



Custom Electronics Systems, Inc.
455 Forum Parkway
Rural Hall, NC 27045

Cigarette Pressure Drop And Ventilation Tester



User and Field Technician Manual

Contact Information

If you have any questions or comments about this instrument please feel free to contact us.

Address:

Custom Electronics Systems, Inc.
455 Forum Parkway
Rural Hall, NC 27045

Email: ces@draftrange.com

Phone: (336) 969-2411

Fax: (336) 969-2412

Legal Notice

This manual is provided for information purposes only. All information included herein is subject to change without notice. Custom Electronics Systems ("CES") is not responsible for any changes, direct or indirect, arising from or related to use of this manual.

This manual contains confidential and proprietary information. You may not disclose the contents of this manual or reveal any confidential and proprietary information obtained directly or indirectly from this manual to any third party without prior written consent from Custom Electronics Systems, Inc. Furthermore, you may not make copies nor redistribute this manual without the express written consent of CES.

Table of Contents

Introduction.....	1
Features.....	1
Specifications.....	1
Installation Instructions.....	3
Operator's Instructions.....	4
Initial Power Up.....	4
Ventilation and Pressure Drop Calibration.....	4
Product Test.....	5
Appendix.....	6
Appendix A – Maintenance.....	6
Filter Inspection and Replacement.....	6
Front Filter Replacement.....	6
Back Panel Filter Replacement.....	6
Back Panel Inlet Filter Replacement.....	6
Autozero Calibration.....	7
Appendix B - Troubleshooting.....	8
Appendix C – Product Innovations.....	9
Appendix D – Flow Signal Diagram.....	12
Glossary.....	13

Introduction

Thank you for your purchase of the CES 508 Cigarette Pressure Drop and Ventilation Tester ("CES 508"). This instrument was designed and manufactured to meet your company's need to accurately and repeatably measure total flow and ventilation flow through a test sample cigarette in a temperature controlled environment.

This manual describes the installation, general operation, technical specifications, maintenance procedures for the CES 508. You will also find a section which details some of the design and engineering decisions for this instrument. Following the instructions in this manual will help ensure that your CES 508 will provide accurate and repeatable readings for many years to come.

Two of the key innovations in the CES 508 is its ability to automatically compensate for absolute pressure variations and performs an auto-zero before every test. You can read more about these innovation and others in the Production Innovations Section ([Appendix C](#)).

Features

- Accurately maintains and measures user settable air flow from 0-100.0 ml/s
- Automatic pressure drop compensation (i.e. accounts for absolute pressure variations in the environment and test equipment)
- Accurately measures ventilation (0-100 %)
- Auto-zero for flow, ventilation, and pressure drop.

Specifications

General

Size: 318 mm (h) x 534 mm (w) x 445 mm (d)

Total Flow

Flow Sensor: NIST Traceable w/Input Pressure Compensation

Flow Indicator: 3.5 digit LCD display, 13mm digit height, 3 readings / sec

Flow Zero: Automatic

Low Flow Range

Read Out: 0-19.99 ml/s

Control Range: 2-19.99 ml/s

High Flow Range

Read Out: 0-100.0 ml/s

Control Range: 20-100.0 ml/s

Flow Control

Flow Control: Automatic (user settable)

Flow Accuracy: $\pm .75\% \pm$ LCD

Flow Control Zero: Automatic

Pressure Drop

Drop Pressure Zero: Auto

Pressure Drop Range: 0-1200 mm / H₂O

Low Pressure Drop Range: 0-199.9 mm of H₂O

High Pressure Drop Range: 0-1200 mm of H₂O

Drop Pressure Indicator: 3.5 digit LCD display, 13mm digit height, 3 readings / sec

Ventilation

Ventilation Pressure Indicator: 3.5 digit LCD display, 13mm digit height, 3 readings / sec

Flow Sensor: NIST Traceable w/Input Pressure Compensation

Low Ventilation Range: 0-19.99 ml/s

High Ventilation Range: 0-100.0 ml/s

Installation Instructions

Please reference the picture below when following the instructions in this section and later sections.

