STATEWIDE

STANDARD OPERATING PROCEDURE

FOR

TELEDYNE-ADVANCED POLLUTION INSTRUMENT

MODEL T703 AND 703E OZONE CALIBRATOR

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL PROTECTION

OFFICE OF AIR MONITORING

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Designated Approving Manager

DOCUMENT HISTORY

Revision	Date	Responsible Person	Description of Change
0	August 2011	Tammy Eagan	Initial Draft
1	August 2016	FAMAC	Update to conform to the State's Standard Operating Procedure Format
2	September 2023	PQAO	Changed DEP SOP control number from 06-11 to 06-17. Removed vacuum leak check procedure. Added photometer flow check procedure. Updated forms. Miscellaneous grammatical changes and reference updates

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1.0 PURPOSE

The purpose of this standard operating procedure is to guide the operator in the installation, set up, and maintenance of the calibrator to conform to the practices used for the Teledyne-API T703 Ozone Primary Standard used in the State of Florida Ambient Air Monitoring Program. Other information such as theory of operation, servicing and microprocessor control are covered in the manufacturer's instruction manual and will be referred to as needed. Both the manual and this SOP are to be accessible to the operator at all times.

This document has been prepared for operator use during routine, periodic and calibration visits to ambient air monitoring sites in the Florida air-monitoring network utilizing the API-Teledyne T703-PS ozone primary standard. It is not designed to cover all the technical details that are included in the API Teledyne instruction manual, or quality assurance or other in-depth information found in 40 CFR Parts 50, 53, and 58; EPA Technical Assistance Documents (TAD's), and related reference materials. Following this manual will enable the site operator to know and follow statewide requirements. Site operators, however, should be knowledgeable of and refer to the references noted in this Standard Operating Procedure (SOP). In this SOP, Teledyne-API Ozone Primary refers to models T703 or the 703E ozone PS refers to the ozone calibrator. The 703E and the T703 are essentially the same instrument. The two models share the same EPA equivalency designation number. The differences between the two units, besides physical appearance, are the T703 has two front panel USB ports and the 703E has none, and the 703E uses pushbutton controls while the T703 uses a touch screen. The analytical components and the operation for the two units are identical. The T-API 703E/T703 is a microprocessor-controlled analyzer that measures low ranges of ozone in ambient air using a method based on the Beer-Lambert law, an empirical relationship that relates the absorption of light to the properties of the material through which light is traveling over a given distance. The 703E/T703 features advanced electronics, pushbutton controls or LCD Graphical User Interface with capacitive touch screen, bidirectional RS-232 and/or 10/100Base-T Ethernet, optional USB and RS-485, ports for remote operation and front panel USB ports (T703 only) for peripheral devices. Both samplers will be referred to as the API T703-PS. This T703-PS is used to calibrate ozone analyzers such as the Thermo Environmental Instrument (TEI) model 49i, or the API-T400, among others.

2.0 SCOPE AND APPLICABILITY

The Teledyne API T703-PS is typically installed in a temperature-controlled enclosure and configured to generate and deliver specific concentrations of ozone to an ozone monitoring system. The standard ozone monitoring system also includes an ozone analyzer such Teledyne API Model T400 Ozone Analyzer, or the TEI 49i ozone analyzer among others. The ozone analyzer-ozone calibrator setup typically includes a zero air, data logging and computer control systems. All sample lines that interconnect the API T703-PS, ozone analyzer and sample line use inert components. Typically, Teflon tubes are required for the inter connections.

These procedures are based on requirements contained in the instruction manual supplied by the manufacturer with the calibrator, Parts 50, 53, and 58 of the Code of Federal Regulations.

3.0 SUMMARY OF THE METHOD

The primary purpose of an ozone transfer standard is to transfer the accuracy of the ozone concentration standard of higher authority from one instrument to another. Because a transfer standard has initially no authority of its own, its authority must first be established. The essence of establishing the authority of the transfer standard is to establish a high probability or confidence that the ozone standard has reproducibility by certifying its accuracy to a higher level ultraviolet (UV) standard and then by periodically re-certifying its accuracy and stability. Certification requires the comparison between the transfer standard and Standard Reference Photometer (SRP). This method of assaying ozone is based upon the tendency for it to absorb light at a specific wavelength (254 nanometers). The amount of light absorbed is directly proportional to the amount of ozone present. The SRP introduces a clean gas (reference gas) into the photometer and measures the amount of light (254 nanometers) through it. Then, a sample gas is introduced and the amount of light passed is measured. Based upon the above variables, an ozone concentration is then calculated.

The API T703 ozone PS uses a high energy mercury vapor lamp to generate a beam of UV light. The light passes through a tube filled with the sample gas where ozone absorbs the UV radiation at 254 nm and the change is detected by a specially designed detector which the instrument uses to calculate the quantity of ozone in the sample stream. The quantity of ozone produced is determined by the setting on the calibrator's front panel.

NOTE: The principle of operation employed by the Calibrator to quantify the amount of ozone produced is described in Chapter 9 of API T703 Instruction Manual of February 14, 2019.

4.0 DEFINITIONS

Accuracy – The degree of agreement between an observed value and the accepted reference value. Accuracy includes a combination of random error (imprecision) and systematic error (bias) components which are due to sampling and analytical operations.

Audit Device – A calibrated instrument or tool used to align, adjust or calibrate other components of the ambient ozone measurement system.

Calibration – Calibration is the process employed to verify and rectify an instrument's measurements in order to minimize deviation from a standard. Calibration requirements for critical equipment are found in DEP SOPS and the specific instrument's operational manuals. It is also the multipoint check/adjustment to an ozone analyzer that confirms the analyzer is operating at peak performance.

Certification – Establishes traceability of a transfer standard to the Standard Reference Photometer (SRP).

Precision – A measurement of mutual agreement among individual measurements of the same property usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

Site Operator – The individual(s) tasked with properly running and maintaining instrumentation at the site(s). This is a field-based position that relies heavily on proper maintenance tracking and documentation to ensure the equipment is operating properly.

Ozone Primary Standard – A microprocessor-controlled ozone-generating instrument that is used to provide known concentrations of ozone to an ozone analyzer. The Ozone Primary Standard remains in a fixed location and is only moved for its annual re-certification against a higher-level standard.

Ozone Transfer Standard – Similar to the Ozone Primary Standard, the Ozone Transfer Standard does not remain in a fixed location.

Zero Air System – A stand-alone system composed of inline scrubbers meant to remove any contaminants from the air that are used in generating ozone concentrations using the Ozone Primary Standard. This system can either be a commercially available unit or a unit constructed using a pump/compressor, activated carbon scrubber, and a scrubber with desiccant. The goal is to provide dry, pollutant free zero air.

The API T703-PS calibrator has a built-in zero air system that can be used during calibrations. The zero-air system of the ozone primary requires dry air supply to the system. An indicating silica gel drying tube can be used to supply dry air. The silica gel unit should be checked at each site visit and change if it is needed.

One Point QC Check – The analyzer check done at a precision point that is required by the EPA or DEP.

Zero, Span, Precision Check (z/s/p) – The analyzer check done to establish legally defensible data. This check is also done to bracket periods of valid data and it is done before and after any major maintenance/repair to the analyzer or sample train.

Parts per Billion (PPB) – A scientific measurement indicating one part in one billion.

Sample Line Integrity Check (SLIC) – The check done to verify the integrity of the sample line and ensure that the sample line is not having a negative effect on the concentration values read by the analyzer. It typically is made from a short piece of ¼" Teflon FEP tubing with a Teflon "T" in the middle for a vent. One end is connected to the output of the Ozone Primary Standard and the other end to the input of the analyzer. It is normally required quarterly but can be performed if the operator suspects that the sample line is compromised.

Data Logger – An electronic device used for short term storage and retrieval of measured data at a site.

5.0 HEALTH AND SAFETY PRECAUTIONS

Only those trained and authorized are to operate the API 703-PS and associated equipment.

Electrical Hazards: Equipment used in air monitoring operates on 110/120 volts alternating current (VAC). Site operators must be very careful to avoid touching (with the hands or tools) live wiring and electrical components. Whenever possible unplug any equipment being worked on.

Eye Protection: Ozone analyzers and calibrators use ultraviolet (UV) lamps. Never look directly at a UV lamp.

