7500

SMOKE OPACITY METER

WAGER

COMPANY

570 MONTROAL RD, RURAL HALL, NC 27045

(336) 969-6909 • 1-800-562-7024 (US) • WWW.WAGERUSA.COM

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WAGER
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WARRANTY

Robert H. Wager Co., Inc.'s full, legal warranty statement is printed on the following page. Here is a quick overview:

The customer is required to return the malfunctioning unit freight prepaid to:

Robert H. Wager Co., Inc.
Attention: Technical Services
570 Montroyal Road
Rural Hall, NC 27045

Please request a Return Authorization if at all possible. We need at least your return shipping address, a contact with telephone and fax number (in case we have questions), and an explanation of the type of error message or problem you have encountered.

Robert H. Wager Co., Inc. will make the appropriate repairs as rapidly as possible (usually within three working days) and return the unit freight prepaid unless otherwise instructed.

If Robert H. Wager Co., Inc. finds—at its sole discretion—that the malfunction was due to customer abuse, misuse, attempts to repair, or other conditions caused solely by the customer, the warranty is void. The unit will be repaired in the normal manner and the customer is invoiced.

In order to establish the date of your purchase and match the serial number of the unit to our records, we require the attached form "Warranty Registration" to be filled out and returned to us.

We reserve the right to alter, amend, or adjust our warranty policy without further notice.

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, anticipate profits.

GENERAL

The Model 7500 Smoke Meter is in full compliance with the requirements of the SAE J1667 test criteria—the current U.S. standard.

The standard requirements are:

40% opacity vehicles 1991and newer,
55% opacity vehicles between 1990 and 1974
70% opacity on vehicles 1973 and older.

We have preset the pass/fail criteria to those points.

In addition, specific requirements for New York and New Jersey's test have been accommodated with the appropriate screen prompts, error messages, and information in the printout.

The meter's simple design and portability makes it easy to obtain accurate measurements. It provides an accurate means (± 1%) of detecting and measuring the opacity of smoke emitted by a diesel engine.

The use of the Model 7500 Smoke Meter promotes combustion efficiency for fuel economy and ensures compliance with diesel emission standards set by environmental air quality codes.

The program document for SAE J1667 is Surface Vehicle Recommended Practice.

It can be obtained from:

SAE International
400 Commonwealth Drive
Warrendale, PA 15096-0001
Telephone: 724/776-4970

Or, if you have access to the Internet, a copy can be downloaded from the web site maintained by California Environmental Protection Agency, Air Resources Board.

http://www.arb.ca.gov/msprog/hdvip/saej1667.pdf

MINIMUM SYSTEM REQUIREMENTS FOR CUSTOMER'S OWN COMPUTER

Windows XP, Vista, Windows 7 Operating System
CD ROM and 3 ½ " Floppy Drive
64 MB RAM, Pentium or Celeron 800 MHz or Higher
VGA/SVGA graphics adapter with 800 x 600 min screen resolution
One USB port (for connection to DCU) - or - One 9 pin serial port Parallel Port, and a parallel port for connection to the printer

*NT SP-6, or higher

Note:
If you are using your own system, there are some files you need to load that will match the filter value and record them on your system. To load the information from the floppy disk provided, see "New Filter Section" section.

To perform the actual filter calibration see "Set-Up for Testing" section.

Please call 1-800-562-7024, ask for "Technical Services" and we will assist you in loading the proper file. Instruction Manual Model 7500 Smoke Meter (New Jersey Version) 14

SYSTEM DESCRIPTION

Data Collection Unit

The DCU collects data from all attached sensors and communicates with the computer. The banana jacks (red and black) allow a 0 –1 VDC output for a chart recorder.

Sensor Head Assembly (Partial Flow)

The partial flow sensor head is attached to the vehicle exhaust in accordance with the criteria in the SAE J1667 document. (The document describes the different stack configurations and the placement of the sensor head).

The Partial Flow Sensor Head is shipped with a straight, curved, and clamping style nozzle. The nozzles are attached with simple snap buckles.

The Bayonet (straight) Nozzle

The bayonet (straight) nozzle hooks over the straight stack..

The Curved Nozzle

The curved nozzle has a stop that allows correct positioning.

The Clamping Style Nozzle

A clamping style nozzle is for quick and easy placement.

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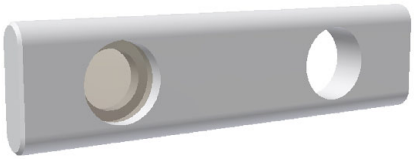
Cable

The connecting cable is 25 feet long. An optional 25' extension cable is available.

Power

The meter is shipped with an AC Adapter/Charger, which operates in 110V. The 12 V sealed, lead-acid cell battery will allow up to 40 hours of continuous operation with a full charge.

Calibration Filter



A .2 Neutral Density Filter (Melles Griot) is supplied with the system. It is a small round glass in a special holder for the partial flow head.

A special "Calibration" sequence is available on the main menu screen. It will prompt you to insert the filter as shown below.

The date of the last calibration will be added to your test print-out.

Extension Pole

A telescoping extension pole is designed specifically for each system. It allows the operator to attach the sensor head to the stack from the ground.

Printer
An HP Deskjet. USB Port, full page portable, battery-operated color ink-jet printer. Or any printer will oper-ate under a Windows environment.