CES 508 (Back Panel)

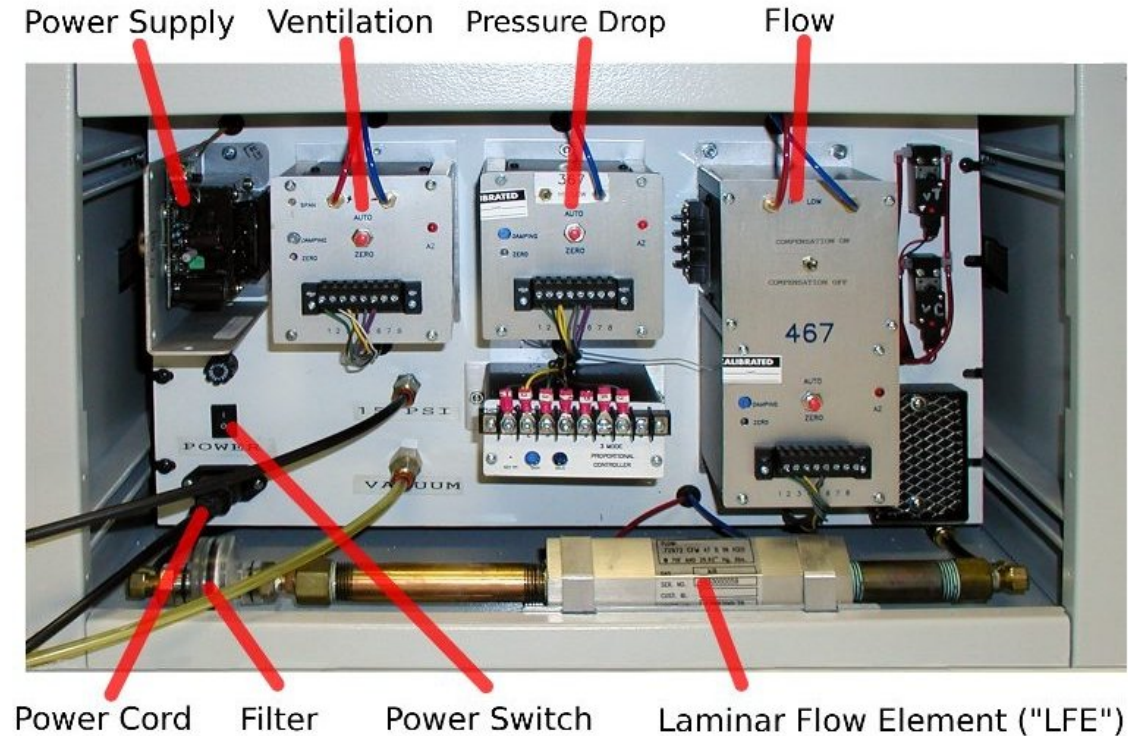


Figure 1

1. Select a space for the unit - This unit requires access to a standard wall power outlet (110V) within 5'. This unit also requires access to a house vacuum line and 30 psi instrument air. When selecting a spot, be sure that the unit is not within 5' of any HVAC vents, fans, or any other device that will influence air flow as this will affect the accuracy and repeatability of your readings.
2. Place the unit in the desired location and plug in the unit's power cord to the wall.

Operator's Instructions

Reference the diagram below when following the instructions in this section.

