

1972

*Pollution Analyzing  
and Monitoring Instruments*

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and Monitoring Instruments  
1972**

**Thirty-Six Dollars**

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## FOREWORD

Before air, water and other pollution problems can be solved, the pollutants must be identified correctly and then measured accurately. Only after qualitative detections and quantitative determinations have been carried out, can a full scale attack be planned. Failure to observe these rules of war against pollution will lose the war, since the pollutant enemies fight dirty and insidiously.

This book gives basic technical information of what may be called step one in a systems approach to total war on pollution. Here are the descriptions and specifications of what is available in ready made, on-the-line commercial equipment for sampling, measuring and continuously analyzing the multitudinous types of pollutants found in the air, in the water, in the soil and food or feedstuffs, or making themselves evident as noise and radiations.

The book is based directly on information supplied by makers of chemical and physical laboratory instruments or by manufacturers of special sampling, analyzing and monitoring equipment especially designed as adjuvants for the abatement of pollution of every type.

The equipment and instrumentation described in this book comprises the following facets of step one in the systems approach to pollution control:

1. Sampling of air, stack emissions, exhaust emissions, water, sewage and factory effluents.
2. Analysis of pollutants, both qualitative and quantitative, by methods which vary from simple colorimetric tests and pH measurements to the use of the most sophisticated chromatographs, spectrometers, and electronic counters of particulates.
3. Monitoring of various pollutants, including hydrogen sulfide, sulfur dioxide, chlorine, ozone, nitrogen oxides, dusts and particulates, including the more insidious poisons such as lead and carcinogens.
4. Direct measurement of air, water, noise, heat, and radiation pollution.

The data appearing in this volume were selected by the publisher from each manufacturer's literature at no cost to, nor influence from, the manufacturers of the materials, instruments, and other equipment.

All together, 157 companies are represented. About 350 instruments or other analytical equipment pieces are described. Many other materials, including small test kits and sampling devices are also listed. The major listings include one or more of the following:

1. Diagrams of the apparatus with a description of its components and accessory equipment.
2. Technical discussion of the analytical reactions involved.
3. Specifications of the instrumentation.
4. Brief statement about the specific and all-around uses of the instrument or apparatus.

Governments on all levels have been setting standards for acceptable pollution levels and their control. This constitutes step two in the systems approach which cannot be taken without step one - in other words: No company can intelligently cope with its pollution problems without first setting up an accurate sampling, measuring and analyzing program to find the amount and character of the pollutants it discharges.

This book supplies detailed technical data on the types of measurement and analyses which can be made and the companies which provide such instrumentation.

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## OXYGEN ANALYZER - Galvanic Cell, Precision

For determining oxygen content in liquids such as waste waters, liquors, inland or sea waters, chemical effluents and process streams. Oxygen content is easily determined in mg per liter or parts per million and can be readily converted to percent oxygen or mm partial pressure. Single tests on oxygen levels of up to 50 mg per liter or 50 ppm can be completed in less than five minutes, or monitored continually. Accuracy is  $\pm 0.1$  mg per liter in a temperature range of 5 to 35°C.

The probe is placed into the sample container, stream or body of water to be analyzed. The four-way control switch is turned on to "Temp. Adj." The meter needle is then adjusted until it reads 40°C. The switch is then turned to "Temp. Read" and the temperature of the sample is read from the meter. With switch of "Oxygen", the  $O_2$  reading is taken. This reading is adjusted by a previously determined conversion factor to obtain the actual oxygen content.

The heart of this unit is a probe consisting of ring shaped lead anode surrounding a silver cathode in an epoxy plastic housing. Probe is durable, non absorbent, acid resisting and high dielectric strength assembly which produces its own precise current. Electrodes are first covered by a thin electrolyte pad, saturated with electrolyte and enclosed by a permeable membrane for maximum current production and high accuracy.

Combination meter has 0-15 microampere  $O_2$  scale and 0.50°C. temperature scales, with input jacks for oxygen and thermistor probes and recorder output jack.

## SHIMADZU MODEL QV-50 SPECTROPHOTOMETER

The potentiometric measuring system of the QV-50 provides a linearity better than  $\pm 0.2\%$ , and is free from the non-linearity of the amplifier because of the null-balance method employed in measurement. Reproducibility is  $\pm 0.1\%$ . The spectrophotometer accepts the Direct Meter Readout accessory (which is especially useful in flame photometry and atomic absorption) and the QV Digital Reader as alternate readout devices for direct measurement. An outlet for connection to a recorder is provided at the rear of the monochromator. The potentiometric scale of the QV-50 can be expanded over two ranges. A 0-10 position allows the operator to make measurements from 0-10% transmittance or from 1.000 to 3.000 absorbance. The 90-100 position allows the measurements from 90-100% transmittance to be expanded over the full length of the slidewire. Conversion to absorbance is accomplished by means of a table included with the instrument. Thus, materials with very strong absorption or very weak absorption can be easily handled without further sample preparation.

The QV-50 allows the sensitivity of the detector to be increased by a factor of 10 by merely turning a switch on the detector housing. Thus, smaller slit widths can be employed where maximum resolution is needed.

### ATOMIC ABSORPTION ATTACHMENT

Atomic absorption spectrophotometry is a method of analyzing metallic elements. It presents the following advantages over flame photometry or emission spectroscopy:

1. Easy sampling because of little influence of co-existing elements.
2. Less sensitive to temperature change of the flame.
3. Can detect almost everything that is quantitatively analyzable by flame photometry and can analyze precious metals as well.

The atomic absorption attachment features a hollow cathode tube as a light source; a fish-tail type burner, to insure high sensitivity, a wavelength fine adjustment and a compensatory circuit which serves for the correction of emission. Hollow Cathode Lamps are not supplied. For operation on 115 Volts, 60 cycles, AC.

