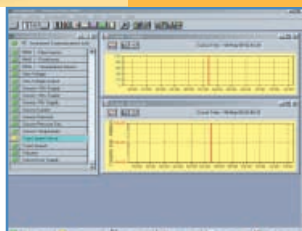


The Thermo Scientific Sentinel  $\delta$ B sets a new standard for fast, reliable and flexible environmental analytics. It reliably monitors multi-component VOCs in seconds and enables immediate chemical leak detection for improved plant safety. A rugged design along with infrequent calibration ensure maximum uptime.

## Thermo Scientific Sentinel $\delta$ B Environmental Mass Spectrometer



### Features and Benefits

- Parts per billion detection provides early warning of toxic buildup
- Fast, species-specific analysis limits false alarms
- Standard 64 port inlet for wide-area monitoring
- Flexible communications to ensure plant alarm system compatibility
- Infrequent calibration for maximum uptime
- Rugged design supported by industry-best warranty
- Ergonomic design for ease of maintenance

### Unsurpassed Performance

Backed by more than 25 years of proven magnetic sector technology success, the Thermo Scientific Sentinel  $\delta$ B offers unmatched analytical performance. It measures in parts per billion (PPB) to provide early warning of toxic buildup and offers fast, species-specific analysis to limit false alarms. With hundreds of systems operating at chemical plants worldwide, we have developed application expertise that is both broad and extensive. Whether your requirement is to protect the workforce from toxic organic compound leaks or to provide exposure data for regulators, the Sentinel  $\delta$ B provides accurate, reliable data to help you optimize your operations as well as maintain a safe work environment.

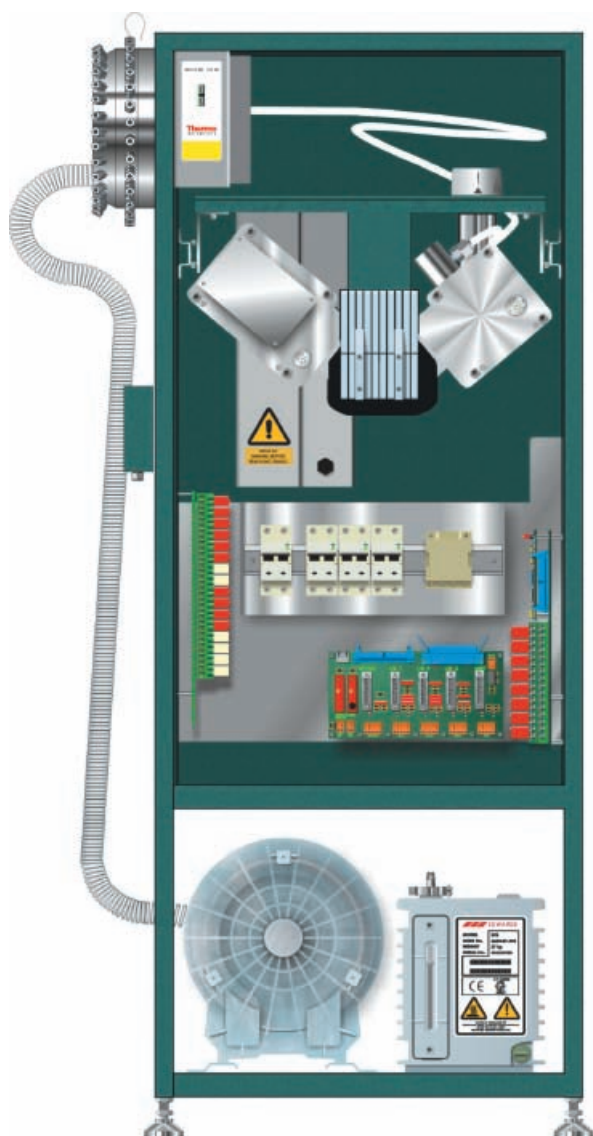
### Atmospheric Monitoring Applications

- PVC Production – Vinyl Chloride Monomer
- ABS Polymer Resins – Acrylonitrile, Butadiene, Styrene
- Pharmaceutical – Chlorinated Solvents
- Semiconductor – Halogenated Organic Compounds
- Petrochemical – Benzene, Toluene, Xylene
- Paint Manufacturing – Organic Solvents
- Epoxy Resin – Epichlorohydrin
- Synthetic Fibers – Dimethylacetamide
- Solvent use – Explosive limit analysis