Protection from Chemicals: Certain zero air system components as well as certain solvents used can create hazards from breathing or skin contact. Be sure to read and be familiar with Material Safety Data Sheets (MSDS) or Safety Data Sheet (SDS) for any chemicals used. Ozone calibrators generate ozone. Be sure ozone calibrators and analyzers are properly vented to the outside.

Burn Hazards: Certain electrical components within the equipment used for ozone monitoring generate heat. Be knowledgeable of these components and do not touch them.

Mechanical Hazards: Pumps, fans, and other components with moving parts can cause injury. Keep clear of these hazards.

Weather and Natural Hazards: Outdoor work in the field can result in exposure to lightning and other weather hazards. During lightning conditions take cover indoors. Insects (wasps, bees, fire ants, etc.), spiders, snakes, and other animals can create hazards. Be alert when working in the field and avoid these hazards.

6.0 INTERFERENCES

It should be noted that the UV absorption method for detecting ozone is subject to interference from several sources. The possible sources of interference are: sulfur dioxide, nitrogen dioxide, nitric oxide, water, aromatic hydrocarbon, and mercury vapor. The basic operating principles of the ozone analyzers reject the effect of most of interferences listed above. *(See 9.6.1.4. Interferent Rejection in the Teledyne API T703/T703U Calibrator Operation Manual.)*

7.0 PERSONNEL QUALIFICATIONS

Personnel who operate instruments used for the ambient monitoring of ozone within the State of Florida are typically selected for the position required knowledge, skills, and abilities to perform the essential elements of the position. Prior to independently operating ozone monitoring equipment, personnel are to be thoroughly trained in these duties. Supervisory/Management staff will then document they have the required training and will then authorize the employee to perform the operations outlined in this SOP.

8.0 EQUIPMENT AND SUPPLIES

The following equipment and supplies are necessary for ambient air monitoring of ozone.

Ozone Analyzer - The Ozone analyzers must be designated by EPA as an official reference or equivalent method and bear the designation sticker on the instrument. The analyzer must meet factory specifications and be set up and operated per the factory manual and this SOP.

Ozone Primary Standard - API T703 or Equivalent -- The primary calibration standard used must meet EPA requirements for primary O3 standards. An ozone primary standard remains at each site. The primary standard will be related back to an SRP (standard reference photometer) annually. The primary standard utilizes the same principle of operation (UV Photometry) as the ozone analyzer. Refer to the appropriate SOP for these instruments.

Zero Air (Dilution Air) System - Zero air must be free of contaminants, which will cause analyzer response or react with ozone. The zero-air system must be equipped with a pressure regulator capable of maintaining a stable output pressure. Refer to the appropriate SOP for this instrument/equipment (identified in section 14 of this SOP). Note that the API T703 calibrator has the option to use the internal zero air system with ambient dry air system or it can be connected to an independent zero air system.

Flow Meter - Used to verify sample flow from the instrument.

Sample Line - Constructed Teflon, 1/4" outside diameter (O.D.), ¼" to 3/16" inside diameter (I.D.).

Exhaust Line - Used to direct the calibrator or connected analyzers exhaust to the outside of the shelter. Typically constructed of 1/4" outside diameter (O.D.) Teflon (clear FEP Teflon or white TFE Teflon can be used) with all fittings being Teflon or stainless steel.

Particulate Filter - Made of Teflon, two-inch (47 mm) diameter with a five-micron pore size. The filter is to be enclosed in a Teflon filter holder utilizing Teflon or stainless-steel fittings and components. The stainless-steel fittings shall be lined with Teflon where the ozone from the calibrator or to the analyzer to prevent degradation of the ozone stream.

Thermometer - Used to calibrate the internal O3 analyzer temperature probe, graduated in 1-degree Celsius (°C) increments (minimum), calibrated against an NIST traceable thermometer and accurate to ±2 °C.

Sample Shelter - Of adequate size to house equipment, internal temperature must be maintained between 5 to 40 degrees Celsius (°C) for the operation of the API T703 ozone calibrator. *Note: Although the API T703 calibrator can be operated between 5 to 40 °C, other instruments in the shelter may require operation between 20 to 30 °C.*

Sample Shelter Temperature Probe - Used to document the internal sample shelter temperature to stays within specifications. Calibrated initially and then annually against a NIST traceable primary or secondary temperature standard, continuous readout, accurate to ±2 °C.

Minimum/Maximum Thermometer - Used as a backup to the temperature probe. Calibrated initially and then annually against a NIST traceable primary or secondary temperature standard, resettable, accurate to ±2 °C.

Data Logger - Used to electronically record instrument outputs (raw data). Calibrated against a NIST traceable voltage standard initially and then at annual intervals, The Data Logger must be properly initialized. The channels must be taken offline until the analyzer is calibrated and begins official data collection.

Computer – Capable of communicating with the data logger (Note: the computer may be an on-board computer module as is the case with the Agilaire 8872, an off-site computer connected through TCP/IP, or operator laptop/tablet device). The computer is used for electronic documentation of calibrations, checks, maintenance, and other operations using Microsoft Excel or other software for documenting the activities.

Logbooks, Log Forms, etc. - Must be designed to accommodate all pertinent information in an organized manner. These are typically on Excel spreadsheets, but other software products capable of recording the documentation per this SOP are acceptable.

Tubing and Fittings - All tubing and fittings must be made of a non-reactive material. The tubing must be FEP Teflon. Fittings can be Teflon. Do not intermix materials (e.g. stainless threaded onto a Teflon fitting) or mix fittings of different manufacturers due to potential safety and operational problems.

NIST Traceable Barometer – Used to calibrate or verify the pressure of the calibrator or analyzer.

9.0 INSTALLATION AND START-UP

9.1. Site Set-Up

The API T703 may be installed within an air monitoring shelter or weather-proof instrument enclosure. In either case, the shelter/enclosure must provide adequate controls to stay within the temperature operating range as specified by the manufacturer or the US EPA FEM designation (EQAO-), whichever is more stringent.

It is important that the inlet assembly is installed with proper vertical support and secured through the shelter/enclosure and join the analyzer inlet at the ozone analyzer intake. The calibrator should be connected to the ozone analyzer inlet via a tee at the analyzer sample inlet to afford through the probe (TTP) for calibration and verification.

The operator will follow the detailed instructions for installation, mounting, and connections provided in the API T703 instruction manual.

9.2. Instrument Set-Up

CAUTION: *When lifting the instrument, use procedure appropriate to lifting a heavy object, such as, bending at the knees while keeping your back straight and upright. Do not attempt to lift the instrument by the cover or other external fittings.*

A. Position the calibrator on a level and sturdy surface, allowing easy access to both the front and rear panels.

B. The installation procedure includes connecting the API T703 to an ozone analyzer (e.g. T-API T400, TEI 49i). The ozone calibrator must have been compared and certified with an ozone primary standard to establish traceability back to FDEP (Florida Department of Environmental Protection) Ambient Air Monitoring Standards Laboratory NIST certified standard. The slope from the site ozone calibration standard (calibrator) and FDEP primary standard comparison must be 1.000 ± 0.03 (0.97 to 1.03) with no single point being > 3%. This procedure must have been done within the past year (within 365 days)

C. Using FEP Teflon®, with an outer diameter (OD) of ¼-inch and a minimum inner diameter (ID) of ⅛-inch, connect a sample line from the output port at the rear panel of the API T703, through the manifold to the tee-funnel on the roof (For example, see Figure 9-1 for a picture of the funnel and the connecting Teflon tubes from and to the ozone analyzer respectively). From the T-connection, using the same Teflon material, run a sample line through the manifold, to a filter cartridge and then to the sample inlet port of the ozone analyzer. Ensure that the sample line is not contaminated by dirt, wet, or incompatible materials. Figure 9-2 show a typical ozone analyzer and calibrator setup inside an air monitoring housing.