## OXYGEN ANALYZER - Portable, Type D.C.L., 101 Mk, 11

A portable battery operated analyzer for use in chemical plants, refineries, boiler-houses, steel-works, gas-works, brewing and fermentation processes and in physiological applications. Approved for use with gases of Group 2a, b, c, d, and e of B. S. 1259.

The measuring cell is extremely resistant to physical shock. A resolution of better than 0.1% oxygen and a range of 0-100% oxygen are achieved by obtaining the read-out from a ten-turn dial. The basis of measurement is the magnetic susceptibility. A silica dumb-bell is suspended in a non uniform magnetic field, and experiences a torque which is directly proportional to the oxygen content of the surrounding gas.

The instrument has a range from 0 to 100% oxygen on a 3600° ten-turn linear dial with readings to 0.1%, and an accuracy to  $\pm 0.1\%$  oxygen. The ambient temperature range is from 0-40°C. but sample temperature up to 100°C. will not cause physical damage. Complete with a sintered glass disc filter with two pinch valves to control analyzer and by-pass flows, a blow-ball and silica gel drying tube. Dimensions are 13¼ x 8 x 9½ inches. Operates on U-A type cell 1.5 volt battery.

There is no restriction on the working position producing less than .0005% change in oxygen reading per 1° tilt in any direction.

The sample flow-rate must be in the range 0-150 ml/minute when readings are taken. The maximum variation of reading between these limits is 0.1% oxygen.

## SAMPLER - Sewage, A. P. H. A.

Sampler, constructed of brass, nickel plated, with no delicate parts whatever, it is essentially simple, and so ruggedly constructed that it will last indefinitely. It is resistant to corrosive agencies with which it is likely to come in contact.

Cover, yoke and inset, all on integral casting, with no joints. Machined thread between cover and body insures an air-tight closure without wrench or gasket. Cover and body are chained to prevent accidental misplacement of cover when sampler is not in use. Sample bottle is properly positioned by built-in platform and filling tube, which will accommodate ordinary variations of different sample bottles.

## PHOTOMETRIC ANALYZER - Model 260, Delta

This analyzer is designed specifically to perform the chemical analysis of water and wastes in accordance with the official "Standard Methods" as specified by the American Public Health Association. For maximum accuracy, each instrument is individually calibrated and the test cells are optically ground and polished. 38 different tests can be performed, from Aluminum to Zinc as well as pH.

Control panel has a direct-reading meter with a large, easy-to-read scale and an indicating needle that deflects automatically. A tube filled with water is inserted to set the meter at 100. Test is made by inserting a second tube which contains the reagent-treated water being analyzed and recording the specific, lower value on the meter. Correct result is then obtained from a standardization chart.

Unit comes in a compact, waterproof, all formica carrying case that measures only 9 x 8 x 5 inches. Supplied with a comprehensive procedure and instruction manual and square sample cells, but without individual tests, reagents or calibration charts. For operation on 110 Volts, 60 cycles, AC.



## Ace Scientific Supply Co., Inc.

Ace Scientific Supply Co., Inc. is a distributor for a number of manufacturers of instruments for sampling, analyzing and monitoring pollutants of air and water. Some of the products which they carry for this purpose are described below.

### MERCURY ANALYZER SYSTEM

#### COLEMAN MODEL MAS-50

The first complete, self-contained Mercury Analyzer. It can be used in many scientific fields.

Pollution: Air, water, food, soil, tissue.  
Clinical: Urine, blood, tissue.

Industrial Control: Food, metal, soil, fertilizer. PROCEDURES ARE SUPPLIED.

- Sensitivity .01  $\mu\text{g}$  of mercury, equal to or better than A.A.
- Direct reading in  $\mu\text{g}$  of mercury.
- Hatch and Ott procedure.

This compact, self-contained, low-cost system makes determination of mercury in solids and solutions, organic or inorganic, or in air an inexpensive routine procedure. Coleman MAS-50 is so easy to operate, no special training is required. A 5-step reagent and standards kit, capable of 100 determinations, is also available.

### MDB FOR SEWAGE PLANTS

The Ohaus MOISTURE DETERMINATION BALANCE is especially designed to permit accurate testing for sludge solids content in 15 minutes, for percent volatiles in 20 minutes, and for mixed liquor total solids in 30 minutes.

It replaces six pieces of equipment — analytical balance, weights, bird bath heater, drying oven, muffle furnace and dessicator.

The balance has a built-in IR lamp which adjusts vertically and swivels for safety. Heat intensity (0-500 watts) and timer controls are located on top of the balance housing (see insert). The timer provides settings from 1-60 minutes, signal bell and automatic heater shut-off. Decrease in weight and percent moisture loss can be read simultaneously. Magnetic damping insures rapid reading.

Total Capacity	10g.
Optical Range	10g x 0.01g. 100% x 0.1%
Sensitivity	0.01g. to 0.1%
Tare Capacity	$\pm 5\text{g.}$
Power	
Requirements	115V. 50/60 cy. —500 watts
Dimensions	8½" x 14½" x 17"
Shipping Weight	30 lbs.
Heating Unit	Standard Tungsten Filament IR Lamp
Temperature	
Range	0-600°C.

### HIGH VOLUME AIR SAMPLER

#### DESIGNED FOR CONTINUOUS USAGE

- Complies with ASTM D2009.
- Complies with USPHS Specifications.
- Gauge indicates flow in CFM.
- High capacity blower — up to 80 c.f.m. free air.
- Stainless steel filter holder with dual mesh stainless steel filter support.
- Choice of outdoor shelter or indoor floor stand.

For large volume air sampling, and suitable for either outdoor use (in the standard USPHS aluminum shelter) or indoor use (on a floor stand). The sampler is supplied with a funnel-type holder for a standard 8" x 10" filter paper, but an accessory filter assembly is also available, accommodating 4" circular filter paper. Also standard on the sampler is a pressure gage calibrated in cubic feet per minute to provide a continuous indication of air flow. Blower assembly consists of a high capacity twin turbo-blower and series motor mounted in a cast aluminum housing with single, fixed-diameter exhaust orifice. Line cord equipped with in-line switch.

