AIR QUALITY SURVEILLANCE BRANCH

ACCEPTANCE TEST PROCEDURE (ATP)

FOR

TELEDYNE ADVANCE POLLUTION INSTRUMENTS (API) MODEL 701 ZERO AIR GENERATOR

AQSB ATP 702

First Edition

MONITORING AND LABORATORY DIVISION

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AIR RESOURCES BOARD

Approval of Acceptance Test Procedure

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API 701 Zero Air Generator

1.0 ACCEPTANCE TEST PROCEDURE

1.1 General Information:

The following outlines the California Air Resources Board Air Quality Surveillance Branch (AQSB) acceptance test procedures for the Teledyne Advance Pollution Instruments (API) Model 701 Zero Air Generator (API 701).

Before beginning acceptance testing of the API 701, read the API 701 instruction manual thoroughly to become familiar with the theory of operation and hardware of the instrument. Initiate an acceptance test log and an instrument lab test report. Record the dates of the individual tests, problems, contacts with the manufacturer, and any other pertinent information on the acceptance test log.

1.2 Physical Inspection:

Inventory all the parts noted in the shipping document. Check for any shipping damage and incorrect or damaged parts or sub-assemblies. Assemble all parts as necessary for proper operation of the instrument.

The API 701 is shipped from the factory with screws mounted under the pump assembly. These will need to be removed before testing can begin. Refer to instruction manual (Section 1.1 “Unpacking”).

Check the instrument for proper power cord phasing and frequency.

1.3 Pre Acceptance Testing Procedures:

Prior to beginning acceptance testing of the API 701, procure all necessary testing apparatus and refer to ARB’s specifications (Appendix D) used to purchase the equipment. Start acceptance testing documentation file. For proper acceptance testing, a strip chart recorder should be connected to the test rack instrumentation analog output(s) so that the zero air purity tests may be properly monitored and evaluated.

Recorder charts should be cut into 24 hour segments and labeled at the bottom with the following:

1. Test Performed
2. Date of Test
3. Manufacturer, Model Number and Serial Number
4. Instrument Identification, Range, Trace Color, Parameter Identification

Clear and precise notations should be entered on the chart indicating when the tests were started and ended, pertinent information regarding API 701 performance and any unusual conditions observed. Charts should be attached to the final acceptance reports.

Prior to operation of the API 701 refer to instruction manual (Section 1.3 "Electrical and Pneumatic Connections"). Install the provided inlet filter in the "Air-In" port. Connect a water collection jar to the ¼" swagelock connector to the "water drain" port. Connect the API 701's port labeled "Zero Air Out" to a gas dilution system.

1.4 Physical, Performance and Operational Checks:

The physical, performance and operational checks of the API 701 are designed to verify that the instrument meets or exceeds the specifications required by the AQSB. The API 701 physical and performance specifications are located in Appendix C and D of this document. The Air Quality Surveillance Branch's Operations Support Section (OSS) uses the following operational checks to acceptance test the API 701***:***

Operational Checks:

1. Perform initial start-up checks. Connect the API 701 to a test instrument rack containing a gas dilution system and at least three (3) other gaseous instruments. At a minimum, these instruments should consist of an ozone (O3), a total oxide of nitrogen (NOx) and a carbon monoxide (CO) analyzer. Verify that the API 701's "Zero Air Out" port is connected to the zero air inlet of a test gas dilution system via ¼" Teflon tubing. Turn the API 701's front panel power switch to power on. Note that the cooling fan and compressor start. After 30 to 60 seconds, the front panel pressure gauge should read approximately 30 pounds per square inch gauge (psig). Record front panel pressure gauge reading. The dew point indicator lamps should illuminate as per the API 701 instruction manual (Section 4.19, "Dew Point Indicator"), if the unit was purchased with the humidity option.

   Verify the pressure switch operation. The API 701 pressure switch senses the pressure in the storage tank. The pressure switch has a mechanically controlled range of 20 to 25 psig. No adjustments should need to be made to the pressure switch.

2. The pressure is factory set to turn off (cut-off) the compressor at approximately 70 psig and turn on (cut-in) the compressor at approximately 45-50 psig.