***NOTE**: Gas must be delivered to the analyzer at atmospheric pressure.*

Figure 9-1 Example of Single Line Probe Plumbing

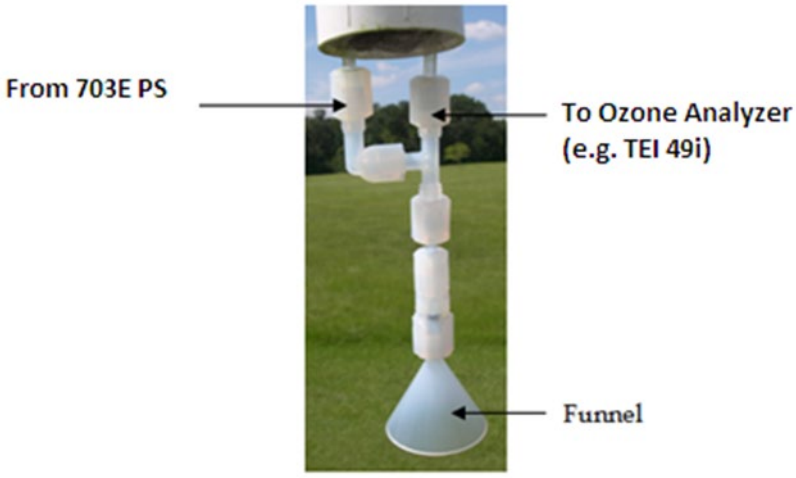
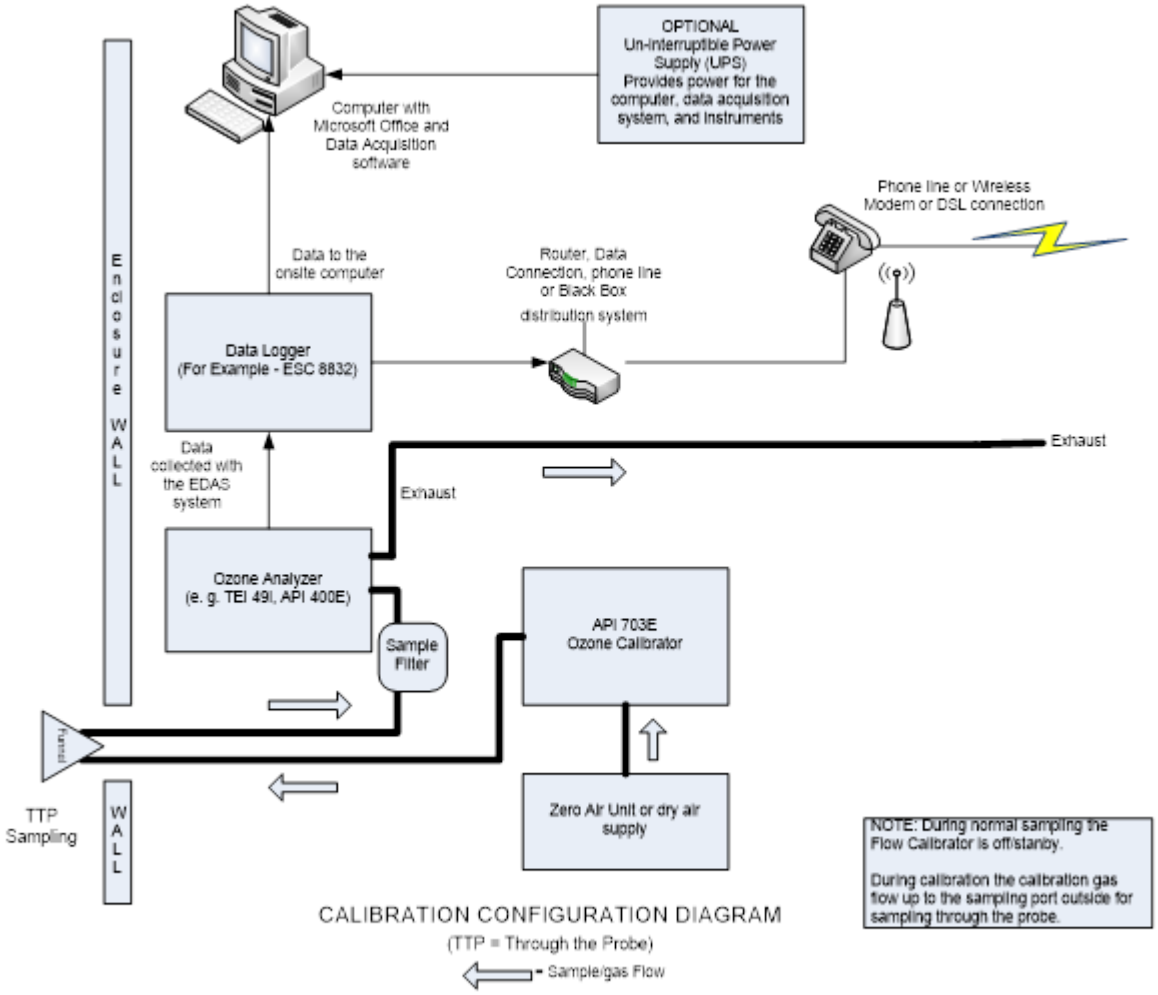
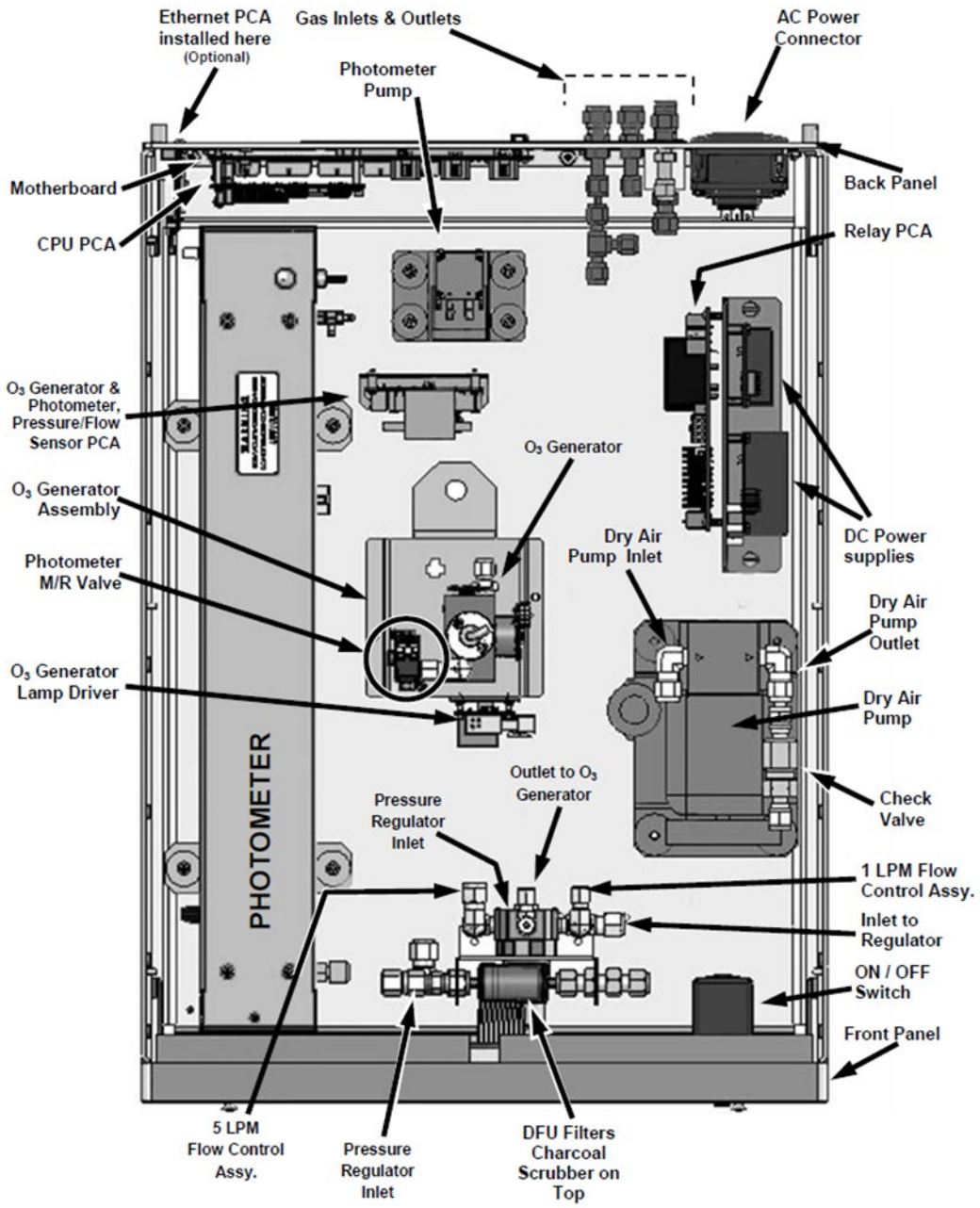


Figure 9-2 Interconnecting Calibration Setup with an Ozone Analyzer



D. Plug the analyzer into an outlet of the appropriate voltage and frequency. The labeled diagram representing the internal component of API T703-PS is shown in Figure 9-3.

