

# Stack Check System Manual

MSC Version

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## Section 1 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.

### Contact Information

During installation, operation, or for any reason you need to contact us, there are several methods.

Robert H. Wager Co., Inc.  
570 Montroyal Road  
Rural Hall, NC 27045

Phone : 336-969-6909  
Fax : 336-969-6375  
Email : [info@wagerusa.com](mailto:info@wagerusa.com)

## General Description

The WAGER Stack Check system provides an accurate means of detecting and measuring the opacity of smoke being emitted from an onboard stack. The measurement of the opacity of the exhaust gas is accomplished by passing a beam of light through the exhaust flow. The system knows how much light is being emitted, and how much light is received. The difference is the amount of light that is absorbed and is displayed in percent (%) opacity, with 0% being no blockage of light and 100% being total blockage of light.

The electronic control unit operates using 120vac and may be located at any convenient distance up to several hundred feet from the optical heads.

The system consists of a Transmitter unit, which emits the beam of light; a Receiving unit, which receives the light; a Control unit, which contains the display meter; a main cable, and a sensor cable.

The control unit has a single set point relay to activate an alarm or horn and a retransmission 4 – 20 ma for remote signal monitoring.

Also, the control unit has an internal switch to operate the light unit of your previous installation visual smoke system.

## Component Description

### Light Unit - P/N 197-0029

The light unit consists of three anodized aluminum castings, the first of which is the threaded lamp housing connection directly mates to the 4" pipe penetration nipple extending from the stack.

This casting is equipped with two quick release latches which hold the main housing in place and also has ports for purge air.

The main housing contains the optical lens, light source, LED switch board, and the main transmitter logic board. There are various physical adjustment points and several electronic test points contained in this housing. The front of the housing contains a Pyrex window, which seals the lens and electronics from the exhaust gases.

The LED switch board contains a red LED, green LED, a slide switch, and a push button switch. These components are electrically equivalent to the LED / switches that are located in the control unit. This duplication of the LED / switches is best used during initial calibration of the unit and enables the installer to operate the system and observe the LED from either the control unit location or the transmitter location.

The third casting is a weather resistant cover. This cover is mounted using the 6 hole bolt pattern and is removed for the beam adjustment procedure.

### Receiving Unit - P/N 197-0028

The receiving unit also consists of three castings, i.e. connection, housing and cover.

The main housing contains the optical lens, light detector, and the main receiver logic board. There are various physical adjustment points and several electronic test points contained in this housing. The front of the housing contains a Pyrex window, which seals the lens and electronics from the exhaust gases.

The third casting is a weather resistant cover. This cover is mounted using the 6 hole bolt pattern and is removed for the beam adjustment procedure.

#### Control Unit - P/N 197-0030

The Stack Check control unit is a steel powder-coated enclosure. It contains all of the electronics and controls necessary to operate and calibrate the system and operates off 120vac.

The multi-color display is a Veeder-Root Brand S628 B DC Volts/Amps process meter and has a single set point relay. Green characters are shown when the reading is below the set point and red characters are shown when the reading is above the set point.

Three outputs are supplied with the unit, Alarm output (Normally Open, Common, and Normally Closed Contacts), a 4-20 mA retransmission output, and Lamp Connections (For control of existing visual lamp unit).

#### Main Cable – P/N 197-0025

This cable provides connection between the control unit and the transmitter and is a shielded heat resistant cable with standard length at 250 ft.

#### Sensor Cable – P/N 197-0026

This cable provides connection between the transmitter and receiver and is a shielded heat resistant cable with standard length at 50 ft.

#### Damper Units - P/N 110-A

Damper units may be provided with any smoke opacity system to allow the operator to have a means of closing off the 4" pipe nipples located in the stack during maintenance of the units mounted there.

These Damper units may be used on positive ducts to prevent the furnace gases from escaping or on negative ducts to prevent an excessive inrush of ambient air during repair or replacement of other units.

Damper units are individual, independent castings, which are located on the 4" nipples between the stack and the transmitter and receiving units.

The dampers have a manually operated gate, which when closed provides a temporary seal against gas or air leakage during maintenance operations.

The units are so designed that the damper gate is locked in either the open or closed position and will not change even if subjected to shock or vibration.