The 8" x 10" filter paper is glass fiber meeting ASTM standards. It has a DOP efficiency of 99.9% at 28 feet per minute. Stainless-steel filter paper support consists of a pair of frames equipped with dual broad-mesh, stainless-steel supporting cloth and quick disconnect knurled nuts. For operating on 120 Volts, 60 cycles.

### CONTINUOUS NO<sub>2</sub> MONITOR—ASTM D2012, Precision

The Precision NO<sub>2</sub> Monitor provides continuous measurement of NO<sub>2</sub> or NO in the atmosphere — indicating the concentration on a panel-mounted digital display meter. The output is compatible with a variety of data-gathering equipment or a recorder.

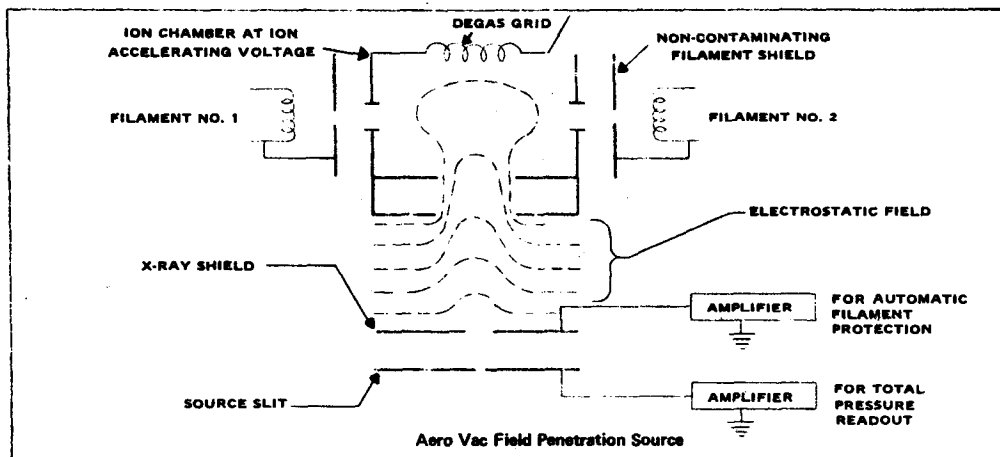
The NO<sub>2</sub> Monitor is a colorimetric instrument, in which a continuously flowing air sample is scrubbed with a continuously flowing stream of Griess-Lyshkow Reagent. The color formation that takes place depends on the level of NO<sub>2</sub> contamination. The colorimeter uses two matched flow cells — a reference cell through which passes the fresh reagent, and a detector cell through which passes the colored, reacted reagent. Light from a common source passes through the two flow cells to strike two cadmium photo resistors. At no time does the reagent or air sample come into contact with any pumps, or any component other than glass or inert plastic tubing.

The NO<sub>2</sub> Monitor enclosure is heavy-gauge aluminum finished in two-toned baked enamel. Access panels provide total entry to the chemical system and to the mechanical/electronic components. The chemical system includes reagent capillary, two flow cells, scrubber coil, separator, drain trap, two cadmium photo-resistors, and silica gel vapor trap for exhaust air, flowmeters (air and reagent). The right-hand section contains the air compressor, circulating fan, control valves, pressure gage, air filters, light source, control switches, and all electronic components. Multi-turn potentiometers for instrument calibration and the digital meter are located on the front panel. The readout device is a 3½-digit display with a built-in binary coded decimal output. Supplied complete with sample air inlet filter, box of 100 filter discs, 1 lb. activated charcoal, all feed and drain lines, 13-liter reagent reservoir, and complete instructions. For operation on 120V 60 cycles, 250 watts.

### SEQUENTIAL SAMPLER, PRECISION

The Precision Sequential Sampler is a most versatile instrument, accommodating up to three tubes in a series at each of its twelve stations. Three determinations (e.g., NO<sub>2</sub>, SO<sub>2</sub> and CO<sub>2</sub>) can be made in any one sampling period — or three tubes using the same reagent can be used for maximum scrubbing efficiency. Two precision timers, one for sampling time and one for interval time, provide a time range from two minutes to four hours. With each timer at its maximum setting, the sampler will operate unattended for four days, then shut itself off automatically. A bronze-tinted acrylic dust cover permits observation of the test tubes and yet protects light-sensitive solutions from damage. For precise control of air flow, a dual-ball flowmeter accurately indicates the flow rate from 0.2 to 11.0 liters per minute. The chassis is heavy aluminum sheet finished in two-tone enamel. A pair of removable stainless-steel racks accommodates up to three test tubes per station. The controls include the sampling timer, the interval time, the line switch, the start button, the air flow rate control and flowmeter, and pilot light to indicate completion of the 12 sampling cycles. The oil-less diaphragm pump provides a free-air capacity of 12 liters per minute. Corrosion-resistant tubing is used throughout. For operation on 120 Volts, 60 cycles 2a.

## in 1963 AERO VAC introduced the FIELD-PENETRATION FOCUSED ION SOURCE



### ALLOWS OPERATION IN CONTAMINATED ENVIRONMENTS

In the Aero Vac design, filament shields which are at the same potential as the filament, prevent electrons from "seeing the cage" thus eliminating contamination buildup which results in decrease in sensitivity. The filament plates also cause the electron source to operate in a "space charge limited" mode meaning that the number and energy of electrons entering the cage are controlled by the constant electron accelerating voltage rather than filament conditions. This mode significantly decreases changes in the

ionization due to aging and contamination of the filaments and results in a longer term stability.

