8500

WIRELESS SMOKE OPACITY METER

FULL FLOW HEAD

WAGER
COMPANY

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WARRANTY

Seller expressly warrants to Buyer (a) that the equipment will comply with the description set forth herein; (b) that the components and parts fabricated by Seller will be free from detrimental defects in workmanship and materials.

If it appears within one year from date of shipment by Seller that the equipment does not meet these express warranties and Buyer gives Seller prompt and reasonable notice, Seller shall, at its option, either repair or replace at its expense, F.O.B. Seller's works, but not dismantle or reinstall, the defective parts provided, upon request such parts are shipped freight prepaid to Seller's works.

These warranties shall not apply if equipment is subjected to other than normal and proper storage, handling, installation, operation and maintenance or to unauthorized repairs or alterations. Equipment, components and accessories made by other manufacturers are warranted only to the extent of the original manufacturer's warranties to Seller. The foregoing warranty obligation of the seller shall constitute the sole and exclusive remedy of the buyer and the sole liability of the seller, except as set forth herein and except as to the title it is expressly agreed (a) that there is no warranty of merchantability of any other warranty, express, implied or statutory, nor any affirmation of fact or promises by Seller with respect to the equipment or parts or otherwise which extend beyond the specifications mutually agreed upon in writing by Seller and Buyer, and (b) that the Buyer acknowledges that it is purchasing the equipment solely on the basis of the commitments of Seller expressly set forth herein, in no event shall Seller be liable for special, indirect, or consequential damages including, without limitation, anticipated profits.

GENERAL

The Wager Model RHW Series 2 Full Flow Smoke Meter is in full compliance with the requirements of the SAE J1667 test criteria—the current U.S. standard.

The system's simple design, portability, and ease of use provide the user an effortless method to measure diesel exhaust opacity readings with an accuracy of + or – 1 percent. With all system components being wireless, this eliminates the need for cables and harnesses. The wireless nature of the system reduces the effort of the operator greatly and also enables the operator to perform testing and printing without the need to attach and detach devices. RHW Series 2 provides readings which ensure compliance with local diesel emissions standards, promotes combustion fuel efficiency, and also indicates if a engine requires maintenance.

The guidelines and rules of the SAE J1667 can be acquired from:
•SAE International
•400 Commonwealth Drive
•Warrendale, PA 15096 Telephone (724)776-4970

or electronically downloaded at:
•www.sae.org

The RHW Series 2 Full Flow enables the operator to enter test information (VIN, customer address, etc) into the system, reads ambient weather conditions (relative humidity, barometric pressure, air temperature), performs 3 preliminary and 3 final snap tests using full flow technology, and outputs all this data for printout on the wireless portable printer.

Throughout this manual HC referrers to hand controller and SH referrers to senor head.

SYSTEM PARTS LIST

Description	Part Number
HC Assembly	199-0000
SH Assembly Module	199-0012-BB
Full Flow Yoke Assy	194-0002
Magnetic Band Clamp	194-0005
Transmitter Wireless Assy	199-0164
Receiver Wireless Assy	199-0165
Transmitter Cable Assy	199-0164-2
Receiver Cable Assy	199-0165-2
Charger, SH &HC	199-0005
SH Battery Pack	199-0003
HC Battery Pack	199-0004
.2ND Verification Filter FF	544-0006
Carrying Case	147-0150-2
Extension Pole	147-C0092
Removable Pole	199-0028-7
Pole Bracket Top	199-0028-5
Pole Bracket Bottom	199-0028-6
Xbee Wireless Module	199-0033
Wireless Printer Assy	OM7212-ZB
Charger, Printer	199-0036
Paper Roll	566-0007

R.H.W. Series 2 Full Flow complete system includes the HC, the SH, three wall chargers, a .2 neutral density verification filter, portable printer, carrying case, and telescopic pole.

Hand Controller

The hand controller is a battery powered wireless device that contains the atmospheric sensors and is operated using the membrane keypad in the menu driven operation program. Charging jack in located on the left side of the HC.

Sensor Head

The sensor head assembly uses full flow technology and is attached to the vehicle exhaust using a band clamp and magnetic hook. Latches are used to gain access to the optical lens for maintenance. Potentiometer screws are located in the optics to perform adjustment of the optical signal. Charging jack is located on the underside of the sensor head module.