Carrying Case or Shop Cart

Several options are available to provide easy portability or convenient shop use. Please call us or email info@wagerusa.com to discuss your needs.

Shop Cart

Used in a shop setting to provide ease of daily service.

SYSTEM DESCRIPTION

Model 7500 Smoke (Opacity) Meter System Components

Description	Part Number
Data Collection Unit (DCU)	196-0008-1
Power Supply Transformer 110V	196-0006
Hewlett-Packard Desk Jet 450CBI Printer	PRINTER
12V, Sealed, Lead-Acid Battery	196-0030
Fuse	4143551
RPM Phototach Kit (w/base)	196-0012
RPM Extension Cable	195-0018
Reflective Tape, 1 inch wide (per yard)	579-0003
Oil Temperature Probe	195-0023
Oil Temperature Extension Cable 10’	195-0019
25’ Connecting Cable	192-0003A
25' Extension Cable	191-0011
*Partial Flow Sensor Head (lens set below)	194-0028
Transmitter Assembly	147-0164
Receiver Assembly	147-0165
Curved Nozzle	194-0018-C
Straight Nozzle	194-0018-S
Clamp Nozzle	194-0018-SC
Extension Pole, Partial Flow Head	147-C0092-PF
Neutral Density Filter .2 in holder (for PF head)	194-0029-2
Serial Interface Cable	196-0001
Serial/USB Converter Cable	196-0017
Instruction Manual	7500 Manual

*P/N for sensor head assembly is listed without lens set.

Please call us for any item not listed here.

TECHNICAL SPECIFICATIONS

Design Criteria

The Wager Model 7500 Smoke Meter meets SAE J1667 specification, Appendix C, using the required algorithm.

Accuracy

The unit's accuracy is ± 1.0% nominal ± one digit. The system is initially calibrated under clear stack conditions with checks at 0% and 100% opacity.

The accuracy of the unit is verified by use of the .2 Melles Griot neutral density filter supplied with the system.

Ambient Conditions

The unit operates in 32° to 120° F (0° to 50° C).

Please note that under N.J.A.C 7:27B-24, additional ambient conditions apply. This is addressed under "NJ Ambient Conditions".

Reliability

Zero stability at less than 1% drift per use. The pulsed green LED has infinite life expectancy. Check filter provided for easy calibration. All solid state electronics.

Applications The Model 7500 Smoke Meter can be used on any diesel engine, with primary application in testing trucks, busses, and cars. Contact WAGER for special applications, such as stand-by power, mining operations, railroad use, boating/maritime, industrial, etc.

Functional Description

The sensor head consists of two components, a light source (transmitter) and a light detector (receiver).

When the unit is activated, the transmitter emits a light beam at a known intensity. As the light passes through the smoke plume, some or all the light is diverted.

The light detector measures the amount of light received, and compares this with the amount of light being emitted. The difference between the two values is opacity.

SET-UP FOR TESTING

Important:

New Jersey Regulation N.J.A.C. 7:27B-4 requires a number of test criteria that are above and beyond the SAE J1667 document. If you are to perform testing in New Jersey, Please be sure you are familiar with all requirements set forth in the document.

Installation of Sensor Head

Full Flow Head:
Position the sensor head over the top of the exhaust stack with the extension handle.

Partial Flow Head:
Use either the curved, straight, clamping style nozzle depending on the shape of your stack. The strong magnets on the extension pole will assist in placing the head correctly into the stack.

Attachment of Connecting Cables

The connecting cable is attached to the DCU and the sensor head assembly by means of “MultiMate” connectors. The ends of the cable have connectors that will fit into matching grooved receptacles.

Align the pins on a connector with the holes on its mating receptacle. Insert the connector into its mating receptacle. Lock the connector in place by screwing the locking ring clockwise until a firm connection is made.

Repeat these steps for all required sensors.

Oil Temperature Probe

The oil temperature probe inserts into the oil pan as you would insert the normal dipstick. Attach the plug end as described above.

Note:

The oil temperature probe requires approximately 90 seconds to acclimate from normal room temperature to the engine oil temperature.

RPM (Photo-Tach) Sensor

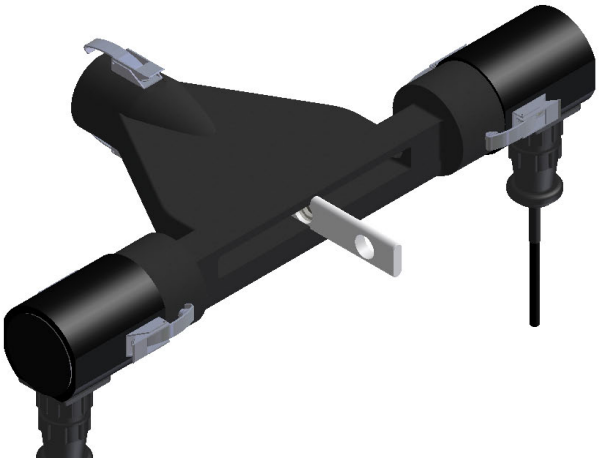
Pull off approximately 1 inch of reflective tape provided with the system. If the damper is very new and glossy, a small area may have to be smudged to make it matte. It is recommended that the optical sensor be placed at a slight angle (15 degrees) from perpendicular, so that only pulses from the reflective marker will be received by the sensor. The sensor should be at least 1 inch from the reflective target to avoid false triggering. Attach the plug end as described above.

