

## RAC 3-Gas Sampler



The RAC 3-Gas Sampler is a wet-chemical system that samples ambient air for up to three different pollutant gases simultaneously and features a thermoelectric system to assure maximum accuracy for SO<sub>2</sub> sampling.

The 3-Gas Sampler tests for sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S), ammonia (NH<sub>3</sub>), aliphatic aldehydes (R-CHO) and other pollutant gases for which there is a suitable reagent (absorbing solution). This sampler can be used virtually anywhere that line power is available to serve widely diversified gas sampling requirements.

In its basic configuration, the 3-Gas system is designed to collect samples of SO<sub>2</sub>, NO<sub>2</sub> and a third (optional) gas simultaneously. Modular components permit easy changes in sampling train configuration - except for the SO<sub>2</sub> arrangement (Station 1) - to meet varying sampling needs.

## FEATURES

Meets or exceeds U.S. EPA Reference Method specifications for sampling SO<sub>2</sub> in ambient air Thermoelectric cooling-heating system maintains SO<sub>2</sub> reagent between 5 & 25°C for optimum sample stability at ambient temperatures from -25 to 50°C All-weather shelter portable & easy to operate Critical orifices provide 200ml/min flow rate (nominal) through system Orifices protected by in-line filters & moisture traps to prevent clogging & flow reduction Sampling train compartment has an adjustable heater & fan to prevent reagent freezing in non-thermoelectrically-controlled bubblers Optional timer mechanisms available

## MAXIMUM SO<sub>2</sub> SAMPLING ACCURACY

Tests performed by the U.S. Environmental Protection Agency (EPA) revealed that the accuracy of established wet-chemical SO<sub>2</sub> sampling procedures is adversely affected by high ambient temperatures. At 50°C (122°F), for example, about 75% of the SO<sub>2</sub> in a collected or stored sample will be lost because of thermal instability within a 24-hour period. Sample degradation begins in the 20°C (68°F) range, with an initial loss factor of approximately 0.9% in 24 hours, and progresses at an increasing rate as the ambient temperature rises. The rate of decay increases five-fold for every 10°C increase in temperature over the range of 20 to 40°C (68 to 104°F).

## The RAC 3-Gas Sampler design eliminates this problem in SO<sub>2</sub> sampling!

It features a rugged solid-state thermoelectric (Peltier Effect) cooling-heating system that maintains the temperature of the SO<sub>2</sub> bubbler and reagent between 5 and 25°C (41 and 77°F) in an ambient temperature range from -25 to 50°C (-13 to 122°F). As a result, all the SO<sub>2</sub> collected during a sampling cycle is preserved for optimum accuracy of sample evaluation by standardized wet chemistry and spectrophotometric procedures.

## 3-GAS SAMPLER COMPONENTS

The RAC 3-Gas sampling system is supplied in a portable all-weather shelter for outdoor use and is furnished complete and ready to operate (reagents not included). This self-contained design includes a heavy-gage steel cabinet with a hinged, lockable top lid, two separate compartments inside and a weather-resistant baked enamel finish. The preassembled complete sampling train, the thermoelectric system and a thermostatically-controlled heater assembly are installed in an insulated compartment; the system's vacuum pump, vacuum gauge and electrical junction box are installed in the second compartment, which has louvers on three sides for heat dissipation. A 3-wire power cord is supplied as standard.

### SAMPLING TRAIN:

The RAC gas sampling train assembly includes a polypropylene inlet tube with a conical rain shield and an aluminum rack containing a 3-branch glass inlet manifold, 3 polypropylene 100ml bubblers with interchangeable caps, 3 polypropylene moisture-entrainment traps, 3 critical/limiting orifices, a 3-branch exhaust manifold and all necessary connecting tubing. The sampling rack is positioned on a base module that supports the thermoelectric device for the SO<sub>2</sub> bubbler and the non-related compartment heater and blower assembly. The complete sampling module is easily removed for filling, cleaning or changes in configuration (except for the SO<sub>2</sub> station). The base module is also easy to remove for periodic inspection or servicing.

The bubblers in Station 1 (SO<sub>2</sub> sampling) and Station 3 (third gas sampling) contain orifice-type 0.4±0.1mm glass bubbler tubes. The unit in Station 2 (NO<sub>2</sub> sampling) has a fritted glass dispersing element (70 to 100µ).

### TEMPERATURE CONTROL:

The SO<sub>2</sub> bubbler is encased in an insulating jacket and its temperature is controlled between 5 and 25°C solely by the thermoelectric cooling-heating system. To prevent reagents in the other two bubblers from freezing during cold weather, a constant (variable) temperature above 16°C (60.8°F) is maintained in the insulated compartment by the integral heater, which does not affect the temperature of the specially insulated SO<sub>2</sub> bubbler.

The thermoelectric system uses a finned heat sink and blower combination for efficient heat transfer and is protected by a thermal cutout on the heat sink as two fuses in the electrical circuit.

### FLOW-REGULATING ORIFICES:

The critical/limiting orifices are precision-bore glass tubing encased in Tygon plastic tubing. The orifices provide a 200 ml/min flow rate (approximate) to all bubblers and are easily cleaned in small ultrasonic baths.

### DETACHABLE LEGS:

The all-weather shelter has sturdy angle-iron legs that can be attached flush with the cabinet for carrying/transporting. The legs are securely attached in either the extended or retracted position by rust-resistant bolts threaded into captive nuts.

