



DVR-3000

Digital Vacuum Regulator

Operation Manual



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DVR Overview

This manual provides the necessary information for proper installation, operation, and maintenance of the CANNON DVR-3000 Digital Vacuum Regulator.

DVR Function

The CANNON DVR-3000 instrument is designed to regulate vacuum at 300 mm Hg below atmospheric pressure, at flow rates of up to 3 LPM. Vacuum may be adjusted to other settings, from 95–450 mm Hg. The DVR is suitable for use with all CANNON temperature baths, including the CT and TE Series high and low temperature baths.



Figure 1: DVR-3000

DVR Application

The DVR is ideal for use with Cannon-Manning calibrated CMVC series viscometers, Modified Koppers Calibrated MKVC Series viscometers, Asphalt Institute Vacuum Calibrated AIVC series C Series viscometers, and Asphalt Institute Vacuum Calibrated AIVC series viscometers for measurement of highly viscous materials such as asphalt cement at 60 °C (140 °F) per ASTM D2171 specifications. Both Cannon-Manning and Modified Koppers permit viscosity measurement from 42 to 200,000 poise. Asphalt Institute AIVC Series 400R and 800R viscometers, also available from CANNON, extend that range to 1,400,000 poise and 5,800,000 poise, respectively.

The DVR is also useful in other laboratory systems where accurate measurement and control of vacuum from 95–450 mm Hg below atmospheric pressure is required.

Specifications

Table 1: DVR Specifications

Specifications	Details
Model	DVR-3000
Methodology	ASTM D2171
Applications	Common applications include asphalt cement and asphalt binders, with an operational range of 95–450 mm Hg below atmospheric pressure
Dimensions (W × D × H)	16.8 cm x 25.0 cm x 18.5 cm (6.62" x 10" x 7.25")
Weight	5 kg (11 lb)
Shipping Weight	6.8 kg (115 lb)
Vacuum Range & Accuracy	95–450 mm Hg below atmospheric pressure ± 0.5 mm Hg (Factory preset to 300 mm Hg below atmospheric pressure) NIST certified and traceable
Safety Limit	746 mm Hg below atmospheric pressure
Operating Conditions	15 °C to 30 °C, 10% to 75% relative humidity (non-condensing), Installation Category II, Pollution Degree 2
Electrical Specifications	120 VAC, 50/60 Hz; 240 VAC, 50/60 Hz; 175 watts power consumption
Compliance	CE Mark: EMC Directive (2004/108/EC); Low Voltage Directive (2006/95/EC); HI-POT (1900 V _{DC} , 60 sec.); ROHS

Notes/Cautions/Warnings

Notes, cautions, and warnings are used in the manual to call an operator's attention to important details prior to performing a procedure or step. Read and follow these important instructions. Failure to observe these instructions may void warranties, compromise operator safety, and/or result in damage to the instrument.



Notes: Provides more information about the content that follows.



Cautions: Alerts the operator to conditions that may damage equipment.



Warnings: Alerts the operator to conditions that may cause injury.

If any part in this manual is not clear to understand or is missing articles, contact your local dealer or sales representative.

The manufacturer is not liable for any loss or damage directly or indirectly caused by use of the instrument or its consequences.

This manual pertains directly to the DVR-3000 Digital Vacuum Regulator. For details relating to other accessories or equipment, please refer to the appropriate manufacturer-supplied documentation.

Safety Precautions

Always observe the following general safety precautions for proper and safe operation of the DVR-3000.

- Only qualified personnel should operate the DVR.
- Read and understand all operating instructions and safety precautions listed in this manual before installing or operating the instrument. Contact Cannon Instrument Company with questions regarding instrument operation or documentation.
- Do not deviate from the installation, operation, or maintenance procedures described in this manual. Improper use of the DVR may result in a hazardous situation and may void the manufacturer's warranty.
- Handle and transport the unit with care. Sudden jolts or impacts may cause damage to components.
- Position the instrument on a sturdy table or workbench.
- Provide at least 15 cm (6") of ventilation space for the rear of the unit.
- Do not turn the power switch on and off rapidly and repeatedly.
- Observe all warning labels. Never remove warning labels.
- Never operate damaged or leaking equipment.
- Unless procedures specify otherwise, always turn off the unit and disconnect the MAINS cable from the power source before performing service or maintenance procedures, accessing the electronics drawer, or before moving the unit.
- Never operate the equipment with damaged MAINS power cables.
- Refer all service and repairs to qualified personnel.