## Quick Reference Data

|                    |   |
|--------------------|---|
| Manufacturer:      | Robert H. Wager Co., Inc.<br>570 Montroyal Road<br>Rural Hall, NC 27045 |
| Type:              | Smoke Opacity Meter   |
| Model              | Stack Check   |
| Power Requirements | 110VAC – 60Hz – 2 Amp   |

### Performance Specifications:

|                        |                                |
|------------------------|--------------------------------|
| Range                  | 0 - 100% Opacity               |
| Warm-up Time           | 10 seconds                     |
| Meter Response time    | <2.0 seconds, 0 – 100% opacity |
| Resolution             | 2% from 0 - 100% Opacity       |
| Linearity              | 2% from 0 - 100% Opacity       |
| Zero Stability (Drift) | < 1% in 24 hours               |
| Operating Distance     | 6' (minimum) 30' (maximum)     |
|                        |                                |

### Electrical Specifications

|                   |  |
|-------------------|--|
| Light Source      | Light emitting diode, Red Ga AL As, 660 nm |
| Light Detector    | Silicon Photo Diode                        |
| Connecting Cables | Length as desired                          |
| Meter             | Digital DC Volts/Amps Meter                |
| Meter Accuracy    | 2% Full Scale                              |

### Cable Specifications

|              |   |
|--------------|---|
| Main Cable   | 8 conductor shielded rubber covered 20 AWG Belden #8418 |
| Sensor Cable | 6 conductor shielded rubber covered 20 AWG Belden #8426 |

## Section 2 INSTALLATION OF 4" PIPE NIPPLES

**Note:** 4" standard schedule 40 pipe nipples must be installed by customer in appropriate location in duct or stack.

### Site Selection

The best location for the stack or duct mounted units is in a straight section of vertical pipe with the pipe nipple being parallel to the ground.

The location should be chosen for easy access, to assure regular maintenance. Sufficient gratings or ladders are recommended, to make this task as easy as possible.

In choosing a site, the following should be considered:

- Monitoring required
- Straightness of gas path
- Accessibility to units
- Negative or positive pressure
- Restrictions of space

**Note:** The mounting of the 4" IPS pipe nipples in the duct or stack is the most important part of the installation of the system.

Misalignment of these nipples will result in no signal from the LED.

The surest way to get proper alignment is to start with a single piece of 4", schedule 40 pipe, long enough to go across the duct or stack in question and to protrude on either side approximately 6".

Installation should be made as follows:

- Cut 4" IPS Schedule 40 steel pipe to proper overall length.
- Thread both ends of pipe with 4" pipe thread.
- Burn or cut holes to accommodate this pipe on opposite sides of duct or stack so that pipe will be level and perpendicular to gas flow. A location in the approximate center of the duct should be chosen and both holes should be equidistant from the top or bottom of the duct.
- Insert pipe through holes across duct or stack.
- Seal weld pipe to duct, both inside and outside if possible. First tacking the pipe in several places around the circumference.
- Burn or cut out center section of pipe inside duct or stack 2" from the inner walls on either side.

Note: Make cut as square as possible.

## Installation Of Stack Units — Positive Pressure

With nipples properly installed, proceed with the installation of the stack units as follows:

### Damper Unit - P/N 110-A - Optional

If this unit is supplied, it should be mounted first, directly to the 4" pipe nipples protruding from both sides of the duct or stack. If the stack pressure is positive, the dampers should be mounted with the handle side toward the duct, so that pressure will tend to push the damper gate toward its seat, when the gate is in the closed position. A lock nut (P/N 45 supplied with unit) should be installed on the nipple first.

Position the damper units so that the housing is at top to prevent soot from collecting in this area. Tighten lock nut. Check operation of handle to be sure that there is sufficient clearance to open and close gate. Thread on additional 6" length of threaded pipe to each side to mate to the housing connections.

### Light Unit - P/N 197-0029

Thread the transmitter unit onto the threaded pipe nipple. Note the orientation of the connector. During maintenance if the transmitter is removed, ensure that it is re-installed in the same orientation. If not, the beam adjustment will be incorrect. Use the 4" lock nut to fasten securely the transmitter into position.

### Receiving Unit - P/N 197-0028

Thread the receiver unit onto the threaded pipe nipple. Note the orientation of the connector. During maintenance if the receiver is removed, ensure that it is re-installed in the same orientation. If not, the beam adjustment will be incorrect. Use the 4" lock nut to fasten securely the receiver into position.