### TIMING MECHANISMS:

To meet a variety of sampling requirements, a 24-hour timer or a 7-day skip timer can be supplied with the RAC 3-Gas Sampler as optional accessories. The 24-hour timer has permanently attached trippers that provide up to 96 on-off cycles in 15-minute increments over a 24-hour period. The 7-day skip timer permits settings one week in advance and has 14 trippers that provide minimum sampling cycles of 3 hours and maximum cycles of 7 days. Both timers are attached to the shelter hinged lid and positioned in the pump compartment.

## OPERATION

In operation, the vacuum pump draws ambient air in through the conical rain shield and inlet tube (the rain shield is inverted to prevent precipitation from entering the sampling device). The inlet manifold divides the air stream into equal volumes that flow through Teflon tubing to the bubblers. Each bubbler has a 2-hole cap with a standard glass bubbler tube, either constricted or fritted, on the inlet port. The sample air passes through these tubes into 50ml of reagent contained in each bubbler.

After bubbling through the reagent, the air exhausts through Tygon tubing connected to the outlet port in the cap. Each sample stream then passes through another polypropylene bubbler containing a foam demister followed by a membrane filter. This dual-trap arrangement protects the critical orifices from moisture or other entrainments and helps to maintain continuous full-flow operation for optimum sampling efficiency. The scrubbed air streams then flow through the critical orifices to the exhaust manifold and are discharged through the pump.

In this instrument, contaminate gas samples contact only polypropylene, Teflon or glass before entering the absorbing reagents. This design concept provides for optimum sample collection. All materials in contact with the sample stream are widely recognized for their non-contaminating characteristics when used in a broad range of air pollution instrumentation.

After a sampling cycle is completed, the sampling train assembly is removed from the shelter. The reagent tubes are removed from the rack and the 2-hole caps are replaced with solid, leak-tight, threaded caps. These then are taken to a laboratory for analysis of contents according to appropriate procedures. Tubes containing thermally unstable gas samples, such as SO<sub>2</sub>, should be transmitted in refrigerated containers.

## Specifications:

<b>Vacuum Pump</b>	1/6 hp, 1.8 cfm free flow
<b>Electrical</b>	110V/60Hz, 3.7 amp; 220V/50Hz, 1.9 amp
<b>Dimensions, H x W x D</b>	27 x 18 x 14-inches (70 x 46 x 36cm) with legs extended
<b>Weight</b>	33 pounds (15kg) without timer
<b>Timer Weights</b>	24-hour: 3 pounds (1.4kg); 7-day: 6 pounds (2.7kg)

## Ordering Information

209068	3-Gas Sampler, All-Weather Shelter with Glass Orifices, 110V/60Hz
209097	3-Gas Sampler, All-Weather Shelter with Glass Orifices, 220V/50Hz
992424	24-Hour Timer, 110V/60Hz
209047	24-Hour Timer, 220V/50Hz
992425	7-Day Mechanical Skip Timer, 110V/60Hz
992408	7-Day Mechanical Skip Timer, 220V/50Hz
992113	Orifice Calibration Kit, 110V/60Hz
209002	Orifice Calibration Kit, 220V/50Hz
994083	Orifice Calibration Kit Flowmeter Only
209039	100ml Yellow Poly Tube with Shipping & 2-Port Caps
209041	100ml Green Poly Tube with Shipping & 2-Port Caps
209042	100ml Orange Poly Tube with Shipping & 2-Port Caps

990818	Tube Retaining Spring
991596	Pump, 110V/60Hz
950-5051	Pump, 220V/50Hz
992458	Duplex Receptacle Only
994064	Demistor Sponge
994088	Poly Inlet Tube
994091	Poly Butt Connector
994129	Poly Demistor Tube
994501	Box of 25, 37mm Filters with Back-Up Pads
994538	Membrane Filter Holder, 2-piece
995241	Cabinet Support Leg
997015	Pack of Five (5) Glass Impinger Tubes, 54/55 Drill Size
997018	Glass Fritted Tube for NOx
997589	Corrugated Teflon® Tubing with One (1) Cap
997605	Poly Inlet Funnel
997818	Corrugated Teflon® Tubing with Two (2) Caps
998135	Vacuum Gauge Only, 0 to 30-in. Hg
998145	Quick-Connect Connector
998163	1/4-inch Hose Barb x 1/4-inch MPT
998176	Calibrated Glass Orifices, 0.2 lpm, Pack of Five (5)
998176-0.5	Calibrated Glass Orifices, 0.5 lpm, Pack of Five (5)
209027	3-Gas Bubbler Rack
209092	3-Gas T.E. Heat Exchange Assembly
209095	3-Gas T.E. Power Module, 110V/60Hz
209096	3-Gas T.E. Power Module, 220V/50Hz
209025	3-Gas T.E. Module Complete, 110V/60Hz
209185	3-Gas T.E. Module Complete, 220V/50Hz
991601	Fan Motor Only
992183	Oven Heater Socket
992316	1.5 Amp Fuse for 220V
992319	3 Amp Fuse for 110V
992321	7 Amp Fuse for 110V & 220V
992464	3-Gas Power Transformer Only, 110V/60Hz
992525	3-Gas Power Transformer Only, 220V/50Hz
992465	3-Gas Choke
992466	3-Gas Bridge Rectifier
992467	3-Gas Relay, 110V/60Hz
992550	3-Gas Relay, 220V/50Hz
996531	3-Gas T.E. Module Heat Sink
993476	3-Gas Condenser
992477	3-Gas Heater Lamp
994181	3-Gas Fan Plastic Blade
995214	3-Gas Bubbler Tube Rack Only
996533	3-Gas Heater Shroud
996535	3-Gas Heater Deflector
996543	3-Gas Exhaust Manifold
997104	3-Gas Glass Inlet Manifold
997765	3-Gas Fan Aluminum Blade