



## **D-2 INCORPORATED**

### **HYDRO-LIGHT WATER PAD READER JF-WA1**

## **OPERATION MANUAL**

### **REVISION - FIRMWARE VERSION 1.09 P/N A480-003**

This manual covers the operational aspects of the D-2 JF-WA1 Hydro Light Sensor. D-2 continuously strives to meet the full expectations of our customers and we welcome comments on the structure, content and the ability of this manual to answer your questions regarding our product. If you have any suggestions or comments please contact us at [Mail@D-2inc.com](mailto:Mail@D-2inc.com). This document is provided with the understanding that future versions of this instrument may have additional commands, and the function of the commands shown in this document may vary from the present operation.

**TABLE OF CONTENTS****OPERATION MANUAL**

<b>1.0 GENERAL</b>	<b>3</b>
<b>2.0 USAGE</b>	<b>3</b>
<b>3.0 THEORY OF OPERATION</b>	<b>3</b>
<b>4.0 OPERATING INSTRUCTIONS</b>	<b>6</b>
<b>5.0 FIELD VERIFICATION PROCEEDURE</b>	<b>7</b>
<b>6.0 SPECIFICATIONS</b>	<b>8</b>
<b>7.0 SERIAL DATA INTERFACE</b>	<b>9</b>
<b>8.0 CALIBRATION</b>	<b>12</b>
<b>9.0 FILTERED OUTPUT</b>	<b>12</b>
<b>10.0 MAINTENANCE</b>	<b>13</b>
<b>Appendix A: Service &amp; Warranty Policy</b>	<b>14</b>

## 1.0 GENERAL

The D-2 JF-WA1 Hydro Light Sensor is a reliable instrument for the measurement of water pads used to measure free water in fuels. The JF-WA1 Hydro-Light Sensor incorporates innovative optics and electronics which use Digital Signal Processing (DSP) techniques to accurately determine the fluorescence of free water test pads in accordance with ASTM 3240. The instrument will measure 1.0" test pads with free water in the range of 0 – 50 ppm, although it is optimized and normally used in the 0 to 12 ppm range. The sensor offers RS-232 data output. User instrument calibration terms are stored in internal non-volatile memory. The D-2 sensor is continuously internally electronically calibrated. Absolute calibration relies only on the sensor optical geometry that is very stable by design. The sensor has a built-in temperature sensor which is used to compensate for ambient operating temperature.