### Thermo Scientific GasWorks Software

The Thermo Scientific GasWorks software suite provides an intuitive, information rich, and flexible window into the operation of the environmental analyzer. Initial setup uses the remote computer which can then be used to display air analysis and diagnostic data, or it can be unplugged leaving the Sentinel  $\delta$ B to operate in full stand-alone mode. From conceptual design through several generations of production, fully accredited ISO 9001 quality procedures have been rigorously enforced by our software team, resulting in a best-in-class software package.



### Inlet Bay

A variety of sample inlet configurations is available, depending upon the number of sample points to be monitored. The illustration shows the ultra-reliable 64-port Thermo Scientific Rapid Multi-stream Sampler (RMS) that uses a high-flow Roots Blower to draw sample air down plastic tubing at high velocities assuring fast response to sub ppm concentrations of toxic volatile organic compounds.

### Analyzer Bay

The analyzer is a fast and highly stable scanning magnetic sector mass spectrometer that generates a high energy ion beam from the sample gas. This ion beam is separated into its constituent molecular fragments by the electromagnet and the signal intensity is measured by the auto-zeroing amplifier. A series of distributed micro controllers provide complete automatic control of the process without requiring any manual interventions.

### Communications Bay

Data communication is provided by a series of fully redundant gateways that can be independently configured for optimum communication with the DCS or SCADA system. Many data highway protocols can be supported by use of an integral protocol converter and discrete contacts, or analog signals, can be connected to PLCs for various control and alarm purposes.

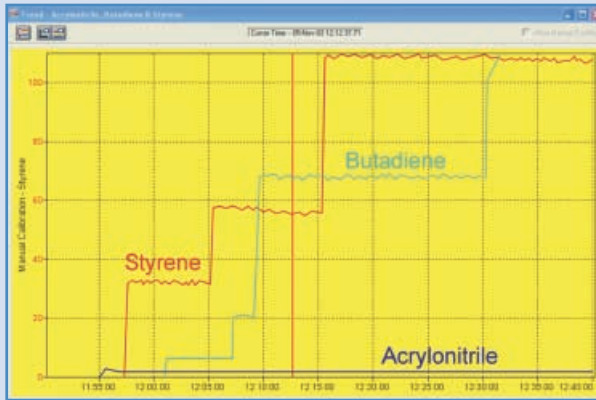
### Pump Bay

The Sentinel  $\delta$ B enclosure is available with a variety of temperature control and purge options to ensure that the analyzer provides reliable service in the most demanding environments. The entire system has been designed with the maintenance engineer in mind. The analyzer bay slides forward for all-around access, and the pumps are situated for easy inspection and oil changing.

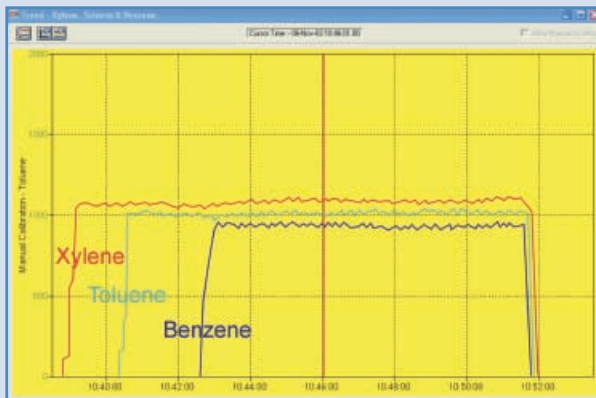
### Sensitivity and Selectivity

The Sentinel  $\delta$ B can monitor, at ppb levels, the majority of volatile organic compounds used in industry today. Sensitivity is approximately 10 to 100 times greater than that required by most legislative bodies, ensuring that the Sentinel  $\delta$ B will not become obsolete when legislation demands lower exposure limits. An

