

*FORSYTH COUNTY OFFICE OF  
ENVIRONMENTAL ASSISTANCE AND  
PROTECTION*

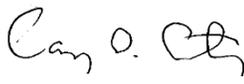


**STANDARD OPERATING PROCEDURE (SOP)**

**Zero Air  
Generators**

**Signature Page**

By the signatures below, the Forsyth County Office of Environmental Assistance and Protection (FCEAP) certifies that the information contained in the following Standard Operating Procedure (SOP) is complete and fully implemented as the official guidance for our Office. However, due to circumstances that may arise during the sampling year, some practices may change. If a change occurs, a notification of change and a request for approval will be submitted to EPA Region 4 at that time.

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## **STANDARD OPERATING PROCEDURES FOR ZERO AIR GENERATORS**

### **Forsyth County Office of Environmental Assistance and Protection**

## **13.0 Introduction**

All equipment, chemicals, field operating procedures, and laboratory operating procedures used during the use of Teledyne 701 H series zero air supplies will comply with CFR requirements. The following procedure manual is to be used as a supplement to the Code of Federal Regulations (CFR). Siting and various quality assurance (QA) procedures are followed in accordance with the Code of Federal Regulation Title 40 Part 50, Part 58 and EPA-454/B-13-003: Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II.

This “Standard Operating Procedure” (SOP) will provide guidance for the operation and maintenance of Teledyne API 701H/T701H/T751 Zero Air Generators.

## **13.1 General Overview**

Zero Air Generators are used to clean air from any particles, gases, and moisture while maintaining the level of oxygen found in ambient air. This cleaned air is then used by gas calibrators to produce contaminant/moisture free calibration gas.

A zero air system to be used in the field should be set as follows:

Ambient air entering the instrument is passed through a 5 µm Teflon filter to remove particulates. An air compressor is connected to a drying system to extract any moisture from the air and followed by a storage tank. The dried air is then routed through a hydrocarbon scrubber (catalytically converting hydrocarbons to CO<sub>2</sub> and H<sub>2</sub>O), a CO scrubber (oxidizes CO to CO<sub>2</sub>), columns of purafil (oxidizing NO to NO<sub>2</sub>) and activated charcoal (removing NO<sub>2</sub>, O<sub>3</sub>, SO<sub>2</sub> and H<sub>2</sub>S), and then routed to the zero air output.

The Forsyth County Air Quality network uses Teledyne API 701H and Teledyne API T701H high performance zero air generators. For audit purposes a custom zero air generator is used. See section 13.4 for details about the audit zero air generator.

### **13.2 Initial Instrument set up (Teledyne API 701H and T701H)**

Upon receiving a new Zero Air Generator, remove the four red shipping screws on the bottom that secure the compressor to the chassis.

13.2.1 Install the inlet air filter in the ‘Air In’ port on the back of the instrument.

13.2.2 The tubing from the ‘Drain’ port should end in a 5 gallon bucket to collect water. The operator must check the bucket for water. Only small amounts of water should be visible (less than 1” of water collected over a two week period). If more water starts collecting in the bucket

it can be a hint that the air inside the monitoring shelter is high in moisture which can lead to instrument malfunctions or the zero air generator needs servicing.

13.2.3 Connect a line of Teflon tubing from the ‘Zero Air Out’ on the zero air generator to the site calibrator so the zero air can be used.

13.2.4 Turn on the instrument power. A few seconds after the power light (green LED) and cooling fan have started, the compressor should start. Observe the pressure gauge on the front panel which should reach ~30 psi within a few minutes. If not, adjust the regulator knob to set the pressure to 30 psi or contact the program manager.

13.2.5 The instrument is producing zero air and ready to use when the pressure is steady at 30 psi and the dew point sensor LED is illuminated green.



**Fig. 1: Front panel of the T701H Zero Air Generator.**

### 13.3 Zero Air Generator Maintenance

Once a year the zero air generators have to be serviced. On a more frequent basis, as part of a routine site visit, check the overall cleanliness (remove dust) of the instrument, especially the ‘Air in’ filter and fan inlet, cooling fan, cooling coil and water bucket.

Before transportation, storage or maintenance work, turn the power switch to off, wait approximately 1 minute and turn power back on to drain any water that may be present in the coalescing filter and/or pressure tank. Refer to Operation Manual, Models T701, T701H, 701 and 701H Zero Air Generators, (Oct 2014) Chapter 3.5.2. and Operation Manual, Model 751H Zero Air Generator, (July 2014) Chapter 3.6.