Reflective Tape can be ordered per yard. Call 1 800 562-7024 or write info@wagerusa.com.

Filter Calibration

New Jersey State Requirements require a valid filter calibration to be performed every seven days. The Model 7500 software has been programmed to flash the red “filter calibration” button when this is due. **(NJ Software revisions only)**

You will not be able to proceed with the test until this calibration has been performed. You can still access the System Configuration and the Logfile Maintenance files while this lock-out is in effect.



The Melles Griot Neutral Density Filter allows you to verify that that the system operates within the acceptable range. Each filter’s calibration range is set when the system is shipped.

> If you are using your own computer, or if you have purchased a new filter, a floppy disk has been supplied which will add the calibration values to your system. See next page for instructions.

Neutral Density Filter

To assure continuous accuracy of the opacity test performed, a .2 Melles Griot Neutral Density Filter is provided with the system. The system will lock out further use after seven days, until the calibration test has been performed. (NJ Software revisions only)

After calibration sequence has been performed, the date of the test will be printed with each successive test print out.

Note: Neutral Density Filters are manufactured to very exacting standards. They have a finite life expectancy, which can be extended, if they are kept in a dry dark place between uses.

New Filter

A filter will come with a floppy disk containing data required for the 7500 to calibrate properly. You will only need to perform this task once for the duration of the life of the filter. To load the data on to the CPU, start at the Wager DCU main menu and select "System Configuration". Then, on the bottom left select "New Filter". Insert floppy disk into the drive and click "OK" The system will prompt to replace the file. Click replace. Remove floppy disk and store in proper place.

Filter Calibration Test

From Main Menu, press “Filter Calibration” button. Connect all sensor to the DCU and the laptop. Make certain the system is turned on, and the DCU has been reset. Press “Calibrate” button with clear light path. System will prompt to insert the calibration filter and then press “Start.” Allow the system to record the filter value for approximately 10 seconds. It will stop automatically and check the filter value. The system will show either one of the following messages: Test Passed, updating calibration date. The system will automatically update the 7 day calibration date. It will shut down the software for changes to take effect. If the filter is outside the specified range, the system will display "Test Failed". To re-test, remove the filter and press the calibration button again. If the failure message continues, contact the Wager Company.

SAEJ1667 Snap Acceleration Test

The Model 7500 Smoke Meter has been designed in accordance with the specifications of SAE J1667. The meter will prompt the operator through the required test sequence, compute the average, spread, and zero drift. New Jersey (Rev. 1) 21

QUICK START INSTRUCTIONS

1

Connect all sensor head, RPM Sensor and Oil Temperature Probe to DCU.

2

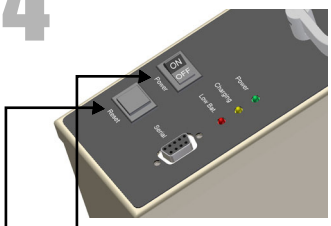
Connect DCU to the laptop using the supplied interface cable. (You might want to connect the printer at this time as well).

3

Turn the laptop on.

Location of "ON" button varies. Please review your computer's manual, if your unit is different.

4

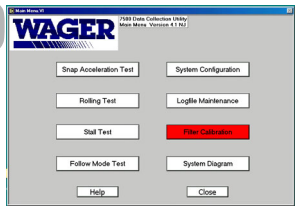


Turn ON the DCU, press the RESET button.

5

Open the Wager 7500 program by using the left button on your mouse on top of the desktop icon marked "Wagerdcu".

6



Press the Filter Calibration button and follow on screen instructions.

***This system needs to be configured one time only upon initial set up. In this field you may enter company name, telephone number, test location, date, etc.. It is important that you enter your DEIC number at this time.**

To access this, press the System Configuration button on step 6, and Save settings. After saving settings, a pop up diolog box will appear. Click REPLACE and the press the back button until you return to the main menu.

If you have purchased a complete system including the lap top computer, your comm port has already been preset by the factory. Please do not change this number.

If you have purchased the basic system and are using your own lap top computer, please contact Wager so that we may assign a comport number for you.

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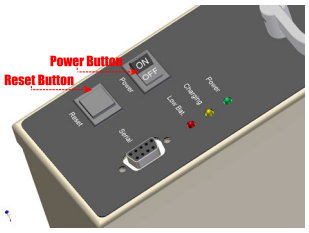
SNAP ACCELERATION TEST

1



Connect all sensors to DCU. After powering on the DCU, press the reset button.

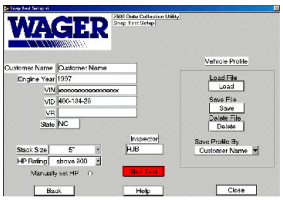
2

Double click on “Wagerdcu” icon to launch software.

3

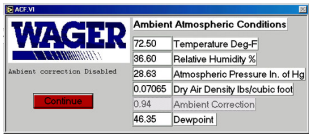
On the main menu, Select the “Snap Acceleration Test” button.

4



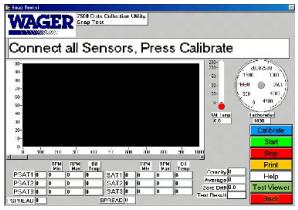
Fill in fields for customer test set up. Then Press “Start Test” Button.