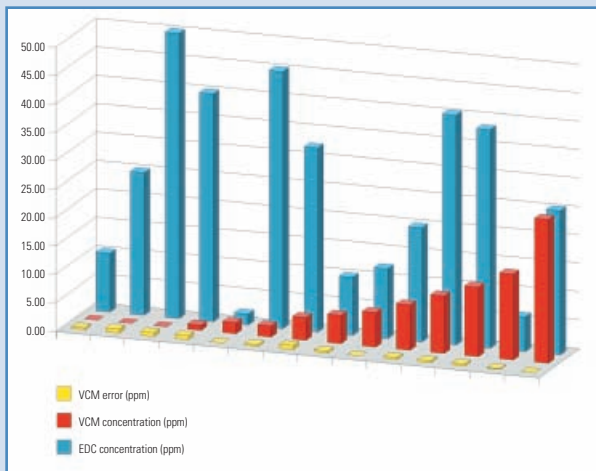
additional benefit is toxic leaks from valves and flanges can be detected and corrected before they start to cause a serious health hazard. The highly stable and precise nature of the measurement provided by the magnetic sector ensures that specific compounds are identified without the false alarms that are often associated with less specific technology.



**Monitoring 2 ppm of acrylonitrile in the presence of increasing levels of butadiene and styrene.**



**Xylene, toluene, and benzene monitoring at 1 ppm with no cross interference.**



**The spectra for VCM and EDC are very similar; therefore, there is a danger that safe levels of EDC might trigger false VCM alarms. The VCM error stays below 1 ppm for various injected combinations of VCM and EDC.**

### Versatility

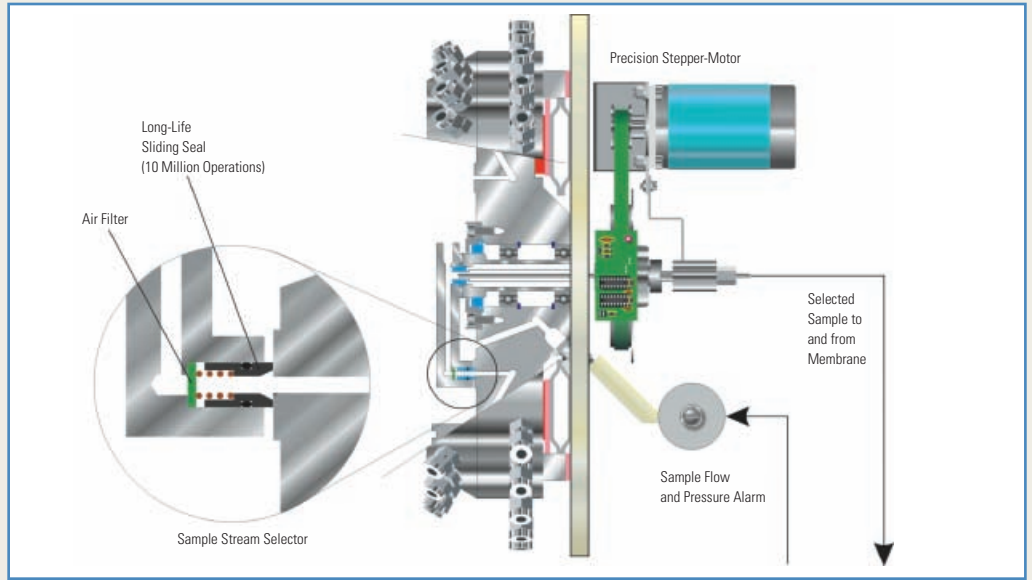
To demonstrate the versatility of the Sentinel  $\delta$ B, listed below are examples of the compounds which can be detected in the 0.01 to 1 ppm range.

