only 60 ppm. Sampling connections that are long enough to permit temperature changes will always cause anomalous results. If cooling takes place, the reading will be high and vice versa.

It is possible for free water to remain for several hours in jet fuel that is not saturated. Why water will dissolve almost instantly up to saturation in one jet fuel and not in another has never been explained.

The method that was used to calibrate the Aqua-Glo Water Detector eliminated these variables. There was no laboratory or field method that could determine undissolved water content. The method that was selected was the direct injection of a 1000 ppm water-in-fuel concentrate to the Aqua-Glo detector pad while a stream of saturated fuel was passing through the pad. To insure that the fuel was actually saturated, it was kept in a temperature controlled room in continuous contact with water in a container having a humidity controlled vent. The use of a 1000 ppm concentrate, and a hypodermic syringe to inject it, eliminated errors in measurement that would have resulted from having to measure minute quantities of water.

The Aqua-Glo Water Detector Kit has been used very extensively in the testing of filter separators. Aside from the advantage that it is fast, it completely eliminates the inaccuracy of the Karl-Fischer titration method. One problem with that method is that the fuel is usually below saturation, even after it has passed through the filter separator. If the filter separator is allowing 20 ppm of free water to pass and the fuel is 20 ppm below saturation, the Karl-Fischer results will show that there was no free water. The Aqua-Glo kit will accurately report 20 ppm.

NOTE

The Aqua-Glo Water Detector Kit that has been supplied to you is the new Series III model that replaced the Series II in 1983. We are pleased to advise you that substantial improvements have been made in the ultraviolet light unit to insure a longer battery operating period. Other advantages are as follows:

1. The battery recharger is built into the light unit and is not a separate item. Therefore, there is no need to remove the battery to recharge it.
2. You can operate the Aqua-Glo Series III directly from 120 V, 60 Hz or 50 Hz power by turning the selector switch. If your order specifies 220 V, we wire the circuit accordingly, and identify the assembly with a -1 suffix, e.g. GTP-322-1 or GTP-323-1, depending upon whether it is a standard Aqua-Glo kit or a combination kit.
3. You can also operate from an auxiliary battery, GTP-2404, which may be carried in the field to provide supplementary power. Also order the wire connector GTP-2403.
4. When the change was made from Series II to Series III, the calibration of the Aqua-Glo instrument was not effected because the change was in the ultraviolet light unit only.
5. Series II kits that are now in use can be modified to the new Series III configuration and will fit in the standard carrying case. Contact the factory for a quotation and instructions.
6. You can recharge the auxiliary battery pack thru the unit, charging both internal and external batteries at the same time.

OVERHAUL AND REPAIR POLICY

If this instrument ever requires repairing, we recommend that it be returned to the factory. Here is the procedure:

1. Place a telephone call to 1-800-524-0287, and ask for the Order Entry Department. Explain that you want to return an Aqua-Glo kit for repair.
2. You will be given a Returned for Repair Authorization (RFR) number which you must mark on the package.
3. Ship the instrument to us at your expense. Be sure to include the Calibrating Standard in the shipment. We strongly urge that you make shipment in the original carrying case for safety in transport. If any items in your kit have been lost, be sure to tell us so that we can quote the price of replacements.
4. Within one day after receipt of your kit, we will prepare an estimate of the cost of repairs and notify you of the amount. If you elect to have us proceed with repairs, send us a purchase order. We accept most credit cards. If you decide not to have the repairs made, we will return the kit to you at our expense.
5. If the instrument is less than one year old and we determine that the malfunction was not caused by operator abuse, we will make the repairs and return the instrument at our expense.

An alternative to returning the instrument for repair is for you to request trouble shooting and overhaul instructions. A qualified instrument or electrical technician is necessary.