Warning: *Always ensure the protective ground (earth) terminals of the instrument connect to a protective conductor of the MAINS power cord. Use only the manufacturer-supplied power cord, and do not use an extension cord without protective grounding.*



DVR Setup

Unpack and Inspect

Unpack and inspect DVR and all accessories as soon as they are received. Refer to the Packing List to verify all materials are present. See **Table 2**.

Table 2: Packing List (Main Components)

Quantity	Description	Part Number
1	DVR-3000	9726-T70
1	MAINS AC Power Cable	Varies by locale
1	Tubing, 4' (122 cm) $5/16$ " ID x $5/8$ " OD Neoprene	42.9
1	CE Note	N/A
1	Manual	41.3041

Tubing Connections

Tubing connections for the DVR-3000 may be arranged in a variety of ways to suit application and environment. Make sure that there is adequate slack in the tubing to avoid kinks in the line (kinks prevent optimal control).

Connect to Your Application

DVR-3000 features an international standard G1/8 parallel port on the front of the unit. A simple push fit can be made with a rubber hose; alternatives may be fitted by simply unscrewing the fitting.

1. Connect the DVR-3000 to your vacuum manifold or application using the 4' (122 cm) length rubber vacuum tubing provided by CANNON. Secure the tubing to the Vacuum Manifold Inlet on the front panel of the DVR. Refer to **Figure 2**.
2. Push the tubing firmly into place over the barbed nipple fitting.
3. Attach the other end of the tube to your manifold/application, clamping the connection if necessary.
4. Check all vacuum connections to make sure they are secure.

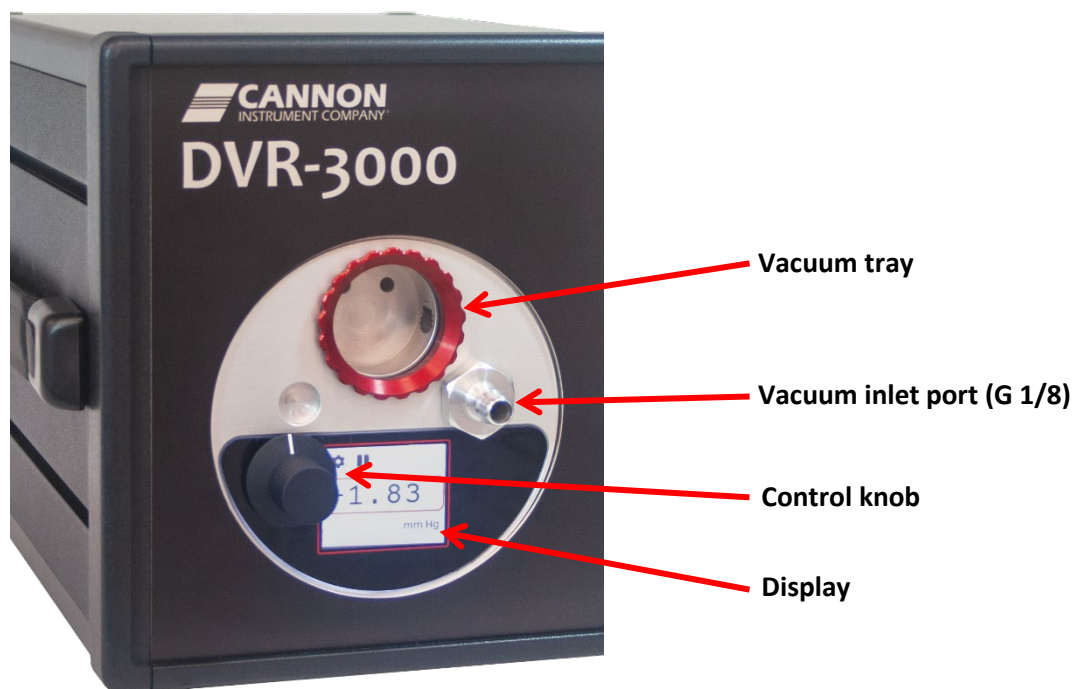


Figure 2: DVR Front Panel Connections

Vacuum Trap

An integral vacuum trap is provided on the front of the DVR-3000 and is designed to prevent liquids from being pulled into the system and damaging the internal components.



Caution: *Avoid pulling liquid solvent past the vacuum trap as this may cause internal damage to DVR components and create a safety hazard.*

The trap can only “catch” about 20 mL of fluid; it is not suitable for use as a reservoir or waste receptacle. In the event a small amount of fluid enters the vacuum system, perform the following:

1. Immediately power OFF the unit.
2. Unscrew the hand-tight ring on the front to empty the chamber.
3. Clean the connecting rubber tubing with appropriate solvent(s).
4. Thoroughly dry the tubing before reconnecting it to the DVR.