Verification Filter

This filter is used during the filter test and contains a .2 neutral density filer and is placed flush up against the metal baffle centered over the hole that is emitting the green light (transmitter).

Power Packs

There are two universal power packs that are used to charge the HC and SH and a third one to charge the printer.

Portable Wireless Printer

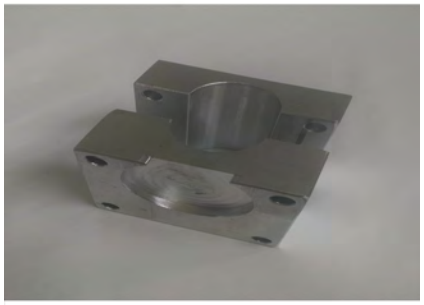
This wireless printer is battery powered with the power jack and on/off switch located on the back of the unit. It uses 45mm thermal paper.

Telescopic Pole

This pole is expandable and is used to raise the SH above the cab to reach over-the-cab exhaust pipes. It may have a detachable mini segment for use on below-vehicle exhaust systems.

Carrying case

The case is used for transportation and storage of the system and provides individual compartments for each of the system components. Lifting the tray reveals the bottom section.



Pole Brackets

These brackets are used to mount the sensor head black box module to the telescopic pole. Note that the bracket in the foreground has a circular cutout and is used to mate to the module.

INITIAL SET UP

1.	PRESS THE **ON / OFF** BUTTON TO POWER ON THE METER
2.	PRESS THE **A KEY** FOR CONFIGURATION
3.	PRESS THE **E KEY** FOR EDIT TEST FACILITY INFORMATION
4.	USE THE **ARROW KEYS** AT THE BOTTOM OF THE KEY PAD TO SCROLL THROUGH EACH LINE AND THE **NUM ALPHA KEY** TO ENTER NUMBERS. ENTER IN YOUR TEST FACILITY INFORMATION
5.	ONCE COMPLETE, PRESS THE **SAVE KEY**
6.	PRESS THE **HOME KEY** TO RETURN TO THE MAIN MENU
7.	PRESS THE **A KEY** FOR CONFIGURATION AGAIN
8.	PRESS THE **I KEY** TO SET TEST OPTIONS
9.	TO CHANGE ANY OF THE TEST OPTIONS, PRESS THE CORRESPONDING LETTER BUTTON
10.	PRESS THE **HOME KEY** TO RETURN TO THE MAIN MENU
11.	PRESS THE **A KEY** FOR CONFIGURATION AGAIN
12.	PRESS THE **M KEY** FOR DATE AND TIME
13.	TO CHANGE ANY OF THE MENU ITEMS, PRESS THE CORRESPONDING LETTER BUTTON
14.	WHEN COMPLETE, PRESS THE **ENTER KEY**
15.	PRESS THE **HOME KEY** TO RETURN TO THE MAIN MENU

SET-UP FOR TESTING

Installation of the Sensor Head

No matter what style of exhaust system your vehicle has, the Full Flow style attaches the same way. Engage the magnetic hook over the lip of the pipe and fasten the band clamp using the latch and hair pin. Once the magnetic bland clamp it fastened, loosen the nut and bolt and rotate the yoke into position so that the beam is centered over the opening of the exhaust and is about 1-2 inches from the end of the pipe. The full flow head never touches the flow of exhaust and is best for long duration testing, including tests that are performed using a Dynamometer. Ensure the beam of light is parallel to the ground.

Caution: *Ensure the sensor head has been powered on and self-calibrated before affixing the sensor head to the exhaust. If you self-calibrate the unit while the sensor head is in the flow of exhaust, the equipment will see the exhaust, think the exhaust is the normal dust in the air, and call it zero.*

SNAP ACCELERATION TEST

The R.H.W. Series 2 Full Flow Smoke Meter has been designs in details to meet the specifications of the SAE J1667.

The HC has a menu driven user interface that will prompt the user to enter required data, depress required buttons, and guide the user to completion of the snap test.

A snap test is defined as the peak measurement of opacity of a diesel engine when the throttle is depress so as to enable the engine to run at maximum governed rpm for a duration of 5 – 7 seconds. Once the snap is completed, release the throttle, and let the engine return to base idle.

Performing this snap test 3 preliminary times will enable the user to perform the 3 final snaps. The spread of the tests is calculated by subtracting the smallest measurement from the largest measurement. The preliminary spread must be less than 5% to perform the final snaps and the final spread must be less than 5% to be a valid test. Once all preliminary and final snaps are performed, the system will average the 3 finals snaps and output the average as the result of the snap acceleration test.