CES 508 (Front Panel)

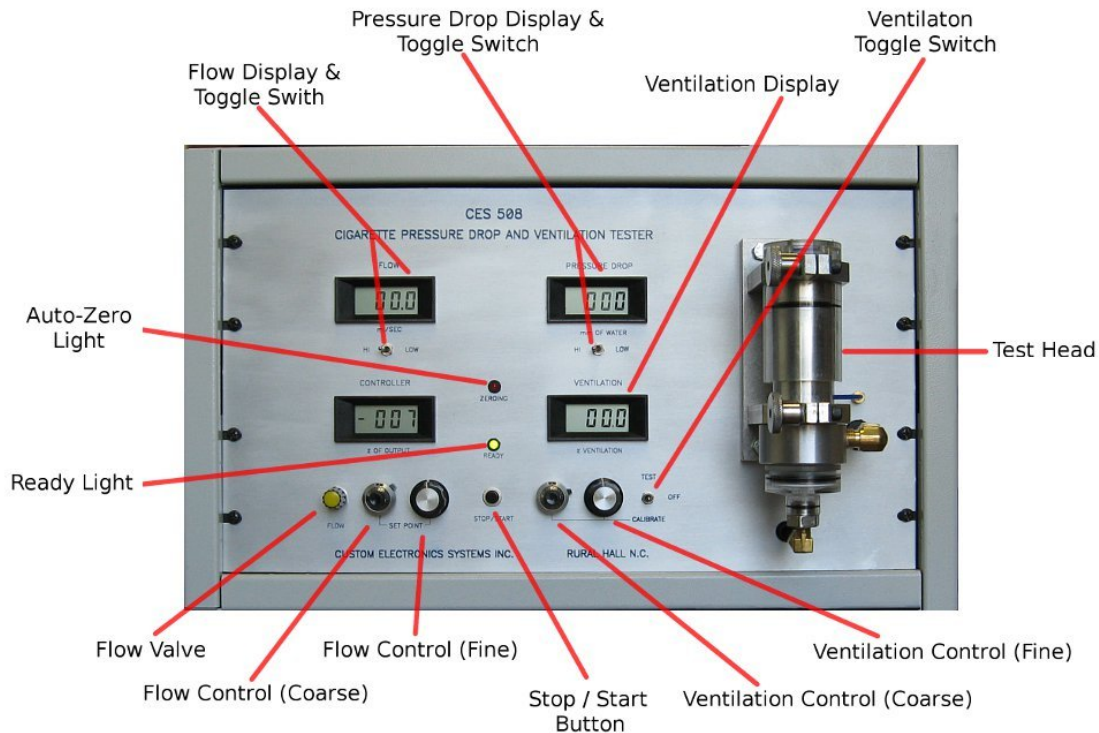


Figure 2

Initial Power Up

Perform the following steps every time the unit is powered on.

1. Turn on the power switch located on the back panel beside the power cord (see [Figure 1](#)). Allow the unit 10 minutes to warm up and acclimate itself to the room's conditions before attempting to run any tests.

Ventilation and Pressure Drop Calibration

Note that performing the calibration steps in this section are only necessary if you are using a ventilated test sample. In order to achieve accurate readings, please calibrate this instrument each time it is turned on or any time you wish to

change the flow rate you are measuring in a ventilated test sample. To calibrate the instrument please perform the following steps:

1. Set the Flow toggle switch (see [Figure 2](#)) to the desired setting (Low = 0-19.99 ml/s and Hi = 20.00-100.0 ml/s).
2. Set the "Ventilation Toggle Switch" to the "Calibrate" position.
3. Push the "Stop / Stop" button to begin calibrating the unit.
4. Set the Flow display to the desired level of flow using the coarse (left) and fine (right) "Set Point" knobs. Slide the lock on the side of the coarse Set Point knob downward. This will prevent the unit from being knocked out of adjustment by someone accidentally bumping or adjusting the knob.
5. Set the Ventilation display so it reads 100.0% using the coarse (left) and fine (right) "Calibrate" knobs. Once the ventilation reads 100%, slide the lock on coarse Set Point knob downward. This will prevent the unit from being knocked out of adjustment by someone accidentally bumping or adjusting the knob.
6. Push the "Stop / Start" button to finish calibrating the unit.

Product Test

Perform the following steps each time you would like to test a sample.