Figure 9-3 Internal Layout of the API T703 Ozone Primary



9.3. **Start-Up Procedure**

Operators are required to read the manufacturer's instruction manual supplied with the analyzer to become familiar with the analyzer's various controls and components prior to attempting any operation described in this procedure. The manufacturer's manual contains useful analyzer information that has not been repeated in this SOP. To help in the navigation of the instrument, a diagram of the monitor's front panels is shown below. Figure 9-4 shows the front panel for the older model API 703E monitor and Figure 9-5 shows the front panel of the newer model API T703. Both models operate in the same way except that the older version has push button controls whereas the newer model has a touch screen interface and can have two different software configurations, Legacy or NumaView, examples of which are shown in figures 9-6 and 9-7 respectively. The T703 calibrator is a computer-controlled calibrator with a dynamic menu interface for easy yet powerful and flexible operation. All major operations are controlled from the front panel display and keyboard through these user-friendly menus.

Figure 9-4 Front Panel Layout for the API 703E Model

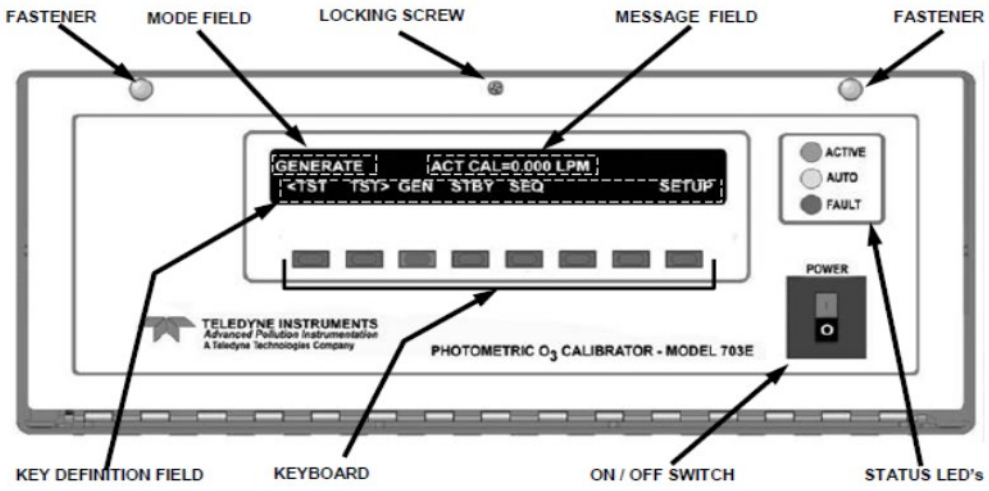


Figure 9-5 Front Panel Layout for the API T703

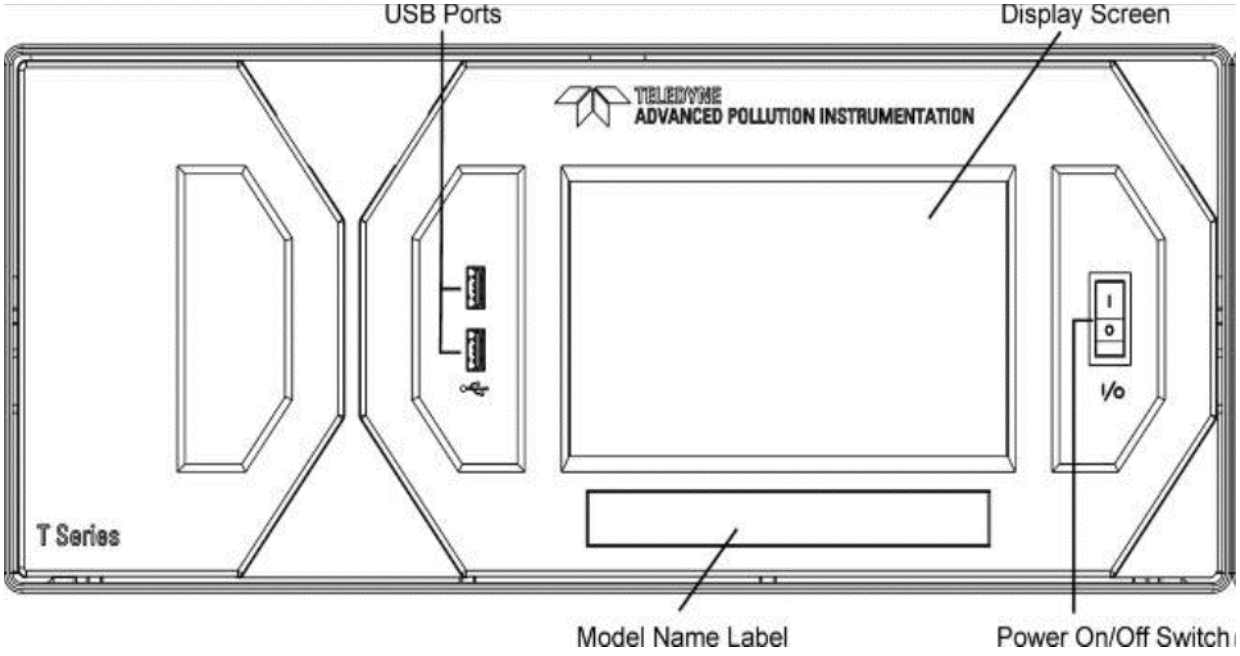


Figure 9-6 T703 Touchscreen Interface (Legacy Software)

Figure 9-7 T703 Touchscreen Interface (NumaView Software)

A. Instrument Startup

1. After all tubing and electrical wiring connections have been made, connect the monitor, primary standard, data logger and zero air units to their respective 120 VAC electrical outlets and turn each component on. A typical setup of the interlocking components is shown in Figure 9-2. Press the front panel power switch of the API T703E on the front panel to energize the unit. (Normally, the ozone analyzer, data logger, computers, and other ancillary equipment will be operating to collect ambient ozone data.)

2. The Status LEDs on the 703E will indicate the status of the calibrator. The table below shows the reason and the description of the indicated LED.

Table 9-1 LED Status

Button	Color	Status	Significance
Active	Green	Off	The unit is operating in STANDBY mode. The LED glows green when the instrument is actively producing calibration gas
Auto	Yellow	Off	This LED only glows when the calibrator is performing an automatic calibration sequence.
Fault	Red	Blinking	The calibrator is warming up and therefore many of its subsystems are not yet operating within their optimum ranges. Various warning messages will appear.

***Note**: The calibrator and ozone analyzer shall be allowed to warm up for a minimum of two (2) hours from a cold start before proceeding.*

3. The fault light will be flashing indicating that the power was turned off. Press the CLR push button to clear the fault. The calibrator will not operate until the UV source block heats up to the proper temperature.

4. Set the clock as follows:

   a. Press the [SETUP] button.

   b. Press the [CLK] button.

   c. Press the [TIME] button.

   d. Using the four pushbuttons under each number set the time to a NIST traceable time transfer standard.

   e. Press the ENTER pushbutton.

   f. Press the EXIT pushbutton three times to return to the main menu.

5. Set the ozone generator operating mode to BNCH (Bench) as follows:

   a. Make sure the T703 is in the "Standby" mode.

   b. Press the [SETUP] pushbutton.

   c. Press the [MODE] pushbutton.

   d. Press [BNCH] pushbutton.

   e. Press the [ENTR] pushbutton.

   f. Press [EXIT] twice to return to the main menu.

6. If the internal zero air system is to be used, the internal pump will need to be enabled. If an external zero air system is used, the internal pump will need to be disabled. Follow the steps below to enable or disable the internal pump.

   a. Press the [SETUP] pushbutton.

   b. Press [MORE] pushbutton.

   c. Press [VARS] (Internal Variables) pushbutton.

   d. Set the password to 818.

   e. Press [ENTR] pushbutton.

   f. Press [NEXT] four times. You should see "4) ZA_PUMP_ENAB=OFF" (or ON)

   g. Press [EDIT] pushbutton.

   h. Toggle the farthest left pushbutton to the desired setting (ON or OFF)

   i. Press [ENTR] pushbutton.

   j. Keep pressing [EXIT] until you return to the main menu.