### Purge Air Piping - Compressed Air

The use of purge air on a positive pressure installation is imperative to the successful operation of any smoke opacity monitoring system. The compressed air piping for this system should be run as follows:

Note: The compressed air supply should be taken from the plant air system. There is no need to use instrument air.

Install a 3/4" airline from the plant air source to a location midway between the light and receiving units mounted on the stack.

Install an air filter with a minimum capacity of 60 cubic foot per minute at 80 - 100 psi on the end of this line.

Install a 3/4 x 1/2 x 1/2 tee in outlet side of filter and run 1/2" OD copper tubing to vicinity of light and receiving units.



Remove one of the 3/8" pipe plugs from each of the aspirating flange assemblies.

Install a 3/8 pipe x 1/2" tubing fitting in the flanges.

In a location convenient to the operator, install two assemblies consisting of a 0-60 psi gauge mounted in a brass tee and a 3/8" globe valve.

Run 1/2" OD tubing from the light and receiving units to the gauge tees.

Connect the 1/2" OD tubing from the filter to the inlet side of the 3/8" globe valve.

Before boiler comes on the line, turn on main air supply and adjust globe valves until gauges indicate a pressure of 2-3 psi.

**Note:** If it is possible to do so, run ID and FD fans to represent maximum boiler load conditions before light off. With a manometer, check the stack pressure.

To determine the amount of compressed air pressure required to counter balance the duct pressure, remove either the light or receiver unit casting from its connection housing; positive pressure will blow out the pipe. Slowly open the compressed air globe valve on the aspirating flange until you feel suction instead of pressure at the end of the open pipe. This is the amount needed to overcome the duct pressure.

For example, pressure of 7 - 10 psi is required to overcome 1" of water pressure in the duct when working with an open pipe.

With the light and receiving units tightly in place, a pressure of 1 - 2 psi is sufficient to keep the dirt away from the lenses. However, over a period of months some dust will tend to settle in the 4" pipe nipples. These nipples should be periodically blown out with full air pressure.

Once the constant air pressure required to keep the lenses clean has been established, a regulator can be substituted for the globe valve. However, a by-pass around the regulator should be maintained so that full pressure can be utilized to clean out the pipes.

## Installation of Cables

After choosing a desirable location for the control unit, connect the sensor cable into the transmitter and receiving units and connect the main cable into the transmitter and the terminal strip in the control unit and connect power to the system.

The interconnecting cables are fitted with MIL Spec. connectors. The insert arrangement of pins and socket types cannot be connected improperly.

Since connecting cables are rubber-covered, be sure that they are properly tied down so that they cannot touch the hot stack or be subjected to undo strain so that they could be pulled out of the connectors.

The system is now ready for calibration and operation.

## Section 3 CALIBRATION AND OPERATION

### Initial Calibration

- Step 1* Remove the 6 bolts / nuts and remove the cover from both the transmitter and receiving units and switch the LED slide switch to the on position that is located in the transmitter.
- Ensure that the system is in clear stack conditions. If there is any smoke present during calibration, the system will see it, think the smoke is the normal dust in the air and call it zero. This will cause you to have inaccurate measurement
- Step 2* Power the system on using the on switch located in the control unit. Both green LED in the control unit and led switch board should be flashing and the transmitter should illuminate solid.
- Step 3* Unlatch the receiver unit from the housing connection, and place a white sheet of paper over the hole. A full moon light pattern should be formed on the paper. If you have a crescent moon light pattern, then the transmitter is not sending the light beam straight across the exhaust stack. Adjust the 3 beam adjustment screws located in the transmitter until a full moon light pattern is formed. Then re-latch the receiver onto the housing connection.
- Step 4* Place a voltmeter on TP2 and TP1 of the receiving unit and adjust the 3 beam adjustment screws on the receiver to increase the DC voltage reading for the highest value. This will cause the receiver to look directly into the beam.
- Step 5* Move voltmeter to TP7 and TP5 on the transmitter and unit and adjust the 3 beam adjustment screws on the transmitter to increase the DC voltage reading for the highest value. This will cause the transmitter to shoot the beam directly into the receiver.
- Step 6* Repeat steps 4 – 5 until maximum values have been achieved on both sets of test points. NOTE : TP7 / TP5 are electrically equivalent to TP2 / TP1. This gives the installer multiple test points to measure the same signal.
- Note:** If the value of the test points exceed 4 volts, this means the optics are too close together and the light beam needs to be partially obstruct to reduce the voltage level.
- Step 7* Once the optimal voltage have been achieved, press the calibrate button in either the control unit or on the led switch board. The green led on the control unit and the green led on the switch board should begin to flash.