### ELIMINATES TUNING AND FOCUSING ADJUSTMENTS

Engineering analysis by Aero Vac shows that there is a unique mechanical spacing for which all of the normally variable voltage focusing plates can be permanently fixed at the cage potential thus eliminating all other focus adjustments. This design results in a permanent focus of the ion beam over the entire mass range and allows the magnet position to be fixed.

## MODEL AVA2 RESIDUAL GAS ANALYZER

### ELECTRONIC CONTROL

The power supply, emission regulator and electrometer amplifier are completely contained in a single, light weight cabinet. Filament protection is provided both when measuring total pressure and when measuring residual partial pressures. Heavy-duty filament elements and controlled filament warm-up insure unusually long life.

The vacuum analyzer provides a scan of mass numbers from 2 to 11 and 12 to 70 with an option to extend down to mass 1 and up to mass 200. Mass numbers are directly indicated on the panel meter. Scans can be made automatically and continuously or manually. Scanning of the mass range may be done in thirty seconds or two minutes. In addition a single mass peak may be selected and monitored over an extended period.

Seven decades of amplification permit operation from  $10^{-3}$  torr to  $10^{-10}$  torr. Total pressure readout is directly in torr. Relative pressure may be selected by the total-partial switch. A jack is provided for a plug-in of an optional remote torr-meter, an arrangement very useful for searching out leaks in the vacuum system. Both mass indication and

peak height outputs are provided for permanent mass spectrum data on either an x-y or strip chart recorder.

Rugged design of all components provides long trouble-free service.

### SPECTROMETER TUBE

The Spectrometer Tube is available with a 5" O.D. standard rubber O-ring seal for non-bakeable use, or a  $4\frac{1}{2}$ " O.D. conflat  $\odot$  for bakeable systems to  $400^{\circ}\text{C}$ . Pre-aligned magnet guide bars are welded to the Spectrometer Tube. Two magnets of different field strengths are used to shift the mass range. Magnet mounting can be done in less than five seconds. The ion source is flange mounted so as to extend into the vacuum system in a nude type configuration for highest accuracy. A degassing grid in the ion source allows direct degassing of the source for clean up of moderate amounts of contamination. The standard long-life dual filaments are tungsten. In the event that a filament should need replacement, this is easily accomplished using a pre-aligned filament assembly which needs no further adjustment after installation.

### SPECIFICATIONS

Mass Range	2-70 AMU (std.) (1-200 with 6 KG Elec. Mag.)
Unit Resolution	35 AMU (std.) (50 AMU with 6 KG Elec. Mag.)
Sensitivity range for $\text{N}_2$	$10^{-10}$ Torr
Scan	30 sec or 2 min/mass range Manual Selection of any peak
Max. Operating Press.	$10^{-3}$ Torr
Total Press. Meas. Range	$10^{-3}$ to $10^{-10}$ Torr

Spectrometer Tube	4" O.D. Conflat $\odot$ Type flange - Copper sealed Bakeable to $400^{\circ}\text{C}$ or 5" O.D. elastomer O-ring sealed Flange 600 Mag. Sector
Outputs	Pressure - 0-100 mv F.S. Mass - 0-10 v F.S.
Weight	85 lbs.
Cabinet Dimensions	$19\frac{1}{2}$ " x 15" x 9" (WDH) 19" rack mountable

## MODEL AVA200 RESIDUAL GAS ANALYZER

## GENERAL DESCRIPTION

While maintaining all of the simplicity of the Model AVA2 design, the Model AVA200 gives a significantly extended range of performance. The mass range to 200 AMU permits detection of mercury, xenon, crypton, freon and a wide variety of other gases. Unit resolution at 100 AMU provides crisp spectra which enhances identification of high peaks. The  $10^{-12}$  torr sensitivity provides reserve gain even for Ultra High Vacuum Systems and permits analysis of minor gas components down to one (1) part per million. The standard units come complete with control, mass spectrometer tube, 2 magnets and 8 foot cables.

## SPECIFICATIONS

Mass Range .....	2-200 AMU (std.) (1-300 with 6 KG Elec. Mag.)	Total Press. Meas. Range .....	$10^{-3}$ to $10^{-10}$ Torr
Unit Resolution* .....	100 AMU (std.) (170 AMU with 6 KG Elec. M')	Spectrometer Tube .....	4" Q.D. Conflat © Type flange - copper sealed Bakeable to 400°C 60° Mag. Sector
Sensitivity range for N <sub>2</sub> .....	$10^{-12}$ Torr	Outputs .....	Pressure - 0-100 mv F.S. Mass - 0-10 v F.S.
Scan .....	2½ min or 10 min/mass range Manual Selection of any peak	Weight .....	145 lbs.
Max. Operating Press. ....	$10^{-3}$ Torr	Cabinet Dimensions .....	19½" x 15" x 9" (WDH) 19" rack mountable

## MODEL AVA610 RESIDUAL GAS ANALYZER

## GENERAL DESCRIPTION

The Aero Vac Model AVA610 is a general purpose residual gas analyzer which has been designed for simplicity, ease of use, and reliability. The Model AVA610 is one of the most compact units available with controls conveniently arranged in three sections. The emission section has the main power switch for the entire unit. The scan section features a back-lighted expanded mass number meter. The proven Aero Vac innovation of total pressure readout in torr is a feature of the pressure section. The complete electronic control which includes an electrometer is designed with plug-in modules for easy accessibility and service. The standard units come complete with control, mass spectrometer tube, 2 magnets and 8 foot cables.