Electrical Connections

After vacuum tubing is successfully connected, use the MAINS power cord provided with the DVR to supply electricity to the unit.



Caution: *The main plug for the power cord should only be inserted in a socket outlet or receptacle provided with a protective ground (earth) contact. Do NOT use an extension cord/power cable without a protective conductor (grounding).*

The ~MAINS symbol indicates instructions or connections for the AC power supply. The AC Power input must match the electrical specifications listed on the label on the rear panel of the instrument. The supplied AC MAINS power cord must attach to the connector labelled ~MAINS. This connection serves as a means of disconnect and should be readily accessible.

The (O) symbol indicates the OFF position for the electrical switches for the unit (AC Mains or accessories).

Connecting Power Cable

1. Plug the power cord into the DVR rear panel IEC Power Inlet connector. See **Figure 3**.
2. Plug the other end of the cord into an appropriate electrical outlet.

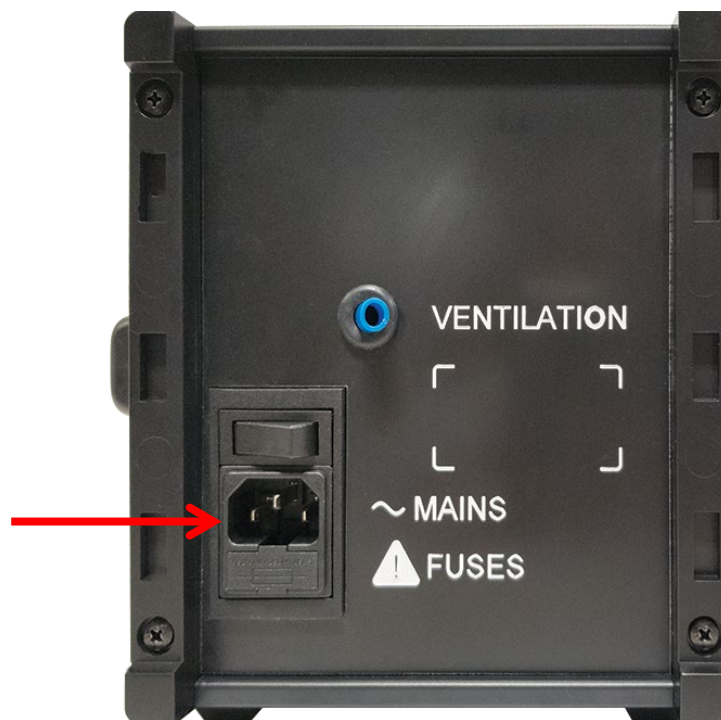


Figure 3: Rear View of Unit



DVR Operation

Default Settings

The DVR is designed to display and regulate vacuum for viscometry applications per ASTM D2171 specifications. The DVR regulates vacuum for efficient regulation of vacuum at 300 mm Hg below atmospheric pressure.

To adjust the control settings to regulate other pressures, refer to section **Adjusting Set Point**.

Accessories

The DVR is designed for use in conjunction with the CANNON 3VM and 4VM vacuum manifolds. The 3VM manifold (part number 9726-V10), see **Figure 4**, has three valves and pairs with the CANNON CT-500 Series Constant Temperature Bath. The 4VM manifold (part number 9726-V05) has four valves and pairs with the CANNON CT-1000 Series and CT-2000 Series Constant Temperature Baths.



Figure 4: 3VM Vacuum Manifold

Turning ON the DVR

1. Make sure the instrument power cord is connected to an appropriate power source. Electrical requirements are specified on the rear panel of the DVR unit.
2. Ensure that all vacuum connections are secure.
3. Switch the POWER switch on the DVR rear panel to the ON position. This action activates the display and turns on the internal vacuum pump. Factory default is set at 300 mm Hg; to adjust, see section **Controls operation**.

Adjusting the Flow Rate

It is not necessary to adjust the flow rate manually. The DVR-3000 incorporates automatic internal regulation which compensates for demanded flow quickly and accurately.



DVR Cleaning & Maintenance

Cleaning



Caution: Before cleaning the DVR, turn off the instrument and unplug the MAINS power cord. Do NOT clean the instrument while it is in operation.

Best practices dictate that it is ideal to periodically clean the outside of the unit with a cloth moistened with water and/or a mild detergent solution. Do not allow water or detergent solution to drip into the unit.

1. Wipe down the front panel, sides and top.
2. Remove the vacuum trap cover and wipe out the vacuum trap enclosure.
3. If there is oil or residue in the glass jar, use an appropriate solvent and drying agent to clean the jar.
4. Replace vacuum trap cover. The unit is inoperable unless the vacuum trap is in place.

