

**TI 226B** Flow Check

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## 1. PURPOSE AND APPLICABILITY

The purpose of this SOP is to describe the flow check procedures used during field maintenance for all IMPROVE network sites.

## 2. SUMMARY OF THE METHOD

The field technician performs a flow check of the modules during field maintenance to test current flow rates and equations in order to determine if there has been any drift since the last maintenance visit. Flow rate values for each module are checked and recorded.

## 3. CAUTIONS

Make sure that the magnehelic is set to zero when vertical and that the tubing for the device is straight before beginning the flow check.

## 4. EQUIPMENT AND SUPPLIES

A black, hard-cased flow check kit should contain the following:

- Magnehelic and Probe
- One flow check cartridge for each module, four total (or five if a double "C" cartridge has been added)
- One 5/32" hex key
- NIST-certified thermometer

The field technician should also have a prepared, site-specific flow check sheet.

## 5. PROCEDURES

### *5.1 Preparing the Modules and Controller for the Flow Check*

- 1) Open the controller door and press the "Enter" button, which will bring up the main menu.
- 2) Remove the sampling cartridges from the modules. Make sure that final readings have already been taken.
- 3) Insert each flow check cartridge into its corresponding module.

### *5.2 Recording Temperature, Max Orifice, and Zero Values*

- 1) In the flow check device case, there will be a NIST-certified thermometer. Please take the thermometer out of the case and place it in the shade next to the "C" module. Turn the power switch to the "On" position and the unit switch to "C°." Do not remove the tip cover from the thermometer, as this can cause the reading to become unstable. Disconnect the temperature probe from the "C" module and place the tip of the probe next to the thermometer. Allow the thermometer to equilibrate for approximately ten minutes.
- 2) To take the temperature reading from the probe, press the "1" key. The millivolt reading will be on the left-hand side of the display. Record this value in cell A25. Then, record the value reported by the thermometer in cell B25.

- 3) To take Max Orifice (or MxORI) values, make sure the display is showing the main menu. Press “2.” All the pumps should turn on. After running for a few seconds, MxORI values will appear for each module. Record the values for each module in cell E25 for each sheet.
- 4) To take zero values for the ORI and CYC of each module, go to the main menu and press “F3” for the advanced menu. Enter the code “9051” and then press “F2” for “Get Zero Flows.” Note that if the system was sampling upon arrival, going to the advanced menu will halt sampling. The controller display will show the zero values for the “A” module. Enter the values in cells F25 and G25 of the “A” module sheet. Cycle through the modules by pressing “Enter” and record the values in the appropriate sheets and cells. When finished with the last module, press “Enter” to return to the advanced menu. Press “Enter” again to return to the main menu.

### 5.3 Preparing the “A” Module and Magnehelic

- 1) Place the magnehelic on the inside of the module “A” door. Note that it is important that the dial remains vertical while being read. The magnehelic has a magnet on the back, so it will stay attached. Make sure that the magnehelic reads “0.” If not, adjustments can be made using the two knobs in the lower left corner of the device. First, loosen the outer knob, which is the smaller of the two. Then, turn the larger knob (which is between the two metal pieces) to adjust the pitch of the device until it reads “0.”
- 2) Once the device reads zero, tighten the smaller knob down to the metal so that the outer metal piece is held in place by the two knobs.
- 3) Inside the “A” module, locate the stack plug and the black plastic cap. Remove the cap by pushing down on it from the top, and remove the plug by pulling down on the brass fitting.
- 4) Place the probe into the Tee. Do this by pushing the probe (hose end down) through the bottom of the module and up into the Tee until the probe bottoms out.