## SPECIFICATIONS

Mass Range .....	2-300 AMU (std.) (1-500 with 6 KG Elec. Mag.)	Total Press. Meas. Range .....	$10^{-3}$ to $10^{-11}$ Torr
Unit Resolution .....	150 AMU (std.) (200 AMU with 6 KG Elec. M.)	Spectrometer Tube .....	4" O.D. Conflat © Type flange - Copper sealed Bakeable to 400°C 60° Mag. Sector
Sensitivity range for N <sub>2</sub> .....	$10^{-13}$ Torr	Outputs .....	Pressure - 0-100 mv F.S. Mass - 0-10v F.S.
Scan .....	.1 sec or 25 min/mass range Manual Selection of any peak	Weight .....	115 lbs.
Mass Operating Press. ....	$10^{-3}$ Torr	Cabinet Dimensions .....	19½" x 15" x 9" (WDH) 19" rack mountable

Aero Vac Corporation  
MODEL 170 SERIES MASS SPECTROMETER SYSTEMS

### GENERAL DESCRIPTION

The Aero Vac Model 170 series of mass spectrometers provides optimum reliability and ease of use with the lowest investment instrumentation for routine gas or liquid analysis. These units are systems engineered to provide a complete portable package including analyzer, vacuum system and inlet system. The instruments are easily rolled to any location and require only standard electrical power for immediate operation.

### PUMPING SYSTEM

Pumping is accomplished by a 2" air-cooled diffusion pump backed by a two-stage 0.9 cfm mechanical pump. The analysis chamber is baffled and orificed to 10 liters/second to provide a stable analyzer pressure with a constant thru-put. A base pressure of  $5 \times 10^{-7}$  torr in the analysis chamber is attained without liquid nitrogen or cooling water. The base pressure limitation is primarily water vapor out-gassing.

The vacuum system is automated with the only controls being a front panel main power switch and hi-vac switch. The system construction of stainless steel with high vacuum seals of gold wire or copper removes the high outgassing associated with elastomers and insures low system background levels.

### INLET SYSTEM

The standard inlet probe consists of a five foot, small diameter tube which can sample from gas sources at pressures ranging from several atmospheres to below 100 torr. The sample is pulled through a variable needle valve via a special connection to the interstage of the two-stage mechanical pump.

The inlet valve allows setting of the analysis chamber pressure at any desired value with widely varying inlet pressures. The by-pass type of inlet system provides fast time response as well as extremely flexible sampling capability.

Aero Vac engineers are available to design different inletting systems for special applications such as leak detection or vacuum furnace requirements.

### ANALYZERS

The Aero Vac Model 170 series mass spectrometer systems consists of the standard Model 170 pumping system integrated with one of the three AVA series residual gas analyzers described fully in the previous sections. The unique non contaminating source as well as the pre-tuned features of the Aero Vac residual gas analyzers combined with the 170 pumping system make the Aero Vac mass spectrometer the most reliable and easily operated units available.

### INTERLOCKS

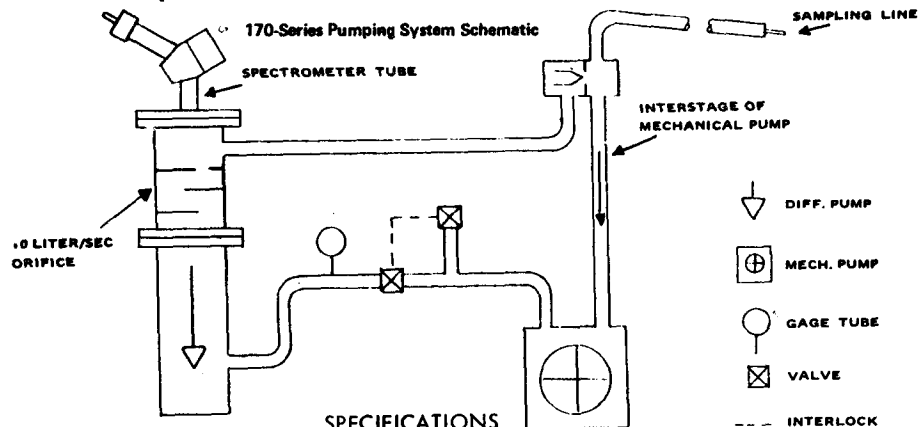
The Model 170 series is completely interlocked to provide proper sequencing and protection so that the front panel vacuum controls can be operated in any order without system damage. Included in these are:

1. A temperature sensor on the diffusion pump prevents over-heating of diffusion pump in event of cooling fan failure or obstruction.
2. A separate thermocouple vacuum gage - This unit gives a front panel reading of foreline pressure and shuts off power to the diffusion pump and mass spectrometer control should the foreline pressure exceed a pre-set value. This gage is essential since the over-pressure protection of any mass spectrometer tube (essentially an ion type gage) will not operate at high pressures and turning on the mass spectrometer at this point could result in tube filament burnout.
3. Automatic Shutdown - A solenoid valve isolates the roughing system, preventing backstreaming. After a pre-set time delay another solenoid valve opens and vents the mechanical pump to atmosphere.

### OPERATION

Operation on the Model 170 series mass spectrometers is initiated by turning on the main power switch and the hi-vac switch. The diffusion pump will activate automatically when the foreline pressure, as measured on the thermocouple gage, reaches a pre-set value. After the vacuum system has reached a base pressure in the  $10^{-7}$  torr range samples can be introduced and analyzed. This is accomplished by adjusting the by-pass inlet valve such that the mass spectrometer pressure attains a value in the  $10^{-5}$  torr range. The mass spectrometer is then continually analyzing the gas being drawn through the inlet probe.

Since the interlocks protect against component or power failure, the high vacuum system can be left in operation without operator supervision.



### SPECIFICATIONS

Item	Model 170-2	Model 170-200	Model 170-610
RGA Model Number	AVA2	AVA200	AVA610
Mass Range	2-70 AMU	2-200 AMU	2-300 AMU
Abundance Sensitivity	20 ppm	5 ppm	5 ppm
Unit Resolution	35 amu	100 amu	150 amu
Base Pressure	$5 \times 10^{-7}$ Torr		
Outputs	See RGA descriptions		
Dimensions	Standard 19" cabinet, 23½ x 22 x 55½ (WDH)		
Power Requirements.	110 volts - 60 cycles - 1 phase - 15 amps Weight 350 Lbs.		