In the event of completely overcoming the trap, it is possible to remove an internal cover and clean the insides of the DVR mechanism. Only authorized personnel are permitted to perform this procedure.

Maintenance

Do not allow oil to accumulate in the vacuum trap. Remove the cover, empty, and clean as often as necessary. Remove MAINS power from the instrument BEFORE removing the vacuum trap.

Periodically inspect the line cord for fraying and/or exposed wiring. When removing the cord from the power outlet, pull it out with the plug. Do not pull the cord.

Troubleshooting the DVR

Upon discovery of a problem with the DVR, first make sure that all tubing and electrical connections are correct and secure, and that the power switch is in the correct ON position.

Vacuum System Leak

If the vacuum system is leaking, check the vacuum trap cover to ensure it is tightly screwed into position.



Controls operation

The DVR unit offers user adjustable options. Use the control knob (see Figure 2) to move the cursor around the screen. The control knob can be rotated left and right. The red highlighting box will move over the options for the instrument. Then press the control knob, to select option.

Setup Option

Select the gear icon to access the update function. Press the knob to enter the option. See *Figure 5*.

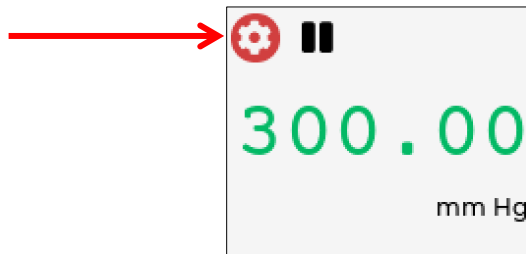


Figure 5: Setup Option Selection

Pause Pumping Motor

Select the pause button (see *Figure 6*) to stop the motor but allow the high precision pressure sensor to continue to read. Press the control knob to turn OFF the pump. Keep it highlighted and press it again to turn it back on. This function is particularly useful for locating system leaks.

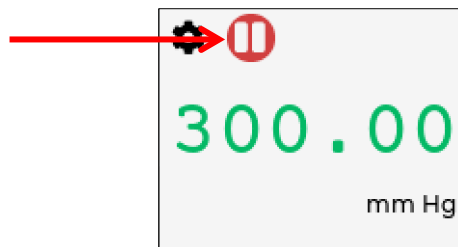


Figure 6: Pause Pumping Selection

Adjusting Set Point

1. For small adjustments of setpoint, rotate the knob to put the highlighting red box around the indicated pressure; see *Figure 7*.

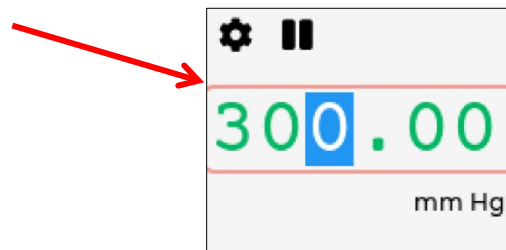


Figure 7: Set Point Adjustment Selection

2. Press again, to select the **setpoint**.
3. Twist the control knob left or right, to change the pressure in 1 mm increments. If a big change is required, press the control knob again to highlight the right most digit; press again to highlight the next digit, etc. At each step, the highlighted digit is changed by twisting the control knob left or right.
4. On completion, press the control knob once, to set the new point.



Software update

A potentially useful function, available since the introduction of the new, high-performance DVR-3000, is the availability of an over-the-air software update (OTA). In normal use, the OTA function is carefully hidden so it cannot be accidentally enabled. To use OTA, it will be necessary to open the unit to allow radio energy from a smartphone into the case.

1. Open the unit.
 - a. Remove the four screws on the back panel.
 - b. Pull off the two plastic trims over the rear panel.
 - c. Slide out the metal top of the box, leaving enough room for radio to get into the electronics. See *Figure 8*.