Figure 1. Removing the Plastic Cap and Stack Plug

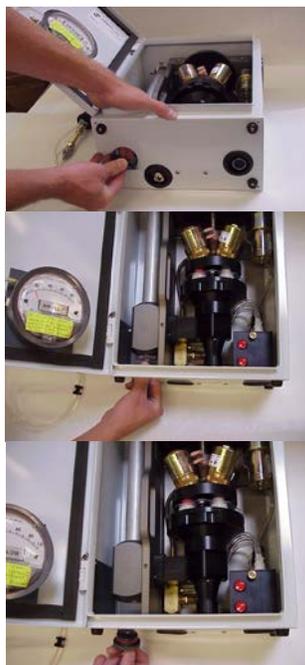




Figure 2. Inserting the Probe into the Tee

#### *5.4 Begin the Flow Check*

- 1) Return to the controller's display. From the main menu, select "F3" for the advanced menu. The display will ask for a password. Enter "1123." Do not press the "Enter" button after submitting the code.
- 2) Now, select "F1" for "Calibration" mode. The module "A" pump will turn on.

#### *5.5 Filling in the Flow Check Sheet*

- 1) Check the magnehelic value. Enter the displayed number into cell H4 of the flow check sheet, making sure to place a decimal before the number. Note that each tick mark on the magnehelic represents two units.
- 2) Look at the controller display. It will show two values for position 1, the Orifice (ORI) and the Cyclone (CYC). Enter these in cells I4 and J4, respectively. If either of the values is unstable, note the full range of values in the comments section on the bottom left of the flow check sheet.
- 3) Once these values are recorded, press the "F4" button to move to the second position of the flow check cartridge, and record the magnehelic and ORI/CYC values in cells H5-J5. Repeat the previous steps 1 and 2 for each of the four positions, making sure to record the values in the appropriate cells.
- 4) Repeat steps 1-3 for modules "B" and "C."

#### *5.6 Preparing Module "D"*

- 1) In order to flow check module "D," first raise the stack to accommodate the flow check probe. There are two things that need to be loosened before the stack can be raised. First, loosen the locking collar on top of the module by turning it counterclockwise. Then, take the 5/32" hex key and loosen the four screws of the "D" brace. Do not remove the screws.
- 2) Slide the stack up approximately four inches or until it is above the "D" brace. After moving the stack, retighten the locking collar to temporarily secure the stack.



Figure 3. Module "D"

### 5.7 Preparing the Magnehelic Probe

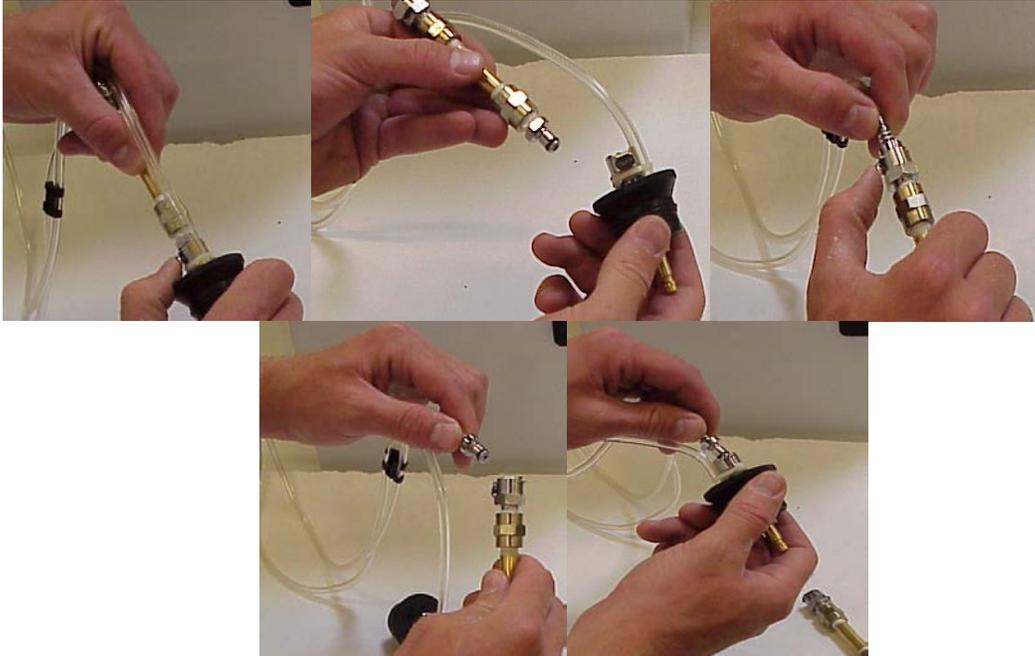
In order for the probe to fit into the funnel of the "D" module, it is necessary to make two modifications to the probe itself:

- First, locate the spring-loaded coupler, which is between the probe and the probe plug. Push this coupler's outer sleeve down (toward the hose). This will release the probe plug.
- Secondly, locate the 3-inch brass extender bar, which is attached via quick connects. To remove this extender bar, disengage the quick connects by pushing on the buttons and gently pulling the bar away. After removing the extender bar, attach the quick-connect fitting on the hose to the probe quick-connect.



Figure 4. Releasing the Probe Plug

Figure 5. Modifying the Probe



#### 5.8 Conducting the Flow Check on Module "D"

- 1) Place the probe into the top of the funnel (where the stack was previously) and gently push down until it bottoms out.
- 2) With the flow check probe in the funnel of the "D" module, the "D" module flow check can now be completed. Repeat the steps in 5.4 for the "D" module.



Figure 6. Placing the Probe in Module "D"

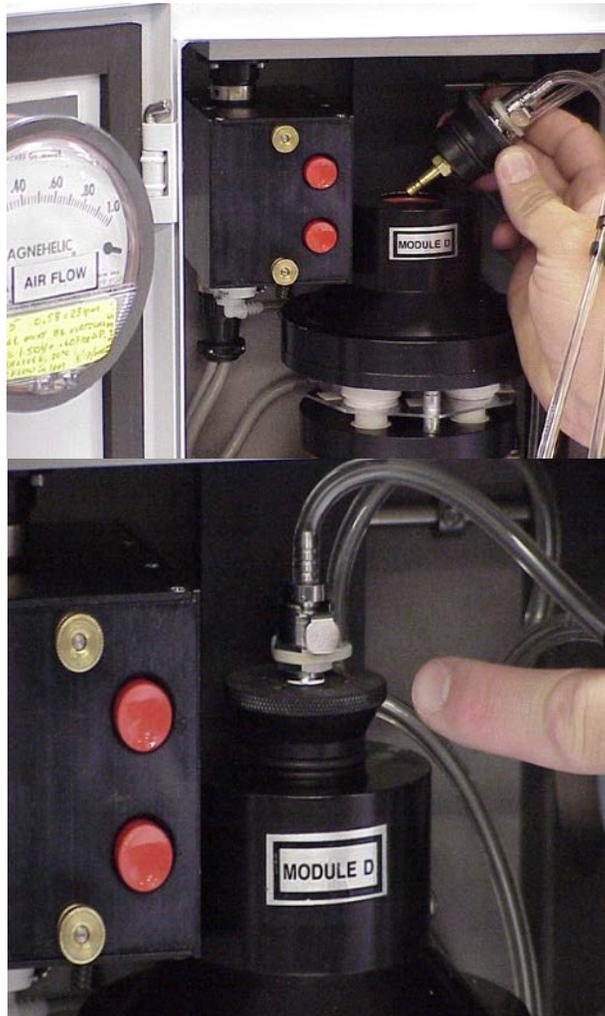


Figure 6. Placing the Probe in Module "D" (con.)

#### *5.9 Re-installing the "D" Stack*

- 1) Remove the "D" funnel's bottom lid. Using both hands with thumbs on the recessed channels of the funnel, pull downwards to separate the bottom lid from the rest of the funnel (Figure 7). Sometimes it is necessary to use a soft mallet to gently tap the bottom lid to separate the two pieces.

