SMOKE DETECTORS SENSITIVITY ANALYZER

Model 501-A & 501-A/BAT Aerosol Generator

USER'S GUIDE

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ANALYZER FOR SMOKE DETECTORS

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Serial No.
Date Shipped
Inspected by
Sold To

GEMINI SCIENTIFIC CORP., 1122-B ASTER AVENUE, SUNNYVALE, CA 94086, (408) 554-0310.

FOR TECHNICAL ASSISTANCE DIAL 1-800-582-8882

Rev. July, 2003

Table Of Contents

Warranty

Gemini Scientific Corp. warrants the instrument described herein to be free from defects in material and factory workmanship for a period of one year, and agree to repair such instruments, which under normal use and service disclose the defect to be the fault of Gemini Scientific Corp.

Gemini Scientific Corp.'s obligation under this Warranty relates to the original purchaser and is limited to a return of the purchase price or at the Gemini Scientific Corp.'s sole discretion, to the repair or replacement of the instrument or any of its parts which, prove to be defective. For this Warranty to be in effect, any material or part alleged to be defective is to be returned to Gemini Scientific Corp. with our prior written approval, fully insured and transportation prepaid by the purchaser, within 12 months from date of delivery.

This Warranty shall not apply to an instrument which has been (l) subjected to misuse, negligence, or accident; (2) connected, installed, operated or adjusted other than in accordance with instructions furnished by the Gemini Scientific Corp.; (3) repaired, modified or serviced by someone not authorized by the Gemini Scientific Corp., so that in our judgment on the performance or reliability of the instrument has been impaired.

We reserve the right to make replacement with equivalent merchandise and to make changes at any time in the specification, design, or construction of the instrument without incurring obligation to make any commensurate changes in units previously delivered.

Gemini Scientific Corp. assumes no liability for consequential or contingent damages for a defective instrument covered by this Warranty, failure of delivery in whole or part, or for any other cause. This Warranty and the writing to which it is attached constitute the understanding of the buyer and seller so that no terms, conditions, or agreement purporting to modify the terms hereof shall be binding unless made in writing and signed by an authorized agent of the home office of the Gemini Scientific Corp.

Warning

THE AEROSOL FROM THIS INSTRUMENT MAY BE HARMFUL TO THE HEALTH OF THE OPERATOR IF PRECAUTIONS ARE NOT TAKEN.

The Model 501-A Aerosol Generator/Smoke detector Analyzer generates an aerosol consisting of a refined NF-Grade white mineral oil in air. Aerosol concentration at the discharge point of the hose is adjustable from 0 to 45 mg/m^3 (0 to 6 mg/min). Room air would dilute the discharge quickly. The aerosol smoke is odorless and not visible. Proper precautions to avoid over exposure such as good ventilation and limited discharge time are recommended. Do not hold end of hose close to face during aerosol discharge.

The maximum allowable limit under OSHA (Occupational Safety and Health Administration) regulation in an eight-hour weighted average for oil-based aerosol is 5 mg/m^3 . The oil, RUDOL White Mineral Oil, is approved by the FDA (Food and Drug Administration) for use on skin and incidental food contact.

To reach the OSHA allowable limit, for example, you need to discharge at the maximum concentration rate (6 mg/min) into a non-ventilated 14x12x10 feet room for a period of about 50 minutes. However, in typical testing, very little aerosol is introduced into the room. The normal time per test is only about 30 seconds at 1/4 of the maximum concentration, far below the OSHA safety limit. However, precaution is necessary to avoid situations where exposure can reach above the OSHA limits.

THIS INSTRUMENT <u>SHOULD NOT</u> BE USED IN OR NEAR CONCENTRATED OXYGEN ENVIRONMENTS SUCH AS OXYGEN TENTS OR OPERATING ROOMS IN A HOSPITAL.

THIS EQUIPMENT OPERATES AT VOLTAGE LEVELS THAT CAN BE HAZARDOUS TO OPERATING PERSONNEL.

The Model 501-A Aerosol Generator-Analyzer for Smoke Detectors operates on 115 volt 50/60 Hertz. This voltage appears at the on-off switches and various other points on the chassis. Input power to the instrument should be disconnected before
you remove the back panel for filter change or repair. Only qualified personnel who are familiar with the location of the voltage and the hazards involved, may open the cabinet with power circuit energized.
Note that the power supply cord is equipped with a ground lug and should be attached to a suitable ground.

FOR ANALYZERS WITH RECHARGEABLE BATTERIES:

When handling the battery leads, make sure the power supply cord and the battery charger are disconnected, and that all switches are in the off position. When connecting a new battery, make sure to observe correct polarity. Connect the red positive (+) line to the red positive (+) battery terminal and connect the black negative (-) line to the black negative (-) battery terminal.

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1.0 Introduction

The Gemini 501-A Smoke Detector Analyzer/Aerosol Generator is an instrument ideally suited to measure the sensitivity response of installed smoke detectors. The Generator produces an aerosol with particles size characteristics resembling fire smoke. The range of concentration, between 0 and 45 mg/m^3 or from 0 to 4 %/ft obscuration (UL-268), is sufficient to trigger the alarm thresholds of all UL-approved ionization and photoelectric smoke detectors.

The calibration curve for each instrument relates its flowmeter readings to both the UL-268 obscuration standard in (%/ft) and to aerosol mass concentration in (mg/m^3). The calibration allows the operator to determine the sensitivity of the detector and compare it to the range specified by the manufacturer as printed on the back of each detector.

The instrument can save a considerable amount of time for inspection personnel who must remove detectors from ceiling positions for periodic cleaning or testing. Using the hose, wands, and shroud, test smoke is delivered to the detector without removing it from the ceiling. From the test results, inspectors can decide whether to remove the detector for cleaning or sensitivity adjustment.

The current NFPA 72 Fire Alarm Code (1996) recommends sensitivity inspection of installed detectors within one year after installation and every alternate year thereafter.

2.0 Specifications

Aerosol Characteristics
Particle size
- Number median diameter ..... 0.2 micrometer (um)
- Mass median diameter ..... 0.45 um
- Repeatability ..... ± 5 %

Generation Characteristics
- Test stream flow rate ..... 60 L/min.
- Aerosol flow rate ..... 0 - 4.2 L/min.

Concentration Range
- Adjustable ..... 0 - 40 mg/m3 (0 - 4 %/ft obscuration)
- Reset, concentration ..... ±4%
- Type of aerosol ..... Rudol Oil *
- Operating temperature ..... 24 ±3°C (75 ±5°F)

Mechanical Characteristics
- Dimensions, overall ..... 16 x 11 x 10 in. (41x 23 x 25 cm)
- Weight, approximately ..... 12 lb. (5.5 kg), 18 lb. (8.2 kg) w/ battery
- Hose length ..... 5 ft. (1.5 m)

Oil Reservoir Volume ..... 30 ml

Power Requirement
- Total, blower, compressor and vacuum pump ..... 115 V AC, 60 Hz, 3.0 A
- With Battery Option ..... 12 V DC, 3 amp. (7 Amp-Hr Lead-Acid Battery)

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*RUDOL oil, a NF-grade white mineral oil, aromatics-free, saturated aliphatic hydrocarbons. Viscosity = 29 centistokes @40 C. Specific gravity = 0.87 @25 °C. RUDOL is a registered trademark of Witco Chemical Corp. It conforms to the FDA-CFR 172.878, which allows for direct skin & food contacts and stabilized with Vitamin E for long shelf life.

3.0 Principles of Operation

3.1 General

The Gemini 501-A Aerosol Generator/Smoke Detector Analyzer operates on the principle of nebulization of a liquid to produce a polydispersed micro-sized spray with a relatively large mass median diameter. An impactor reduces the median diameter by selectively removing the larger diameter particles. The remaining aerosol is diluted by a large volume of room air at a constant rate from the blower. Hose and wands carry the aerosol up to a shroud, which covers the test detector at the ceiling.

A dual-head compressor/vacuum diaphragm pump is used in the system. The compressor line provides the air pressure necessary for the operation of the nebulizer. Aerosol output and particle size distribution from the nebulizer is kept constant by maintaining a constant pressure from the compressor. The vacuum line provides suction to vary the aerosol concentration of the test stream by diverting part of the aerosol from the generator. The amount of diversion is controlled by an adjustable valve and measured by a flow meter.

3.2 Main Elements of the Instrument

Figures 1 and 2 show the locations of some of the elements (pages 4 & 6).

3.2.1. Compressor / Vacuum Pump

The compressor line generates the air pressure necessary to operate the nebulizer. Air pressure, adjustable from the front panel, is monitored by the pressure gauge. A plastic tube extending from the front panel connects the compressor with the nebulizer.

The vacuum line removes a specified quantity of aerosol using a control valve that varies the final concentration of the aerosol in the test stream. This flow is monitored by a flow meter.

3.2.2. Nebulizer and Oil Reservoir

The heart of the aerosol generating system is the white plastic nebulizer. The nebulizer produces the aerosol from pressurized air by forcing the Rudol oil through a small orifice onto a sphere, which breaks the spray into fine particles. Calibration of each instrument is based on the particular nebulizer supplied. **Nebulizers are not interchangeable with other instruments**.

Oil for the nebulizer is stored in the 30-ml transparent plastic reservoir.