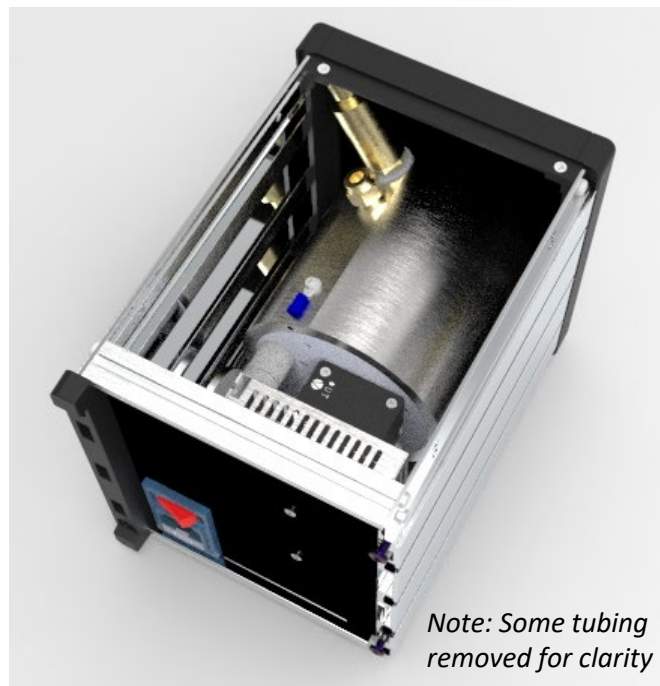


Figure 8: Open Unit

2. Download ESPTouch app from App Store or Google Play. See *Figure 9* and *Figure 10*.

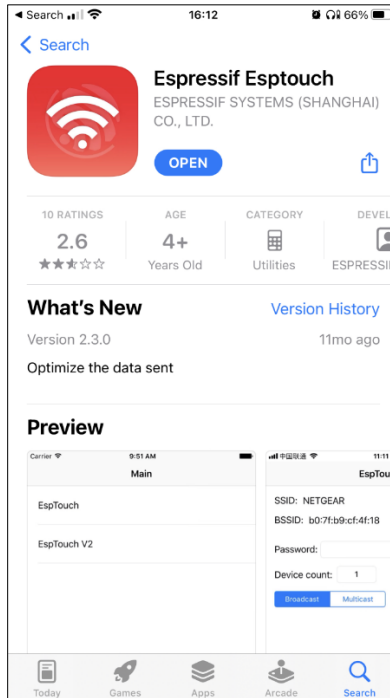


Figure 9: App on App Store (Apple)

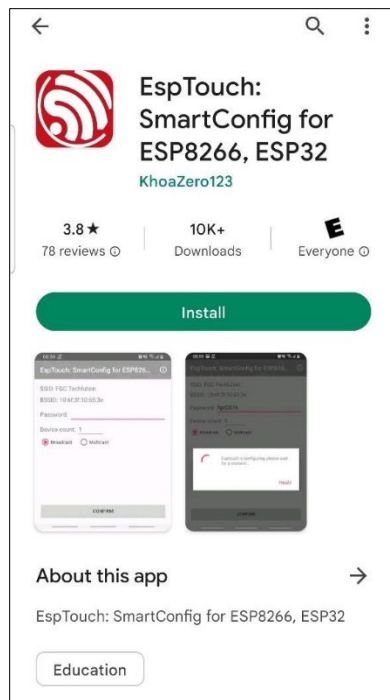


Figure 10: App on Google Play (Android)

3. On unit, rotate the control knob to highlight the gear and press knob to select. See *Figure 11*.



Figure 11: Select Gear

4. When the **Settings** window opens, rotate the control knob to highlight **Wi-Fi** and press the control knob to select. See *Figure 12*.



Figure 12: Settings Menu

5. When Wi-Fi window opens, rotate the control knob to highlight **Connect Ap** and press knob to select. See *Figure 13*.

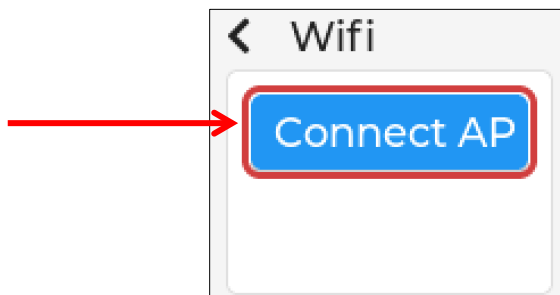


Figure 13: Wi-Fi Setting Screen

- When message to configure app appears, choose Cancel as this was completed in steps 2--5. See *Figure 14*.

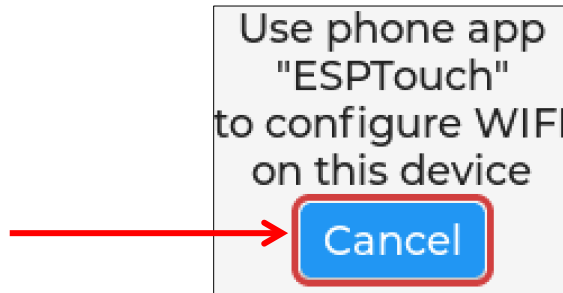


Figure 14: Configure App Screen

- In the ESPTOUCH app, your phone needs to be connected to the same Wi-Fi Network you intend to use on the DVR. Input the Wi-Fi password and hit **Confirm**. See *Figure 15*.