   Turn off power switch of the API 701. Refer to the API 701 instrument

manual (Figure 4-2, “Plan View”). Disconnect the ¼” Teflon tubing from the cut out switch to the ¼” tee on the surge tank and connect a 0 – 100 psig pressure gauge inline between the pressure switch as shown by the Test Pressure Gauge for Setting Pressure Switch in the instrument manual (Figure 4-2, “Plan View”). Turn on power switch to the API 701, the compressor should start with in 30 to 60 seconds and fill the storage tank to cut-off pressure. Note the pressure on the test pressure gauge when the compressor cuts-out (nominally 70 psig). Set the gas dilution system to command a flow of 13 standard liters per minute (SLPM) at 35 psig output. This will cause the API 701 storage tank pressure to drop and start the compressor when tank pressure reaches cut-in pressure (nominally 45-50 psig). Record the inline pressure gauge reading when the compressor starts. If the pressure switch does not turn off compressor at 70 psig and start compressor at 45-50 psig, adjustments to the pressure switch are required. Refer to the 701 instrument manual (Section 5.8, “Adjusting the Pressure Switch”).

3. Set pressure regulator on the front panel of the API 701 to 35 psig. See instruction manual (Section 4.11, “Pressure Regulator”). Disconnect the pneumatic line connected to the gas dilution system and install a 0 to 60 psig pressure gauge in-line to the port labeled “Zero Air Out”. Note the pressure as measured by the 0 to 60 psig pressure gauge (nominally 35 psig). If the 0 to 60 psig gauge does not read 35 psig, adjust the pressure regulator until the test gauge reads 35 psig. Record the front panel indicated output pressure. Disconnect the pneumatic line at the input of the gas calibrator. Install a mass flow meter to the “Zero Air Out” port of the API 701. Verify that the output of the 701 is 20 SLPM.

4. Check dew point of output air. Connect a dew point hygrometer in-line to the output of the API 701 supply line connected to the gas dilution system via a tee connector. Connect the analog output of the hygrometer to a strip chart recorder. The analog output of the hygrometer will be a negative voltage when the hygrometer reads a negative dew point. Therefore the readout on the strip chart recorder must be adjusted to accommodate this voltage and polarity. Set the gas dilution system to command a flow of 13 SLPM. Record the dew point indicated by the hygrometer and record on strip chart recorder. The dew point should be lower than – 16 Celsius (° C) after 30 to 60 minutes of operation

5. Check purity of output air using standard AQSB air monitoring instrumentation. With the API 701 connected to the test station containing at least an O3, NOx and CO analyzer, command the gas calibration system to zero all instruments. After a 30 minute zero, record the instrument zero readings on strip chart recorder.

6. Perform the zero tests every 24 hours for 72 hours and record results. The limits on the impurities must be less than the following:

Parameter	Purity Limit
Ozone (O3)	Less than 1.0 ppb
Nitrogen Oxide (NO)	Less than 1.0 ppb
Nitrogen Dioxide (NO2)	Less than 1.0 ppb
Sulfur Dioxide (SO2)	Less than 1.0 ppb
Carbon Monoxide (CO)	Less than 0.1 ppm
Total Hydrocarbon (THC)	Less than 1.0 ppb
CH4 (Methane)	Less than 1.0 ppb
Sulfur Dioxide (H2S)	Less than 0.1 ppb
Non-Methane Organic Compounds	Less than 1.0 ppb

Table 1: API 701H Impurity Limits Table

1.5 Environmental Chamber Temperature and Voltage Stability Tests**:**

Place the API 701 in the Thermotron environmental chamber and connect the power cord to the variable voltage power strip. Connect the API 701 output to the gas transfer standard in the environmental chamber test rack. Use the chambers test rack analyzers to evaluate the performance of the API 701 during testing. Command a Temperature/Voltage program using the Thermotron program 7 while the API 701 is generating zero air. Repeat the Temperature/Voltage run at varying voltages and temperatures (see Instrument Lab Test Form 702). Compare the responses of the API 701 to the purchase specifications. Record results on the AQSB IL Test Report 702.

1.6 Post Acceptance Test:

1. Review manufacturer's specifications, instrument lab test log, charts, test reports, data sheets and all other testing documentation, and submit for review to the Operations Support Section Manager.

2. Measure output pressure of the API 701 using a pressure gauge. Verify output air pressure is at 35 psig. If not, adjust pressure regulator until pressure gauge on the rear of the instrument reads 35 psig. Record front panel pressure gauge reading.