5



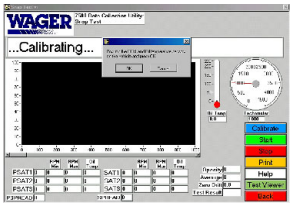
Ambient Conditions will register. Press “Continue” button to advance to the next screen.

6



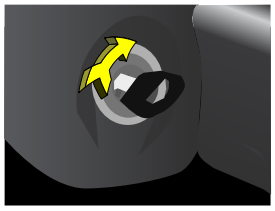
Make certain there are no obstructions in the opacity head light path. Press “Calibrate” button.

7



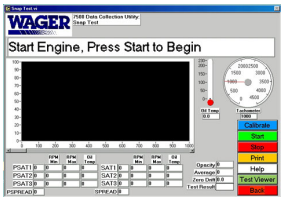
Position the RPM and Oil temperature sensors on the vehicle and press “OK”.

8



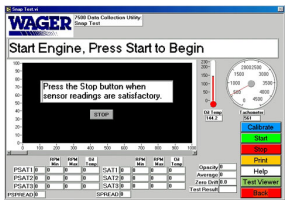
Start your engine.

9



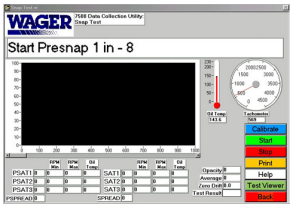
Press the start button.

10



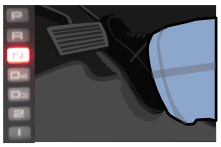
When oil tempature and RPM readings are satisfactory, press “Stop” button, Pre-snap test will automatically begin.

11



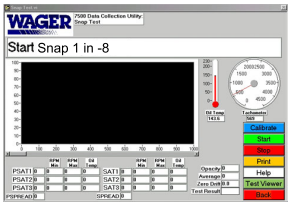
The computer will produce a count down, followed by a prompt to “Accelerate” to maximum governed RPM.

12



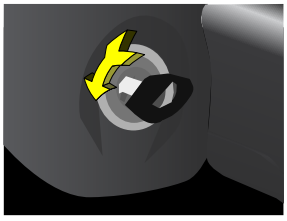
Maximum RPM’s should be maintained for 4 to 5 seconds. Computer will advise “Release Throttle”.

13



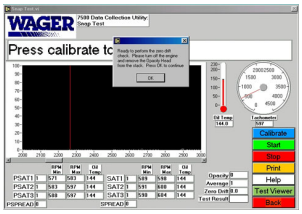
Repeat steps 11 and 12.

14



Turn off engine, and remove sensor head.

15



Perform the “zero drift check” by pressing “OK”.

If tests passed, please enter certificate number, and click on “OK”.

In the event of a computer lock up, press control Alt Delete, and end task. Reboot the Wager DCU and press restart button. Begin test sequence again.

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Test Messages

Test Invalid

This indicates that one of the following test criteria was not met:

Preliminary Spread: Difference between the highest and lowest PSAT was greater than 5%.

Spread: Same as above but during the SAT.

Oil Temperature: Oil temperature was not at the minimum operating temperature of 140°, and the engine coolant temperature was below 180 degrees.

RPM: RPM minimum was equal to zero during the test sequence.

Weather Condition: Ambient temperature was not between 35° and 95°F, and/or above the dew point.

Zero Drift: Was greater than ± 2%.

Test Failed: The computed average opacity value is greater than allowed under SAE J1667 and/or your state specifications based on the year model of the vehicle.

Performing the Stall Test or Rolling Test

Connect all sensors as described above.

In the Main Menu, select either
"Stall Test" (automatic transmissions) or
"Rolling Test" (straight drive).

All screen prompts are specific to the test performed and will step the user through the respective test sequence.

Printing Saved Tests The Model 7500 can save numerous test records. Test storage capacity is limited only by hard drive space. The system default printer will be used to print the test results.

You can print the test by pressing the PRINT button either before you save the test, or immediately after completion of the test.

If you need to print only a specific record, go to "Log File Maintenance" in the "Snap-Test Viewer". You can use the "Search" function, by typing in the identical VIN number needed. When this record is on the screen, select "PRINT".

An alternate method is to use the scroll buttons

To scroll through the logfile until the needed record is displayed. When the desired record is on the screen, press the **“PRINT"** button.

Printer Options: The Model 7500 “Complete” system is shipped with a full-page portable, battery-operated ink-jet printer, or you may use any printer that will operate in a Windows environment.

The software automatically prints to the Windows operating system default printer.