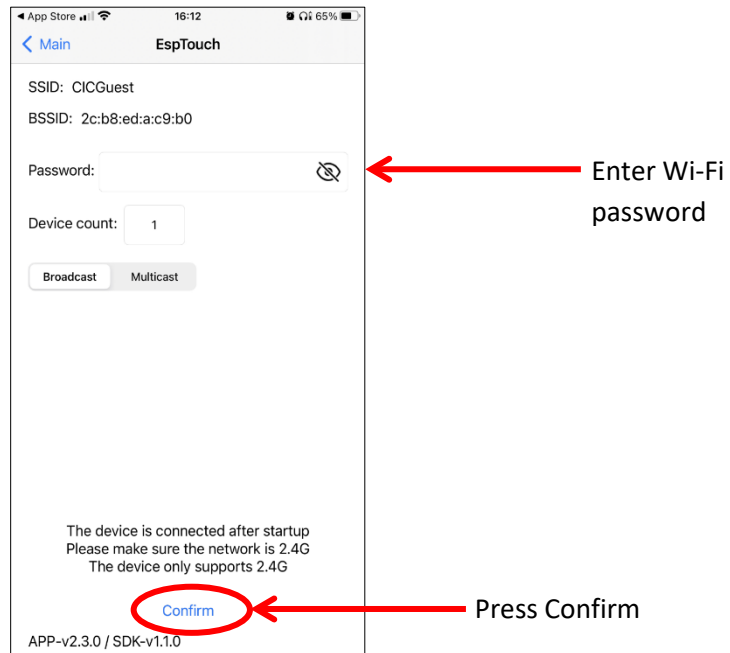


Figure 15: Connect to Wi-Fi in ESPTouch

8. When the connection is successful, the ESPTouch app will display IP address. Take note of this IP address for **Step 10**. Note: This address may change every time a new connection is established. See **Figure 16**.

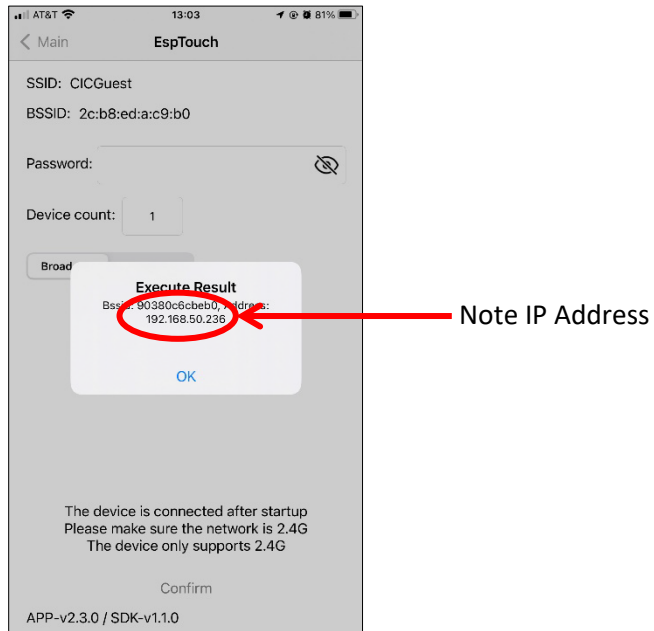


Figure 16: ESPTouch IP Address Display

9. At the same time, the DVR Screen will automatically refresh and display the network information (Access point name, IP address, etc.). The items on this screen can be highlighted by turning the knob. See **Figure 17**.

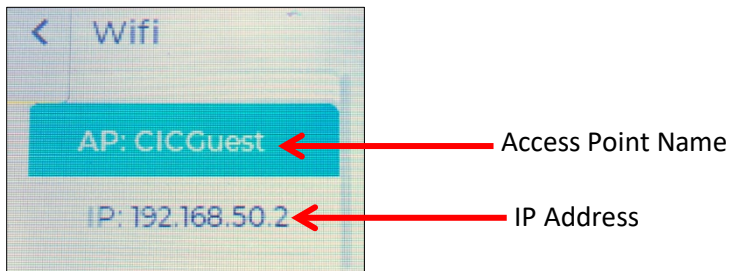


Figure 17: DVR Network Information

10. On a PC connected to the same Wi-Fi network as the DVR, open a web browser and type in the DVR's IP Address in the following format: `https://IPAddress` (example: `https://192.168.50.236`).

11. The Choose a File webpage will appear, see **Figure 18**. If it does not, verify you have typed “https://” before the IP Address from your DRV (**Step 9**).