3. Perform shut down procedure as per instruction manual (section 1.5 "Shut Down").

4. If all acceptances testing data is approved, send instrument to stockroom for barcoding and field assignment.

INSTRUMENT LAB TEST LOG

Manufacturer _____ Model # _____

S/N _____

Date	Action

AQSB INSTRUMENT LAB TEST REPORT

API 701 Zero Air Generator

Serial Number:		ARB Barcode	
Software Version:		Tested By:	
Date Started:		Reviewed By:	
Date Completed:		Date:	
Accept or Reject:			

Physical Inspection	Notes	Initials
1. Unpack and Inventory Parts		
2. Check for shipping damage		
3. Remove compressor shipping screws		
4. Check line voltage and power phasing		

Pre-Acceptance Test Checks		
1. Start documentation file		
2. Check operation of valves, switches, gauges etc.		
3. Pneumatic connections		
4. Confirm firm ware version		

Operational Tests		
1. Initial Start-up checks		
2. Record initial front panel pressure gauge		
3. Check pressure switch operation		
4. Pressure regulator (Front display/Test gauge)	/	

Operational Tests (Cont.)	Notes	Initials
5. Record Zero Air Out flowrate (SLPM)		
6. Check Dew Point		
7. Check Zero air purity		
7. Perform 72 hour zero air purity test		

Environmental Chamber Test

1. Temperature and Voltage Variation Test		
1a. 35 deg C, 115 V		
1b. 35 deg C, 125 V		
1.c 35 deg C, 105 V		
1d. 15 deg C, 115 V		
1e. 15 deg C, 125 V		
1f. 15 deg C, 105 V		

Post Acceptance Test

1. Verify output pressure @ 35 psig		
2. Perform shut down procedure		
3. Complete IL Test Documentation		
4. Submit Test Documentation for review		

API 701 Physical Specifications

1. Each pure air generator system shall be of a modular design allowing easy access for servicing. It shall be supplied in a cabinet and fitted with all the necessary hardware, including slides and brackets necessary for mounting in a 19" wide by 25” deep equipment rack.

2. All components shall be constructed so that they can be quickly and easily removed, serviced, and reinstalled. All units and sub-units shall be interchangeable and shall be of modular construction with each sub-unit capable of being replaced within a maximum service time of 30 minutes.

3. The AC input power cord shall be 3 conductor, minimum 8 feet in length with a 3-prong connector plug. The AC input to each generator shall be at the rear of each unit. The connectors shall be wired so that the "hot" terminal (black wire) is connected to the brass terminal throughout. The supply voltage shall be nominally 115 +/- 10VAC, 60 +/- 3 Hz.

4. All electrical connectors except power cords shall be Amphenol, Molex, or Cannon Type with retainers, or equivalent.

5. Gas inlet and outlet connectors shall be made of brass or stainless steel and shall be located at the rear of the cabinet. To reduce light-end hydrocarbons, the following is highly recommended:

    (a) The use of stainless steel fittings at the scrubbers and output final filter.

    (b) Teflon O-ring in the final filter.

API 701 Performance Specifications

These specifications describe the minimum acceptable quality or performance level of the equipment. Superior alternatives will be considered as compliant to specifications.

1. Pump and Pure Air Generator: Shall deliver 1-20 standard liters per minute of ultra pure, dry air @ 30 psig with the following upper limits on impurities:

   <1.0 ppb SO2, 0.1 ppb H2S, 1.0 ppb NO, 1.0 ppb NO2, 1.0 ppb O3, 0.1 ppm CO, 1.0 ppm THC (expressed as methane), 1.0 ppb NMOC (see attached PAMS compounds)

2. The dew point of the clean zero air delivered by each generator shall be -20 C or lower. Indicator(s) shall be provided on the front panel to warn t he operator when the dew point is greater than -15C.

3. Temperature Range: Each generator shall meet all specifications listed herein while experiencing ambient temperature variations from 15 C to 35 C. Each generator shall not be damaged by exposure to ambient temperature variations from 4 C to 44 C.

4. Supply Voltage: Each generator shall operate on 115 VAC @ 60 Hz.

5. Power Line Variation: Each pure air generator system shall meet all specifications listed herein while experiencing input line voltage variations from 105 to 125 VAC.

6. Power Consumption: The maximum power consumption shall not be greater than 500 watts when operated with a flow demand of 13 liters per minute at 25 pounds pressure.

7. Warm-up Time: Each clean air generator system shall be ready for operation within 30 minutes after connection to a source of power.

8. Power Failure: In the event of a power failure, each pure air generator system shall automatically restart after power restoration.

9. Vibration: Each clean air generator system and component parts shall be unaffected by ordinary vibrations during transport or use.

10. Duty Cycle: Each clean air generator system shall operate unattended for a period in excess of 168 hours, and shall not require major maintenance more often than once per twelve (12) months.

11. Attitude: Each clean air generator system shall maintain all flows and pressures within specifications while undergoing attitude changes of up to 45 degrees.

12. Atmospheric pressure: Each pure air generator system shall operate within specifications at altitudes up to 8000 feet above sea level.

13. Operating the air generator unconnected (open to atmosphere) shall NOT affect the dew point.

14. Each pure air generator system shall be operated by either electrical or pneumatic command from the gas calibrator, or upon direct front-panel command.