# Aero Vac Corporation

## MODEL 270 SERIES MASS SPECTROMETER SYSTEMS

### GENERAL DESCRIPTION

The Model 270 family of Mass Spectrometer Systems maintains all of the simplicity, reliability and ease of operation of the Model 170 Series while offering the additional capability of a lower base pressure (for better threshold detection limits) and a more sophisticated inlet system. The standard Model 270 includes 100 millivolt 10 speed Strip-chart recorder. These completely portable units like the 170 require only standard electrical power for operation.

### SPECIFICATIONS

Item	Model 270-2	Model 270-200	Model 270-610
RGA Model No.	AVA2	AVA200	AVA610
Mass Range	2-70 AMU	2-200 AMU	2-300 AMU
Abundance Sensitivity	20 ppm	5 ppm	5 ppm
Unit Resolution	35 AMU	100 AMU	150 AMU
Base Pressure	5 x 10 <sup>-8</sup> Torr		
Outputs	See RGA descriptions		
Dimensions	Standard 19" rack cabinet, 23½ x 22 x 70½ (WDH)		
Weight	500 Lbs.		
Power Requirements	110 volts - 60 cycle - 1 phase - 20 amp		

## MODEL 685 MASS SPECTROMETER SYSTEMS

### GENERAL DESCRIPTION

The Aero Vac Model 685 is the ultimate in a low background general purpose mass spectrometer, featuring a fully baked 5 x 10<sup>-10</sup> torr ultra high vacuum system. The model 685 is ideal for those applications where analysis of very minute samples is desired.

### SPECIFICATIONS

RGA Model Number	AVA610
Mass Range	2-300 AMU Std (1-500 AMU with E mag. Scan)
Partial Press. Sensitivity	10 <sup>-13</sup> Torr Range for N <sub>2</sub>
Abundance Sensitivity	1 PPM
Unit Resolution	150 - 250 with Opt. Electromagnet
Base Pressure	5 x 10 <sup>-10</sup> Torr
Dimensions	50 x 28 x 63 WDH
Weight	750 Lbs.

## MODEL 686 MASS SPECTROMETER SYSTEMS

### GENERAL DESCRIPTION

The model 686 is the only commercially available mass spectrometer designed specifically for trace gas analysis. Peak tailing on the mass spectra which commonly obscures small peaks close to extremely large ones has virtually been eliminated. As an example, on an argon spectrum a 20 part per billion peak can be detected at mass 39 one mass unit away from the major mass peak at mass 40. This capability has been attained by use of a special differentially pumped mass spectrometer tube featuring two stages of momentum filtering combined with one stage of energy filtering.

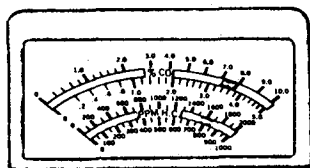
### SPECIFICATIONS

RGA Model Number	AVA610
Mass Range	1-500 AMU
Abundance Sensitivity	0.02 PPM
Partial Press. Sen.	10 <sup>-13</sup> Torr. Range for N <sub>2</sub>
Unit Resolution	250 AMU
Base Pressure	5 x 10 <sup>-10</sup> Torr
Dimensions	60 x 24 x 60 WDH
Weight	1000 Lbs.

Allen Electric & Equipment Co.

ALLEN CARBON MONOXIDE/HYDROCARBON ANALYZER, MODEL 15-02

Enables you to do much finer tune-ups; detects troubles in engine, ignition, fuel and intake systems and to sell more customer-pleasing service.



Large, direct-reading meter shows per cent of carbon monoxide and hydrocarbons present in exhaust. Has high and low scale to read Carbon Monoxide from 0 to 5% in increments of 0.1% and 0 to 10% in increments of 0.2%. Read Hydrocarbons from 0 to 1000 parts per million in increments of 25 ppm and 0 to 2000 ppm in increments of 50 ppm. Sand pouches hold meter in desired position on vehicle.

- \* Solid-State Electronic Unit gives extra fast response—no long waiting periods—90% of reading in 4 seconds.
- \* No filter maintenance—no water used.
- \* Operates at all engine speeds.
- \* No exhaust pump to wear out.
- \* Self-contained calibration system.
- \* Continuous sampling of exhaust gas.
- \* Easy-to-operate—simply switch on and shove adapter in tailpipe.
- \* Meter can be placed next to engine as carburetor adjustments are being made.
- \* Accurate to  $\pm 5\%$  of full scale.
- \* Rugged, shock-proof construction.
- \* Not affected by temperature or humidity extremes.

EMISSION TESTING AND ADJUSTING IS A PROFITABLE AND VITAL POLLUTION CONTROL SERVICE

*equip now for the service that may soon be mandatory in all states!*

Vehicle emission control problems are among the top priority problems being considered by State and Federal Pollution Control Agencies. Several States have already passed legislation requiring emission testing . . . more will follow shortly.

Reduction of exhaust pollution is not the only benefit of emission testing and service. All vehicles equipped with emission controlled engines will operate at maximum efficiency when carburetors are properly adjusted for minimum carbon monoxide and hydrocarbon output. With the new Allen 15-02 Analyzer, you will be able to do the job quickly and profitably. You will also be able to spot troubles that need repair or adjustment. Your customers will also be more satisfied with engine performance.

**Operation is simple and speedy**

here's all you need to do to use the new Allen CO/HC emission analyzer:

- (1) Plug in power cord, switch on. Let meter needle stabilize.
- (2) Zero meter needle in both CO and HC positions.
- (3) Secure tube to Analyzer. Insert tube in tailpipe.
- (4) Keep Analyzer fresh air intake clear of exhaust path.
- (5) Set Analyzer in CO position. Test carburetor adjustments.
- (6) Switch to HC position and check hydrocarbon content.