Figure 18: Choose a File Webpage

12. If software update is available, CANNON instrument Company will send the user a binary file that can be uploaded on this screen. Drag and drop the .bin file, then click Upload. See **Figure 19**.

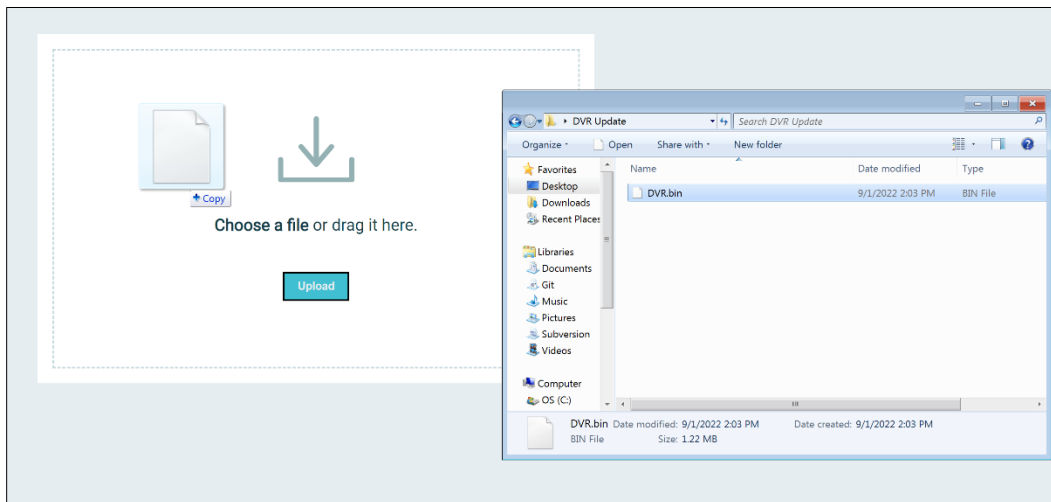


Figure 19: Drag and Drop .bin File for Upload

13. The Screen will state **Uploading**. If the upload is successful, the DVR will automatically restart, and the main screen will appear.

14. There is no confirmation of a successful upload on the web page; however, if the upload fails, the web page will display an error message. See **Figure 20**. Errors may occur if the DVR has lost its Wi-Fi connection or has powered off during the upload.

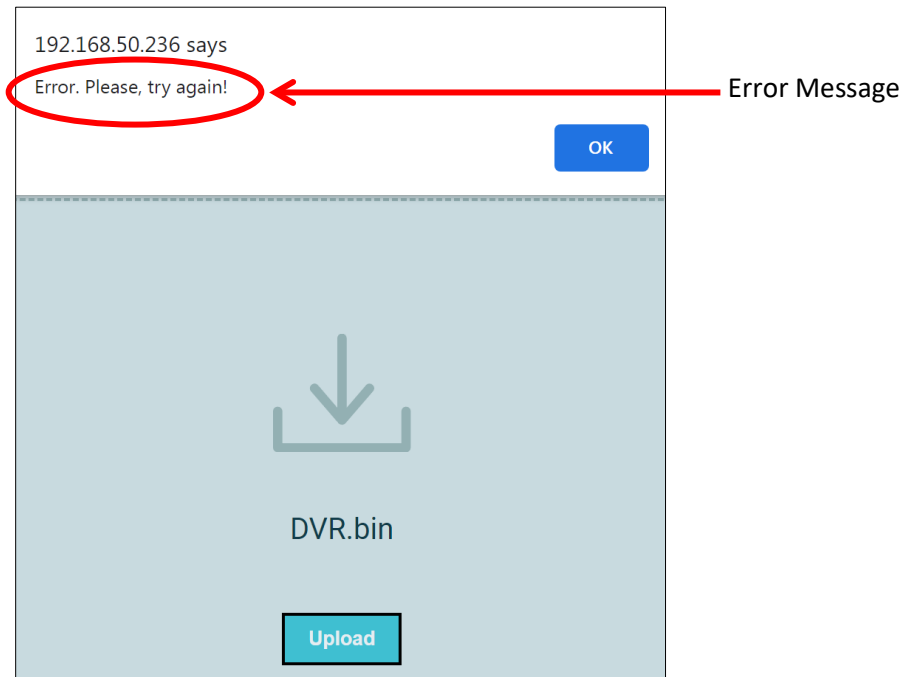


Figure 20: Unsuccessful Upload Error Message

15. To retry, simply refresh the web page and redo the steps of this procedure.



Replacement Parts

Replacement parts are available from CANNON Instrument Company. Identify the part number in **Table 3** when ordering DVR replacement parts. Direct requests for other required parts to CANNON Service Department at 814-353-8000 or email service@cannoninstrument.com.