*Step 8* Now the unit is sampling opacity and will continue to sample until the system. Finally, reattach the housing covers using the 6 bolts.

Note: Calibration should take approximately 5 seconds.

*Step 9* Power the system off.

*Step 10* Power the system on, wait 5 seconds, and then press the CALIBRATE button.

*Step 11* The system should again be in the operation mode and should be displaying 0.0 on the display.

- Note: If at any time you have any question or problems, please contact customer service at 800-562-7024.

## Operation

There are no particular steps to follow for operation. Once the system has been calibrated, the system will self-monitor the stack, running unattended with continuous live readings on the display. The retransmission of the signal is also continuous with live data. Please note that the lenses must be kept clean, to assure accuracy.

The 0% calibration should be checked whenever a clear stack is available. The 100% calibration should not vary, but can be checked at any time by blocking the light path. The 100 % check can be used by closing one of the damper units.

Note: The amount of purge air needed to keep the lenses clean is dependent on stack pressure and will be different for each installation.

## Theory Of Operation

The Stack Check is a solid-state microprocessor-based opacity system, with dual location on-off switches and indicators. This gives the installer / operator local and remote locations to operate the system. The process meter with display contains two relays with set points. Normally open / closed terminals are present and additional 4-20 m amp retransmission is available.

## Section 4 PARTS LIST

### Parts List

#### Control Unit –P/N 197-0000-MSC

|                             |          |
|-----------------------------|----------|
| Process Meter with Display  | 643-0026 |
| Inner Panel Assembly        | 197-0022 |
| Amplifier Board Assembly    | 197-0021 |
| Power Supply                | 197-0009 |
| Fuse Holder                 | 636-0001 |
| Fuse 1A                     | 635-0001 |
| Fuse 250mA                  | 635-0004 |
| Error Indicator (Red)       | 197-0006 |
| Calibrate Indicator (Green) | 197-0007 |
| Power Switch                | 676-0003 |
| Lamp Switch                 | 676-0003 |
| Calibrate Switch            | 676-0009 |
| Relay                       | 197-0040 |
| Charger                     | 197-0043 |

#### Light Unit - P/N 197-0029

|                                      |           |
|--------------------------------------|-----------|
| Transmitter PCB Assembly w Insulator | 197-0023  |
| Led/Switch Assembly                  | 197-0044  |
| Power Switch                         | 197-0034  |
| Calibrate Switch                     | 197-0035  |
| Error Indicator (Red)                | 197-0032  |
| Calibrate Indicator (Green)          | 197-0033  |
| Main Receptacle (8 pin)              | 627-0002  |
| Sensor Receptacle (6 pin)            | 627-0049  |
| Vision Glass                         | 36-A      |
| Optical Lens                         | 543-A0001 |

Receiving Unit - P/N 197-0028

|                                   |           |
|-----------------------------------|-----------|
| Receiver PCB Assembly w Insulator | 197-0024  |
| Sensor Receptacle (6 pin)         | 627-0049  |
| Vision Glass                      | 36-A      |
| Optical Lens                      | 543-A0001 |

Cables (Custom Lengths)

|                       |          |
|-----------------------|----------|
| Main Cable Assembly   | 197-0025 |
| Sensor Cable Assembly | 197-0026 |

Damper Unit

|             |       |
|-------------|-------|
| Damper Unit | 110-A |
|-------------|-------|

## Section 5 Normal System Operation and Use

### Power Up and Calibration – Daily Usage

Power Up and Calibration for daily usage should only be performed when the lenses are clean and clear of any obstructions. It is recommended that this process be done when the boiler is not in operation.

- Step 1* Power the control unit on, by opening the control cabinet door, and toggling the POWER Switch to the ON position.
- The Calibration Lamp on the control cabinet door should flash, indicating a calibration is required.*
- Step 2* Toggle and hold the CALIBRATE Switch for 2 seconds, then release.
- The Calibration Lamp on the control cabinet door should be ON, and should remain ON, for up to 30 seconds. The Calibration Lamp will finally turn OFF and the system will continue to acquiring data and displaying opacity on the digital process meter.*

### Process Meter Usage

The Stack Check system uses a Veederroot Digital Process meter to perform several functions. The main function of the meter is to display the measured opacity (0 to 100%). The meter also may be connected to an audible or visual signaling device in order to provide an “Alarm” in the event the opacity exceeds a user configurable set-point. If the opacity reading of the exhaust exceeds the set-point, this will trip the relay and associated NO/NC contacts. The process meter is pre-programmed at the factory. If you need to change any of the setting, then please contacts tech support.