1. Place the test sample in the test head (Figure 2).
2. Ensure that the Flow, Pressure Drop, and Ventilation all read 0.0. If any of the previously mentioned displays read ± 0.2 please refer to the [Auto-zero Calibration](#) instructions in Appendix A.
3. If you are performing a Total Flow only test (i.e. the test sample is not ventilated) set the "Ventilation Toggle Switch" into the "OFF" position. If you are testing a ventilated test sample, set the "Ventilation Toggle Switch" into the "TEST" position.
4. If you are performing a Ventilation test (i.e. your test sample is ventilated) then set the "Pressure Drop Toggle Switch" into either the Lo setting (0-0-199.9 mm of H₂O) or the High (0-1200 mm of H₂O) setting.
5. Press the "Stop / Start" button to begin your test.
6. Wait for the displays to settle.
7. If you are measuring ventilation, set the Pressure Drop toggle switch (see [Figure 2](#)) to the desired setting (Low = 0-19.99 ml/s and Hi = 20.00-100.0 ml/s).
8. Press the "Stop / Start" button and, if necessary, set the "Ventilation Toggle Switch to the "OFF" position. Your test run is now complete.

Appendix

Appendix A – Maintenance

Filter Inspection and Replacement

In order to maintain optimum accuracy, you should periodically inspect, and if necessary, replace the air filters on the front and back panels of the instrument. If your filter has become old and somewhat clogged, perform the following steps to replace the appropriate filter.

Front Filter Replacement

1. Turn the unit off.
2. Locate the filter on the bottom of the test head.
3. Pull gently downward on the filter and it will detach from the rest of the test head.
4. Grip the test head by the largest part of the filter and pull the brass fitting away from the test head.
5. Replace the filter and reattach the filter to the test head.

Back Panel Filter Replacement

1. Turn the unit off.
2. Locate the air filter on the bottom left hand side of the unit.
6. Unscrew the air fitting on the left hand side of the filter.
7. Unscrew the old filter from the brass fitting and discard.
8. Place a small amount of pipe dope on the threads of the brass fittings that screw into the air filter.
9. Screw the new air filter into the brass fittings.

Back Panel Inlet Filter Replacement

1. Turn the unit off.
2. Locate the inlet filter on the bottom right hand side of the back panel (see picture on right). The inlet filter has a black plastic housing, a metal grill that is retained by two screws.
3. Remove the two retaining screws and remove the metal mesh.



4. Remove the filter material and clean it under a faucet. If the filter is too deteriorated, replace the filter with normal computer case fan filter material. Case fan filters are readily available from many computer parts suppliers and other retailers.
5. Insert the inlet filter and then the retaining metal grill.
6. Screw in the two retaining screws.

Auto-zero Calibration

Over a long period of time, you may notice that when the unit is idle (i.e. you're not running a test) the Flow, Pressure Drop and / or the Ventilation displays may no longer read as close to 0.00 as it used to. If any of these displays read greater than |0.2|, your unit's Auto-zero should be calibrated to ensure optimum accuracy. If this occurs, please perform the following steps to recalibrate the Auto-zero function on your instrument.

1. Obtain a small flat head screw driver.
2. Make sure there is not any air in the system (i.e. you're not running any tests or calibrating the unit).
3. Note which display is out of adjustment.
4. Locate the "Hi / Lo" toggle switch that is directly under the display you wish to adjust. Set the toggle switch to the "Lo" position.
5. Locate the transmitter on the back panel of the instrument which needs adjusting (e.g. Ventilation, Pressure Drop, or Flow).
6. Press the red button labeled "Auto-zero" on the transmitter you just located. Wait for the green "Ready" indicator on the front panel to illuminate.
7. On the back panel of the instrument, locate the small hole labeled "Auto-zero" drilled into the transmitter's case you previously located.
8. Turn the screw slowly to adjust the Auto-zero until the display on the front reads 0.00 again. You might find it helpful to have another person assist you with adjustment since you will need be unable to see the front panel display as you adjust the auto-zero. When you are satisfied with your adjustments, press the red Auto-zero button again. Once the auto-zero test completes, if you find that the front panel display no longer reads 0.00, repeat this entire step. If the auto-zero test completes and your front display still reads 0.00 you may proceed to the next step.
9. Repeat all steps until all displays read 0.00.