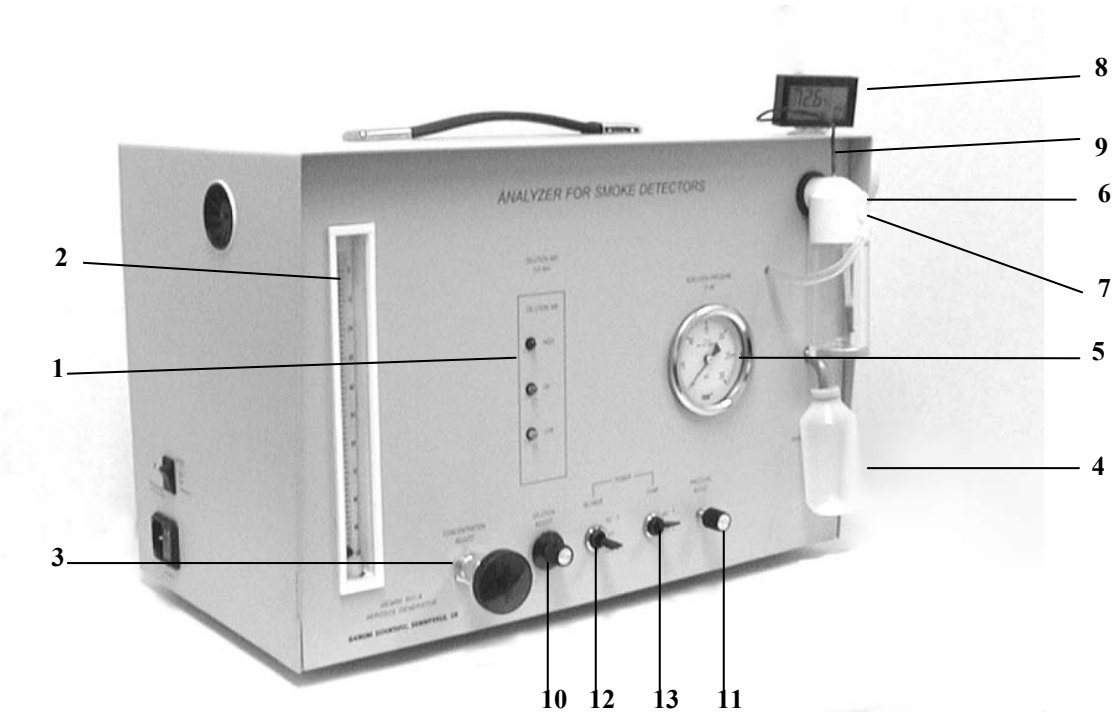


Figure 1, Front View of Model 501-A /Bat Tester

1. Dilution Air LED Indicator
2. Flow meter
3. Concentration Adjust
4. Drain Reservoir
5. Pressure Gauge
6. Nebulizer
7. Fitting, Pressurized Air
8. Temperature Sensor / Timer
9. Temperature Probe
10. Dilution Air Adjust
11. Pressure Adjust
12. Power (AC/Bat) & Blower Switch
13. Compressor/Vacuum Pump Switch

3.2.3. Manifold

The manifold is a central flow-switching chamber, which connects the nebulizer, impactor, vacuum line, drain outlet, and drain reservoir. It is from this chamber that adjustable portions of the aerosol are discarded through the drain and vacuum system while the remainder goes to the final test stream.

3.2.4. Impactor

The impactor, located inside the manifold, consists of a metal disc with 3 small holes *(older models may have 4 holes)* and an impaction plate behind the disc. The function of the impactor is to select the aerosol particulate with proper size distributions (smoke sized particles). The large-sized particulate coagulates at the impacting plate as a liquid and is fed into the drain system by gravity. During the test, over 80% by weight of the nebulizer aerosols are impacted out.

3.2.5. Drain Reservoir

In order to control the concentration of aerosol in the test stream, varying amounts of aerosol from the nebulizer are pulled by the vacuum into the filter, or by gravity into the drain reservoir. The drain reservoir should be attached to the drain outlet before any testing. The drain reservoir should be emptied when it is about 3/4 full.

3.2.6. Filters

The instrument contains two (2) filters. The first filter, located between the compressor and the nebulizer, filters the compressed air and also acts to dampen pulsation from the pump. Under normal operation this filter *does not* require periodic replacement. Replacement would be necessary if the filter become plugged in a dusty environment and the pressure can not be maintained at 15 psig during testing.

The second filter, located between the flowmeter and the manifold, absorbs all of the particulate in the aerosol going into the vacuum. It protects the flowmeter and the vacuum pump.

The filter element for the vacuum filter assembly should be changed after about **150-200 tests.** If oil is found pooled in the bowl during filter change, more frequent filter change is recommended. When changing the vacuum line filters, make sure all O-rings are seated properly before re-tightening the nut. (See Appendix E for instructions)

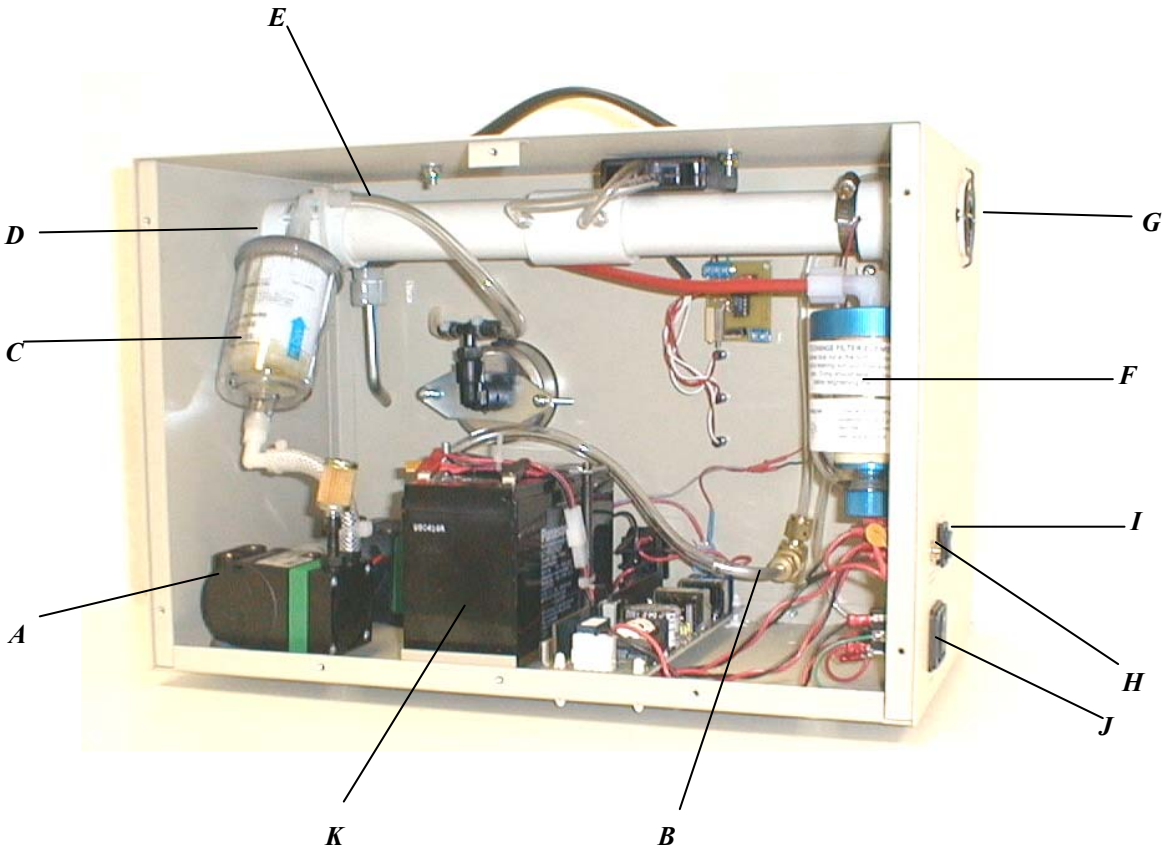


Figure 2, Back and Side View of Model 501-A/Bat Tester

A.	Compressor/Vacuum Pump
B.	Vacuum Line
C.	Compressed Air Filter
D.	Test Stream Outlet
E.	Manifold
F.	Vacuum Line Filter *(Newer Model uses a different filter. See P. 24 for details.)*
G.	Blower & Dilution Air Inlet
H*	Battery Charger Power Inlet
I.*	Function Switch
J.	AC Power Inlet
K.*	Battery

* For Battery Powered MODEL 501-A/BAT Only.

3.2.7. Controls, Gauges, and, Flow meter

Electric Switches. There are two switches on the front panel: one for the blower and the other for the compressor and vacuum pumps. The blower switch that selects the power source must be at the ON (top for AC; bottom for DC) position before the pump switch can be activated.

Always turn the blower on before turning on the pump. After the test, leave the blower on for about 20 seconds after the pumps are turned off to clear out the remaining aerosol in the line.

Dilution Indicator. The indicator LED lights (Red, Green, Yellow) shows the dilution airflow rate. The correct rate is shown by the green light. Red and yellow mean "high" and "low" respectively. To maintain the correct air flow rate, adjust the dilution knob on the bottom left of the front panel until the green light is on. If normal adjustment is not enough, some of the 6 holes of the diffuser in the shroud *(the clear plastic bowl)* may have to be enlarged or diminished. (See Table 1, Problem Diagnostics, P. 18).

Pressure Gauge. This gauge measures the air pressure entering the nebulizer which controls the air flow rate and the particle size distribution of the aerosol. Pressure must be maintained at 15.0 psig.

Flow meter. The flow meter measures the concentration (amount) of aerosol in the test stream. Use the concentration adjust valve to change the concentration.

The calibration curve located on the back page of the Manual, shows mass concentration and obscuration as function of flow meter readings. Temperature correction curves for 70 °F and 80 °F are also shown.

The obscuration scales derived from the calibration curve for ionization (I) and photoelectric (P) detectors for oil temperature at 75 °F are also posted on the flow meter. Slight temperature correction is needed for temperatures other than 75 °F. Refer to the calibration curve (back of this manual) for details.

3.2.8. Blower, Hose, Wands, Diffuser, and Shroud

Blower. The blower provides air to dilute the aerosol from the nebulizer. The dilution-air adjust knob controls the flow rate of the dilution air.