- Acetone
- Acetonitrile
- Acrylonitrile
- Benzene
- Butadiene
- Carbon disulfide
- Carbon tetrachloride
- Chloroform
- Chlorobenzene
- Cyclohexane
- Dichloromethane
- Dimethylacetamide (DMAC)
- Dimethyl formamide (DMF)
- 1,4-Dioxane
- Epichlorohydrin
- Ethyl benzene
- Ethyl lactate
- Freons
- Hexamethyldisilazane
- Methyl bromide
- Methyl ethyl ketone
- Methyl iodide
- Methyl isobutyl ketone
- Methyl methacrylate
- 1-Methyl-2-pyrrolidinone
- Methyl tertiary-butyl ether (MTBE)
- Propylene oxide
- Propan-2-ol
- Perchloroethylene
- Styrene
- Tetrahydrofuran
- Tetrachloroethylene
- Toluene
- Trichloroethylene
- Vinyl acetate
- Vinyl bromide
- Vinyl chloride
- Xylene

### Rapid Multi-stream Sampler (RMS)

One of the keys to the Sentinel's success has been the unique RMS sample stream selector, available with 32 or 64 ports. The zero dead-volume design allows fast flushing, typically 5 seconds, with zero crossover effects. A single system can therefore replace a whole rack of often less sensitive discrete detectors. With the launch of the latest Sentinel  $\delta$ B, a single system can be fitted with multiple RMS assemblies (up to four) for a maximum number of 253 inlets

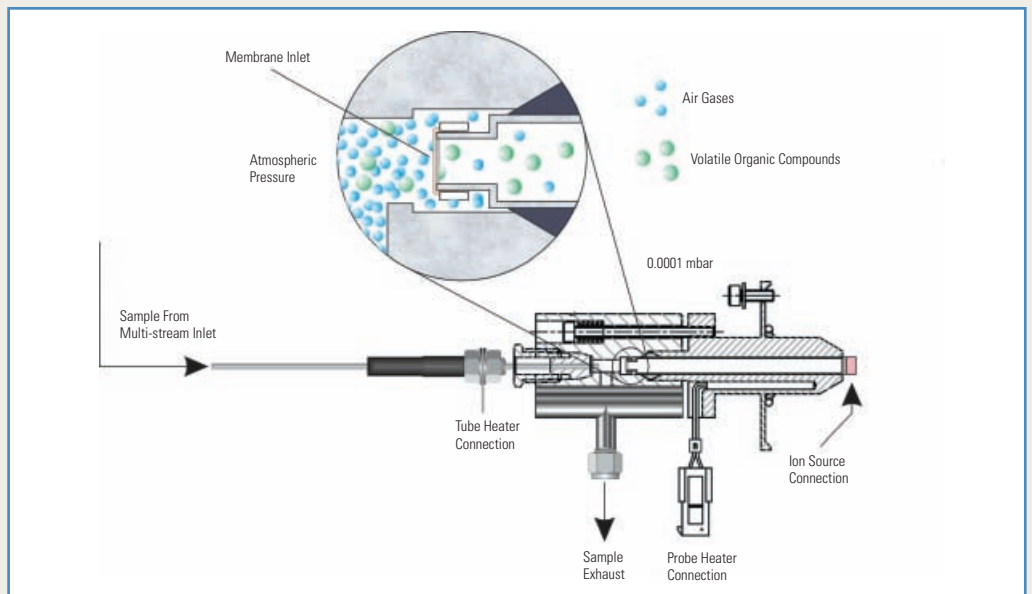
(249 sample + 4 calibration), enabling one Sentinel  $\delta$ B to provide complete site coverage. The RMS includes a sample bypass design that permits a single flow detector to monitor each of the streams, providing a system alarm in the event that a filter becomes plugged or liquid blocks a sample tube. The ultra-reliable RMS comes with a standard 3-year warranty. This corresponds to over 10 million operations for a typical installation. No other multi-point inlet offers such an extended warranty.