Appendix B - Troubleshooting

Problem: The unit will not turn on.

Solution: Ensure the unit is snugly plugged into the wall and into the back of the unit. If the unit will not turn on, ensure the power switch (next to the power cord) at the back of the unit is in the on position. If the unit still will not turn on, replace the .75 Amp fuse in the back of the unit. If the unit still refuses to turn on, please call CES at (336) 969-2411 for service.

Problem: The Ventilation Display reads "1"

Solution: This problem occurs when you flip the Hi / Lo Ventilation Toggle Switch in the middle of a test (i.e. the unit's "Ventilation Toggle Switch" is set to "Test"). Flip the instrument's "Ventilation Toggle Switch" to the "Off" position. Then flip the toggle switch back to the "Test" setting.

Problem: When flow switch is set in the high setting, cannot get Flow to read high enough to reach the desired level.

Solution: Turn Flow Valve Knob counterclockwise so the Controller display reads anywhere between 10-90%.

Problem: Controller Display reads negative when the machine is *not* taking a reading.

Solution: This is a normal operating behavior.

Problem: Controller Display reads negative when taking a reading.

Solution: Please call (336) 969-2411 for service.

Problem: The Flow, Pressure Drop, or Ventilation displays do not read close to zero.

Solution: Refer to the Auto-zero instructions in [Appendix A](#).

Problem: While running a test, the unit stops testing after approximately 5 minutes.

Solution: This is a normal operating behavior. The unit will only allow a set amount of time to run a test. This is a built in mechanism to prevent the unit from running for extended periods of time and to ensure the unit retains maximum accuracy over its life.

Appendix C – Product Innovations

Custom Electronics Systems (“CES”) was able to make a number of design improvements in the CES 508 in relation to the Eastman Flow and Ventilation Tester. Some of the improvements made were due to improvements in technology over time (e.g. microprocessor technology) while other improvements stem from CES' decades of experience in designing and manufacturing draft range instruments. This section will describe some of the improvements made.

One of the greatest advantages to the CES 508's design is that all processes and calculations have been automated to the greatest extent possible. This allows the operator of the instrument to obtain readings faster, more accurately readings, minimize training for new operators. Automated processes and calculations the instrument performs include the following:

- The instrument is auto-zeroed automatically before every test (accurate within 0.01 ml of H₂O).
- The instrument automatically calculates total flow and ventilation.
- Compensates total flow to account for small and moderate changes in house vacuum pressure (accurate within 0.01 ml of H₂O). This automated process relieves the operator from being forced to manually adjust the total flow to compensate for house vacuum changes. It is recommended that when fast and dramatic changes in house vacuum are common that you place an air tank between this unit and the house vacuum.
- Ventilation percentage is automatically calculated and displayed on the front panel. This relieves the operator from manually calculating flow percentages.
- Total flow and ventilation are both automatically pressure compensated relieving the operator from trying to calculate pressure variations.

By automating as much as possible human error is eliminated almost entirely from the testing process leading to more accurate and repeatable results. Two of the key innovations made during the design of this instrument is its auto-zero function and its ability to compensate for pressure drops.

The auto-zero function of this instrument automatically resets the zero in all the instruments within the CES 508 before a reading is taken. The CES 508 also periodically performs an auto-zero when it is idle.

This instrument's absolute pressure compensation system automatically adjusts the unit's readings to account for barometric pressure variations in the environment (weather, elevation, etc.) and even pressure drop variations within the unit (i.e. new or dirty filters, upgrades to equipment attached to the unit which impact pressure drop, etc.). During testing, CES found that it's pressure

drop compensation system made the curve more linear and eliminated 3% error that would have remained hidden.