7. Check the calibrator's operating parameters using the following procedure.

   a. From the main menu, press the [<TST" or >TST"] pushbutton to toggle through the following operating parameters to make sure they are within specification shown in Table 9-2.

   b. Operating Parameters shows the expected target ranges. Deviations outside the targeted ranges should be investigated and corrected before proceeding with using the calibrator. Check the calibrator's manual or consult with the company for solutions to deviations from the targeted range.

Table 9-2 Calibrator's Operating Parameters

Parameter	Target
ACT	1% of Target
TARG	0-1000 PPB
Output Flow	2-5 LPM
Reg Pressure	15 ± 2 PSG at 5 LPM
Box Temp	20 - 35°C
O3 Gen Ref	0-5000 mV
O3 Gen Drive	0-5000 mV
O3 Lamp Temp	48 ± 1°C
Photo Measure	2500-4700 mV
Photo Reference	2500-4700 mV
Photo Flow	0.720-0.880 LPM
Photo Lamp Temp	58 ± 1°C
Photo Spress	-1" Ambient in. HG A (Approximately 28.9-30.9)
Photo Stemp	25-48°C
Photo Slope	1 ± 0.15
Photo Offset	0 ± 10 PPB

8. Check the API 703's barometric pressure as follows:

Disconnect or turn off any zero-air flow through the calibrator.

a. Press the [<TST>] button until the PHOTO SPRESS is displayed. The number in the display is inches of Hg.
b. Obtain a barometer reading from a primary standard barometer or a NIST traceable standard.
c. Convert the mm Hg reading to inches of Hg as follows:

The primary standard barometer and the API T703 calibrator should agree to within +-0.2 inches Hg. If not refer to the API T703 operator's manual. A new comparison will need to be done after any repairs to correct the barometer's reading.

9. Check the T703's photometer temperature (PHOTO STEMP) as follows:

a. Remove the instrument cover and place a NIST traceable thermometer on top of the photometer assembly (on left side of instrument). Place insulation over the thermometer and replace the cover.
b. Press the [<TST>] button until PHOTO STEMP is displayed. Wait approximately 5 minutes for the temperature to stabilize.
c. Note the PHOTO STEMP reading from the T703 display. Remove the cover and read the thermometer.
d. The primary standard thermometer and the T703 should agree to within 2 degrees centigrade (°C). If not, rerun the above steps to recheck the measurement.

10. Internal Pump Dry Air Connection – Follow these steps if the internal pump is used.

a. Ensure the API T703's internal pump has been enabled (see step 9 above).
b. Connect filter assembly to the "Dry Air In" port on the rear of the T703. A 47 mm 5-micron filter is recommended.
c. Connect a silica gel dryer with fresh (blue) silica gel to the filter assembly.
d. Cap the "Zero Air In" port.
e. Make sure the "Vent" and Exhaust ports are not capped.

11. External Zero Air Connection - Follow these steps if an external zero air system is used. Refer to "Zero Air Systems", Appendix E, of the DEP SOP for zero air system operational procedures.

a. Ensure the API T703's internal pump has been disabled (see step 9 above).

b. Connect the zero-air system outlet to the "Zero Air In" port on the rear of the API T703.

c. Cap the "Dry Air In" port.

d. Make sure the "Vent" and Exhaust ports are not capped.

e. Turn the zero-air system on and set the zero-air systems outlet pressure to between 20 to 35 PSIG.

12. Check and adjust output and photometer flow as follows:

a. Adjusting Output Flow Rate

(1.) Press [<TST>] multiple times until OUTPUT FLOW is displayed.
(2.) This flow should be about 4 to 5 LPM. If it is not in this range, do steps C. through D below.
(3.) Unlock the two latches located at the top of the front panel by pulling them forward.
(4.) Open the front panel. It is hinged on the bottom.
(5.) Locate the round black regulator. Pull it forward to unlock it.
(6.) Rotate the knob clockwise to increase flow (counterclockwise to decrease).
(7.) When the flow is adjusted, push the black knob in to lock it.
(8.) Press [<TST>] to view the REG PRESSURE. This value should be about 15 + 2 PSIG @ 5 LPM.

13. Verifying Photometer and Output Flows.

Both flow sensors should be verified during instrument setup and annually, before photometer recertification, as described in section 11.1.

9.4. **Serial or TCP/IP Ethernet Connection (for the T703 Calibrator)**

The API T series instruments are equipped with a 10 Mbps Ethernet RJ-45 connection. The instrument must be configured to a proper TCP/IP network. This can be done using a static IP address or using DHCP service. This service is used for digitally retrieving data from the API T703 calibrator.

9.5. **Remote Connections**

The API T series instruments can be remotely controlled and communicated with by connecting the instruments to a network via ethernet cable and using one of two Teledyne software programs, APICOM and NumaView Remote. These programs can be downloaded from Teledyne-api.com and the program that is required depends on the age/software of the analyzer. If the T703 is running Legacy software APICOM is used to communicate, while if NumaView is installed the NumaView Remote program can be used. These programs are installed on a computer that has access to the network that the T703 is operating on. NOTE: Depending on the security settings of the network, it may be necessary to add the appropriate TCP Port access to the network firewall rules.

A. APICOM

1. Request a software download of the APICOM software from the Teledyne API website.

2. Install APICOM on a computer that is connected to the network the T703 is operating on (an 8872 data logger can be used)

3. Open the program, choose EDIT > New Instrument. Input an appropriate instrument name, change the connection type to TCP\IP, click on SETTINGS and input the IP Address of the instrument and use TCP Port 3000, click OK to complete the setup.

4. Once the program settings have been set up, double click on the instrument icon in APICOM and you will be able to view the instrument front screen and control the interface.

B. NumaView Remote

1. Request a software download of the NumaView Remote software from the Teledyne API website.

2. Install program onto a computer that is connected to the same network as the T703.

3. Open program and click File > Add New Instrument. Enter the instrument name, IP address, instrument family and model, and leave the Ports on their default settings, then press OK to complete the setup.

4. Once the instrument has been added to the program you can then Right click on the instrument name and select Launch, which will give you full access to the instrument controls.

10.0 OPERATION OF THE API T703 OZONE PRIMARY STANDARD

All primary standards and audit devices are certified by outside calibration and certification services before use at air quality monitoring stations. The FDEP Division of Air Resources Management (DARM) is the principal source for certification of new ambient air quality measurement instruments as a burn-in period is required. Recertification of deployed instruments is normally accomplished in the field during periodic audits and certifications.

This section shall cover the use of the API T703 calibrator in the generation of gas concentrations used to verify or calibrate an ozone analyzer. Under normal operations, the calibrator is used to generate a zero and four or more upscale concentrations. The number of calibrations points can be found in the standard operating procedure for the ozone analyzer. The zero is processed first and the analyzer is calibrated to the zero setting. The rest of the calibration starts with the highest concentration and progresses sequentially running successive lower concentrations and an additional zero at the end of the calibrations. The generating of the required ozone concentrations is shown in the following procedural steps.

Before the API T703 is used for the calibration, the condition of the calibrator must be documented, either on the Equipment Status Check Sheet Form DEP 06-17-A, or on the associated QC check/Calibration log if there is a designated space for the parameters. Both forms are found in Appendix A

10.1. **Prepare the system for calibrations or verification.**

A. Log into the Electronic Data Acquisition System (EDAS) (for example the Agilaire 8872) and take the ozone analyzer offline.

B. Fill out the required logs with the required information per the ozone analyzer SOP.

C. Complete the instrument's daily status log and complete all boxes and enter NA for items that are not applicable.

D. Check and complete the maintenance form as required.

10.2. **Generate the required ozone concentrations as follows:**

A. From the main (standby) screen press [GEN]

B. Press the [AUTO] pushbutton.

C. Toggle the [O3/Zero] pushbutton to O3.

D. Set the unit pushbutton to PPB.

E. Set the O3 concentration to the desired concentration using either the push buttons or touchscreen interface.

F. Press [ENTR] pushbutton. You will hear the photometer turn on. If the internal pump is enabled, you will hear it turn on also.