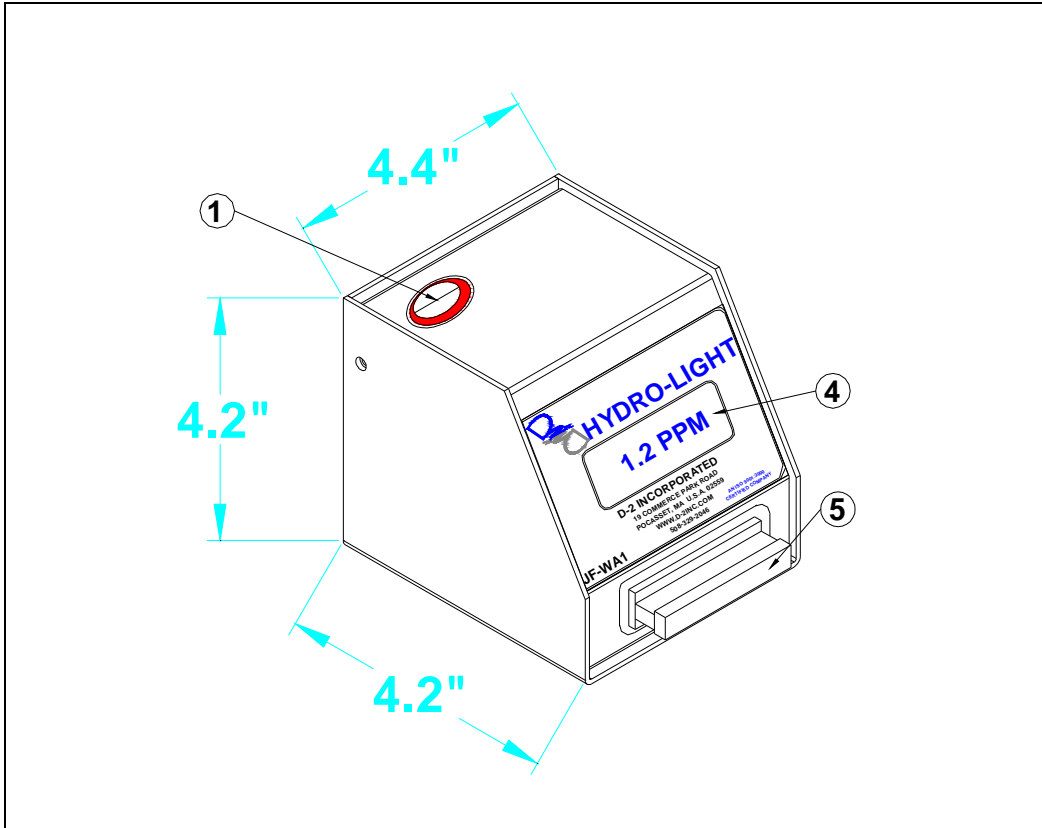
## 2.0 USAGE

Fuel products such as jet aviation and diesel fuels can have free water content from a variety of sources. A known volume of Fuel is run through a paper test pad per the requirements of ASTM 3240. If the fuel has free water it reacts with the fluorine dye on the pad. This reaction is read optically by the JF-WA1 Hydro-Light.

## 3.0 THEORY OF OPERATION

The D-2 JF-WA1 Hydro-Light Sensor uses Light Emitting Diodes (LED's) to illuminate the test pad, while it is inside the sensor chamber. A high performance detector receives the fluorescent light reflected back from the pad. The instrument measures the amount of light received back to determine the concentration of free water which came in contact with the pad as a result of its exposure to fuel. The display reads directly in PPM scaled to the standard size 500 ml fuel sample as outlined in ASTM D3420. If an alternate amount of fuel is sampled through the pad the displayed number need only to be scaled by the ratio of the amount fuel sampled to the standard 500 ml sample size.

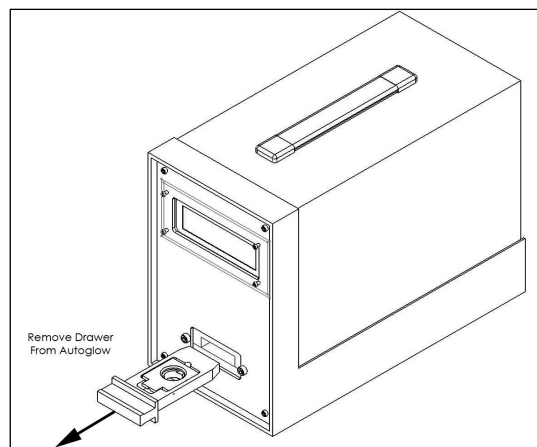
Figure 1  
Major System Components



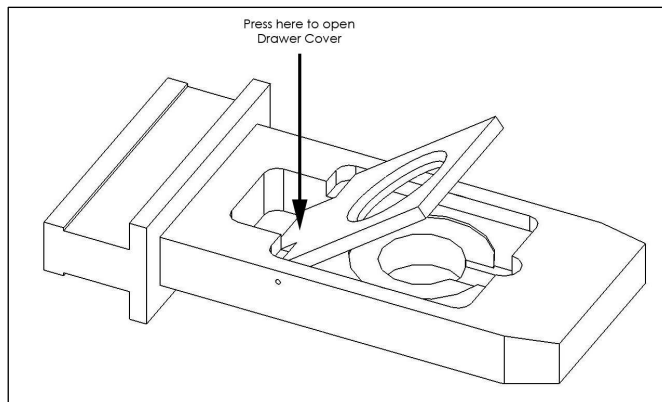
- 1 On-Off Switch
- 2 Wall Power Adaptor (rear not shown)
- 3 RS-232 Port (rear not shown)