Samples of Completed Test Print-Outs

Snap-Idle Test

```
Test Location:                          Customer Information:
 XXXXXXXXXXXXXXXX                       Customer Name: XXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXXX                       VIN: XXXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXXX                       VID: XXXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXXX                       Year Model:  1999
 XXXXXXXXXXXXXXXX                       HP Rating:   5
 XXXXXXXXXXXXXXXX                       Stack Size:  5
DEIC#  XXXXXXXXXXXXXXX                  VR: XXXXXXXXXXXXXXX
Pass/Fail Qualifications:(Snap Test)    State: NJ
Max Opacity:          40                Time:  02:05:27
Max PSPREAD:          5                 Date:  05-29-2002
Max SPREAD:           5                 Ambient Correction:  Disabled
Max Zero Drift:       2                 Certificate #   xxxxxxxxxxxxxxxx

Test Results: Opacity:      Oil Temp:   Min RPM:      Max RPM:      Rise Time:
PSAT1:        34            178         746           4124          5.69
PSAT2:        34            178         752           3815          3.35
PSAT3:        34            178         758           4020          3.97
PSPREAD:      0
SAT1:         34            178         734           4017          4.01
SAT2:         34            178         734           3997          3.65
SAT3:         34            178         852           4124          4.28
SPREAD:       0
AVERAGE:      34
Zero Drift:   0.00                       Pass
Inspector:  xxxxxxxxxxxxxx              Signature_____________________________
Calibration Date:  5/17/02              ----------------------------End-of-Record
```

Samples of Completed Test Print-Outs

Rolling Test

```
Test Location:                          Customer Information:
 XXXXXXXXXXXXXXX                        Customer Name: XXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXX                        VIN: XXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXX                        VID: XXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXX                        Year Model:  1999
 XXXXXXXXXXXXXXX                        HP Rating:   5
 XXXXXXXXXXXXXXX                        Stack Size:  5
DEIC#  XXXXXXXXXXXXXXX                  VR: XXXXXXXXXXXXXXX
Pass/Fail Qualifications:(Rolling Test) State: NJ
Max Opacity:          40                Time:  02:13:19
                                        Date:  05-29-2002
                                        Ambient Correction:  Disabled
Max Zero Drift:       2                 Certificate #   xxxxxxxxxxx

Test Results: Opacity:      Oil Temp:   Min RPM:      Max RPM:      Rise Time:
Max           34            178         795           4186          4.00




Zero Drift:   0.08                      Pass
Inspector:  xxxxxxxxxxxxxxx             Signature_____________________________
Calibration Date:  5/17/02             ------------------------------End-of-Record
```

Samples of Completed Test Print-Outs

Stall Test

```
Test Location:                          Customer Information:
 XXXXXXXXXXXXXXX                        Customer Name: XXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXX                        VIN: XXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXX                        VID: XXXXXXXXXXXXXXX
 XXXXXXXXXXXXXXX                        Year Model:  1999
 XXXXXXXXXXXXXXX                        HP Rating:   5
 XXXXXXXXXXXXXXX                        Stack Size:  5
DEIC#  XXXXXXXXXXXXXXX                  VR: XXXXXXXXXXXXXXX
Pass/Fail Qualifications:(Stall Test)   State: NJ
Max Opacity:          40                Time:  02:16:48
Max PSPREAD:          5                 Date:  05-29-2002
Max SPREAD:           5                 Ambient Correction:  Disabled
Max Zero Drift:       2                 Certificate #   xxxxxxxxxx

Test Results: Opacity:      Oil Temp:   Min RPM:      Max RPM:      Rise Time:
PSAT1:        34            178         738           4113          5.00
PSAT2:        34            178         748           4220          4.33
PSAT3:        34            178         746           4089          3.26
PSPREAD:      0
SAT1:         34            178         768           4122          3.31
SAT2:         34            178         787           4144          3.53
SAT3:         34            178         808           4175          3.57
SPREAD:       0
AVERAGE:      34
Zero Drift:   0.00                       Pass
Inspector:                              Signature_____________________________
Calibration Date:  5/17/02              ----------------------------End-of-Record
```

System Configuration

The system configuration menu allows administration of the Model 7500.

Logfile Maintenance

This subroutine allows the user to review all tests performed and saved.

The user may search the logfile by VIN, which retrieves all tests on a specific VIN in the order they were performed.

This subroutine allows the user to save the logfile to disk. This feature allows the user to archive the test records as well as download the test information to a floppy disk for inspectors.

The logfile may also be printed. It is recommended that the logfile be cleared after saving (or archiving). This would be done to minimize the amount of test records in the logfile.

INTERFACE SOFTWARE

Due to the variations of hardware and software environments in which this software may be used, the program may encounter issues on customer's own system, which could not be anticipated by our programmers.

We will make every attempt to assist you, if you encounter a problem when you install the program on your computer.

However, we cannot take any responsibility or warrant for functionality. You expressly waive any liability if our instructions result in a malfunction on your system.

Installation of Software:

The program is supplied on one cd rom. Installation on most computers is a multiple step process. Computers will require at least one re-boot to complete the installation.

Please note that we assume your cd rom to be drive letter "d".

Insert the cd. Double click My Computer, then select drive D:
Double click the folder WagerDCU Installer.
You will see two files named setup.
Double-click the file setup that looks like a computer screen.
Follow the instructions shown by the prompts that are build into the software.
Once the software is installed, it will ask you to reboot the computer.
After reboot, you will see a WAGERDCU icon on your desktop.

Serial/USB Adapter.

If your system does not have a 9-pin serial connection, we have provided an interface adapter to connect your computer to the DCU.

This adapter is a plug-and-play device and will be recognized by the windows operation system.

Plug the adapter into an available USB port on your computer. A window will pop up saying a new device has been detected. Insert the CD for the adapter.

Select “Install the software automatically” and click “next”.