SNAP ACCELERATION TEST

1. FROM THE MAIN MENU, PRESS THE **M KEY** TO ENTER THE SNAP ACCELERATION TEST.

2. USING THE KEYPAD, ENTER THE VEHICLE INFORMATION. USE THE **ARROW BUTTONS** TO SCROLL EDIT DATA.

3. START ENGINE.

4. PRESS THE **ENTER KEY** TO BEGIN TEST.

5. ENSURE THE SENSOR HEAD IS NOT IN THE STACK AND PRESS THE **ENTER KEY**.

6. AFTER CALIBRATION IS COMPLETE, ATTACH SENSOR HEAD TO STACK WITH MAGNETIC BAND CLAMP. PRESS **ENTER** TO START THE TEST.

7. DEPENDING ON WHETHER YOU HAVE THE 3 PRELIMINARY SNAPS ENABLED, YOU WILL BE PROMPTED TO RUN THOUGH A SERIES OF 3 OR 6 SNAP TESTS. **FOLLOW THE INSTRUCTIONS IN GREEN.**

8. THE SPREAD OF THE PRE-SNAP TEST MUST BE WITHIN 5% IN ORDER TO CONTINUE TO PERFORM THE ACTUAL OPACITY TEST.

9. AT THE END OF THE SERIES OF SNAP TESTS, TURN THE ENGINE OFF AND REMOVE THE SENSOR HEAD FROM THE STACK

10. PRESS THE **ENTER KEY** TO PERFORM THE ZERO DRIFT TEST

11. AFTER THE ZERO TESTS IS PERFORMED, IT WILL AUTOMATICALLY STORE THE TEST RESULTS. YOU CAN PRINT RESULTS TO THE WIRELESS PRINTER.

The system comes from the factory with a .2 neutral density verification filter. The filter has a known value of opacity. This opacity value is stored in the system and is used to verify the system is functioning properly. On a periodic schedule, run the filter test from the main menu. Follow the instructions displayed on the HC. Once the filter test is complete, the program will indicate if the system is reading opacity within tolerance of the filter value.

NOTE: Each filter is unique and has its own value. If you have multiple systems at your location, keep each filter assigned to its original meter. If you swap filters from one system to another, the filter verification test may fail.

NOTE: The full flow system does not include a zero filter. When the system prompts the user to insert the zero filter, just ensure that the sensor head is not in the flow of exhaust and that the band clamp is not blocking the beam.

Ambient Conditions Calculator

The HC has ambient conditions sensors located on the bottom side of the HC. These sensors record air temperature, relative humidity, and barometric pressure. The user has the ability to enable or disable ambient corrections on the measured opacity. If the user enables ambient correction, then the printout will display the corrected opacity value.

Printing Saved Tests

The system can store up to 128 tests. There are multiple ways in which you can search for and print stored tests. Power on the unit and select Saved Test Searches from the main menu. The user can search for last record, record number, company name, plate number, or inspector. Enter the first few letters or numbers and then press enter. The system will search the database and display all records that match the search parameters. Then select the appropriate record you wish to print.

Below is an example of a print out that will come from the wireless printer.

```
WAGER: WIRELESS MODEL RHW

SH SerialNum:   131
SH,HC Firmware Ver: 2.00, 1.51
User Filter Verification date:
11/13/2013

     Test Facility:
THE WAGER COMPANY
570 MONTROYAL RD.
RURAL HALL NC 27045
Phone Num:  336 969 6909
Fax Num:  336 969 2561
WAGERUSA.COM
InspCtrl: NAME OR NUM HERE

     Vehicle Data:
Company: WAGER COMPANY
VIN: 3
LIC PLATE: NC 1234
State: 123456init
Inspector: MAC TRUCK
ENG YEAR: 1901
STACK SIZE (in): 4
Horsepower: 201 to 300
TEST DATE:  11/13/2013
TEST TIME:  10:20:38
Amb Correction:  ON !!
     Ambient Conditions:
Temperature = 80.6
Relative Humidity = 23.7
Barometric Pressure = 30.2

Preliminary Results:
       Opacity
Test1    0.0
Test2    0.0
Test3    0.0
PRE SNAP SPREAD  0.0
Actual Results:
Test1    0.0
Test2    0.0
Test3    0.0
OFFICIALSNAP SPREAD   0.0
ZERO DRIFT   0.0
THIS TEST IS VALID
TEST ---> PASSED  /  FAILED
Record Number  106
```