MODEL 15-02 SPECIFICATIONS

**POWER SUPPLY:** 115 Volts, 60 Hz., 100 Watts.

**CONTROLS:** On Meter Case—CO-HC switch, CO balance control, HC balance control, High-Low scale switch. On Sampling Unit—On-Off switch, Calibration control.

**METER:** Six inch with upper and lower scales. CO Upper Scale—orange color band indicates 0-5% CO in increments of 0.1% and 0-10% Lower Scale—blue color band indicates 0-1000 PPM HC in increments of 25 PPM and 0-2000 PPM in increments of 50 PPM.

**DIMENSIONS:**

**Sampling Unit**

Height . . . . . 8 1/2 inches  
Width . . . . . 19 1/2 inches  
Length . . . . . 13 1/2 inches

**Meter Case, including sand pouches**

Height . . . . . 5 1/2 inches  
Width . . . . . 6 1/2 inches  
Length . . . . . 7 1/2 inches

**Power Cord Length** . . . . . 8 feet

**Meter Cord Length** . . . . . 30 feet

**Shipping Weight** . . . . . 33 lbs.

**FUNCTIONS:**

1. Indicates per cent of carbon monoxide in automobile exhaust gas from 0-5% and 0-10% within 0.25% CO and 0.5% CO respectively.
2. Indicates hydrocarbons (n-hexane) in automobile exhaust gas from 0-1000 and 0-2000 parts per million within 50 and 100 parts per million respectively.
3. Indicates within 90% of the final indication within 4 seconds of a change in CO or HC content in the exhaust gas.
4. Drift in zero adjustments less than  $\pm 5\%$  of full scale over any 40-minute period after initial warm-up.

**Temperature and Humidity**—will operate at specified accuracies under all extremes of temperatures and humidity found in service shops and garages.

SERIES 500 GAS CHROMATOGRAPH

MODEL 510

For the first time it is now possible to have a portable gas chromatograph which gives the same performance as has previously been found only in laboratory systems. Containing its own rechargeable batteries and gas supplies, this chromatograph now allows up to at least 8 hours of continuous operation at temperatures up to 250°C before the Nickel-Cadmium batteries must be recharged. Because of circuit design it is also possible to perform analyses when the batteries are being recharged. To the analyst, this means that the instrument may also be operated in the laboratory when "on-site" analysis is not required.

MODEL 520

This version is designed for use in the laboratory for routine isothermal analysis. This type of system is particularly advantageous for a quality control laboratory where a gas chromatograph is normally set up on a "dedicated" basis and performs the same analysis routinely. Because of its small size and top-mounted injection system it is now possible to have the chromatograph and recorder use less space than had previously been used by a typical laboratory chromatograph. Careful design of all detector signal lines and completely D.C. operated electronics makes this chromatograph a truly computer-compatible device. An accessory is available for conversion of this chromatograph to the fully portable mode of operation.

APPLICATIONS

- Pesticide Residue Analysis
- Residual Solvent Analysis
- Phenol-Stream Water
- Air Analysis Methane-CO
- Oxygen in Air

MODEL 530

For those laboratories that find bench space is now at a premium it is possible to have a rack-mounted Series 500 Gas Chromatograph. This means that a number of instruments may be mounted in a vertical position and no more than 19" width and 12" height will be required. For those laboratories that have computer systems available it is also possible to mount the instrument in any suitable space that is available within the computer console.

SERIES 500 FEATURES

DETECTORS

**FLAME IONIZATION** Performance-proven isolated jet design utilizing 150 volts D.C. as the applied potential. The electrometer used with this detector is a Keithley Model 302 which has a maximum sensitivity of  $5 \times 10^{-12}$  amps.

**ELECTRON CAPTURE** A design similar to that described by Lovelock, this detector contains  $H^3$  as its radioactive source and is capable of operation up to 225°C. The same electrometer is used as with the flame ionization detector.

**PHOSPHORUS** The detector is a modified

flame ionization detector and is designed to give maximum response for any phosphorus containing compound. The alkaline salt (KCl) used with this device is pressed into a pellet form and has a lifetime of at least 1 year before it must be replaced. This eliminates one of the most bothersome features of earlier designs.

**THERMAL CONDUCTIVITY** The thermistor beads used are mounted into a micro-detector block for minimum dead volume. This type of thermal conductivity detector has been found to be most sensitive at lower operating temperatures.

INJECTION PORTS

**STAINLESS STEEL INJECTION PORT** Designed to accept  $\frac{1}{8}$  inch stainless steel columns with the facility for on column injection. Carrier gas stream enters injection port through back flash restrictor sweeping the head of the column and the septum be-

fore entering the internal port of the column.  
**GLASS INJECTION PORT** The same physical structure is used as in the stainless steel system with the lone exception being a 4 mm O.D. glass column is substituted for the  $\frac{1}{8}$  inch metal column.

## SPECIFICATIONS

### DETECTORS

#### FLAME IONIZATION

Single flame, isolated jet design. Line-or battery-operated. Sensitivity of at least 20 millicroombs per gram utilizing hydrogen and air.

#### PHOSPHORUS

Modified Flame Ionization detector utilizing a KCl pellet. Sensitive to phosphorous containing compounds with a selectivity ratio of 10,000 to 1 when compared with hydrocarbons.

#### THERMAL CONDUCTIVITY

High Sensitivity two element 8K ohm thermistor bead design.

#### ELECTRON CAPTURE

200 millicuries of  $H^3$  suitable for operation up to  $220^\circ C \pm 5^\circ C$ . Fixed pulse: 35 microsecond interval, 30 volt amplitude, and 1 microsecond width.