ABBREVIATED PROCEDURE

1. Provide a suitable quick disconnect fitting to obtain a sample from a flowing pipe.
2. Calibrate the instrument. Place the calibrating standard in the test pad window, noting the "set point". Check the code on the calibrating standard to insure it is the same code on the fluorescing standard.
3. Switch on the ultraviolet light using the rotary switch. Depress the push button on the Photocell Comparator.
4. Move the lever on the back of the instrument until the red pointer on the instrument settles for 10-15 seconds at the "O" point. Read the position of the lever along the Calibrated scale. If the reading is not the same as the "set point", make an adjustment of the potentiometer with the screw driver. Remove the plug screw first.
5. Repeat the reading process until you get the correct scale reading. Reinsert the plug screw.
6. Flush the sampling port (quick disconnect) first by connecting the Pad Holder without a water detector installed. Lift the handle of the inlet valve and allow 1 liter to pass into a jar.
7. Disconnect the Pad Holder assembly from the sampling port and install a water detector pad from the sealed envelope being careful not to touch the orange coating with fingers or to allow any water contact. The orange coating must face the inlet.
8. Reconnect the pad holder. Hold the calibrated bottle so that the outlet flow from the discharge tube enters the bottle.
9. Open the toggle valve. Close it again when you have collected 500 ml.
10. Remove the Pad Holder assembly from the quick disconnect and take the pad from the holder with tweezers so you can blot the pad 3 or 4 times between dry paper towels using the heel of your hand for pressure.
11. Place the pad under the hinged flap with the orange side facing the open port.
12. Switch on the ultraviolet light using the rotary selector switch. Depress the push button on the Photocell Comparator.
13. Move the lever on the back of the instrument until the red pointer on the instrument settles for 10-15 seconds at the "O" point.
14. Turn off the rotary selector switch and read the position of the lever along the calibrated scale, estimating to one tenth, such as 3.7. This means 3.7 ppm free water content.