SAVE TEST SEARCHES

1. FROM THE MAIN MENU, PRESS THE **I KEY** TO ENTER THE SAVE TEST SEARCHES OPTION

2. ENTER A LETER CORRESPOINDING TO THE SEARCH YOU ARE TRYING TO PERFROM.

3. FOLLOW THE INSTRUCTIONS IN GREEN. ONCE COMPLETE, PRESS THE **ENTER KEY**.

4. USE THE ARROW KEYS TO SCROLL THROUGH TO THE DESIRED TEST. PRESS THE **ENTER KEY** TO SELECT

5. ONCE ENTERED, YOU CAN PRINT THE INFORMATION TO THE WIRELESS PRINTER

6. PRESS THE **HOME KEY** TO RETURN TO THE MAIN MENU.

TECHNICAL SPECIFICATIONS

The R.H.W. Series 2 Full Flow Smoke Opacity Meter meets the SAE J1667 specification for diesel emission testing.

Accuracy

The system is designed to be accurate within + or – 1.0% opacity. The control unit self calibrates each time it is powered on under clear stack conditions with self tests at 0% and 100%.

Ambient Conditions

Normal operating temperature ranges from 32^ to 120^ F (0^C to 50^C). Ambient corrections of the measured opacity can be enabled or disabled prior to testing. If ambient corrections are enabled, the unit will output the corrected opacity reading.

Reliability

Zero stability at less than 1% drift per use.
The backlit TFT display boasts of over 20,000 hours life span.
Optics being pulsed instead of steady on provides extended life of the light source.
Carrying / storage case made of heavy grade material has a life time warranty.
All solid state and state of the art electronics.

Applications

The system is designed for use on any diesel engine, either off-road or on-road, to determine the engines particulate matter (soot).

Functional Description

Powering on the unit, the operator is found at the main menu of the software. Selecting the snap acceleration test option, the HC searches the data base for the current testing location information. At this point the HC also searches the wireless channel to detect other devices (SH, printer) and initializes communications. During the snap test, the unit self-calibrates, testing 0% and 100% limits and then emits a pulsed light beam across the width of the full flow yoke. The system knows how much light is being emitted, knows how much light is being received, and calculates the difference and displays % opacity.

MAINTENCE & TROUBLESHOOTING

The RHW Series 2 Full Flow is built around the most current technology and high grade components.

All parts have a 1 year factory warranty so if the unit is new, do not attempt to alter or replace any of the parts without consent of the factory as this may void the warranty.

As with all electronic systems, do not use when inclement weather is present. Also keep all parts from water.

Charging

The two universal chargers for the SH and HC are interchangeable and can be used on either of these devices. When connected, the LED indicator light on the charger will show green when the battery is half charged to fully charged, and will show red when charging from a deeply discharged battery. Do not attempt to replace any of the battery packs with a non-factory replacement.

The printer charger is specific for the printer only. It is labeled “PRINTER”. Do not use the printer charger to charge the HC or SH. Both the printer and printer charger have LED indicator lights. On the charger, the light will be green when it is plugging into the wall. On the printer, the led will flash when the charger is connected to the printer. After the charger determines the battery requires charging, the led on the printer will turn to solid red. Once the battery is fully charged, the led on the printer will turn solid green.

Filters

The zero filter is clear conditions on the sensor head. Ensure the magnetic band clamp is not blocking the beam and that the sensor head is not attached to the vehicle when you are asked to insert the filter. The reference (verification) filter contains a 12.5mm diameter piece of tinted glass. If during the filter verification test, the filter is reading higher than normal, most likely the filter glass is dirty and requires cleaning with a small dry cloth or q-tip. If during the filter verification test, the filter is reading lower than normal, most likely the filter glass has degraded and would need to be returned to the factory for recertification.

OPTICS SET

The set consists of the transmitter and receiver. The transmitter has 6 pins and the receiver has 5 pins. It is best to periodically clean the lenses with a dry clean cloth. Depending on use, you may have to clean the lenses daily. There are adjustment potentiometers in the optics that adjust the gain of the digital signals. Note : do not adjust these without contacting the technical support as you can render your meter inoperable.