#### ELECTROMETER

Complete solid state device using a Keithley operational amplifier. Input compatible with Flame Ionization, Electron Capture and Phosphorus Detectors.  
Sensitivity —  $5 \times 10^{-12}$  amps full scale on 2 millivolt recorder.  
Dynamic Range—Recorder output  $2 \times 10^9:1$   
Computer Output— $2.5 \times 10^5:1$   
Noise:  $1 \times 10^{-13}$  amps peak to peak  
Background Suppression— $7.5 \times 10^{-7}$  amps  
Output—Computer/Integrator — to 10 volts max.  
Time Constant — Less than 500 milliseconds on all ranges.

#### PORTABLE GAS CHROMATOGRAPH

Includes Self Contained rechargeable batteries and gas supplies and battery recharger.

#### DEDICATED GAS CHROMATOGRAPH

Stationary, bench-operated instrument in carrying case. Line operated.

#### RACK-MOUNTED GAS CHROMATOGRAPH

Stationary, rack-mount unit without carrying case.

Option 01—Gas Sampling Valve Installed.  
Includes 2.5 and 10ml Loops.

### THERMAL CONDUCTIVITY BRIDGE

Continuous current adjust from 0-10 ma. Coarse and fine zero controls, output polarity switch, common output from bridge to recorder or computer/integrator.

#### D.C. PROPORTIONAL TEMPERATURE CONTROLLER

Solid state controls with thermistor sensor in feedback system and integral "fail safe" protective circuit. Injection port and detector have independent heaters slaved to oven temperature controller and operate 5-10 degrees higher.  
Temperature Sensitivity—average  $0.1^\circ C/1^\circ C$  change in ambient.  
Temperature Settability — within  $0.1^\circ C$ .

#### COLUMN OVEN

Accepts up to 20 ft. x  $\frac{1}{8}$  metal columns and 12 ft. x 4 mm glass columns as standard.  
1/16 inch column adaption available on request.  
Temperature Range — Ambient to  $250^\circ C$   
 $220^\circ \pm 5^\circ C$  with Electron Capture detector.  
Power Requirements — 12 watts when controlling at  $225^\circ C$ .

#### INJECTION PORT

Designed for on-column injection with "flash-back" protection.  
Injection port is individually heated.  
Temperature Range — Ambient to  $250^\circ C$ .

#### FLOW SYSTEM

Precision flow controller, Column Head-Pressure gauge.  
Secondary pressure regulator installed. Individual gas controls for  $H_2$  and air.

#### PHYSICAL CHARACTERISTICS

Dimensions (Case):  $15" \times 18" \times 10"$   
Weight: 22 lbs. (w/o power pack)  
Electrical: Requirements voltage 115 A.C. / 28 v. D.C.  
Power — 35 watts maximum.

#### MODEL NUMBER

#### DETECTOR

510	Electron Capture
511	Flame Ionization
512	Thermal Conductivity

520	Electron Capture
521	Flame Ionization
522	Thermal Conductivity

530	Electron Capture
531	Flame Ionization
532	Thermal Conductivity

Option 02—Substitute Phosphorus Detector for Flame Ionization Detector



# Antek Instruments, Inc.

## NANO-COULOMETER

The Antek Nano-Coulometric titrating system represents the most recent development in trace coulometric techniques. The system specifically detects and accurately quantitates nanogram to microgram amount of bound nitrogen, sulfur or halogen (except fluorine) in gases, liquid or soluble solids.

The total system consists of the following items -

- . Pyrolysis Furnace
- . Digital Nano-Coulometer, with magnetic stirrer.
- . Interchangeable titration cells
- . Recorder (Optional)

Samples injected into the furnace inlet are vaporized and contacted with the reactant gas by controlled mixing. The pyrolyzed sample is then eluted into the titration cell where the ion of interest reduces the titrant concentration in the electrolyte. The ion imbalance is immediately detected by sensor-reference electrodes. The titrant ion is generated by a pulsed current to restore its concentration to the original level. The total current required to regenerate the titrant ion obeys Faraday's Law (96,500 coulombs per chemical equivalent). For each current pulse, a count appears on the digital display.

The amount of current supplied with each pulse is controlled by the sensitivity setting. This allows the analyst to select the number of counts he wishes to obtain for a given weight of ions being titrated, thus varying the sensitivity from 0.1 to 4 nanograms per count. This represents 10 ppb in a 10 mg sample, which is at least 10 times as sensitive as competitive coulometers.

The titration cell is compact in design and constructed of glazed ceramic. This offers the advantages of greater durability, no interference from incident light, one-piece construction and ease of direct sample injections into the cell. Electrodes are permanently fused onto the cell walls. Circuitry is engineered to eliminate interference and noise contributed by extraneous A.C. and R.F. signals.

## SPECIFICATIONS

### NANO-COULOMETER MODEL 710

	<u>SULFUR</u>	<u>CHLORIDES</u>	<u>NITROGEN</u>
Detectability, ng	0.1	0.3	0.1
Response, ng/sec	120	50	250
Linear sensitivity, ng/ct	0.1-1.5	0.1-0.6	0.1-3.0
Drift, maximum, ng/hr	0.75	0.4	1.5

Digital counter - visual display

- . Capacity - 99,999 cts. . Maximum count rate 80 ct/sec
- External printer available - not required.

#### Controls

- . Setpoint- 3600° rotation-. Sensitivity adjust
- . Polarity switch . Recorder zero
- . Segment test . Reset button
- . Cell concentration meter . Power switch

#### Physical

6" h x 13" d x 16" w 18 pounds net

### FURNACE - Model 771

Heater elements (4)	Flow controllers (3)
Heater controllers (4)	Flow meters (3)
Pyrometer - 5 positions	Septum inlet
10" h x 13" d x 16" w	36 pounds net

### DETECTOR CELLS

- . Specific . Ceramic construction
- . Fused electrodes . Shields incident light