Hose and Wand. Insert the plastic end of the 5-ft., 1-1/2 inch diameter flexible hose to the output port (right side) of the analyzer and connect the other end to the wand. An operator using a single-length wand can reach a normal ceiling height of about 8 feet. Additional wands may be coupled to reach ceilings as high as 20 feet. For a 30 foot application, contact Gemini Scientific Corp.

Shroud. The purpose of the shroud (*the clear plastic bowl)* is to cover the detector so that the aerosol of known concentration is not affected by room air. For good results the edge of the shroud should touch most of the wall surface around the detector.

However, since the test stream is flowing out at a high rate of about 2.1 ft^3/min (60 L/min), room air would not be able to dilute the smoke stream even though the shroud is as much as 1/2 inch away from the wall

Diffuser. The diffuser inside the shroud has six holes which limits the flow rate and distribute the smoke evenly to the detector. It also serves as a connection between the wands and the shroud.

3.2.9 Thermometer - Timer

To monitor the aerosol temperature, the sensor of the digital thermometer should be inserted into the small well on top of the nebulizer. Temperature reading during the test should be used in interpreting the calibration curve. Temperature correction above 80 °F may be estimated from the trends shown by the 75 °F - 80 °F curve.

A digital timer, located next to the thermometer display, is programmed to show seconds (0 to 59) continuously. To reset it to zero (0) at the start of the test, push or squeeze the middle or white colored button for about one second. Resetting the timer at the start, is not needed if you mentally adding 30 seconds to the clock time at the start to find the stop time. See Appendix B for the operation and battery requirements of the thermometer-timer.

3.2.10 Exposure Time

The purpose of the timer is to help the inspector control the smoke exposure time. If the detector does not respond within 30 seconds after exposure, stop the test. Reset to a higher concentration level for the next test. However, for some brands of detectors, or in borderline cases, 40 seconds of exposure time may be necessary to find the maximum sensitivity.

How fast the detector responds <u>should not</u> be used to judge sensitivity. To avoid nuisance alarm, some detectors are designed to alarm only after exposure to smoke for at least 24 seconds at the proper designated level of concentration.

3.2.11 Battery Operation (for units w/ battery option)

READ ALL INSTRUCTIONS

The Model 501A/Bat. is equipped with a 12 V DC rechargeable Lead Acid Gel Battery.

A. <u>AC Operation</u>:

1. Push the Function Switch located on the left-side panel to the Off (middle) position.
2. Connect the AC cord to the receptacle.
3. When ready to test, push the Blower Switch on the front panel to the "AC" (top) position. (*When not in use, push switch to the "OFF" (middle) position.*)
4. Turn on the pumps by switching the pump switch to the "ON" position. Wait until the Rudol oil is emulsified. Then begin the test.

B. Battery Operation:

1. With the internal battery installed, push the Battery Function Switch on the side panel to the "On" (top) position.
2. The AC cord should be disconnected from the receptacle.
3. When ready to test, push the Blower Switch to the "DC" (down) position. (*Return the switch to the "OFF" (middle) position when not in use.*)
4. Turn the Pump Switch to the "ON" (up) position. Wait until the Rudol oil is emulsified. Then begin the test.
5. Under normal conditions, the battery should supply several hours of operation. The batteries should be recharged when they **fail to maintain 15 psi** on the nebulizer pressure gauge during the test. To conserve battery, turn off the pumps at the end of each test.
6. DO NOT CONTINUE to use the analyzer with its battery in a depleted condition.

C. Battery Charging:

1. Push the Battery Function Switch on the left-side panel to the "Recharge" (bottom) position.
2. Connect the lead from the charger to the "Recharge Input" jack on the left-side panel next to the Battery Function Switch.
3. Plug the charger into a 110 V AC power source.
4. A yellow (fast charge) light will illuminate on the charger when it is connected correctly. A red (fault) light will illuminate when the polarities are incorrect. Check the polarities on the battery if this occurs. (*Note: This applies to charger with Model number HPX-10 only. The older model may not have a yellow light. If this is the case, please refer to the instructions on the charger.)*
6. While charging, the charger transformer may hum and the batteries and charger may become warm. This is a normal condition.
7. A green (float) light will illuminate on the charger when the battery is fully charged.
8. If a battery does not charge properly:
    (1) Check current at receptacle by plugging in a lamp or other appliance.
    (2) Check to see if the receptacle is connected to a light switch, which turns power off when you turn off the lights.
    (3) Check to make sure the battery is connected properly to the charger (see New Battery Installation, section 7.3).

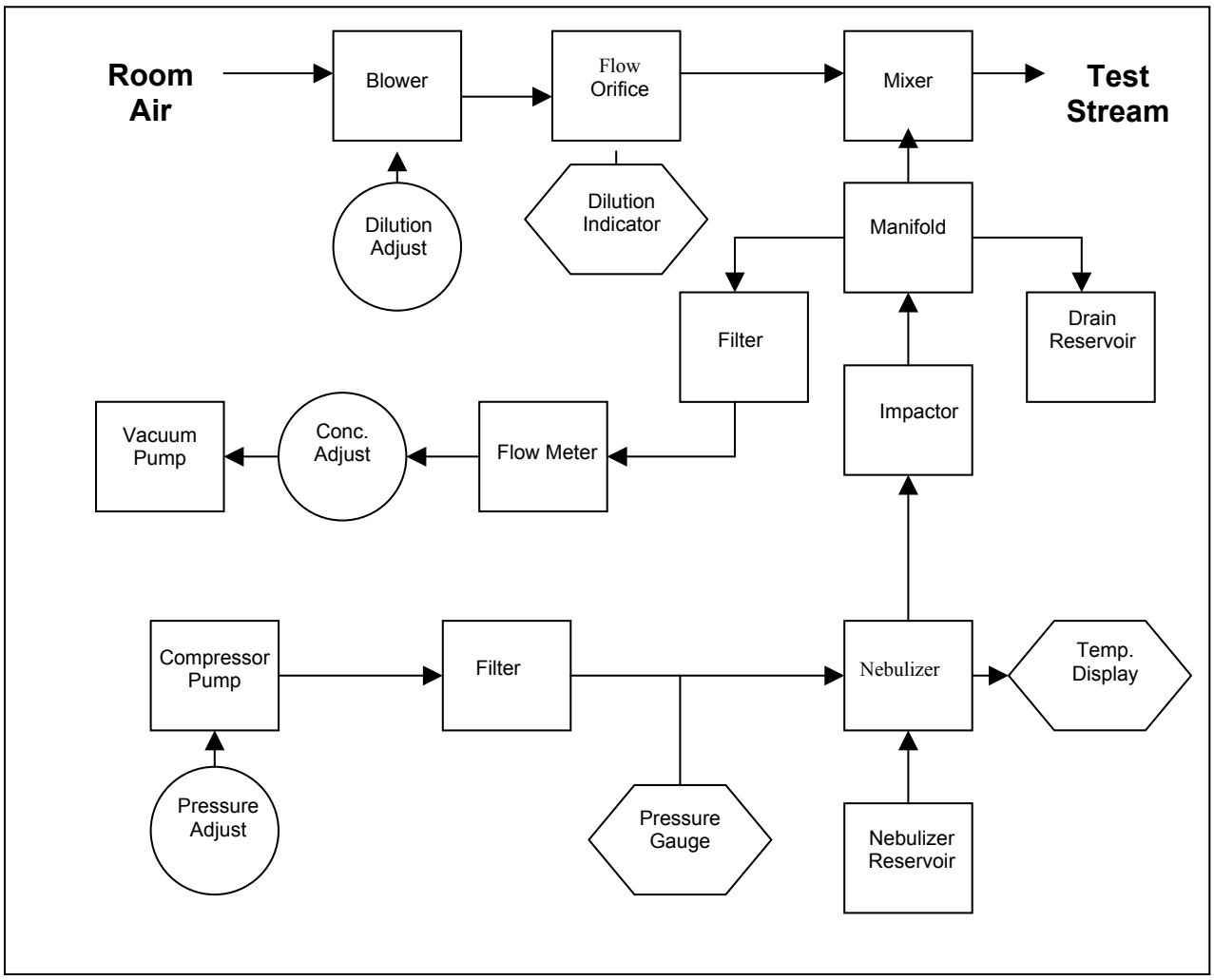
Important Charging Notes:

A) Do not operate charger with a damaged cord or plug. Have them replaced immediately.
B) Do not disassemble charger. There are no consumer serviceable parts inside.
C) DO NOT use any other battery charger. Any other charger may blow the fuse or shorten the battery life if the charging rate exceed 1 amp.
D) Do not use charger in wet or damp conditions. It is intended for indoor use only.
E) The charger is designed to operate on standard US electrical power (115- 120 volts AC only). Do not attempt to use any other voltage.
F) Unplug the charger when not in use.
G) Do not abuse the charger cord.

3.3 Simplified Block Diagram

Figure 3 is a schematic diagram showing relative locations of various components, controls, and flow directions of the system inside the Model 501-A Tester.

Figure 3, Simplified Block Diagram



Operating Instructions

4.1 Initial Operation

Working Standard. Establish a working standard for your analyzer when you receive the instrument for the first time and every time it is recalibrated. (See section 6.2, p. 17).

Location of Instrument. The tester should be used in a ventilated or large room to avoid exposing operator to aerosol concentration greater than the OSHA limit of 5 mg/m^3 .

Level Surface. The tester should be placed on a level and rigid surface. A waist high folding cart is recommended.

Nebulizer and Oil Filling. Fill the reservoir from the housing opening with Rudol liquid (See Figure 5-B, p27). The top level of the liquid should be about 1/4 inch below the joint line between the housing and the reservoir. Refill when the level drops to about 1/4 inch from the bottom of the dip tube.