OPTIC CABLES

These head duty cables are used to connect the transmitter / receiver to the wireless sensor head black box module. The cables are keyed so they cannot be connected incorrectly

Sensor Head Black Box Module

The sensor head module is a sealed unit and no maintenance is required for the operation of the meter. Ensure the battery is fully charged as indicated by the Led on the charging unit.

Zero Drift

The zero drift is a procedure to ensure that lenses are not being soiled during a test. Prior to the preliminary snaps, the meter measures zero opacity. At the end of the three final snaps, the meter directs the user to turn the engine off and remove the sensor from the stack. NOTE: if you only turn off the engine and do not remove the sensor from the stack, there are still hot gases rising. So you may fail the zero drift. So after you have turned off the engine and removed the sensor from the stack, the meter measures zero opacity again. Now the meter will compare the initial zero to the ending zero. To pass the zero drift procedure, the difference between the initial zero and the ending zero cannot be greater than 2% opacity. If you are continuously failing the zero drift, there are certain steps to determine the cause.

First, run a simulated test. Leave the sensor head on a table or bench and run a snap acceleration test without the sensor head on the vehicle. All preliminary snaps, all final snaps, and the zero drift should be zero or close to zero. If any of the readings are greater than 2%, this indicates something is defective and contact your vendor. If all the readings are zero or close to zero, this indicates that the meter is working properly and the most likely reason you are failing the zero drift is that the lenses are being coated by soot. In this case, clean the lenses before you start the test and also a second time at the point where it says “turn off the engine and remove the sensor from the stack”. So turn off the engine, remove the sensor from the stack, unclip the optics one at a time, clean the lenses, re-attaching both optics, and then press enter to perform the zero drift test.

Invalid Test

The number one cause for an invalid test is the spread. The spread is the difference in the highest reading and the lowest reading and cannot exceed 5% opacity. For example, on the preliminary snap readings of 24%, 18%, 12%, the spread will be 24-12=12%. So this will be an invalid test as the spread is greater than 5%. To eliminate this spread failure, ensure the vehicle is at normal operating temperature, and perform a few blowout snaps prior to performing the inspection test, then attach the head and perform the test.

Pass/Fail

Each state or country uses different values for different vehicle years to determine if the vehicle is emitting soot in excess of the limits set by the local guidelines. The RHW Series 2 Full Flow does not determine if the vehicle passes or fails a emission test. It is up to the user to know the local regulations and use the average opacity printed out on a valid test report to compare this result with values stated in the local regulations.

Printer

To replace the paper in the printer, raise the smoke colored lid to expose the paper trough. Remove the empty spool and grooved shaft. Discard the empty spool, insert the grooved shaft into the new paper roll and apply the shaft/spool into the trough. Ensure the paper is feeding from the bottom of the trough, up towards the front of the printer. Close the lid and tear off the excess paper.

Case

The case is made of a modern material and comes with a lifetime limited warranty. It is pretty much indestructible under normal use and requires little or no maintenance.

Pole

The telescopic pole, removal pole, and pole brackets are used to position the sensor head to the exhaust. To elevate the sensor head, use both the telescopic and removal poles. Turn the locking rings counter-clockwise to release the lock, and extend the pole up. Once at the desired height, turn the locking rings clockwise to lock. Raise the sensor head above the exhaust and lower the magnetic hook onto the lip of the exhaust. Secure the sensor head with the band clamp and have a person hold the pole during the test to ensure the head is not ejected from the exhaust and becomes damaged.

To lower the sensor head to behind vehicle exhaust system, remove the telescopic pole to shorten the wand. Use the removable pole to position the SH and nozzle into the exhaust pipe.

Wireless Channels

The system communicates via wireless signals that operate on distinct channels labeled C – N. All devices that are considered a system all must be assigned to the same channel. So if the HC is on channel H, the SH and printer must also be assigned to channel H.

The user can run an energy scan to inspect the local environment to see which channel provides the best communication. Running the energy scan displays each channel and the signal to noise ratio and the higher the number is better.

Once you determine which of the channels is best, change the devices in a specific order to the new channel. Change the channel of the printer first, then the SH, and lastly, change the channel of the HC.

If you change the HC channel first, the HC will not be able to see the SH nor the printer, because they are still on the old channel.

The energy scan needs only run if you are having communication issues.