Once this completes, the screen will say it found another new device.

Select “Install the software automatically” and click “next”

Finally the software will say the device has been installed and then click “finish”

On most computer systems, the USB-serial adapter will be installed as com4.

Select COM4 in the system configuration menu of the wagerdcu software.

TECHNICAL SUPPORT

Wager is proud of the service we provide to all of our customers. We are here to help no matter what the question. You may contact one of our technicians Monday thru Friday from 9AM TO 5PM Eastern Standard Time.

Should questions arise afterhours or it is not convenient to make a call to our office, we suggest you go to our website at **www.wagerusa.com** and check our technical support section.

APPENDIX A. MAINTENANCE

Battery Replacement

Remove the six screws on the top panel of the DCU and carefully lift off the top. Note the color of the wires to color of terminals.

Remove the two screws holding the battery bracket in place. Remove the two connectors from each end of the battery. Place the new battery in place, and screw the holding bracket back into place over the battery.

Re-attach the two connectors on the ends of the battery. Replace the top panel and screws.

Cleaning Lenses

To assure regular easy access to the lenses, we have provides two snap closures. The lenses can be wipes with a soft cloth.

We strongly recommend that a regular procedure of calibration and cleaning the lenses is established. During light use, a daily cleaning may be enough. During heavy testing, we recommend a frequent cleaning throughout the day.

To remove soot, dip soft cloth in denatured rubbing alcohol (make sure to let it dry) and rub gently over lenses.

In laboratory settings and heavy commercial use, please note that we have provided connectors for an external air purge.

Connecting Cables

Connecting cables are subject to wear, based on incorrect handling, abuse, and contact with a hot stack.

Check, repair, and replace cables when their condition affects the operation of the smoke meter.

Filter Calibration

Please see instructions under Section “Set-Up for Testing” which explains calibration for the partial flow head.

APPENDIX B. GENERAL FIELD PRECAUTIONS

The Model 7500 Smoke Meter has been disigned to be trouble free for many years of use. However, some components are subject to unintentional damage / wear and are not covered under warranty.

Sensor Head

Always carry the sensor head assembly by the metal "yoke" or the extension pole. Dangling the sensor head assembly from the cable causes extreme stress on the cable, and could lead to premature failure.

Please make certain to remove the sensor head from the stack and place it out of harms way before allowing the vehicle to leave the test facility.

Battery

The re-chargeable lead-acid battery can withstand many charges/discharges. However, they need to be recharged at least every three months, even if the system is not in use. However, even with excellent maintenance, the battery will gradually lose the ability to hold a charge. Replace the battery when the shortened intervals interfere with your normal operation of the unit.

DCU

The Wager 7500 DCU is a electronic device that is sensitive to water. Please take every precaution to keep it dry. Water damage will affect the circuitry of your system.

Cables

The connecting cable must not come in contact with the exhaust pipe or manifold. If the cable is burned, warranty is voided.

Repairs

Please do not attempt to make any unauthorized repairs or modifications to your system. If you desire a special application, please contact one of Wager's technicians.

Software Conflicts

Wager is not responsible for any third party software conflicts that may affect our software program, or cause the PC to crash..

APPENDIX C. SPECIFICATIONS

Electrical Specifications

Light Source	Led - Green Gallium Phosphide 570 NM
Light Sensor	Si Photo Diode with IR Filter
Meter Accuracy	± 1.0% Nominal, 10th digit
Recorder Output	0-1 Volt
Battery	12V, 2.2 amp hour, sealed, lead acid cell
Charging Transformer	120 VAC 28 Watts in /13.8 VDC @ 1 A out

Mechanical Specifications

	Size	Weight
Control Unit	12" W x 12" D x 3.5" H	5.0 lb.
Sensor Head	14" W x 10" D x 4" H	3 lb. w/o cables
Stack Clamp Assembly	5" Through the Stack	

Performance Specifications

Range:	0.0% - 100.0% opacity
Warm up Time:	Negligible
Response Time/Display*	0.5 seconds
Response Time (Chart Recorder Output)	0.5 seconds
Linearity	± 1% from 0-100% opacity
Zero Stability (Drift)	Less than 1% in 60 minutes
Temperature Stability, Sensor Heads	± 1% from 32 Degrees - 120 Degrees F
Battery Life	40 hours; 1 hour after low battery indication, 8 hours to full charge

APPENDIX D. DEFINITIONS

Follow Mode

A diagnostic mode that allows the unit to continuously read opacity and maintain a “peak hold” reading. The alternate mode is Test Series Mode.

Opacity The percentage of light transmitted from a source that is prevented from reaching a light detector.

Preliminary Snap Acceleration Test A series of Snaps (usually at least 3) performed before testing begins to clear the exhaust system of residual particles.

Snap Acceleration Test The engine is allowed to run at maximum RPM’s and brought back to idle. Three “snaps” are taken for this test. Each individual test is stored and a mathematical formula applied to provide an “average.” See Page 14 for step-by-step instructions.

SAE J1667 A document created to outline specifications to manufacturers of opacity meters, as well as test criteria for performance of opacity (smoke) readings. Available for download on www.wagerusa.com.