To further increase the reliability of our test results, Custom Electronics Systems ("CES") removed as many heat sources as possible from the instrument. This is done because heat impacts the density of the air and, if left unaccounted for, would decrease the accuracy of our readings. Removing sources of heat from the signal flow ensures that our temperature is the same as ambient laboratory temperature and subsequently increases the instrument's accuracy. Considering these factors, CES removed as many of these sources of heat as possible, especially heat sources in the flow signal path (see [Appendix D](#) for a diagram of the flow signal path).

With respect to the flow signal, sources of heat downstream from all measuring devices have been completely eliminated in the CES 508. The old Eastman Flow and Ventilation Tester instrument had numerous sources of heat (110V DC) inside the case and in the flow signal. In the CES 508, all sources of heat excluding one were either placed on the back panel which is on the outside of the instrument. The heat sources located on the back panel are 24V DC which eliminates any heat that might have been transferred to the instrument's internals.

The one source of heat remaining inside the CES 508's case is downstream from any measurements taken, located at the top of the instrument, well ventilated, and is an intermittently used 24V DC power source which, considering all these factors, this small heat source will not introduce any heat to the signal path.

Since there is very little heat generated on the inside of the case, and the case is well ventilated, we are able to do without a case fan. Removing the case fan from the design eliminates a moving part that would eventually need to be replaced, and is also source of noise. The fan would have also introduced a large amount of dust into the unit which could possibly reduce the lifespan of the instrument.

Also, in other areas where full flow is a primary concern, the instruments tubing is sufficiently large and all bends are gentle enough to prevent constrictions.

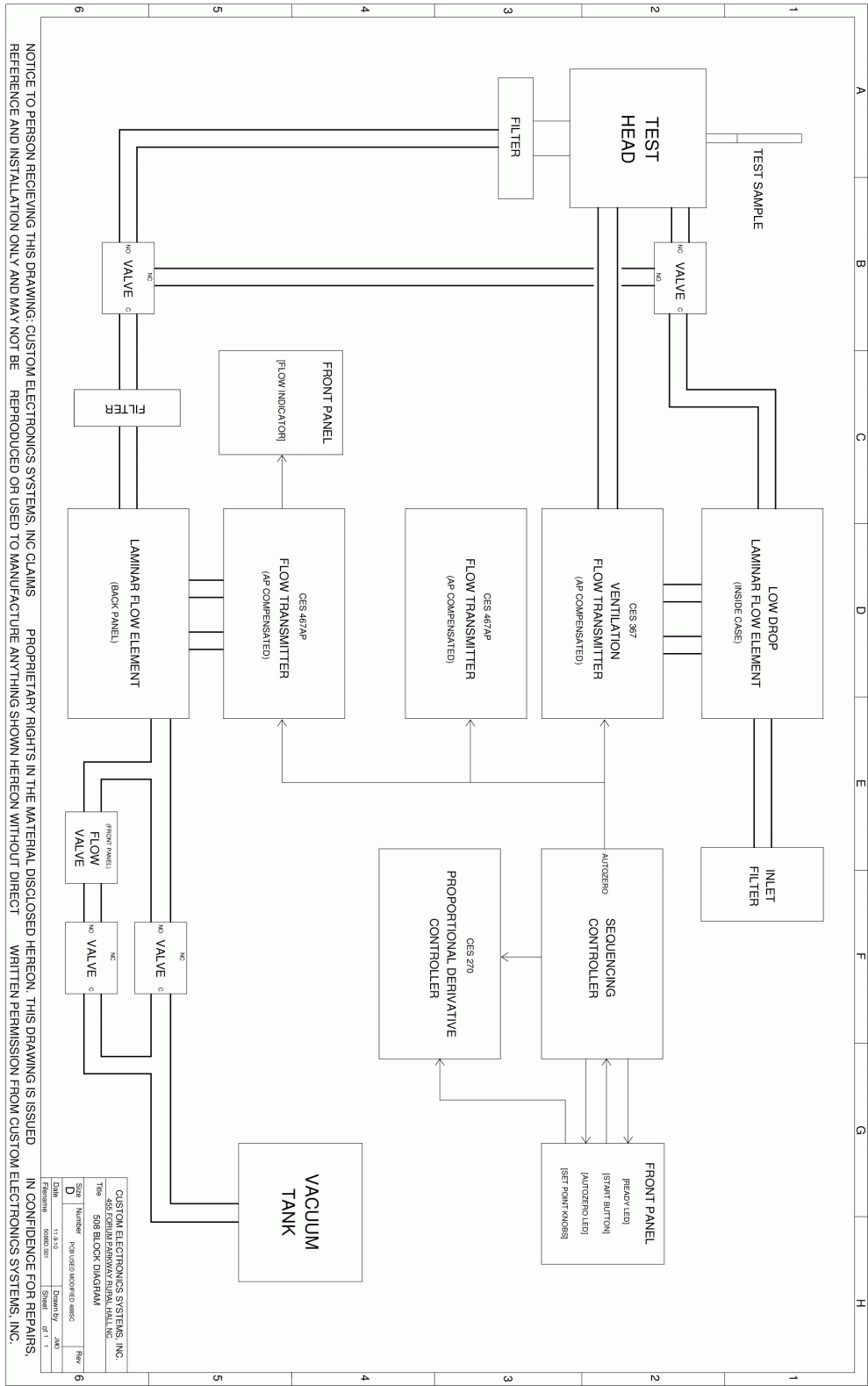
One other refinement made by the CES 508's design is that the operator calibrates ventilation flow with total flow (total flow is user settable). This leads to more accurate and traceable readings.