Wet the manifold O-ring with a little oil before using a twist and push motion to fully insert the nebulizer into the manifold. When you need to remove the nebulizer, tilt the instrument forward slightly for a few seconds to allow the oil at the tip to drain back into the housing. This action will minimize any spillage when the nebulizer is pulled out. To avoid contamination, use a lint-free towel for wiping. After removing the nebulizer from the manifold, be sure to cover the opening of the nebulizer with the orange-colored cap to avoid contamination from room dust. Dust or lint from the inlet can easily get into the opening and contaminate the oil in subsequent use. The contaminant would cause clotting of the small holes inside the nebulizer and may cause unnecessary repair. The appearance of large bubbles coming out from the dip tube is a symptom of clotting. See Figure 5-D p27 and Appendix C for repair and cleaning instructions.

Drain Reservoir. The drain reservoir should be attached to the outlet tube before any operation. Empty the reservoir before it becomes 3/4 full. See Figure 5-C p27 for proper installation.

Dilution Air Adjustment. Connect one end of the hose to the Tester and the other end to the wands. Then connect the wand (with end fitting) to the shroud. Turn on the blower and use the dilution adjust knob to adjust the LED to green. Slight adjustment may be necessary to maintain that reading during the test.

Pressure Adjust. Connect the pressure line with the Luer fitting (or inlet *See page 22)* to the nebulizer. Do not rotate the fitting after insertion.

Turn on the pump switch and adjust the control valve to maintain 15 psig. If necessary, re-adjust during testing.

The oil in the reservoir will become cloudy due to emulsification after the pressure is applied. Testing is ready only after all the liquid above the suction tube in the reservoir is emulsified, in about 45 seconds.

Concentration Adjust. Use the concentration adjust valve to select the initial test value.

Reading the Scales. The transparency (clear plastic sheet) scales in (%/ft), is superimposed on top of the flow meter. The scales are for photoelectric and ionization smoke detectors. The photoelectric (P) scale is red in color while the ionization (I) scale is blue in color. To read the scales properly, position your head so your eyes are level with the float (ball) before comparing the middle of the float with the selected scale next to it.

4.2 Oil Temperature

Oil temperature in the reservoir would affect the aerosol output. For one-degree rise in temperature, smoke output would increase about 2% of the reading. Similarly, output decreases about 2% for temperature reduction of one degree. The oil reference or base temperature is 75°F.

A temperature correction of the reading is necessary if the oil temperature is above or below 75°F. Add the correction if temperature is above 75°F. For example, at a given flow meter reading, smoke concentration would increase by 10% if the temperature is 80°F ((80-75)degree x 2%/degree = 10%). If your reading on the flow meter is 2.0 %/ft at 80°F, the corrected reading would become 2.2 %/ft (10% of 2.0 is 0.2).

The correction should be subtracted from the reading if temperature is below 75°F.

If you are working at an ambient temperature above 85 °F or below 65 °F on a **consistent** basis, please consult Gemini Scientific Corp. A hair dryer may be used to warm the oil or tester in a cold environment. Apply heat evenly. If high temperatures are a problem, try turning the pump off between tests (leave the blower on).

4.3 Test Completion

After each test, reduce the pressure to about 5-10 psig and reduce concentration to about 10-20 (the flow meter scale) before turning the pump off. Allow the blower to remain on for at least 20 seconds to flush the line and the detector. Turn Analyzer off when not in actual use to conserve battery power. **Concentration valve settings need not be changed if you want to retain the same setting for the next test.** If you remove the nebulizer from the manifold, be sure to cap the opening of the nebulizer with the orange cap. See *4.1 "Nebulizer and Oil Filling"*.

4.4 Storage of Instrument

If the Analyzer is not being used for more than 1-2 weeks, its nebulizer and drain reservoir should be removed, emptied, capped and stored in a dust-free bag. The manifold should also be cleaned and its opening capped. **The instrument itself should be covered and stored in an upright position inside or outside the carrying case to avoid oil leakage into the unit.**

5.0 Inspection Protocol and Test Procedures

5.1 General Objective

The Gemini 501-A Analyzer was designed to perform on-site inspections of installed smoke detectors to determine their sensitivities. Sensitivity is defined as the amount (concentration in mg/m^3 or obscuration in %/ft) of smoke needed to trigger the alarm of the detector under test.

Normally only a single test is needed for routine sensitivity inspection of detectors. To assure such an outcome, choose a smoke concentration at the upper limit of the sensitivity range specified by the manufacturer (usually located on the back of the smoke detector). The detector should alarm since it is statistically the highest concentration allowable by the manufacturer. However, if the above detector did not alarm, you have to do additional tests to determine the concentration that would trigger the detector.

In cases where the detector has a history of nuisance (false) alarm, you may have to do two or more tests to find the lowest concentration level below which the detector would not alarm.

Figure 4 (page 15) contains an example in selecting the smoke concentration settings for sensitivity tests under the NFPA 72 National Fire Alarm Code (1996) requirements. To get higher test precision than the routine inspection requirement, use an increment of 0.2 %/ft instead of 0.5 %/ft. You may also want to establish other test criteria by consulting with your state Fire Marshall and manufacturers to fit your own needs and resource. Record all data by using either the sample test report in APPENDIX D or your own recording method.

5.2 Legal and Technical Authorities

Smoke detector inspection and sensitivity testing techniques are based on the following three recognized authorities:

The National Fire Protection Association (NFPA) publishes the NFPA 72 National Fire Alarm Code (1996). It recommends evaluation of smoke detector sensitivity within one year after installation and every alternate year thereafter. The recommended test methods include the use of smoke aerosol and calibrated sensitivity test instrument to verify the approved or manufacturer specified sensitivity range.

Underwriters Laboratories, through its UL-268 standard, considers detectors to be acceptable if its sensitivity are between 0.5 to 4.0 %/ft obscuration when exposed to the visible (gray) smoke in a UL smoke chamber. This standard applies only if the manufacturer has not specified the sensitivity range.

Authority Having Jurisdiction. The Fire Marshal or Fire Chief at the state or local level is responsible for enforcing their published standards or codes. These standards generally follow some national standards with or without modification to suit the local need. For example, the Boston Fire Department requires detectors located in elevator waiting areas to meet a sensitivity of 3.0 %/ft or higher. This is to avoid frequent false alarms from smoldering cigarettes that passengers leave prior to boarding the elevators.

5.3 Sensitivity Ranges

Smoke detector manufacturers are required by UL to specify the nominal sensitivity range of their production detectors. The ranges vary widely among manufacturers and between types of detectors. Typically, nominal sensitivity for a photoelectric type is about 3.0 ± 0.5 %/ft and for an ionization type is about 1.5 ± 0.5 %/ft.

If a nominal sensitivity is given without a range, then according to NFPA 72: 7-3.2.1 (1996), a detector will pass if it alarms between 0.5 and 4.0 %/ft. obscuration (See UL 268 Standards, 31.1, January 4, 1999 ed.).

All the detectors of a given model may not necessarily fall within the extreme values provided by the manufacturer. Consult the manufacturer, if necessary.

Because of the built-in uncertainty of ± 0.4 %/ft in relating field test results from the Gemini 501-A to that of the UL smoke chamber, detectors with results ± 0.4 %/ft beyond the given range may be considered acceptable. As an extreme example, results as high as 2.4 %/ft may be considered acceptable if the listed sensitivity is 1.5 ± 0.5%/ft

5.4 Test Procedures *(For duct detectors, please refer to APPENDIX H.)*

Start the test with the nominal sensitivity value given by the manufacturer. Depending on the test result, you can stop or do additional test using either the upper or lower limit of the sensitivity range. For example, if the specified sensitivity is 1.5 ± 0.5 %/ft, your first test would be 1.5 %/ft and your second could be 1.0 %/ft (1.5 - 0.5), 2.0 %/ft (1.5+ 0.5) or no test, depending on the result from the first test. The third test if needed, could be 0.6 (1.5 - 0.5 - 0.4) or 2.4 (1.5+0.5+0.4) %/ft.

Start testing after the initial warm-up period and total emulsification of the liquid in the reservoir. The initial readings for the pressure gauge, and the flow meter are 15 psig, and 10-20 respectively while the dilution air indicator should stay at green.