- 4 Displays
- 6 Pad Shuttle

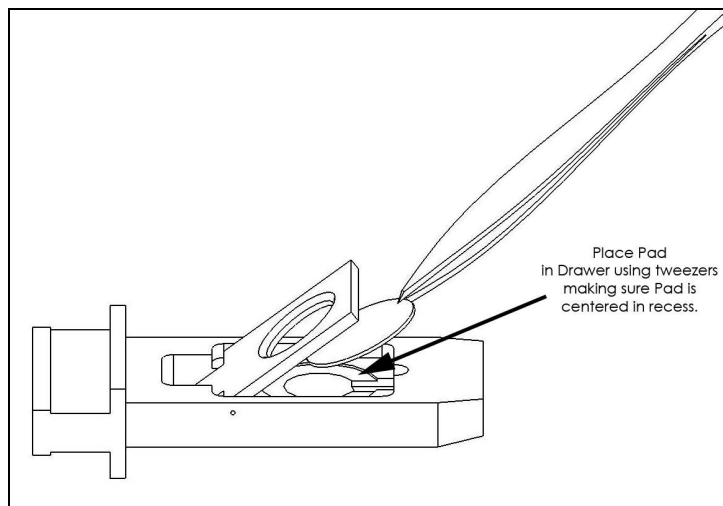
**Figure 2**



**Figure 3**



**Figure 4**



## 5.0 Operating Instructions

### Step-by-Step Operation Procedure

1. Connect Hydro-Light power supply to power input on the rear panel of the unit (Figure 1) and plug into 90 – 340 VAC 50/60 Hertz outlet.
2. Turn the Hydro-Light unit on with switch at the top of the chassis (Figure 1). The display will illuminate. After 10 seconds, the top line of the display will show the text “Hydro-Light”. The Hydro-Light unit is now ready to use. The lower display will indicate the next factory calibration date.
3. If there is no pad present, the display should read “0 PPM”.
4. Remove the pad holder shuttle from the front drawer of the unit. (Figure 2).
5. Press down on the tab to open the shuttle cover (Figure 3).
6. Using tweezers, insert the pad which was produced in accordance to ASTM Method D3240 into the shuttle (Figure 4). Insure that the pad is centered in the recess of the shuttle. The yellow side of the pad that is to be measured should be facing upwards in the shuttle and the box.
7. Let the cover close to hold the pad in place.
8. Re-insert the pad holder shuttle into the Hydro-Light drawer with the pad facing up.
9. Allow 10 seconds for the Hydro-Light unit to fully update the pad reading after insertion. The display number will momentarily flash each time an update occurs.
10. Your Hydro-Light will now display the PPM free water content of your 500ml sample.
11. The Hydro-Light reads directly if the sample volume is 500ml. Correct the reading for other sample sizes by multiplying the displayed reading by  $(500/\text{Sample size in milliliters})$ .
12. Remove the shuttle and remove a discard the test pad.
13. Factory recalibration each year is suggested. To verify calibration in the field use the calibration standard pad and record the daily value, as long as the value remains within the 1.5 ppm of the daily value average the Hydro-Light is calibrated correctly.

## 5.0 FIELD VERIFICATION PROCEDURE

*Note: Verification is at the option of the user, the instrument will remain its calibration if use as described within this document over the annual factory calibration interval.*

### Step-by-Step Operation Procedure

1. Connect Hydro-Light power supply to power input on the rear panel of the unit (Figure 1) and plug into 90 – 340 VAC 50/60 Hertz outlet.
2. Turn the Hydro-Light unit on with switch at the top of the chassis (Figure 1). The display will illuminate. After 5 seconds, the top line of the display will show the text “Hydro-Light”. The Hydro-Light unit is now ready to use. The lower display will indicate the next factory calibration date.
3. With no pad present, the display should read “0 PPM”.
4. Remove the shuttle from the front drawer of the unit (Figure 2).
5. Press down on the tab to open the shuttle cover (Figure 3).
6. Remove the D-2 Calibration Pad (Date Coded for the Month /Year) that you are in. Read the value in PPM from the label on the “down side” of the calibration pad and note. If the date has expired select the correct pad with month and year as verification being made, discard all old standards.
7. Using tweezers, insert a D-2 Incorporated Calibration Standard pad into the shuttle (Figure 4). Insure that the pad is centered in the recess of the shuttle.
8. Let the cover close to hold the pad in place.
9. Re-insert the shuttle into the Hydro-Light drawer.
10. Allow 5 seconds for the Hydro-Light unit to fully update the pad reading after insertion. The display number will momentarily flash each time an update occurs.
11. Your Hydro-Light will now display the calibration value PPM or the standard pad (note if the pad is left in the reader the values will start to drop due to the bleaching effect of the light on the standard pad, DO NOT LEAVE THE STANDARD PAD IN THE HYDRO-LIGHT).

12. The Hydro-Light reading should equal the previously noted standard pad reading +/- 10% ppm (Typically +/- 4 PPM as the standard pads has an absolute reading around 40 ppm). The standard pad and the Hydro-Light read within this tolerance you can proceed to use the instrument.
13. Remove the shuttle and remove the standard pad and return it to its light protecting package.
14. Factory recalibration each year is suggested.