G. The unit will deliver zero ozone concentration to the ozone analyzer.

H. Repeat steps B through F for each desired concentration.

I. Return the API T703/703E to standby mode when done generating ozone.

11.0 INSTRUMENT MAINTENANCE AND CERTIFICATION

The API T703 Ozone Primary Standard requires periodic maintenance to ensure proper, uninterrupted operation. Some components, such as the sample pump, solenoid valves, and the lamps have a limited lifetime and should be replaced or at least checked on a regular basis. The preventative maintenance schedule established for the API T703 Ozone Primary Standard is contained on form DEP 06-17-B Preventive Maintenance Schedule.

Some auxiliary equipment used with the API T703 also requires periodic inspections and maintenance to ensure correct operations of the system. The preventative maintenance schedule for auxiliary equipment and components is found on the corresponding DEP forms.

11.1. **Preventative Maintenance**

Operators should regularly check the preventative maintenance schedule for the API T703-PS and schedule any required preventative maintenance. Each instrument will have its own preventative maintenance record. The API Recommended schedule is shown in Form DEP 06-17-B shown Appendix A.

Additional descriptions of some preventative maintenance tasks may be found in the instruction manual for the API T703 ozone calibrator. These may be useful to operators unfamiliar with the instrument. They can be found in Chapter 7 of the instruction manual for the Model API T703 primary standard.

Note: Some maintenance procedures will have to be coordinated with audit and certification schedules as they potentially affect instrument calibration. Consult with supervisor or QA prior to any T703/E maintenance or repairs to determine if a recertification will be necessary.

11.2. **Verify Test Functions**

A. Verify the Test Function as outlined in Section 3.4.4 of the API T703 manual.

B. To view the TEST functions, press <TEST or TEST> from the main menu and the test function will scroll at the top center of the display. Record each function on Form DEP 06-17-A.

11.3. **Photometer Temperature Verification**

A. Remove the instrument cover and place a NIST traceable thermometer on top of the photometer assembly (on left side of instrument). Place insulation over the thermometer and replace the cover.

B. Press the [<TST>] button until PHOTO STEMP is displayed. Wait approximately 5 minutes for the temperature to stabilize.

C. Note the PHOTO STEMP reading from the T703 display. Remove the cover and read the thermometer.

D. The primary standard thermometer and the T703 should agree to within 2 degrees centigrade (°C). If not, rerun the above steps to recheck the measurement.

11.4. **Pressure Sensor Verification:**

A. Disconnect or turn off any zero-air flow through the calibrator.

B. Press the [<TST>] button until the PHOTO SPRESS is displayed. The number in the display is inches of Hg.

C. Obtain a barometer reading from a primary standard barometer or a NIST traceable standard.

D. Convert the mm Hg reading to inches of Hg as follows:

INCHES Hg = ((Primary Standard reading (mm Hg))/760 mm *29.92 inches

Hg.

The primary standard barometer and the API T703 calibrator should agree to within +-0.2 inches Hg. If not refer to the API T703 operator's manual. A new comparison will need to be done after any repairs to correct the barometer's reading.

11.5. **Dry Air Pump Diaphragm Replacement**

The schedule requires the Pump Diaphragm replacement on an annual basis, if the dry air pump is being used instead of a zero-air system. This procedure should be scheduled prior to the annual recertification of the calibrator. Purchase and keep in stock a pump rebuilt kit for the replacement.

A. Schedule pump rebuilt at less than two weeks prior to recertification so that the ozone analyzer will meet its biweekly zero-precision-span schedule. Additionally, it is beneficial to have a certified spare ozone primary standard on hand if needed.

B. The instructions for repairing the pump come with the kit. Additional assistance is available from the manufacturer.

C. Always perform a leak check after rebuilding the sample pump.

D. Document the repair on the maintenance log.

11.6. **Performing a Leak Test**

Leaks are the most common causes of an instrument malfunction. As such, this should be one of the primary tests to perform when issues arise. In addition, a leak test is performed when any part of the sample train is opened or when the pump is repaired or replaced. The procedures for performing pressure leak tests are presented below.

A tank of pressurized gas with the pressure adjusted to < or = 15 psi with a shut off valve can be used. This procedure can be found in the API T703 operator's manual 7.2.1 2019 manual.

A. Turn off the power to the instrument.

B. Remove the instrument cover.

C. Install a leak checker or tank of gas on the "DRY AIR IN" port at the rear panel.

D. Install caps on the Internal Vent and on the following rear panel fittings:

- Exhaust
- Vent
- Zero Air Inlet
- Both CALGAS OUT fittings.

E. Locate the dry air pump (if installed)

F. Disconnect the two fittings on the dry air pump and install a union fitting in place of the pump.

G. Locate the photometer pump.

H. Disconnect the two fittings on the photometer pump and install a union fitting in place of the pump.

I. Pressurize the instrument with the leak checker or with a tank – without exceeding 15 psi pressure, allowing enough time to pressurize the instrument fully.

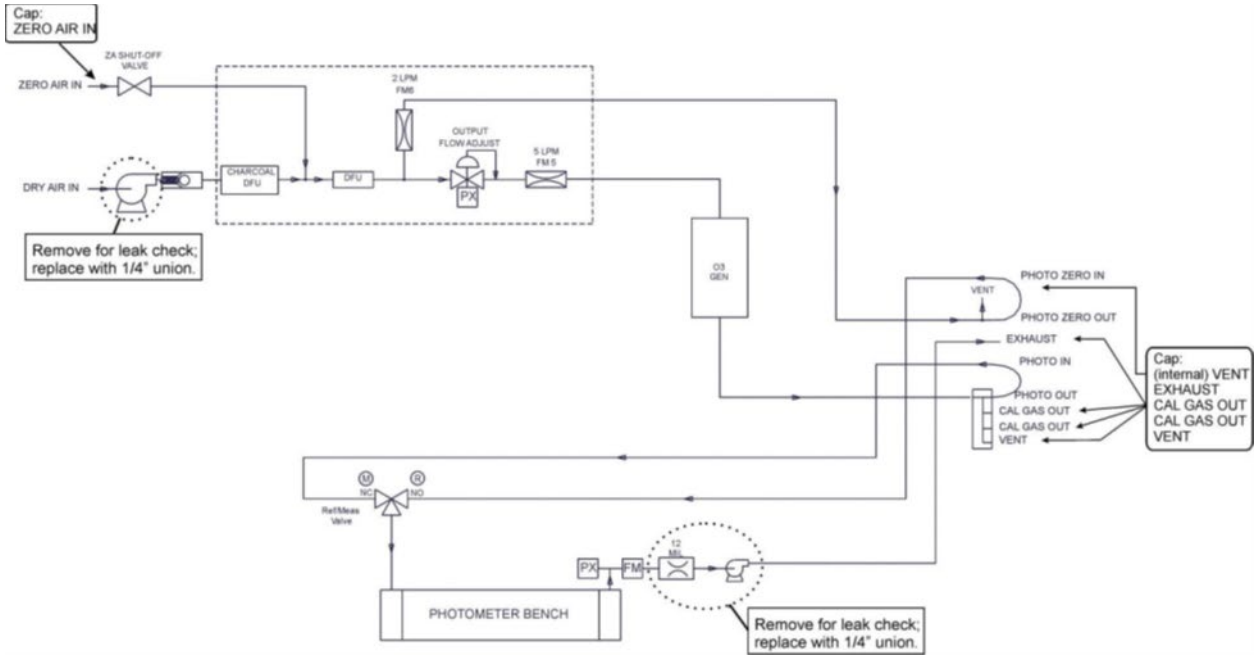
J. The leak-down rate should be < 1 inHg(0.4psi) in 5 minutes after the pressure is shut off.

K. If the leak down rate in > 1 inHg, check each fitting with soap bubble solution, looking for bubbles. Once the fittings have been wetted with the soapy solution, do not apply vacuum as it will draw soap solution into the instrument.

L. Once the leak has been located and repaired, the leak-down rate should be < 1 in-Hg (0.4 psi) in 5 minutes after the pressure is turned off.

M. Document the leak check on the maintenance log.

Figure 11-1 T703 Pneumatic setup for performing Pressure Leak Checks



11.7. **Flow Verifications**

The T703 has two gas flow characteristics that affect its' performance: The flow of gas through the sample chamber of the instrument's photometer (photo flow) and the total gas flow being the Output.