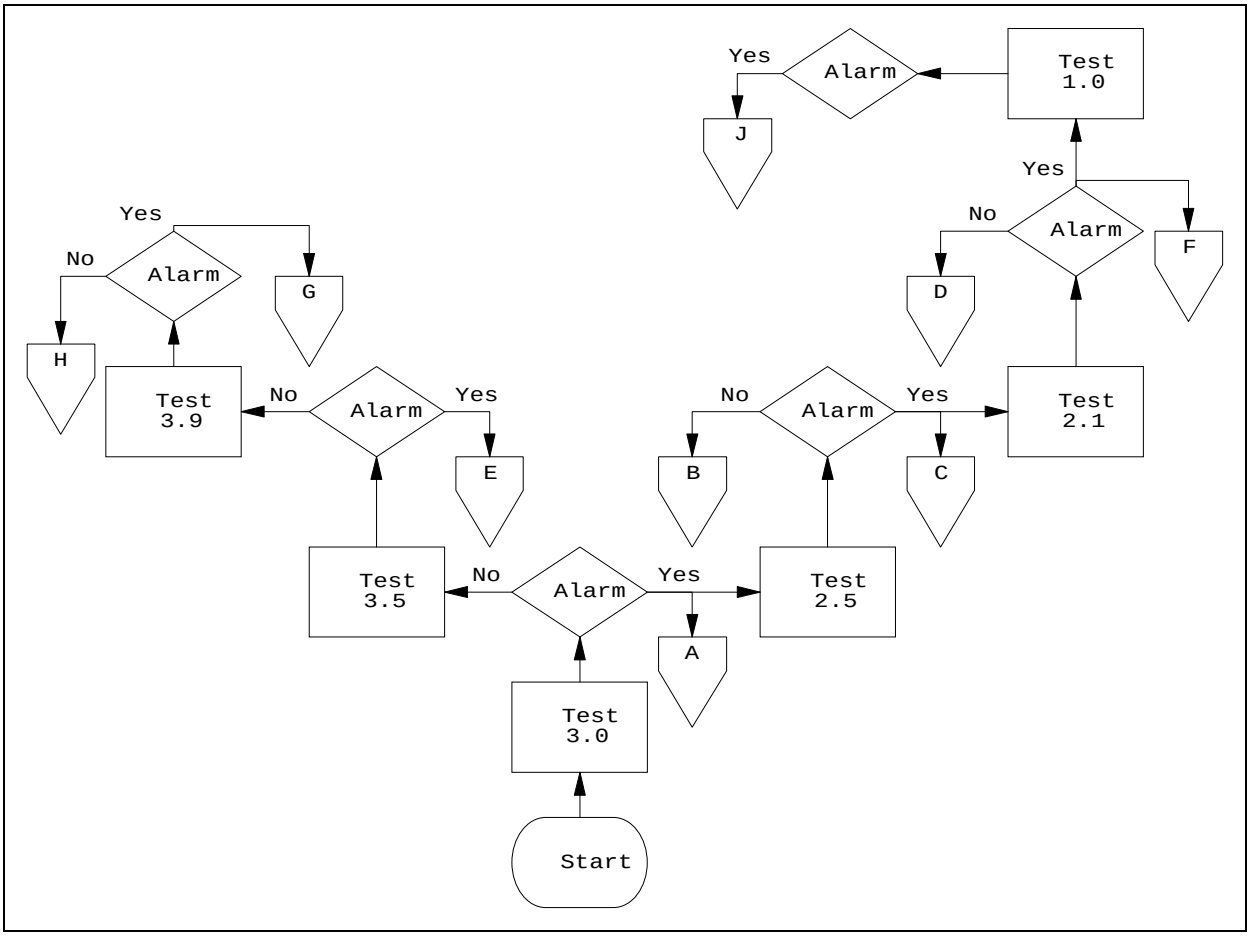
Place the shroud over the test detector. Adjust the flow meter reading to the desired level shown by the appropriate scale. Reset or note the timer as you begin. If the detector **alarms** within 30 to 40 seconds, hold the shroud in place while you reduce the concentration to zero. Immediately turn the pumps off. Wait an additional 5-10 seconds before removing the shroud and shutting off the blower.

If the detector **does not alarm** in less than 30 to 40 seconds, increase the concentration to the next higher value with the shroud still in place. Wait 30 to 40 more seconds for it to alarm.

If the test detector alarms and you want to continue the test at a lower setting, you must reset the alarm. Before testing at a lower value, allow at least 20 seconds to flush out the old smoke with the shroud in place and compressor off.

Figure 4 is an example of the test decision tree and statements you can make based on the test results. It is based on a detector with the stated sensitivity of 3.0± 0.5 %/ft.

Figure 4, Example of Test Decision Tree and Statement of Results



Statement	Alarm at	Not Alarm at	Statement of Test Results
A	3.0 %/ft		Is within manufacturer's specification of 3.0 ± 0.5%/ft
B	3.0 %/ft	2.5 %/ft	Is within manufacturer's specification of 3.0 ± 0.5%/ft
C	3.0 %/ft and 2.5 %/ft		Is within manufacturer's specification of 3.0 ± 0.5%/ft
D	2.5 %/ft	2.1 %/ft	Is within manufacturer's specification of 3.0 ± 0.5%/ft
E	3.5 %/ft and 3.0 %/ft		Is within manufacturer's specification of 3.0 ± 0.5%/ft
F	2.1 %/ft		Is a borderline case. Outside manufacturer's specification. Within test error
G	3.9 %/ft		Is a borderline case. Outside manufacturer's specification. Within test error
H		3.9 %/ft	Is above the upper limit of manufacturer's specification and outside of test error
J	At or below 1.0%/ft		Is outside of the manufacturer's range. Subject to false alarm

If you recommend rejecting detectors based on sensitivity test results, make sure that your tester is in calibration and would survive challenges from the manufacturer or Authority Having Jurisdiction. This is especially important in dealing with borderline cases. For confirmation of test results, we suggest testing the "accepted" and the "rejected" detectors of the same brand sequentially (one after the other or side by side) using a common concentration level.

5.5 Calibration and Accuracy

Each instrument is individually calibrated. The calibration curve relates instrument flowmeter readings to smoke output in terms of its mass concentrations (mg/m^3) and to its corresponding UL 268 light obscuration (%/ft) scales for ionization and photoelectric detectors.

The curve is based on tests performed with pressure at 15 psig, dilution air LED at green (60 L/min) and aerosol temperature at 75 °F. Expected smoke output for temperatures at 70 °F and 80 °F is also shown.

Estimated uncertainty based on our study relating detectors' sensitivity test results between the UL 268 Smoke box and the Gemini 501-A Tester is ± 0.4 %/ft (both operator and measurement errors).

Detailed calibration technique for the instrument can be found in APPENDIX A (page 21).

5.6 Operational Precautions

(1) Attach drain reservoir to drain outlet before any operation.

(2) Empty the drain reservoir periodically.

(3) Do not reuse oil from the drain reservoir.

(4) Do not store Rudol Oil at temperature above 85 °F for long period.*

(5) Read the flow meter with reference to the middle of the float (ball).

(6) Change vacuum filter element when necessary, about every 150-200 tests.

(7) Cover nebulizer opening with orange cap when it is not in use to prevent dust from getting in through the inlet opening (see page 22).

(8) Store instrument in an up-right position in or outside the carrying case.

---

* Rudol Oil left in a truck or car in hot summer days should be discarded because it would affect test result due to viscosity change from polymerization at high temperature. To prolong shelf life, store the unused oil in refrigerator or cold room.

6.0 Servicing

6.1 General

The servicing section discusses the procedure for internal calibration check, routine maintenance information, problem diagnostics, causes, and remedies.

6.2 Calibration and Working Standards

Though the instrument has been calibrated at the factory before shipment, there is no assurance that the calibration will remain unchanged after it has been used in the field for any length of time. By using a working standard, you can check your own calibration and avoid returning the instrument to the factory.

A working standard, in the form of two commercial smoke detectors (one ion chamber type and the other photoelectric), can be used to determine the reference benchmarks while the instrument is new and in calibration. The benchmarks are the alarm threshold of the two detectors based on the flowmeter readings of the instrument. Store these two working standard detectors and only use them to check the Gemini Tester.

Any change in the alarm thresholds of these two detectors in subsequent tests can reasonably be assumed to be a shift in calibration of the instrument, rather than to shift in detector sensitivity. Periodic checking with the standards may be used as the criteria for need of service action (i.e., cleaning of small orifices and filter change) and thus to insure correct calibration.

The two working standard detectors we recommend are the System Sensor 1451 ionization type and the ESL 611U pulse LED photoelectric. Other well-designed detectors may also be used.

After familiarizing yourself with the instrument by triggering the alarm on several smoke detectors and recording the flow meter readings, the alarm threshold for the two standard detectors should then be established. We suggest that the average of several replicate runs be taken. All readings for a single detector should be within 5 mm (one tic mark space = 5 mm) in the flow meter while the difference between the two detectors may be large.

Calibration check using the working standards may be performed after the instrument has tested over a few hundred detectors. The frequency for check should be guided by your own test experience.

Two main causes for shift in calibration are: (1) Clogging of the small orifices (holes) in the nebulizer or impactor. (2) Vacuum filter overload. See Table 1: Problem Diagnostics, on page 18 to remedy these situations.

6.3 Routine Maintenance

The only periodic maintenance for the instrument is to change the vacuum line filter element after about 150-200 tests. If the filter bowl shows a pool of liquid oil, the filter should be changed immediately. The purpose of the filter is to prevent any liquid oil from being pulled into the flowmeter. You need not change the compressed air filter. The oil-like substance in the filter is epoxy filler.

During a test, oil in the reservoir is oxidized continuously and would contaminate fresh oil added to it. The process would eventually affect the test results. We recommend that after about 5-6 oil addition to the nebulizer reservoir, the entire content should be discarded. Oil from the drain reservoir SHOULD NOT be reused to avoid clogging.

6.4 Problem Diagnostics

Table 1 lists common problems and possible causes and remedies during the operation.

Table 1. Problem Diagnostics

Symptom	**Possible Causes**	**Remedies**
Low aerosol generation and or large bubbles in Nebulizer reservoir.	Clogged Nebulizer clogged impactor	Clean Nebulizer. See Figure 5-E & F p27 and Appendix C p22. Clean impactor holes. (**DO NOT enlarge**)
High aerosol generation	Overloaded filter Drain reservoir open	Replace vacuum filter element. Install drain reservoir.
Calibration Shift	See above Vacuum line leak Wrong Nebulizer	See above. Check line, connections, drain reservoir. Calibrate the Tester with the Nebulizer.
Detector fails to alarm	Insufficient aerosol Defective detector Unmatched nebulizer	Increase to the maximum concentration. Switch to a new detector. Calibrate nebulizer with the Tester
Pressure cannot be adjusted to 15 psig	Leakage, defective pump, Low battery	Find and correct leak in line or pump. Low Battery (501-A/Bat. only)
Concentration adjust cannot reach zero	Filter overload Vacuum line leak	Change filter element. Find and correct leak.
Flowmeter float (ball) erratic or not responsive	Flooded by oil or foreign material defective valve	Check and clean flow meter. Check for leak or pump function. Check control valve.
Pump running, no pressure	Major pressure leak	Check for leak or pump function.
Dilution air indicator stays at "Yellow". Or it cannot be adjusted to "Green".	Blocking tube fittings Blockage in hose Incorrect Diffuser openings	Clear fitting clog. See Figure 5-G p27. Remove hose or wand blockage. "Yellow" - Enlarge some diffuser holes. "Red" - Tape-close some diffuser holes.
Stuck needle in Mag. gauge	Blocked gauge tubing	Disconnect tubes from gauge, blow tubes by mouth or squeeze bottle to clear line.
Low aerosol generation	Wand goes in too much into the diffuser	Make sure that diffuser metal plate does not block the opening at the end of the wand.
OTHER PROBLEMS	***CONSULT GEMINI SCIENTIFIC CORPORATION***	

7.0 Replacement Parts

7.1 Table of Parts

This section contains information on replacement parts for Model 501-A, -A/Bat Aerosol Generator from Gemini Scientific Corp. or from the originating manufacturer.