APPENDIX E. NEW JERSEY STATE GUIDELINES

The following information is condensed from N.J.A.C. 7:27-14, and the instructions for test procedures from N.J.A.C. 7:27B-4.3, “Procedures for using a smokemeter to measure the smoke opacity of heavy-duty diesel vehicles”, and provided here as a reference only. The official text of the NJDEP rules are available on the Internet at **http://www.state.nj.us/dep/aqm/rules.htm**. Certified Diesel Emissions Inspection Centers (DEICs) are provided with an official operations manual by the NJ Motor Vehicle Commission that specifies the test procedures and requirements for DEICs.

The New Jersey Heavy-Duty Diesel Vehicle Inspection Program (HDDVIP) applies to all on-highway diesel powered motor vehicles with a Gross Vehicle Weight Rating of 18,000 pounds or greater. Vehicles are inspected for opacity, which measures the soot particles that are emitted in the engine exhaust. New Jersey registered vehicles must be inspected annually at a licensed DEIC. Both New Jersey registered, and out-of-state vehicles, are subject to random inspections under the Roadside Enforcement Program. Only New Jersey registered vehicles are required to be inspected annually under the HDDVIP. Out-of-state vehicles are not required to register for the HDDVIP, and DEICs may not issue a New Jersey inspection sticker to an out-of-state vehicle.

Opacity standards are applied to the vehicles engine, not the chassis, based on its year of production. For example, if the vehicle is a model year 1995, but has a model year 2000 engine, the opacity standard for model year 2000 is applied during testing. The NJ smoke opacity standards are:.

Heavy-duty trucks- 18,000 pounds or more	
1973 and older	40%
1974 to 1990	30%
1991 and newer	30%
No visible blue smoke > 3 consecutive seconds	

Commercial and School Buses- 18,000 pounds or more	
1987 and older	40%
1988 and newer	30%
Retrofitted buses (rebuilt engines with a low emissions kit)	30%
No visible blue smoke >3 consecutive seconds	

Vehicles presented for testing must be at normal operating temperature, with a minimum oil temperature of 140 degrees Fahrenheit, or 60 degrees Celsius. The ambient temperature must be greater than the dew point, without any visible precipitation, such as rain, snow, sleet, fog, and mist. Tests may be conducted indoors during inclement weather, as long as the ambient temperature is greater than the dew point.

General test requirements are:

For full-flow smokemeters, ensure that the final two feet and the exit of the exhaust pipe are straight, with an internal diameter not to exceed five inches. Appropriate exhaust pipe adapters shall be used as necessary to comply with these specifications.

Do not use full-flow smokemeters on vehicles with underbody exhaust pipes that direct the exhaust flow to the ground unless the exhaust gases are redirected away from the ground by the appropriate exhaust pipe adapter mentioned above. Affix the smokemeter to the end of the vehicles exhaust pipe, according to the manufacturer's instructions. DEICs must also attach the RPM sensor to the engine and vehicle, and insert the engine oil temperature sensor into the oil dipstick tube and into the crankcase oil.

SNAP ACCELERATION TEST

The snap acceleration smoke opacity test shall be performed on heavy-duty diesel vehicles and diesel buses that are equipped with low or medium-speed diesel engines as follows:

Chock the drive-wheels and release all tractor and trailer brakes;

Ensure that the transmission is in neutral and start the engine;

Ensure that the smokemeter is calibrated according to N.J.A.C. 7:27B-4.2 and the manufacturer's instructions;

Initiate the test sequence on the smokemeter;

If using a partial-flow smokemeter, the meter will automatically default to a 5 inch diameter stack. There is no selection available.

If using a full-flow smokemeter, enter the engine horsepower and stack diameter as measured from the vehicle exhaust stack.

If using a smokemeter without horsepower input, select the appropriate stack size from Table 1 below, based upon the vehicle‘s engine horsepower;

With each prompt from the smokemeter to “accelerate engine,” rapidly depress the accelerator pedal to the floor and hold it there until prompted by the smokemeter to release the pedal.

Repeat the above procedure at least four more times. This shall include, at a minimum, two preliminary snap accelerations to remove loose soot from the exhaust system for a stabilized reading, and a minimum of three snap accelerations for the official test, the average of which shall constitute the final test result.

The pass/fail determination shall be based upon three valid smoke opacity test results averaged arithmetically and compared to the pass/fail standards appropriate for the engine model year.

ROLLING ACCELERATION TEST

The testing procedures for the rolling acceleration smoke opacity test, required pursuant to N.J.A.C. 7:27-14.5, shall be performed on a straight and level road course, as follows:

Determine the engine horsepower from the engine identification plate or engine serial number. Refer to Table 1 below and input the nominal stack size into the smokemeter. If the engine identification plate is missing, inaccessible or illegible, measure the outside diameter of the exhaust pipe extending from the exhaust manifold with a precision caliper or equivalent gauge, rounding to the nearest inch;

Ensure that the smokemeter is on and calibrated according to N.J.A.C. 7:27B-4.2 and the manufacturer‘s instructions.

Start the engine and operate at curb idle speed.

Purge the exhaust system of loose soot and stabilize the smoke opacity readings. The rolling acceleration portion of the test sequence shall be deemed to be complete as soon as:

1- the vehicle has reached a speed of 10 miles per hour;

2- the engine has reached maximum governed RPM; or

3- the engine has reached 2,500 RPM;

Initiate the test sequence on the smokemeter.