*This set-point is factory configured for 40%*

The meter is also configured to display measurements in GREEN when below this set-point, and RED when greater than or equal to the set-point.

## How to Change the set point for Alarm 1

- Step 1* Press the PGM button on the process meter, until AL 1 is displayed.
- Step 2* Press the > button once to view the current set-point.  
*Example 40.00 (The most significant digit will flash, indicating that it may be changed).*
- Step 3* Press the > button to select the digit you wish to change.
- Step 4* Press the V button to decrement the digit until the desired value is shown.
- Step 5* Press the PGM button twice to enter the new set-point.  
*The display will show AL 1, and will revert to the opacity display within 3 seconds.*

Note: Some systems depending on usage, may require this process to be repeated for AL 2. It is recommended that the same set-point value be used for both AL 1, and AL 2.

## Routine Lens Maintenance

The Stack Check system accuracy is completely dependent on the cleanliness of the protective lenses of the light and receiving units on the exhaust stack. A positive pressured exhaust stack may require the use of purge air routed to the transmitter and receiver housings in order to increase the duration of run time between manual cleanings.

A few items which may indicate a manual cleaning is required are as follows.

*Gradual increase in opacity display over a relatively short period of time.*

*Consistently high opacity display for a long duration of time.*

*ERROR indication upon power-up and calibration sequence.*

Although not a requirement, damper units are detailed in the cleaning steps listed below.

*Step 1* Close the damper unit located between the lens assembly and the exhaust stack.

*(This will prevent exhaust gases from escaping through the lens sight tube.)*

*Step 2* Remove the lens assembly, using the two quick release latches.

*Step 3* Clean the protective lens with a soft cloth and window cleaning solution if needed.

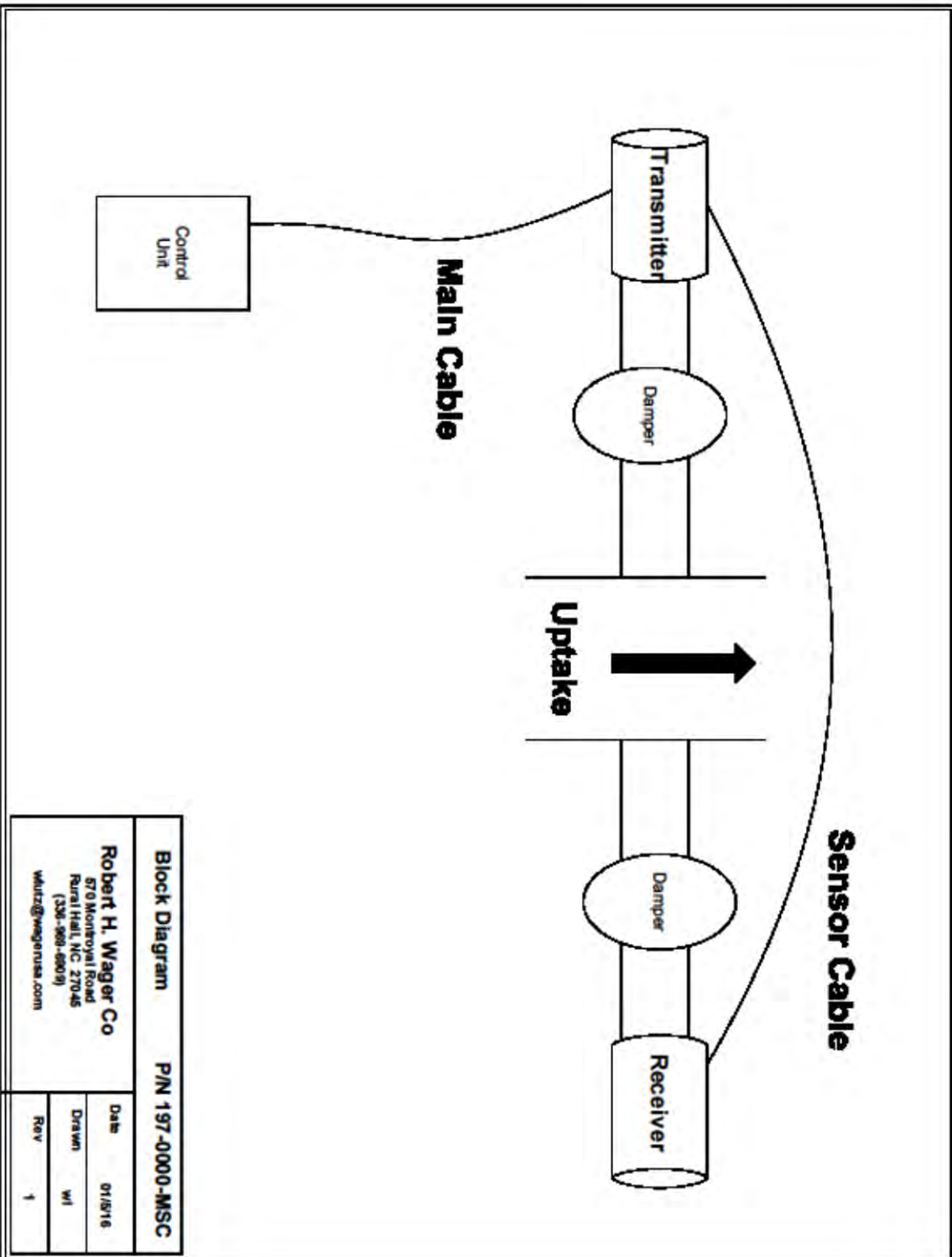
*Step 4* Reattach the lens assembly in the same orientation that it was removed.