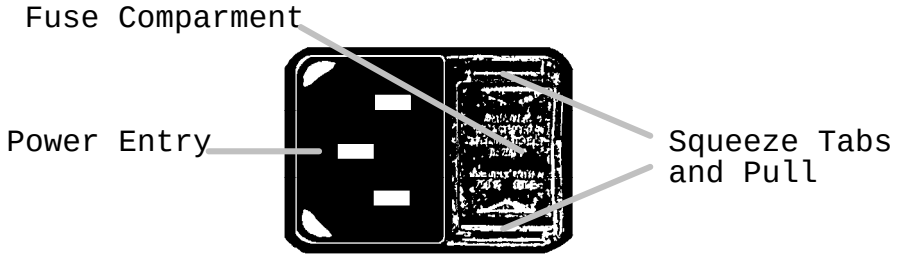
Table 2 Replacement Parts List

Gemini Part Number	Description
B0100	12V, 7.2 Ah Lead-Acid Bat.
B0101	Lead-Acid Battery Charger
F1000	DC Micro Fan
F0412	Digital Thermometer-Timer
F0602	Filter Assembly, Vacuum
F0604	Disposable vacuum filter
F0605	Compressor Outlet Filter
G0701	Ball Flow meter
G0704	Pressure Gauge
N1401	Nebulizer Assembly
N1402	Nebulizer Housing
N1403	Nebulizer Reservoir
N1404	Drain Reservoir
N1409	Impactor Assembly
N1410	Impactor Housing
O1501	Rudol Liquid Oil
P1603	Pump, Compressor
P1604	Pump, Vacuum

7.2 Replacement of Fuse

A fuse holder compartment is located next to the power input receptacle. To change fuse, use finger nails of your thumb and index finger to squeeze simultaneously the top and bottom of the compartment and pull it out.

Use GMC or GDC 3.0 or 3.15 Amp 5 x 20 mm fuse; UL listed fuse only.



7.3 Replacement of Battery

A high-quality 7.2 Amp-Hr. 12 VDC sealed lead acid gel battery, can be used to replace the internal battery:

(1) Unplug the power cord and battery charger; then remove the back panel on the analyzer.
(2) Disconnect the leads going into the lead-acid battery.
(3) Unscrew the wing-nut on the top right side of the battery.
(4) Lift the metal cover plate up above the screw and turn it forward about 180 degrees.
(5) Lift the battery end up and pull the battery out of the analyzer.
(6) Slip in a new battery and **observe correct polarity** while doing this**. Connect the red(+) line to the positive(+) battery terminal and connect the black(~) line to the negative(~)**. (For more information, contact Gemini Scientific Corp.)
(7) Fit the plate back over the screw and secure the battery using the wing-nut.
(8) Close up the back panel of the analyzer

APPENDIX A: Calibration of the Gemini 501-A

The mass median diameter of the aerosol from the Model 501 Aerosol Generator was determined by using the Anderson Cascade Impactor*. Based on 4 replicate runs from 3 generators at a concentration of about 20 mg/m^3, the mean mass median diameter was found to be 0.44 um with a calculated standard deviation of ±0.02 um. The estimated number median diameter is less than 0.2 um. The Model 501-A is based on and uses the same smoke generation apparatus as the original unit.

The mass concentration of the aerosol was determined by a mass monitor**, which electrostatically deposits the aerosol onto a piezoelectric quartz crystal. The frequency shift of the crystal is a function of its weight gain from the depositing aerosol. Thus the monitor measures aerosol mass concentration in terms of frequency change of the crystal. Sensitivity of the monitor is in the order of 0.01 mg/m^3.

The UL Smoke Box and the Gemini 501-A use different methods to measure smoke. The light obscuration property of the smoke is used to quantify the smoke in the UL Box, whereas the mass (weight) concentration is used for the Gemini instrument.

Since the minimum amount of smoke needed to trigger the alarm of the detector, defined as its sensitivity, is equivalent for both the UL smoke box as well as for the Gemini 501-A, the alarm points of detectors are used to bridge the two systems by making equivalent scales.

During calibration, the smoke output mass concentration of the 501-A is measured as function of its flowmeter readings. To construct the scales to relate the mass concentration to the light obscuration for each instrument, the alarm points of 6 standard reference detectors (3 photoelectric and 3 ionization) are determined. The flowmeter readings are then converted to mass concentration by the calibration curve.

The alarm points in terms of light obscuration for the 6 standard reference detectors were previously determined in the UL Smoke Box. The detectors cover the necessary sensitivity range and consist of both type detectors. There are valid physical reasons for the difference in the scales for the two types of detectors.

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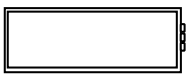
*ACFM Particle Sampler, Anderson 2000 Inc., Atlanta, GA
** Particle Mass Monitor, TSI, Inc., St. Paul, MN 55165

APPENDIX B: Operation of the Thermometer/Timer

Operation Instruction SC18

- Time, calendar and temperature display.
- Alternating time and calendar mode.
- Temperature range: 0 °C – 50 °C
- Temperature power down to save battery power.



Battery Installation and replacement

The unit comes with a piece of battery insulator to save power during transit and storage. To open the battery door (at back of the unit), rotate it with a small coin in the direction of the arrow. Take out the battery and battery insulator. Then place back the battery with the "+" mark facing up.

After battery is first installed, the display will show the time only. To initiate the temperature display, press the POWER UP/DOWN button and the temperature will be shown in a few seconds.

When the display becomes dim, please replace the battery with a new one.

Time setting

Press SET button once during time display and the unit will show time and calendar alternating in every 2 seconds. One more push of the SET button during alternating time and calendar will bring the unit in setting mode, starting by setting the month. To set month, press the MODE button to advance the digit. After setting month, press SET button once and the date digit will be shown. Press the MODE button to advance the digit. After setting date, press SET button once and the hour digit will be shown, press the MODE button to advance the digit (A means A.M. and P means P.M.). After setting hour, press SET button once and the minute digit will be shown, press the MODE button to advance the digit. After setting minute, press SET button once to end the setting cycle and time will be displayed. The clock is stop running now and please press the MODE button to initiate the clock. (Note: during time and calendar setting, press and hold the MODE button and the digit will advance automatically.)

Display modes

The display will show temperature and time right after battery installation. Press MODE button once and the time display will change to calendar display and, will return to time display automatically 2 seconds after the MODE button is released. If, Mode button is pressed once during calendar display, it will change to second display. To change to time display, press MODE button once.

Power down

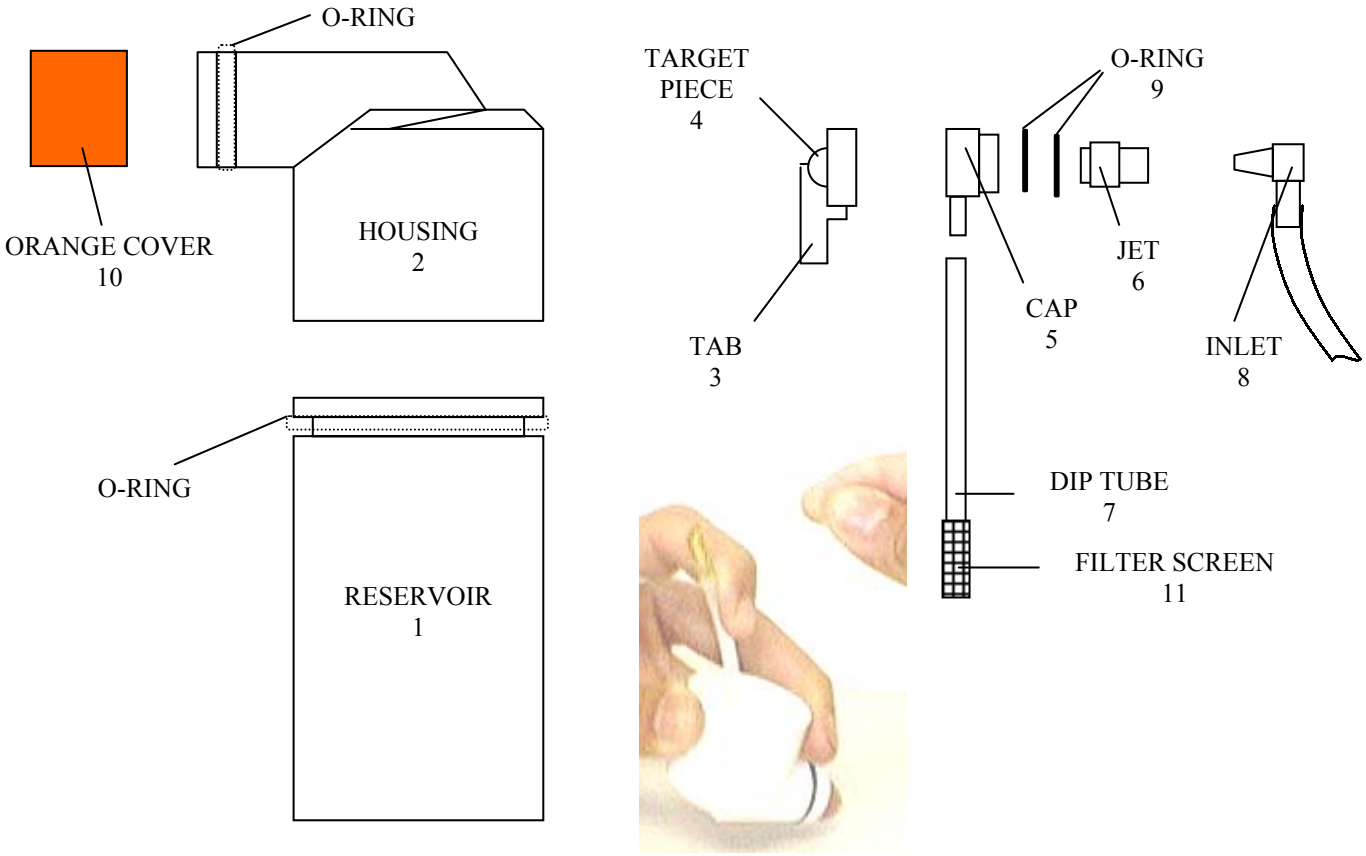
The unit is equipped with a power down function to save battery power when the temperature display is not wanted. To switch off the temperature display, press and hold the Power up/down button for 4 seconds and the temperature display will go off. To initiate temperature again, press the power up/down button once and temperature will be shown in a few seconds.