**To avoid injury, let the unit cool down!** The Hydrocarbon and CO scrubbers operate at temperatures ~300 °C and the hot air is transported in the copper tubes.

The yearly maintenance consists of:

13.3.1 Thoroughly clean the inside of the instrument.

13.3.2 Check all tubing for abrasion as the compressor produces vibration. If any section of tubing shows abrasion, or wear, it should be replaced. Check all fittings for tightness.

13.3.3 Perform a pump check. Typical life span of a freshly rebuilt pump is ~18 months, if used continuously. The best indicator for pump wear is a vacuum check on the pump inlet. To do this, disconnect the power cord from the Control Board. Disconnect the air out side tube line from the pump and attach a vacuum gauge to the air in port instead of the air in filter. Connect the power adapter cord to the pump cord and plug into a wall outlet. The gauge should now show at least -20" Hg of vacuum.

If **NOT**, the pump has to be rebuilt. Refer to Compressor Service Kit Manual shipped with the rebuild kit. (If the pump piston seal rings show a high amount of wear, check the down stream side line for contamination. On the 4-way valve, check the inside of the two brass filters. If these get too dirty and start clogging, a usable dew point can not be reached.)

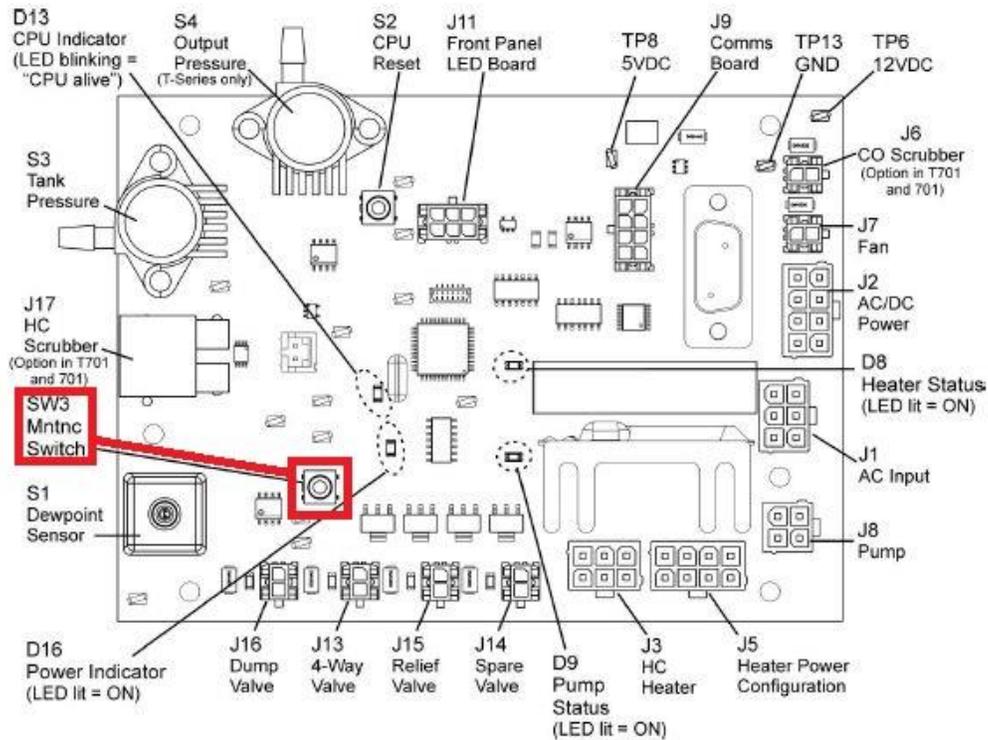
If **YES**, return the instrument back to normal operating set up (procedure is the reverse of 13.3.3)

13.3.4 The charcoal and purafil columns (see Fig. 2) should be replenished. Refer to Operation Manual, Models T701, T701H, 701 and 701H Zero Air Generators, (Oct 2014) Chapter 6.4 and 6.5.



**Fig. 2: Columns filled with charcoal and purafil inside the T701H.**

**T701H only:** After replenishing the columns, right after turning on the unit, press the Maintenance Switch button on the Control Board (see Fig. 3) which sits on top of the storage tank. This places the unit in maintenance mode and will override any fault warnings for 24 hours. When in normal mode a fault warning can turn the unit off.