**NOTE: Standard pads are light sensitive do not leave them exposed to light either inside or outside the Hydro-Light reader. Always return standard pads into the supplied factory package. Discard all standard pads where the date stamp is prior to the current month and year.**

## 6.0 SPECIFICATIONS

Table 2  
SENSOR SPECIFICATIONS

SENSORS:

Parameter	Free Water	Temperature
Range	0 – 50 PPM	0 – 50 C
Accuracy	+/- 0.5 PPM (+/- 2%) of Reading	+/- 1.0 C
Resolution	0.1 PPM	0.1 C
Sensor Type	Optical LED Driven	Platinum RTD
Calibration	Internal Zero & Scale	NIST ITS-90

Table 3  
SYSTEM SPECIFICATIONS

SYSTEM:

ELEMENT	SPECIFICATION
Environmental	10 to 40 C Operation -20 to 60 C Storage
Power	9 VDC Minimum

	38 VDC Maximum
Certification ASTM	D3420
Certification Sensor	ATEX

## 7.0 SERIAL DATA INTERFACE

The D-2 JF-WA1 has a comprehensive serial interface. The instrument contains no internal electrical adjustments. All instrument calibration constants and configurations are stored in internal non-volatile memory. The unit also has programmable optics temperature compensation constants.

***JFWA1WIN can be provided. This program provides a complete PC interface to the D-2 JF-WA1 Hydro-Light Sensor, data collection, real-time display, and data logging for this sensor system. Consult the factory.***

### 7.1 RUN MODE

When powered the unit commences operation in the "RUN MODE." The unit sends the following sign on ASCII message at 9600 Baud, 8 Data Bits, No Parity and 1 Stop bit:

(Note: Orator Text Used For All Instrument Outputs)

```
D-2 Incorporated
Hydro-Light JF-WA1
Version 1.0
PPM, TEMP(C)
```

The last two lines are headers for the data output columns. To collect data the user need only send an ASCII Carriage Return (Hex 0A) <CR> or ASCII Line Feed (Hex 0D) <LF>. The unit will respond with a single line of data:

```
13.0,    15.4<CF><LF>
```

Where: 13.0 = PPM Measured

15.4 = Temperature Inside JF-WA1 in Celsius

### 7.2 CONTINUOUS DATA

To have the unit send data continuously without polling, the user can send the "SC" Set Continuous Command. The unit will commence sending data at the data rate and current averaging rate. To stop continuous data the unit will only accept one command, which is the capital "S" Stop Command followed by a carriage return or line feed.

**Note: The Stop Command is the only case sensitive command!**

### 7.3 OPEN MODE

In OPEN MODE the unit stops collecting data and awaits user instructions such as calibration constants, or averaging settings, etc. The OPEN MODE can be attained by sending the "\*\*\*O" command. The unit after entering open mode will send "OPEN MODE" when polled using a carriage return or line feed. From open mode the user can view all constants using the "RCAL" command. The RCAL Command will return the following:

\*\*\*O

```

Open Mode
RCAL
1314
VER = 1.0
CDATE=10APR09
ZERO=55.000000
FS=1900.000000
BT=67.759354
MT=-9.510620E-05
TREF=20.00000
N=1.000000
NREF=1.00000
    
```

In the Table Below the definition of each of these constants is given:

Table 4  
OPERATIONAL CONSTANTS

Constant	Definition
1314	Unit Serial Number
VER	The Firmware Version

CDATE	Last Factory Calibration Date
ZERO	The value assigned to the zero reference reading, used to set $Y=MX+B$ for the optic channel
FS	The value assigned to the Full Scale reference reading, used to set $Y=MX+B$ for the optic channel
BT	The Temperature Channel Offset Value
MT	The Temperature Channel Slope Value
TREF	The Temperature Reference for Optic Compensation
N	The Number of Samples of PPM Box Car Averaged See Section 13.0
NREF	The number of Reference Channels Averaged

Any constant can be read individually by entering the reference name followed by a <CR>. Any constant can be set by entering the reference followed by an equal's sign and then the new value to be entered. All constants can be stored in non-volatile memory using the \*\*\*E command. Note, cycling power after changing constants and before storing them in non-volatile memory using the \*\*\*E command will result in the unit reverting to the original values stored.

To return to run mode, issue the \*\*\*R command or cycle power.

#### 7.4 CALIBRATION MODE

In CALIBRATION OPEN MODE the unit collects data and outputs all raw data and processes measurements. To enter the CALIBRATION MODE the "\*\*\*C" command sent from the OPEN MODE (See Open Mode Above). After entering CALIBRATION MODE the unit will send the following frame of data when polled using a carriage return or line feed. The SET CONTINUOUS "SC" command also operates in Calibration Mode

\*\*\*C

-9433, -8351, 491, 2.2, 21.0

Where:

-9433 = Counts Electronic Zero Reference

-8351 = Counts Optic Circuit

491 = Counts Temperature Circuit

2.2 = Calculated PPM

21.0 = Calculated Temperature Celsius

(Note that the numbers above are examples only; actual values obtained will vary)

## 8.0 CALIBRATION

Return the unit to the factory.