SPECIFICATION

Control Element	CMOS LSI
Time Base	32768 Hz Tuning Fork Crystal
Battery	1.5 V Button Cell. G12 Or 386
Consumption	3 micro-ampere (Typical)
Operation Temp.	0 - 40 °C

APPENDIX C: Nebulizer Assembly & Maintenance

Note: Nebulizer Assembly consists of part #3,4,5,6,7,9, 11 only.



To Disassemble Nebulizer: Remove Inlet (8) with hose from Housing (2). Remove Housing with the Reservoir from the Manifold on the front panel with a pulling and twisting motion. Separate Reservoir (1) and Housing with a breaking and pulling motion. Remove the exposed aerosol generating parts by grasping the Tab (3) with thumb and forefinger and pull Target Piece (4) straight out of the Housing. Remove Cap (5) and Dip Tube (7). Leave the jet (6) and the O-ring (8) in place (DO NOT take the jet out from the nebulizer housing). *See Figure 5-E & F p27.*

To clean or remove obstruction: Soap or detergent may be used to clean all of the above parts. Flush parts with water. Be careful not to enlarge any of the holes in the parts. Air-dry only before reassemble.

To Assemble Nebulizer:
Using Dip Tub as handle, insert the Cap into the Jet inside the Housing. Hold the housing with your left hand as shown by the above picture, while bending the dip tube, push the cap with your right index finger into the underside of the O-ring until it snaps. Grab the tap and slide the target piece between the guides of Housing and Cap as far as it will go. A few attempts may be needed for it to work. Snap Reservoir back into Housing.

Note:
Always cover nebulizer opening with orange cover (10) when it is not being used to prevent dirt from getting in through the inlet opening.

APPENDIX D: Sample Smoke Detector Test Report

SMOKE DETECTOR TEST REPORT	
☐ Annual Inspection & Function Test	
☐ Bi-Annual Sensitivity Test	

Instrument ☐ Gemini 501-A S/N:_____ ☐ Other: _____

Property Name:

Property Address:

Property Contact Person:

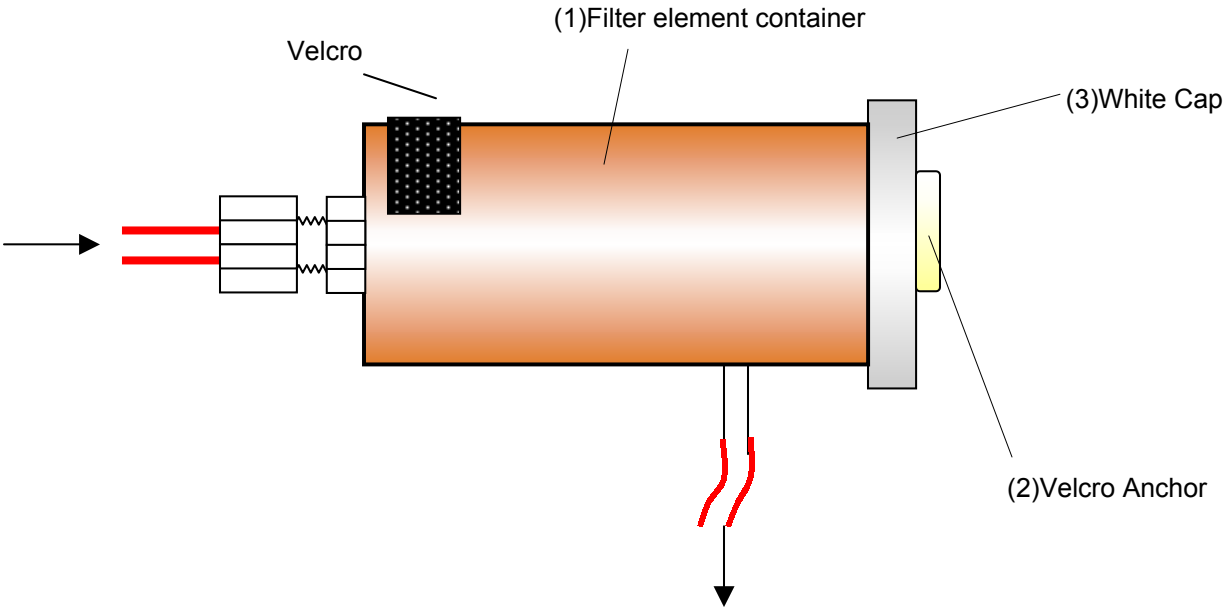
Building: Location: Room/Zone:

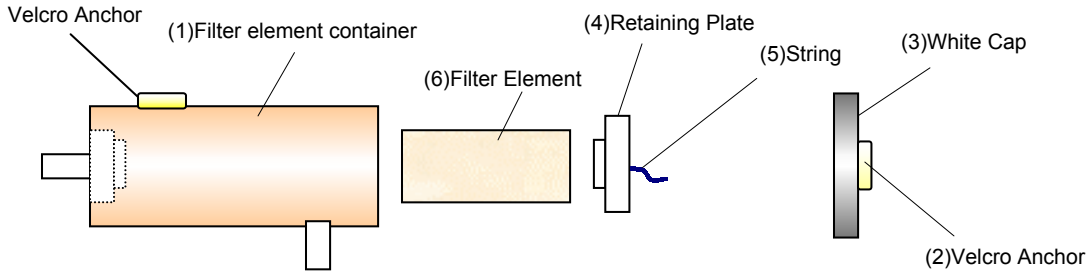
Detector Location	ID Number	Serial Number	Brand/ Model	Type P/I	Listed Sensitivity Range	Alarm Point	Pass (P) Fail (F)	Comments

Tested By: Name _____ Signature _____ Date _____ Page of

APPENDIX E:

Instructions on vacuum filter element replacement *(for models with filter mounted inside the chassis)*:

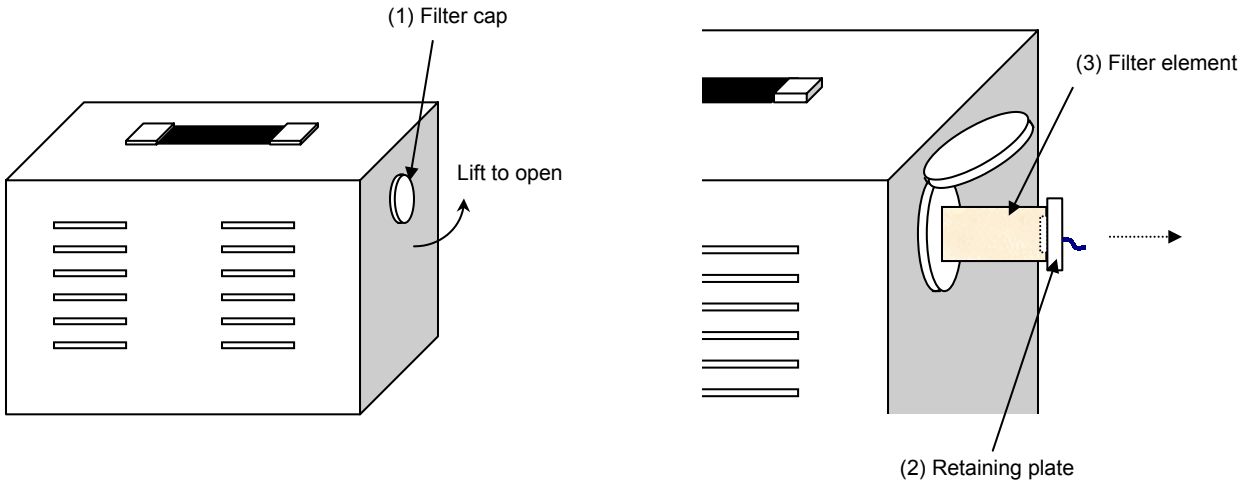




To replace filter element *(recommended after 200-250 tests)*:

1. Do not disconnect any of the tubing. Pull and tilt the filter container*(1)* out from the Velcro anchor (right side).
2. Hold the container with left hand; grab the white cap*(3)* with your right hand. Push and twist the cap*(3)* **counter-clockwise** (about 10-20 degree) and remove the cap*(3)*.
3. Pull the retaining plate*(4)* out by grabbing onto the string*(5)*. Remove the filter element*(6)*, and replace it with a new one.
4. Place a new filter element onto the retaining plate*(4)*. Replace the filter cap*(3)* by push and twist action **(clockwise)**. Finally attach the filter container*(1)* back to the Velcro in the original position.

Instructions on vacuum filter element replacement *(for models with filter mounted on the side panel of the chassis)***:**



To replace filter element *(recommended after 200-250 tests)***:**

1. Locate filter cap*(1)* on the left panel of the tester.
2. Lift filter cap*(1)* up to open.
3. Pull the white retaining plate*(2)* out by grabbing onto the string/wire. Remove and discard the used filter element*(3)* from the white retaining plate*(2)*.
4. Place a new filter element onto the retaining plate*(2)*. It should fit tightly.
5. Insert the new filter element and the retaining plate*(2)* back into the filter container. It should fit tightly.
6. Close the filter cap*(1)*.