*Step 5* Open the damper unit.

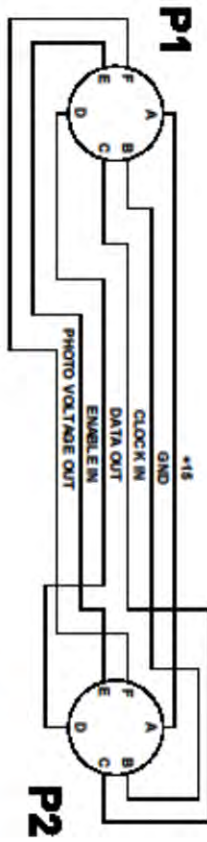
*Step 6* Repeat steps 1 through 5 for the lens assembly on the opposite side of the exhaust stack.

When manually cleaning the lenses, it may also be convenient to inspect the air purge supply, to assure the air flow is sufficient. If lens cleaning is frequent, an increase in the source air provided may be required.





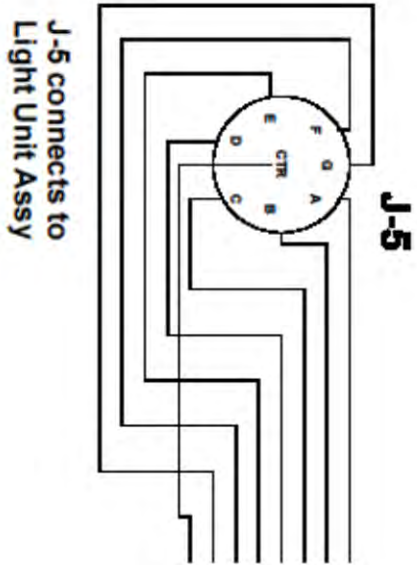
P1 Connects to  
Light Unit Assy  
197-0029



P2 Connects to  
Receiving Unit Assy  
197-0028

Cable is straight through  
A - A, B - B, C - C, D - D, E - E, F - F

|   |  |                     |         |
|---|--|---------------------|---------|
| <b>Sensor Cable Assy</b>  |  | <b>P/N 197-0026</b> |         |
| <b>Robert H. Wager Co</b><br>870 Montroyal Road<br>Rural Hill, NC 27046<br>(336-988-8909)<br>whdrc@wagerusa.com |  | Date                | 01/8/16 |
|   |  | Drawn               | WI      |
|   |  | Rev                 | 1       |