## 9.0 FILTERED OUTPUT

Boxcar (low pass filter) Average:

The D-2 JF-WA1 Hydro-Light Sensor has a user specified filtered output. The output is box car averaged. The number of box cars can be set from 1 (no filtering) to 10 (maximum filtering). The box car filter has the numerical equivalent of a low pass filter. Mathematically the form is:

Filtered Output =  $1/n * \text{new reading} + n-1/n * \text{old reading}$

In the table below 63% and 90% response times are given for each box card setting. See Section 10.0 for setting the box car number constant n.

Box Car Average N	63% Response Seconds	90% Response Seconds
1	1	1
2	3	7
3 *	6	11

4	7	17
5	9	21
6	11	26
7	13	30
8	15	36
9	17	40
10	19	44

- N= 3 is Factory Default

## 10.0 MAINTENANCE

***NOTE: There are no user-serviceable components inside the D-2 JF-WA1 Hydro-Light Sensor. There are NO Electronic adjustments inside the sensor.***

### 15.1 Calibration Interval

The D-2 JF-WA1 Hydro-Light sensor should be calibrated annually by the factory. The instrument has no internal electrical adjustments that need to be maintained inside this period.

### 15.2 ZERO TESTS

The best indicator of static operation of the sensor is the reading of an unused water pad (note excessively humid air may result in higher zero readings). Insert a new sensor pad, zero readings should be stable and less than 1 PPM. If readings are in excess of these values or unstable readings occur, the unit should be returned to the factory for servicing and possible re-calibration.

## APPENDIX A:

## LIMITED WARRANTY

One year from date of shipment, D-2 Incorporated, guarantees its products to be free of defects in materials and workmanship. In the event a product malfunctions during this period, the company obligation is limited to repair of the defective item at our factory, or the defective item may be replaced at our option. Instruments found defective should be returned to the factory prepaid and carefully packed, as customer will be responsible for freight damage. D-2 will pay return shipping on any warranty repairs.

Repairs or replacements under warranty will be at no cost to the customer for parts, labor, or return shipment from our factory to the customer. This warranty is void if in our opinion the instrument has been damaged by accident, mishandled, altered or repaired by the customer where such treatment has affected its performance or reliability. In the event of such abuse by the customer, all costs for repairs plus freight costs will be borne by the customer. All equipment supplied by D-2 that is designed for use under hydrostatic loading has been certified by actual pressure testing prior to shipment.

The customer will be charged a diagnostic fee plus all shipping costs if an instrument is returned for warranty repair and no defect is found by the factory. Incidental or consequential damages or costs incurred as a result of product malfunction are not the responsibility of D-2 Incorporated.

Equipment not manufactured by D-2 Incorporated, is supported only to the extent of the original manufacturer's original warranties. All OEM sensors which utilize electrodes (oxygen cartridges, pH, ORP, etc.) is warranted at the time of shipment, and shall perform upon initial installation within stated specifications. If the product proves to be defective within the OEM's warranty we will replace the product or defective part with a similar model, product or part, but only to the extent that the OEM will warrant.

All returned products must be accompanied by a Returned Material Authorization (RMA) number issued by D-2 Incorporated. Shipments will not be accepted without the RMA number. An RMA number can be obtained by calling Customer Service Department at 508-329-2046 or by emailing [Mail@D-](mailto:Mail@D-2.com)

[2inc.com](http://2inc.com).

The following information should accompany any instrument being returned to the factory:

Return Authorization Number  
Model/Serial Number  
Brief Description of the Problem  
Customer Contact/Telephone Number

#### CALIBRATION SERVICE POLICY

A calibration only service is available for JF-WA1 Hydro-Light Sensors.

The service is limited to instruments requiring only calibration and minor adjustment. Instruments that are not operating properly and require repair or replacement parts will not be covered. If repair is necessary the customer will be contacted and apprised of the additional cost. The customer will be charged the standard repair cost, which includes repair and calibration. In the event that the customer does not approve repair, the unit will be returned in "as received" condition and the teardown and inspection charge will be invoked.

The customer will be required to obtain a return authorization number from Customer Service at D-2 Incorporated prior to the return of the instrument. This number should be displayed on the outside of the container, preferably on the shipping label, and included on the shipping documentation sent with the instrument.

If possible, the following information should accompany the instrument:

Return Authorization Number  
Model/Serial Number  
Customer Contact/Telephone Number