Select the appropriate smoke opacity pass/fail standards, based upon the engine model year.

If using a partial-flow smokemeter, select the appropriate stack size from Table 1 below, based upon the engine horsepower. If using a full-flow smokemeter, enter the engine horsepower and nominal stack size as measured on the vehicle.

If using a smokemeter without horsepower input, select the appropriate stack size from Table 1 on page 34, based upon the vehicle's engine horsepower.

Low speed diesel engines: conduct one rolling acceleration by rapidly depressing the accelerator pedal to the floor and holding it there for three to five seconds, or until prompted by the smokemeter to release the pedal.

Medium or high speed diesel engines: conduct three rolling accelerations by rapidly depressing the accelerator pedal to the floor and briefly holding it there until the engine speed reaches approximately 2,500 RPM, then release. When testing a vehicle with a manual transmission, do not shift to the next gear.

Manual transmissions: depress the clutch and select the appropriate low gear for the degree to which the vehicle is laden to avoid over-gearing or lugging. Gradually engage the clutch.

Automatic transmissions: place the transmission in "D" or "Drive" only, or the gear position immediately next to "N" or "Neutral". Accelerate until the vehicle is rolling forward at a speed equivalent to the engine curb idle, then increase the engine speed by 200 RPM, ±50 RPM.

Release the accelerator pedal, disengage the clutch and bring the vehicle to a stop.

Determine whether the vehicle has passed or failed by comparing the smoke opacity test result to the standards appropriate for the test vehicle‘s engine model year.

STALL TEST

The testing procedures for the stall smoke opacity test, required pursuant to N.J.A.C. 7:27-14.5, shall be performed, on a vehicle with a medium or high speed diesel engine and an automatic transmission only, as follows:

Unless the vehicle engine is of a torque-tube design, inspect the vehicle’s drive shaft, U-joints and slip-joints for mechanical integrity.

Discontinue testing of any vehicle exhibiting signs of appreciable looseness or wear in the U-joints or slip-joints, or any damage to the drive shaft, which would adversely affect the vehicle‘s mechanical integrity. Do not resume testing unless and until the defects are repaired.

Ensure that the parking and service brakes are in good operating condition.

Discontinue testing of any vehicle exhibiting inoperable or inadequate parking or service brakes. Do not resume testing unless and until the defects are repaired.

Determine the engine horsepower from the engine identification plate or engine serial number. Refer to Table 1 below and input the nominal stack size into the smokemeter. If the engine identification plate is missing, inaccessible or illegible, measure the outside diameter of the exhaust pipe extending from the exhaust manifold with a precision caliper or equivalent gauge, rounding to the nearest inch.

Ensure that the smokemeter is warmed up and calibrated according to N.J.A.C. 7:27B-4.2 and the manufacturer‘s instructions.

Chock the drive-wheels.

Set the vehicle’s parking brake.

Start the engine and operate at curb idle speed..

Purge the exhaust system of loose soot and stabilize the smoke opacity readings.

Conduct at least three snap accelerations by rapidly depressing the accelerator pedal to the floor and holding until the engine speed reaches high idle or 2,500 RPM, whichever is lower before releasing, with five to 45 seconds between accelerations.

Initiate the test sequence on the smokemeter. Some smokemeters may not have a testing sequence entitled “stall acceleration test” For these smokemeters, the snap acceleration test sequence may be used.

Select the appropriate smoke opacity pass/fail standard, based upon the engine model year.

If using a partial-flow smokemeter, select the appropriate stack size from Table 1 on page 34, based upon the engine horsepower. If using a full-flow smokemeter, enter the engine horsepower and the actual stack diameter as measured upon the vehicle exhaust stack outlet.

If using a smokemeter without horsepower input, select the appropriate stack size from Table 1 on page 34, based upon the vehicle‘s engine horsepower.

Apply the service brakes.

Place the transmission in “D” or “Drive” or the gear position immediately next to “N” or “Neutral”. Do not use the “LO” or “1” gear positions.

Rapidly depress the accelerator pedal to the floor and hold it there for approximately three seconds or until prompted to release it by the smokemeter.

Repeat the procedure at least two more times for a minimum total of three accelerations, with a pause of between five and 10 seconds between accelerations or until prompted by the smokemeter.

Three valid stall accelerations shall constitute a successful test procedure and terminates the test.

Determine whether the vehicle has passed or failed based upon three valid smoke opacity test results averaged arithmetically and compared to the standards appropriate for the test vehicle's engine model year.

If the test results are invalid and testing must be repeated, allow a minimum of three minutes but no more than five minutes of idling to cool the transmission before repeating the test.

Manufacturer's Rated Horsepower	Nominal Stack Size in Inches †i
Less than 101	2
101-200	3
201-300	4
301 an over	5

†i Note: Nominal stack size shall always be used when measuring engine smoke opacity, irrespective of the stack size equipped on the vehicle being tested. For example, a vehicle equipped with an engine rated at 301 horsepower or above which has an exhaust stack measuring seven inches in diameter shall, for purposes of an official test, have a nominal stack size of five inches input to the smokemeter. If, for example, a vehicle has no engine identification plate and is equipped with an exhaust stack measuring six or seven inches in diameter - but the exhaust pipe from the manifold is five inches in diameter - then the nominal stack size shall be five inches.