**Fig. 3: T701H Control Board, maintenance mode button location**

13.3.5 **701 Models only!** Check the pressure relief valve “cut out” pressure of 70-80 psi (cut-in pressure at ~30 psi). Refer to Instruction Manual, Zero Air Module Model 701, (Oct 2014) Chapter 6.8.

13.3.6 The ‘Final filter’ right before the ‘Zero Air Out’ has to be cleaned.

13.3.6.1 Detach the line from the filter housing and remove the filter from the rear panel.

13.3.6.2 Open the filter housing by unscrewing the bowl and clean the inside. If the filter is too contaminated, it should be replaced. Cleansing with water can remove some debris.

13.3.6.3 Reassemble the filter housing, place it back to the rear panel and reattach the line.

13.3.7 Perform a leak check. See below or refer to Operation Manual, Models T701, T701H, 701 and 701H Zero Air Generators (Oct 2014), Chapter 6.12.

13.3.7.1 Cap the exhaust on the rear panel and the regenerative dryer. Remove the line to the dew point sensor and cap the fitting.

13.3.7.2 Turn on the unit and wait for the pump to turn off. Observe the pressure gauge; pressure should not change for the next five minutes. If the pressure is steady the leak check has passed.

13.3.7.3 Return the unit back to operating set up.

13.3.8 Let the instrument reach normal operating condition (see 13.2.5).

## 13.4 Audit Zero Air Generator maintenance

The primary zero air generators used for audits contain a mobile set up of two parts: a pump and a drier/purifier box.



**Fig. 4: Two part Audit Zero Air supply set up.**

13.4.1 Thoroughly clean both parts of the generator set by removing dust.

13.4.2 The silica gel, Purafil, and charcoal canisters should be replaced as needed, at least once a year.

13.4.3 Check all lines and connections for wear and tightness.

13.4.4 Perform a pump check. Disconnect the tube line from the pump and attach a vacuum gauge to the air in port directly at the pump. Connect the pump into a wall outlet and let it run. The vacuum gauge should now read at least - 20" Hg of vacuum.

If **YES**, return the system back to normal operating set up.

If **NOT**, the pump has to be rebuilt.

13.4.5 Leak check the system.

13.4.5.1 Cap the Air out port on the drier/purifier box.

13.4.5.2 Attach the pump to the drier/purifier box inlet and let it run to build up pressure. Turn off the pump and observe the pressure gauge. The pressure should not drop more than 1 psig in one minute.

13.4.5.3 Slowly release the pressure by slowly opening the cap on the Air out port.

## **13.5 Verifying the Zero Air System**

13.5.1 After the annual maintenance is completed, attach the zero air system to a level 2 transfer standard. Then connect a line between the cal gas out port of the level 2 transfer standard and the sample port of an ozone analyzer.

13.5.2 Turn the level 2 transfer standard on to run a zero point.

13.5.3 Let the analyzer stabilize and observe the ozone value which should read <0.002 ppb O<sub>3</sub>.

## **13.6 Documentation**

13.6 Document all problems, maintenance, test results, and verifications completed on the zero air systems using calibrators and/or analyzers to track the quality of the zero air being produced by each unit. All results should be logged in the \Forsyth County\EAP - Analysis-Monitoring - Analysis-Monitoring\Equipment\Repair Supplies and Logs folder under the Ambient Equipment Repair Log ZERO AIR.xls file. Find the corresponding tab for each unit based on serial number within the excel sheet and add documentation to track the equipment's history.

## **REFERENCES**

Operation Manual, Models T701, T701H, 701 and 701H Zero Air Generators (Oct 2014), Teledyne Advanced Pollution Instrumentation Division, 9480 Carroll Park Drive, San Diego, CA 92121-5201.

Operation Manual, Model 701H High Performance Zero Air Generator, Teledyne Advanced Pollution Instrumentation Division, 9480 Carroll Park Drive, San Diego, CA 92121-5201.

Instruction Manual, Zero Air Module 701. Teledyne Advanced Pollution Instrumentation Division, 9480 Carroll Park Drive, San Diego, CA 92121-5201.

Model SK2668 Compressor Service Kit Manual, Thomas, A Gardner Denver Product, 3524 Washington Avenue, Sheboygan, WI, 53081

Operation Manual, Models 751H Zero Air Generators (July 2014), Teledyne Advanced Pollution Instrumentation Division, 9480 Carroll Park Drive, San Diego, CA 92121-5201.