A. Photometer flow verification

1. Remove the sample fitting on the O3 bench and measure the O3 flow going into the Teflon elbow.
2. Connect flow standard to the Teflon elbow.
3. Press SETUP>MORE>DIAG>818>ENTER>NEXT (until PHOTO FLOW SENSOR CAL)>ENTER.
4. This will automatically turn ON the DC photometer pump.
5. Input the measured flow from the flow standard, press Enter. This will adjust the Photo Flow reading and then move on to the next step in the flow calibration and will turn OFF the DC pump, which will allow for a measurement of the Output Flow
6. Make sure to replace the sample fitting on the O3 Bench from step B.

B. Output flow verification

1. The output flow is measured through the CAL GAS OUT port, attach a flow standard to this port and cap the second cal gas out port and the VENT port.
2. The T703 measures a flow reading immediately after pressing ENTER in step H above, the output flow reading should be taken as soon as possible after pressing enter to ensure accuracy.
3. Record the flow through the CAL GAS OUT port and input the flow into the T703 then press ENTER.
4. If needed, the output flow can be checked individually without adjusting the Photo Flow by going through the same menu SETUP>MORE>DIAG>818>ENTER>NEXT (until PHOTO FLOW SENSOR CAL)>ENTER>EXIT (when Photo flow appears)>Output Flow>ENTR.

11.8. **Pneumatic Line Examination and Cleaning**

The pneumatic system includes all the internal sample lines in the system. Inspect all tubes and tube connections. In particular, clean or replace the absorption tube. Clean the tube by removing it and clean or replace in the following procedure.

A. Remove the center cover from the optical bench.

B. Unclip the sample thermistor from the tube.

C. Loosen the two screws on the round tube retainers at either end of the tube.

D. Using both hands, carefully rotate the tube to free it.

E. Slide the tube towards the lamp housing. The front of the tube can now slide past the detector block and out of the instrument.

F. Clean the tube with distilled or deionized water by running a swab from end to end.

G. Air dry the tube.

H. Check the quality of the cleaning job by looking down at the tube; it should be free of any dirt and lint.

I. Inspect the O-rings that seal the ends of the optical tube. Replace the O-rings if they are damaged.

J. Re-assemble the tube into the lamp housing and perform a LEAK CHECK on the instrument. (Note: It is important for proper optical alignment that the tube be pushed all the way towards the front of the optical bench when it is assembled.

K. Document the line examination and or cleaning on the maintenance log.

11.9. **Certification**

This section details steps to prepare the API T703 ozone standard for field recertification against a Florida Department of Environmental Protection (FDEP) audit device. The API T703 is required to be certified prior to first use in the field. The initial certification is done in the FDEP laboratory, all subsequent certifications are completed in the field. Note that certification process is distinct from the maintenance and calibration processes, and only verifies proper operation.

The API T703 must be recertified at the following times:

A. Annually.

B. Prior to first use and following any major maintenance (consult with supervisor or QA prior to any T703/E maintenance or repair to determine if a recertification will be necessary).

The recertification process has six basic components:

A. Review of calibrator diagnostic information.

B. Scheduled preventative maintenance.

C. Electronic alignment of the digital to analog conversion and back panel outputs (if used).

D. Verification of the internal bench pressure and bench temperatures sensors using certified temperature and pressure standards (Sections 9.3.7 & 9.3.8)

E. Verification of the flow sensors using a certified flow standard (Section 11.1.5) and adjustment of the internal pressure regulators, if needed.

F. Record the results of the temperature/pressure/flow verifications on DEP form 06-17-C.

G. Audit and recertification by FDEP

This procedure is coordinated with FDEP so that the annual maintenance components (Step 1-5 above) are completed by the Agency prior to auditor arrival at the station.

The audit and recertification of the API T703 Primary Standard consists of challenging the instrument with a set of known ozone concentrations generated by the FDEP audit standard while documenting responses of the API T703. Analyzer responses at the zero and span levels are used to evaluate calibration coefficients. Analyzer responses at a set of 4 intermediate points are used to evaluate the quality of the calibration and the linearity of the API T703 primary standard. Exact gas concentrations used in this procedure are determined at the time of the audit by the auditing agency.

12.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance control limits for the calibration or verification of the API T703 are shown in Table 12.1: Certification Quality Assurance Control Limits

Table 12-1 Certification Quality Assurance Control Limits

Parameter	Control Limit	Basis
Zero Reading	≤± 3 ppb	At the time of audit
Each Calibration Point	≤± 3%	At the time of audit
Linearity	All points within 3% of calibration range of best-fit line.	Calculated annually for each analyzer during the annual audit
Slope	0.990 – 1.003	At the time of audit
Intercept	≤± 3 ppb	At the time of audit
Correlation Coefficient	≥ 0.990	At the time of audit

Exceedance of a control limit is cause for implementing formal corrective action procedures. Exceedance of a control limit is not necessarily the cause for invalidating data already collected. Complete a zero-span-precision check (if possible) to bracket the data record before taking any corrective actions. Consult with the QA Officer for a decision on data usability and integrity.

Audit devices require an annual, NIST-traceable certification and a certification certificate from a professional instrument calibration service. If the calibrator requires calibration, the calibration documentation should show both “As Received” and “As Left “data. Inspect both the audit device and the calibration documentation following recalibration and apprise the Quality assurance officer of any anomalies (e.g., excessive calibration adjustment, missing parts). Do not use an audit device for any adjustment required by this SOP without a current calibration certificate on file.

A quantitative measure of similarity between two values where one is a known or reference value and the other number is the observed or test value. The result is expressed as a signed percentage from the reference value:

% Difference = [Indicated – Actual] / [Actual] x 100

Where:

Indicated is the observed or test value.

Actual is the known or reference value.

% Difference signed (+ or -) difference as a percentage of actual value.

The quality control procedures for the calibration and verification of ambient ozone analyzers are documented in their respective SOP. This SOP quality assurance and verification procedures will be documented on the instrument maintenance log, site visit log that documents the conditions of the instrument while at the site when using or troubleshooting the calibrator. These include the equipment status sheet and the calibrator preventative maintenance schedule.

13.0 DATA ACQUISITION AND MANAGEMENT

The data acquisition systems used for data collection at the sites in Florida using a data acquisition system that is interfaced with the API T703 Calibrator. The T703 can be interfaced with analog connection, serial or via network Ethernet cables. The Florida network will be configured to use digital connections from the API T703 through the data acquisition system to the main data storage in the main office. The Florida Statewide Data Handling and Data Validation SOP covers the data handling for the state of Florida.

The calibrator is used primarily during the bi-weekly verification, automatic ZSP assessments, and calibrations. If the calibrator is used only for the biweekly ZSP only, it is left in standby mode until the next use. The data is assessed at the air-monitoring site and later at the office. The data from the calibrator is recorded into the on-site data acquisition system and is subsequently loaded into the main data acquisition system at the main office.

The data sheets are reviewed at the office for accuracy and completeness in conjunction with the ozone analyzer data sheets.

Only the ozone analyzer data is uploaded to AirMVP and EPA's database.