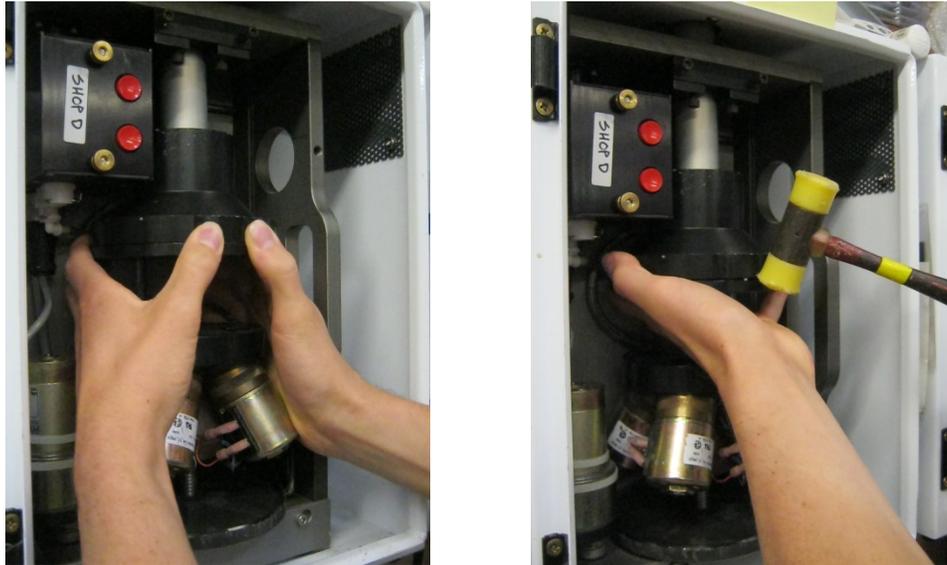


Figure 7. Removing the Bottom Lid of Module "D"

- 2) Gently lower the stack back to its original position, making sure that the stack is fully seated into the black funnel. It should rest on an orange O-ring as in Figure 8.
- 3) While the "D" funnel's bottom lid is still removed, verify that the "D" stack O-ring is securely in place and uniformly positioned between the silver stack and the retaining lip of the "D" funnel.

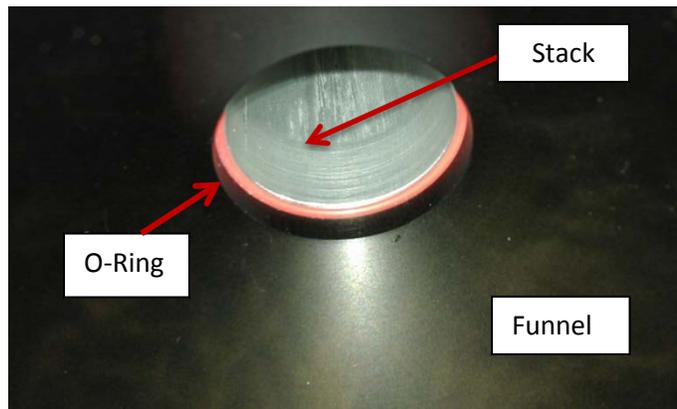


Figure 8. "D" O-Ring Between Stack and Funnel

- 4) Tighten the sleeve collar by turning it clockwise and then tighten the four screws on the "D" brace to secure the stack.
- 5) Replace the "D" funnel's bottom lid.
- 6) If the modules are not being calibrated, perform the following steps:
  - Double-check that all black plastic caps and stack plugs are in their proper position for modules "A," "B," and "C."

- Reassemble the magnehelic probe to its original configuration.
- Place all of the flow check components back into the flow check kit.
- Reload the modules with the exposed sampling cartridges. If a sample change needs to be performed, do it now. Record final readings for all modules, install clean sampling cartridges, and take initial readings.

#### *5.10 "X" Modules*

Some sites have a fifth module for collocated precision measurements, called an "X" module." The "X" module is a duplicate of an "A," "B," "C," or "D" module. If there is an "X" module present, determine what type of module it is and perform the flow check accordingly.