In order to facilitate accurate readings and between the measurement of total and ventilation flow CES decided to use Laminar Flow Elements to measure both ventilation and total flows. CES' tests have concluded that using two different types of flow measurement devices in an instrument (i.e. a laminar flow element to measure total flow and a mass flow sensor to measure ventilation flow), as

found in the old Eastman Flow and Ventilation Tester, results in curve non-conformity (i.e. tracking errors) between the total flow and ventilation flow. CES also found that utilizing laminar flow elements, as found in the CES 508, resulted in the total flow and ventilation flow tracking one another within less than 0.25%.

All of the above mentioned design decisions and others make the CES 508 both easy to use for the operator, virtually maintenance free, while providing accurate and repeatable test results.

Appendix D – Flow Signal Diagram



NOTICE TO PERSON RECEIVING THIS DRAWING: CUSTOM ELECTRONICS SYSTEMS, INC. CLAIMS PROPRIETARY RIGHTS IN THE MATERIAL DISCLOSED HEREON. THIS DRAWING IS ISSUED IN CONFIDENCE FOR REPAIRS, REFERENCE AND INSTALLATION ONLY AND MAY NOT BE REPRODUCED OR USED TO MANUFACTURE ANYTHING SHOWN HEREON WITHOUT DIRECT WRITTEN PERMISSION FROM CUSTOM ELECTRONICS SYSTEMS, INC.

Company	CUSTOM ELECTRONICS SYSTEMS, INC.
Address	455 ECHOLS PARKWAY, RURAL HALL, NC
City	508 BLOCK, DAVISDALE
State	
Zip	
Phone	
Fax	
Drawn By	J. J. JACO
Checked By	
Date	11.18.10
Sheet	D

Glossary

Auto-zero – Components that measure flow have a tendency to settle when over time and as ambient conditions (temperature, air pressure, etc.) change. This settling can gradually introduce errors in the instrument's readings. An instrument that "auto-zeros" periodically resets the instrument's zero (i.e. when the instrument reads 0 flow) and compensates for this drift.

Flow Signal – This is the route the total flow takes throughout the instrument.

Test Sample – This is the cigarette you're testing or the standard.

Total Flow – This is the volume of air that passes through the test sample and the instrument. For the purposes of this instrument, total flow is the combination of the main and ventilation flows.

Ventilation Flow – This is the flow that passes through the holes in the cigarette filter (i.e. the test sample). The ventilation flow is a percentage of the total flow.