APPENDIX F: Material Safety Data Sheet - RUDOL™ OIL

Witco MATERIAL SAFETY DATA SHEET

PRODUCT Rudol White Mineral Oil
FOR GEMINI 501 DETECTOR TESTER

HAZARD RATING (NFPA): 4 – EXTREME, 3 – HIGH, 2 – MODERATE, 1 – SLIGHT, 0 – INSIGNIFICANT
Fire 1 · Reactivity 0 · Toxicity 0 · Special

SECTION I

1 WITCO MANUFACTURING DIVISION OR SUBSIDIARY: Sonneborn Division

2 ADDRESS (NUMBER, STREET, CITY, STATE, ZIP CODE): P.O. Box 336, Petrolia, PA. 16050 — P.O. Box 308 Gretna, LA. 70054

EMERGENCY TELEPHONE (504) 366-7281
MANUFACTURER (412) 756-2210
CHEM TREC 1-(800) 424-9300

3 CHEMICAL NAME OR FAMILY: White Mineral Oil, NF

4 FORMULA: A mix of liquid hydrocarbons refined from petroleum.

SECTION II – CHEMICAL AND PHYSICAL PROPERTIES

CHEMICAL

5 HAZARDOUS DECOMPOSITION PRODUCTS: Upon combustion, CO_2 and CO are generated.

6 INCOMPATIBILITY (KEEP AWAY FROM): Keep away from flame, heat (150°F max.), and strong oxidizing agents.

7 LIST ALL TOXIC AND HAZARDOUS INGREDIENTS: None

PHYSICAL

8 FORM: Viscous liquid

9 ODOR: None

10 APPEARANCE: Colorless liquid

11 COLOR: None

12 SPECIFIC GRAVITY (WATER = 1): <1.0 @ 15°C

13 BOILING PT. IBP: > 230 °C / > 450 °F

14 MELTING PT.: NA °C / NA °F

15 SOLUBILITY IN WATER AT 25 °C: Negligible

16 % VOLATILE (BY WT %): Nil @ 25°C

17 EVAP. RATE (= 1): Nil @ 25°C

18 VAPOR PRESSURE (mm Hg at 20°C): <.5mm

19 VAPOR DENSITY (AIR = 1): NA

20 pH AS IS: NA
pH ( )

21 STRONG ACID ☐ / STRONG BASE ☐ / STABLE ☒ / UNSTABLE ☐

22 VISCOSITY SUS AT 100°F: <100 ☐ / 100 OR > ☐

23 CAS #8042-47-5

SECTION III – FIRE AND EXPLOSION DATA

24 SPECIAL FIRE FIGHTING PROCEDURES: Self-contained breathing apparatus is recommended for firefighters. Water-spray must be used with caution to prevent spread of flames.

25 UNUSUAL FIRE AND EXPLOSION HAZARDS: None

26 FLASH POINT (METHOD USED): ASTM D-92 > 176 °C > 350 °F

27 FLAMMABLE LIMITS %: NDA — LOWER ____ UPPER ____

28 EXTINGUISHING AGENTS: ☒ DRY CHEMICAL ☐ CO_2 ☒ WATER SPRAY ☐ FOAM ☒ WATER FOG ☒ SAND/EARTH ☐ OTHER ____

SECTION IV – HEALTH HAZARD DATA

29 PERMISSIBLE CONCENTRATIONS (AIR): See Section IX - COMMENTS.

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JUN 28 1990
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30 EFFECTS OF OVEREXPOSURE: NDA

31 TOXICOLOGICAL PROPERTIES: NDA

EMERGENCY FIRST AID PROCEDURES

32 EYES – Flush with water. If irritation exists consult a physician.

33 SKIN CONTACT – NA

34 INHALATION – NA

35 IF SWALLOWED – Call a physician.

NA = NOT APPLICABLE NDA = NO DATA AVAILABLE <= LESS THAN >= MORE THAN

Page 1 of 2

CHEMCENTRAL

FORM NO. 851 (4/83)

Witco MATERIAL SAFETY DATA SHEET

PRODUCT Rudol

SECTION V — SPECIAL PROTECTION INFORMATION

VENTILATION TYPE REQUIRED (LOCAL, MECHANICAL, SPECIAL) [36] NA	PROTECTIVE GLOVES [38] None
	EYE PROTECTION [39] Chemical splash goggles
RESPIRATORY PROTECTION (SPECIFY TYPE) [37] NA	OTHER PROTECTIVE EQUIPMENT [40] None

SECTION VI — HANDLING OF SPILLS OR LEAKS

PROCEDURES FOR CLEAN-UP [41]

Shut off leak, dike up spills, absorb with inert material such as sand, earth or vermiculite. Sweep up and dispose of in accordance with Federal, State and local regulations.

WASTE DISPOSAL [42]

Use methods consistent with Federal, State and local regulations.

SECTION VII — SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE [43]

Avoid heat (150°F max.), flame and oxidizing agents.

SECTION VIII — TRANSPORTATION DATA

[44] UNREGULATED BY D.O.T. [X]	[47] U.S. D.O.T. PROPER SHIPPING NAME: NA	
[45] REGULATED BY D.O.T. [ ]	[48] U.S. D.O.T. HAZARD CLASS: NA	I.D. NUMBER [49] NA
TRANSPORTATION EMERGENCY INFORMATION: CHEM TREC 1-800-424-9300 [46]	[50] RQ: NA; [51] LABEL(S) REQUIRED: NA	
	[52] FREIGHT CLASSIFICATION: Petroleum Oil NOIBN	
	[53] SPECIAL TRANSPORTATION NOTES: NA	

SECTION IX — COMMENTS

[54] This product is a fully refined white mineral oil meeting the requirements of the National Formulary XVII as well as the requirements of the Food and Drug Administration as per CFR 172.878. If used in applications where a mist may be generated, observe a TWA/PEL of 5 mg/m^3 of mineral oil mist (OSHA and ACGIH).

Tel: (212) 605-3911

SIGNATURE Alexander Coutras TITLE Manager, Regulatory Affairs

REVISION DATE Jan. 9, 1990

SUPERSEDES Dec. 1, 1989

SENT TO ATTN: DATE

APPENDIX G: Pictorial Illustrations

Figure 5:

Fig. A 6-Wands Extension

Fig. B Correct way of filling the nebulizer

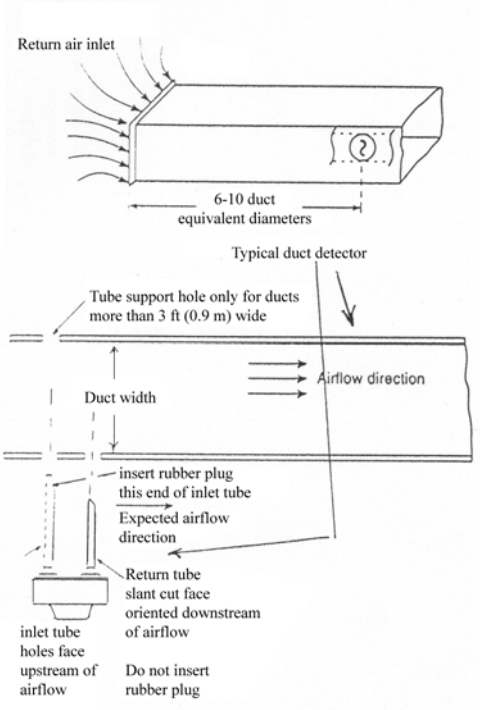
Fig. C Attachment of drain reservoir

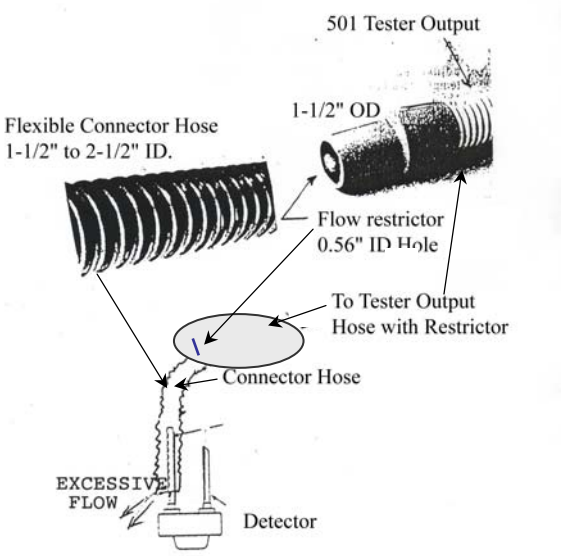
Fig. D Symptom of clogged nebulizer

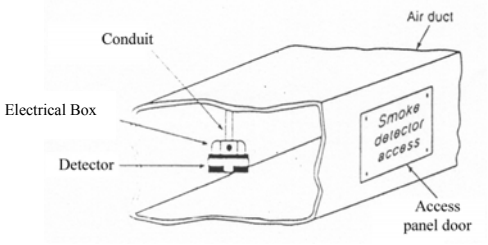
Fig. E Removal of nebulizer housing by twist & pull

Fig. F Removal of target piece from the housing

APPENDIX H: Duct Detector Testing







1. Use the normal method of generating smoke from the Gemini Tester.
2. Do not use the wands and the shroud.
3. Insert a restrictor at the end of the hose (0.6” diameter hole).*
4. Use a connector hose to connect the hose from the tester.
5. Any flexible hose with 1-1/2” to 2-1/2” inside diameter can be used as connector. Tape the connection with duct tape.
6. Insert the hose into the inlet tube of the detector that has been removed from the duct for testing.
7. Allow space for excess smoke to flow out.
8. Maintain 5.0 mm pressure at the Magnehelic gage.

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* The restrictor is available from Gemini. Contact Gemini at (408) 554-0310 if you have any questions.