Table 3: DVR Replacement Parts

Part Number	Description
41.3003	Internal pressure transducer
41.3002	Internal regulator valve
41.3000	Internal Vacuum Pump
73.1.10.2	O-Ring, 1½" ID
41.3004	O-Ring, 96mm x 2.0
74.2110*	Power cord, USA IEC320
41.3013	Pressure Window (Oil Trap Window)
42.9	Tubing, 4' (122 cm) ⁵ / ₁₆ " ID x ⁵ / ₈ " OD Neoprene

**International customers, please contact your local CANNON representative for the equivalent part number.*



Warranty

Products Limited Warranty

In addition to other manufacturers' warranties, Cannon Instrument Company ("the Company") warrants all products (other than reagents and chemicals) delivered to and retained by their original purchasers to be free from defect in material and workmanship for one year from the date of the Company's invoice to the purchaser. For a period of one year from the date of such invoice, the Company will correct, either by repair or replacement at the Company's sole discretion, any defect in material or workmanship (not including defects due to misuse, abuse, abnormal conditions or operation, accident or acts of God, or to service or modification of the product without prior authorization of the Company) without charge for parts and labor. The determination of whether any product has been subject to misuse or abuse will be made solely by the Company.

The Company shall not be liable for any special, incidental, or consequential damages, or any damage to plant, personnel, equipment, or products, directly or indirectly resulting from the use or misuse of any product. Representations and warranties made by any person, including dealers and representatives of the Company, which are inconsistent, in conflict with, or in excess of the terms of this warranty shall not be binding upon the Company unless placed in writing and approved by an officer of the Company.

Reagent and Chemical Warranty

Cannon Instrument Company ("the Company") warrants all reagents and chemicals sold by the Company and delivered to and retained by their original purchasers to conform to the weight, specifications and standards stated on the package. The Company will, at its sole option, either replace or refund the price (net of freight, handling charges and taxes), of any reagent or chemical sold by the Company which does not conform to such weight, specifications, and standards upon the prompt return of the unused portion. Except for replacement or refund of the net price, the Company shall not be liable for any damages occurring as a consequence of the failure of any reagent or chemical sold by the Company to conform to the weight, specifications and standards stated on the package.

Returning a Product to CANNON

Before returning a CANNON product for repair or service, make every attempt to identify the problem. If, after careful checking, the problem remains unidentified or unsolved, telephone CANNON Instrument Company (or the local service agent) to consult with a product specialist. If the specialist cannot recommend a simple solution or repair, CANNON will authorize the return of the product through the issuance of a Return Authorization number (RA).

- CANNON Telephone Number: 814-353-8000
- CANNON Fax Number: 814-353-8007
- CANNON Email: info@cannoninstrument.com

Products returned to CANNON must be carefully packed. Ship prepaid to the following address:

CANNON Instrument Company
ATTN: Return Authorization # _____
2139 High Tech Road
State College, PA 16803 USA

The following information must be included with the return shipment.

Required Information

- The Return Authorization number (RA).
- The name and telephone number of the person at your company to contact regarding the product.
- Shipping and billing instructions for the return of the product to your location.
- A detailed explanation of the reason for the return. If the product is not covered by warranty, the customer will be provided with an estimate of the repair costs and asked for approval before any repairs are made. The customer will be required to issue a purchase order for the cost of the repairs.

Hazardous Materials

Please contact CANNON before returning a product that could possibly contain hazardous material.

Shipping Notification

Products returned without CANNON's prior authorization will not be accepted. The customer may be billed a testing fee if a product is returned to CANNON and found to be working properly.



Appendix A – Calibrating the Pressure Sensor

Calibration Options

A primary concern with any digital manometer is calibration. There are numerous NIST-traceable vacuum calibrators and dead weight testers on the market that are suitable to check the DVR's calibration. When choosing a reference, ensure the accuracy of the calibration unit is superior to the accuracy of the SETRA gauge.

Calibration Procedure

1. Attach the selected measuring device to the Vacuum Manifold Inlet port on the front panel with appropriate tubing. Clamp if necessary.
2. Turn on the DVR and allow it to regulate vacuum at 300 mm Hg, or to the target selected.
3. While the DVR is controlling the amount of vacuum in the system, compare the reading on the DVR's LCD screen to that of the calibrated reference.



Note: *Both instruments must use the same unit of measurement.*

4. Check the display readings several times while the DVR display is relatively steady. If there is a difference greater than 0.06% of full scale between the instruments (in this case that would be ± 0.2 mm Hg) the differential gauge is out of calibration. If it is out of calibration, contact Cannon Instrument Company for assistance.



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