14.0 REFERENCES

Quality Assurance Handbook for Air Pollution Measurement Systems, Vol II, Ambient Air Quality Monitoring Program, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards Air Quality Assessment Division RTP, May 2013, NC 27711

User Manual, Models T703 and T703U Photometric O3 Calibrator, Teledyne Advance Pollution Instrument (TAPI), 9480 Carrol Park Drive, San Diego, California 92121-5201, USA July 2015

Quality Assurance Project Plan for the State of Florida Ambient Air Quality Monitoring Program, FDEP QAPP Revision 2, April 2022, Florida Department of Environmental Protection, Tallahassee, FL

Quality Management Plan for the Florida Department of Environmental Protection's Division of Air Resource Management Revision No. 2014-II

Standard Operating Procedure ESC Model 8832 and AV-Trend PC Site Operations DEP 17-10_Rev 0_02-12_ESC 8832 AV-Trend

Title 40 eCFR Part 58, Appendix A to Part 58—Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards, AUGUST 2016, Washington, DC 20401

Title 40 eCFR Part 50, Appendix D to Part 50—Reference Measurement Principle and Calibration Procedure for the Measurement of Ozone in the Atmosphere (Chemiluminescence Method) AUGUST 2016, Washington, DC 20401

15.0 APPENDICES

15.1. Appendix A-Forms

15.1.1. DEP 06-17-A Equipment Status Report

Form No. DEP 06-17-A		Teledyne API T703 / 703E Equipment Status Report				Effective on: 04/2022	
Identification Block							
Date Performed:		Site Name:		AQS #:		Procedure:	
Instrument Mfr:		Model:		Serial #:		Date Calibrated:	
Calibrator Mfr:	Teledyne API	Model:	T703	Serial #:		Date Calibrated:	
Data Logger Mfr:		Model:		Serial #:		Date Certified:	
Standards Block							
Flow Standard Mfg:		Model:		ID/Serial #:		Date Certified:	
Temp. Standard Mfg:		Model:		ID/Serial #:		Date Certified:	
BP Standard Mfg:		Model:		ID/Serial #:		Date Certified:	
Time Standard Mfg:		Model:		Serial #:		Date Certified:	

Calibrator Checks		
Parameter	Limits	Value
Output Flow (lpm)	2 - 5	
Regulator Pressure (psig)	15 ± 2 @ 5 lpm	
Box Temp (°C)	20 - 35	
O_3 Gen Reference (mV)	0 - 5000	
O_3 Gen Drive (mV)	0 - 5000	
O_3 Lamp Temp (°C)	48 ± 1	
Photo Measure (mV)	2500 - 4700	
Photo Reference (mV)	2500 - 4700	
Photo Flow (lpm)	0.720 - 0.880	
Photo Lamp Temp (°C)	58 ± 1	
Photo SPress (inHG-A)	~ -1" ambient abs	
Photo STemp (°C)	25 - 48	
Photo SLOPE	1.0 ± .15	
Photo OFFSET (ppb)	0 ± 10.0	

Cuncurrency Checks					
Concurrency	Instrument	Data Logger	Difference	Limits	RESULT
Time Display				± 2 minutes	
Concentration Display				± 1.0 ppb	

Operator Comments:			
Performed by:		Date:	

QA Comments:			
Verified by:		Date:	

Completing Form DEP 06-11-A

This form is used to log the instrument status each time the operator performs an activity on the calibrator. When the form is exhausted before the current year, start another page to be used for the current year. However, each year shall have its own form. This form is in Microsoft excel spreadsheet. Alternatively, a hard copy of the form can be printed and filled in.

Complete the identification block in the form.

The following entries are made in the heading of each form before data is entered into the form. These are entered once per form.

Serial Number: Read the serial number from the instrument and enter it into the designated area.

Site Name: Enter the site name.

AQS Number: Enter the AQS number and the location of the site. The AQS number shall be formatted as 12-XXX-XXXX where XXX represents the Florida County and XXXX the site number.

Year: Enter the year that the form will be used.

Complete the Time standard section with the time standard information.

The following entries are recorded during each maintenance activity in the form.

Verify Test Function: Using the <TST> function button, scroll through the test functions indicated Form 06-11-A: Equipment Status report and record the parameter value. If it is not in the prescribed range, trouble shoot and correct the issue and make a note in the comment section of the form detailing the findings.

15.1.2. **DEP 06-17-B Maintenance Schedule**

Form No. DEP 06-17-B				Teledyne API T703/E Maintenance Schedule						Effective Date: 04/2022
Identification Block:										
Year:		Site Name:		AQS #:						
Instrument Mfr:	Teledyne API	Model:	T703	Serial #:						
Data Logger Mfr:		Model:		Serial #:						
Minimum Maintenance Frequency:		Quarterly	Annual					As Needed		
Date	Operator	Sample Line Integrity Check	FDEP Audit/ Certification	Flow Sensor Calibration	Temperature Sensor Calibration	Pressure Sensor Calibration	Leak Check	Examine/Clean Pneumatic Lines/Clean Absorption Tubes (Calibration Required if cleaned)	QA Verification	QA Date
ENTER DATE LAST PERFORMED:									LEAVE BLANK	
	Due Dates:	N/A	N/A	N/A	N/A	N/A	N/A			
	Warnings:	N/A	N/A	N/A	N/A	N/A	N/A			
Comments:										

Completing Form, No DEP 06-17-B

Make appropriate date entries, with respect to the Preventive Maintenance (PM) tasks to be performed, for the following items:

A. Complete the Identification Block for the T703 ozone calibrator.

B. Enter the AQS number and the location of the site. The AQS number shall be formatted as 12-XXX-XXXX where XXX represents the Florida County and XXXX the site number.

C. Record the data logger model and serial numbers in their designated area on the form.

D. Enter the current date in the date field and the operator's initial in the required field.

E. Enter the date when activities are performed.

F. Each box has a drop-down box and Performed, Not Performed, Not Due can be selected.

G. Enter any maintenance activity performed in the comment section with the operator's initial.

H. The QA reviewer shall enter his/her initial and date in the designated cells.

15.1.3. **DEP 06-17-C Annual Sensor Verification**

Form No. DEP 06-17-C		**Teledyne API T703 / 703E Annual Preventative Maintenance Record**					Effective 04/2022
Identification Block							
Date Performed:		Site Name:		AQS #:			
Calibrator Mfr:	Teledyne API	Model:	T703	Serial #:		Date Certified:	
Primary Recorder Mfr:		Model:		Serial #:		Date Calibrated:	
Standards Block							
Flow Standard Mfg:		Model:		ID/Serial #:		Date Certified:	
Temp. Standard Mfg:		Model:		ID/Serial #:		Date Certified:	
BP Standard Mfg:		Model:		ID/Serial #:		Date Certified:	
Flow Rate Verification/Calibration							
Output Flow	Front Panel	Reference Standard	**% Diff**	**Limits**	**RESULT**		
As Found (cm^3/min)				± 2%			
Post Calibration (cm^3/min)				± 2%			
Photo Flow							
As Found (cm^3/min)				± 2%			
Post Calibration (cm^3/min)				± 2%			
Pressure Sensor Verification/Calibration							
	Pressure	Reference Standard	**Difference**	**Limits**	**RESULT**		
As Found (inHg)				± 0.2" Hg			
Post Calibration (inHg)				± 0.2" Hg			
Annual Bench Temperature Sensor Verification/Calibration							
	Bench Temperature	Reference Standard	**Difference**	**Limits**	**RESULT**		
As Found (°C)				± 2°C			
Operator Comments:							
Performed by:		Date:					
QA Comments:							
Verified by:		Date:					

Completing Form, No DEP 06-17-C

Make appropriate date entries, with respect to the Annual Preventative Maintenance tasks to be performed, for the following items:

A. Complete the Identification Block for the T703 ozone calibrator.

B. Enter the AQS number and the location of the site. The AQS number shall be formatted as 12-XXX-XXXX where XXX represents the Florida County and XXXX the site number.

C. Record the data logger model and serial numbers in their designated area on the form.

D. Fill out the Temperature/Pressure/Flow Verification fields as indicated on the sheet.

E. Add any relevant comments about the procedure in the Operator Comments block.

F. Fill in the Performed By and Date boxes.

G. QA will review and comment as appropriate then sign/type in the Verified by box.

15.2. **Appendix B-Glossary**

API	Advanced Pollution Instrumentation
APICOMM	Teledyne software is used to connect remotely to the API instrumentation.
AQS	Air Quality System
°C	Degree centigrade
CAL	Calibration
CLK	Clock
CM3	Cubic centimeters
CONC	Concentration
DEP	Department of Environmental Protection
DIL	Dilution
DFU	Dry Filter Unit
ENTR	Enter
FAMAS	Florida Air Monitoring and Assessment System
GPT	Gas Phase Titration
ID	Internal Diameter
OD	Outside Diameter
IN-HG-A	Inches of Mercury Absolute
MV	Millivolts
PPB	Parts per billion
PPM	Parts per million
PRESS	Pressure
PSI	Pounds per Square Inch
PQAO	Primary Quality Assurance Organization
QAPP	Quality Assurance Project Plan

QAP	Quality Assurance Plan
RNGE	Range
SAMP	Sample
SCCM	Standard cubic centimeters per minute of flow.
SOP	Standard Operating Procedure
TEMP.	Temperature
V	Volts
ZSP	Zero Span Precision