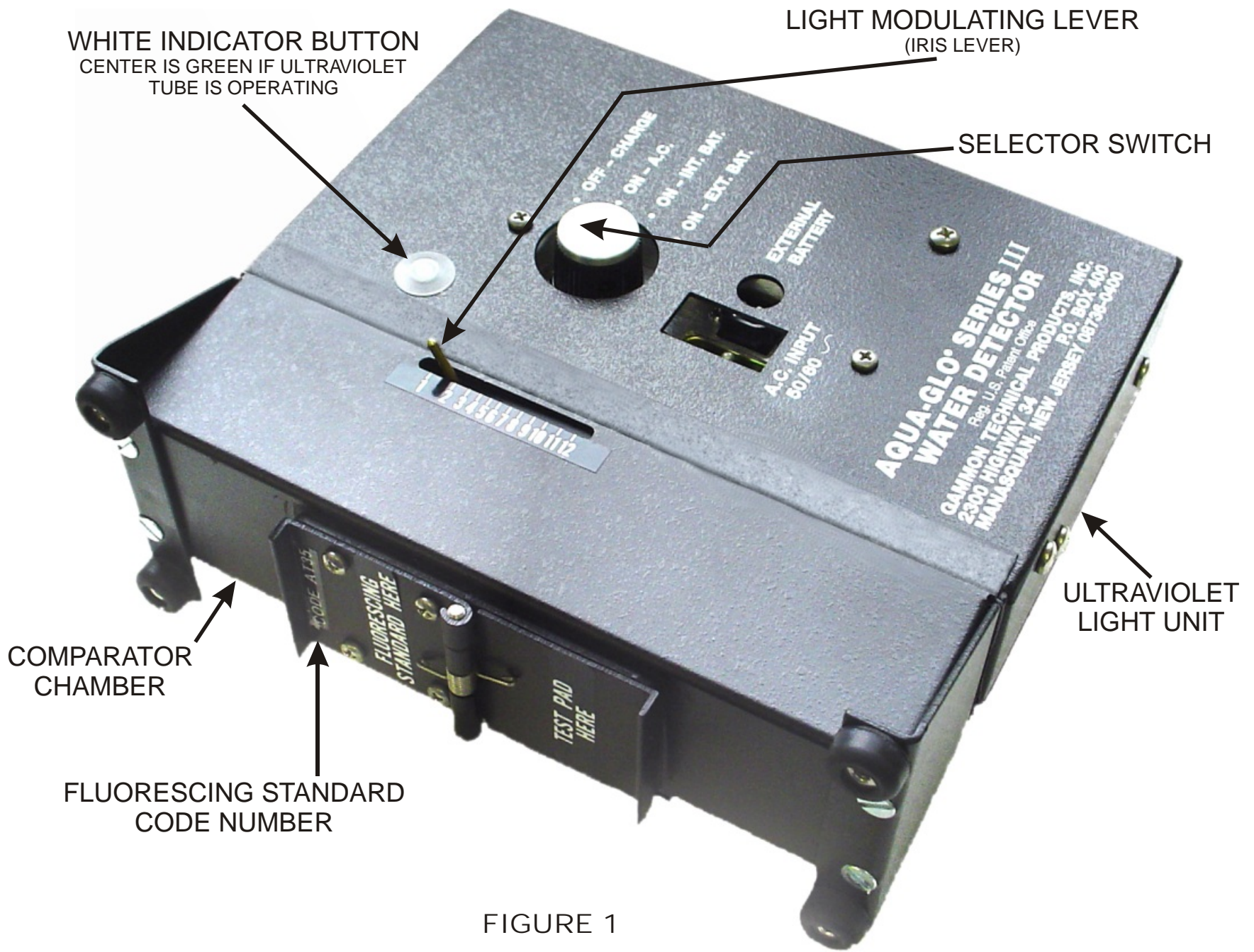


FIGURE 1

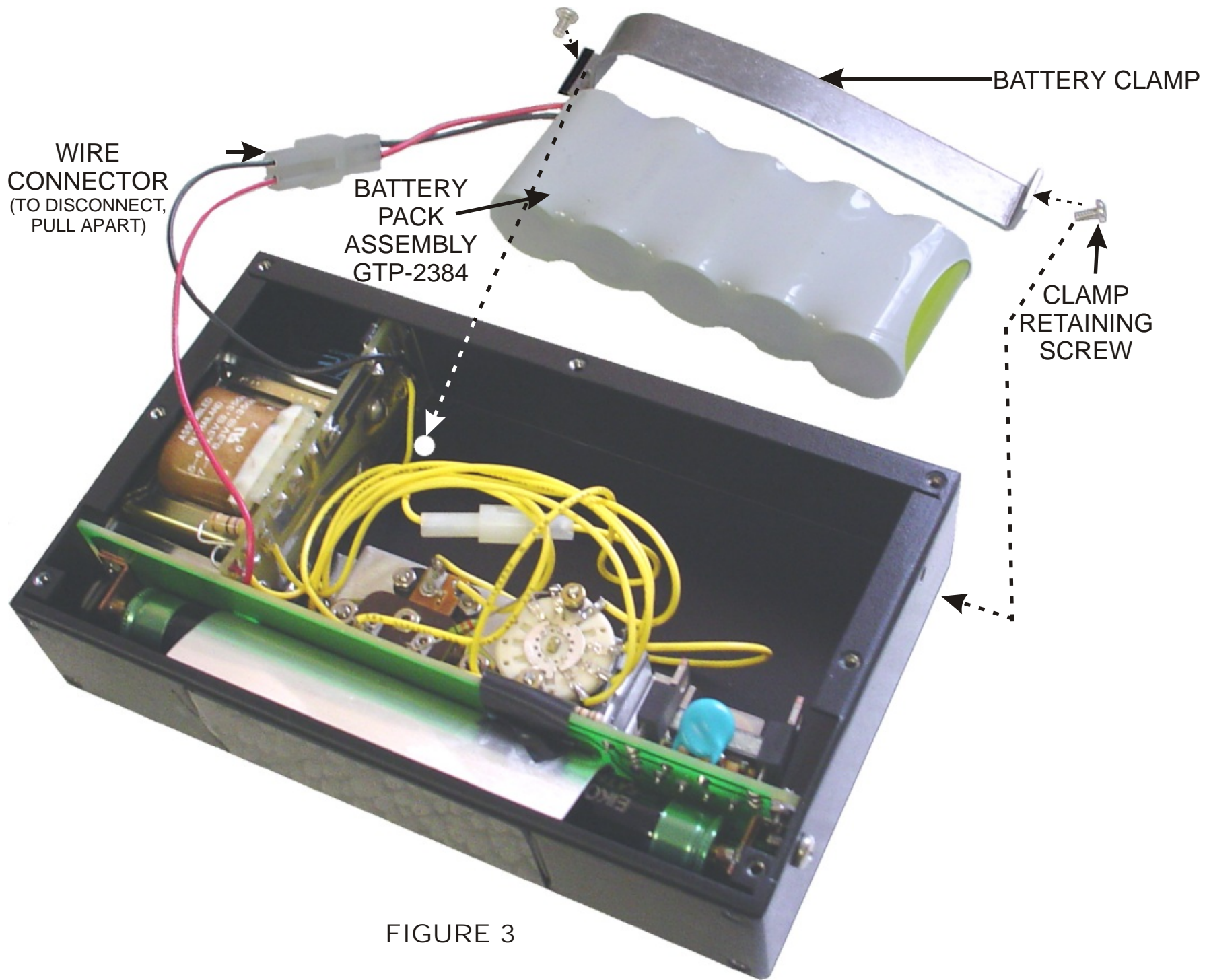


FIGURE 3