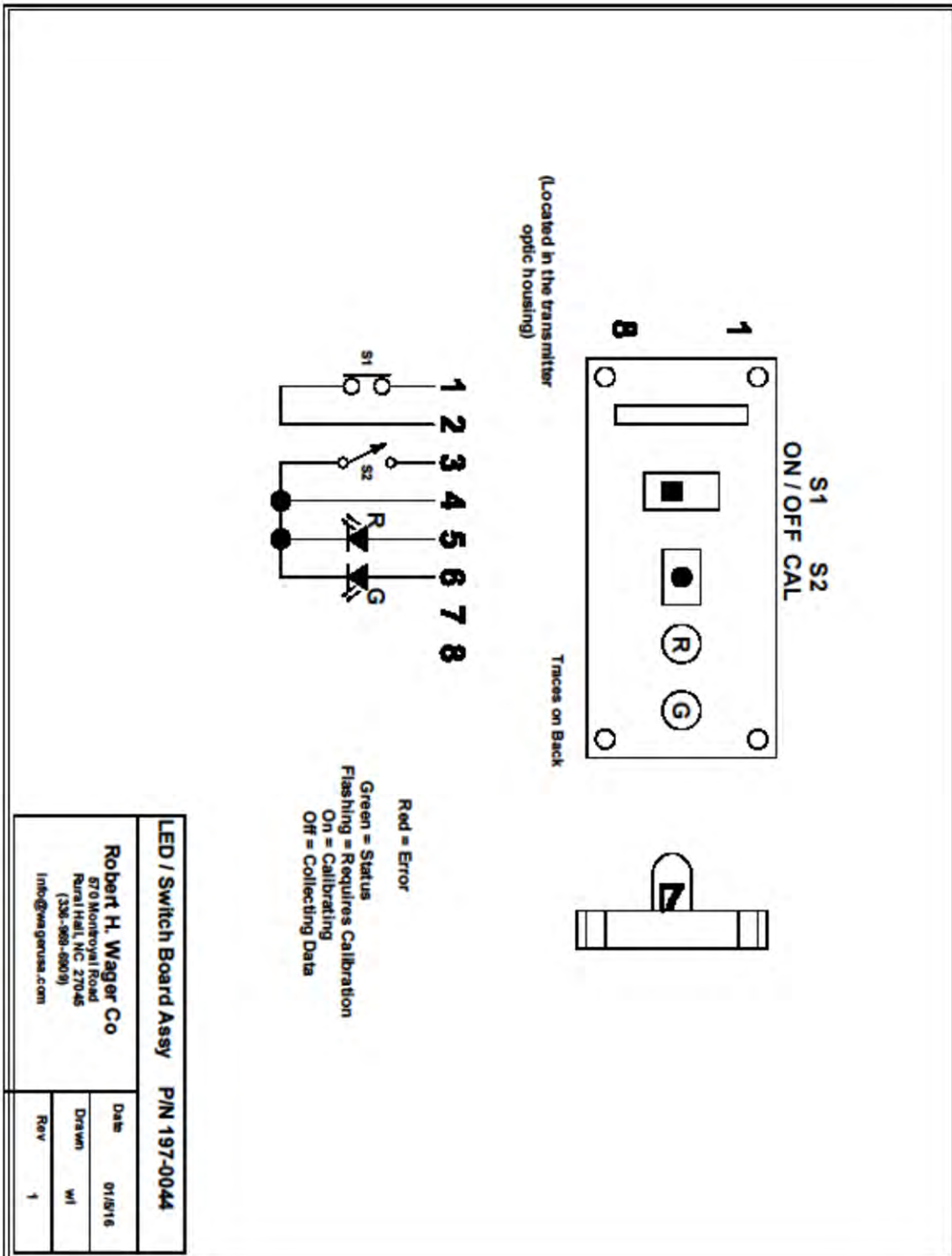
J-5 connects to  
Light Unit Assy

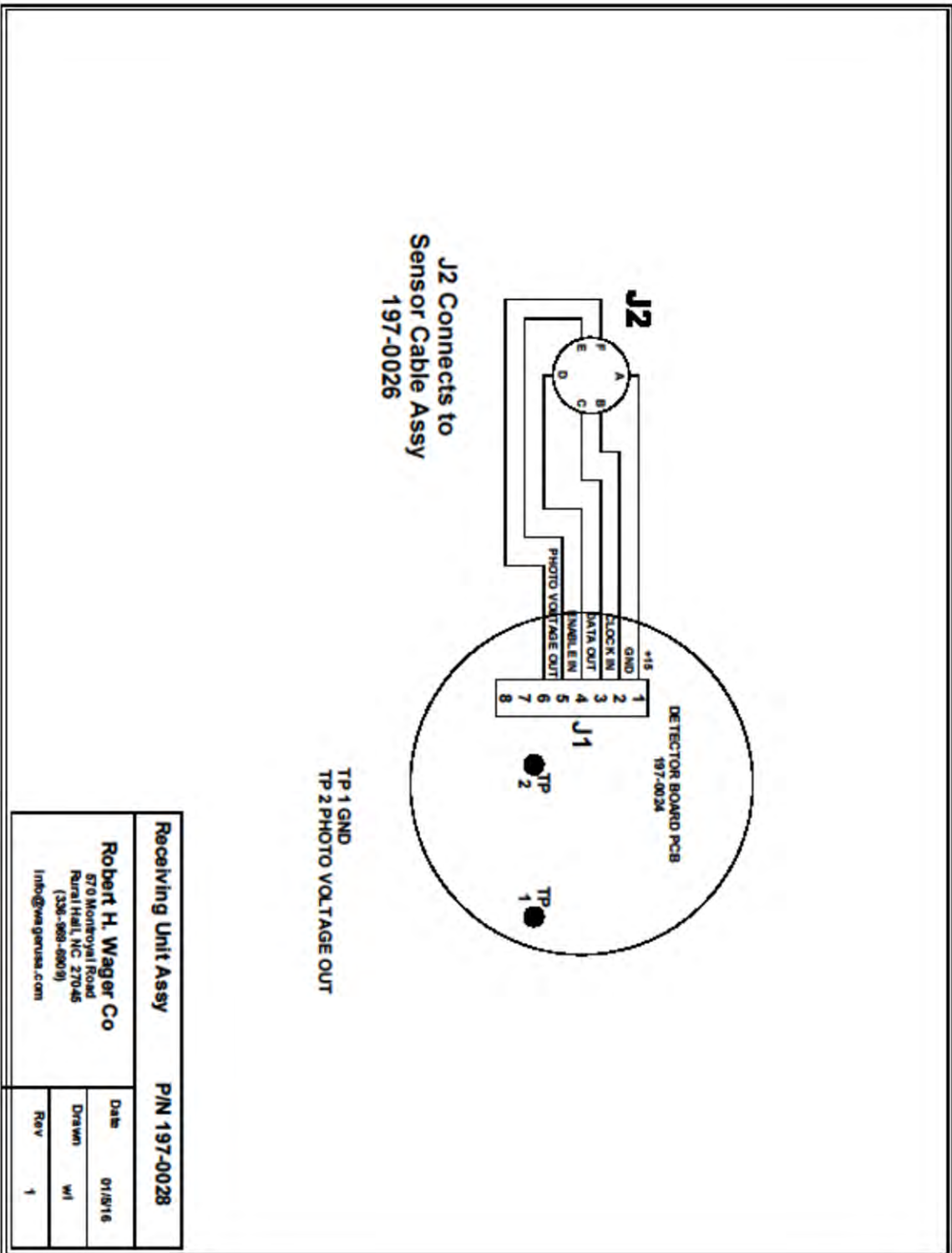
**J-5**

Military  
Version

- RED TS-6 J3-1
- YELLOW TS-7 J3-2
- ORANGE TS-8 J3-3
- BLACK TS-9 J3-4
- WHITE TS-10 J3-5
- BROWN TS-11 J3-6
- GREEN TS-12 J3-7
- BLUE TS-13 J3-8

|  |          |                       |    |
|--|----------|-----------------------|----|
| <b>Main Cable Assy</b>   |          | <b>P/N 197 - 0025</b> |    |
| <b>Robert H. Wager Co</b><br>570 Montroyal Road<br>Rural Hall, NC 27046<br>(336-889-8809)<br>info@rhwagerusa.com |          |                       |    |
| Date   | 01/09/16 | Drawn                 | WI |
| Rev  | 1        |                       |    |





|  |          |                     |    |
|--|----------|---------------------|----|
| <b>Receiving Unit Assy</b>   |          | <b>P/N 197-0028</b> |    |
| <b>Robert H. Wager Co</b><br>570 Montroyal Road<br>Rural Hall, NC 27046<br>(336-889-8800)<br>Info@wagerusa.com |          |                     |    |
| Date   | 01/05/16 | Drawn               | WI |
| Rev  | 1        |                     |    |