### Membrane Inlet

The Sentinel  $\delta$ B is fitted with a membrane inlet which reduces the pressure of the sample air from atmospheric to the working pressure of the mass spectrometer's enclosed ion source (typically  $10^{-4}$  mbar). A membrane inlet system is used because this method of sample introduction greatly enhances the system's sensitivity to volatile organic compounds (VOC). For the majority of VOCs, sub ppm detection limits are routinely achieved, which means the system will accommodate future

changes in legislation. Since the Sentinel  $\delta$ B membrane is more permeable to volatile organic compounds than to the major air gases, it can often provide enrichment by several orders of magnitude. For example, a benzene detection limit of  $<0.01$  ppm is routinely achieved. The heated inlet probe assembly is engineered to provide a stable, representative sample for introduction into the ion source of the mass spectrometer. The ergonomic design of the probe permits easy membrane replacement during annual routine maintenance.



### Scanning Magnetic Sector Mass Spectrometer

Mass spectrometers operate by ionizing neutral molecules or atoms and they separate these components according to the mass to charge ratio. The ionization is carried out by bombarding the gas sample with an electron beam from a hot filament. The technique chosen to separate the ions in the Sentinel  $\delta$ B system is the variable magnetic sector.

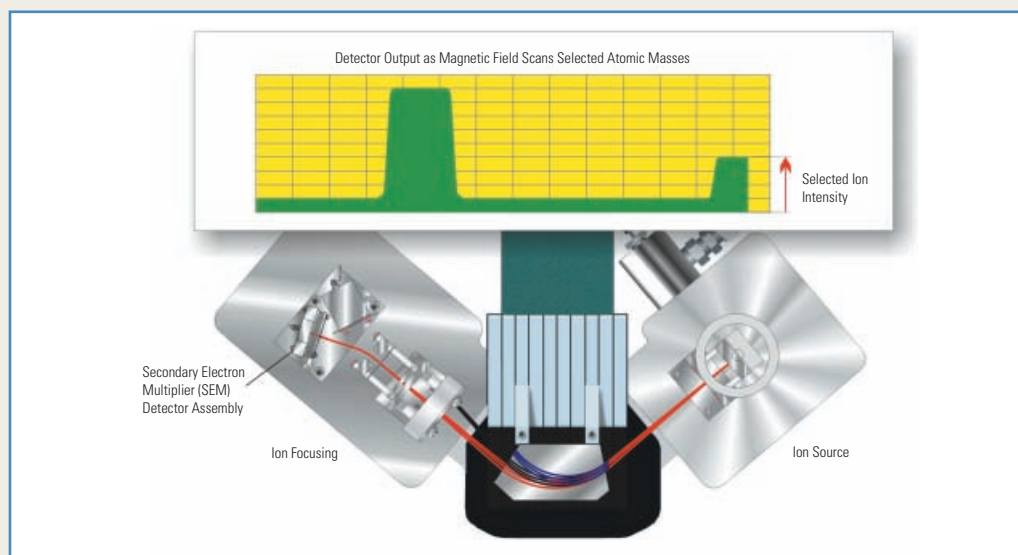
In the magnetic sector analyzer, the trajectory of the ions is controlled by a variable magnetic field, allowing ions of interest to be sequentially collected onto a single detector. Thus, the Sentinel  $\delta$ B is able to scan the air sample to identify both known and unknown species. The advantage of this type of analyzer is that it produces flat-topped peaks where the intensity of the peak is proportional to the concentration of the gas. This optimum peak profile provides the most stable and precise method for measuring the VOC concentration and significantly improves specificity when there are

overlaps in the mass spectra of several gases.

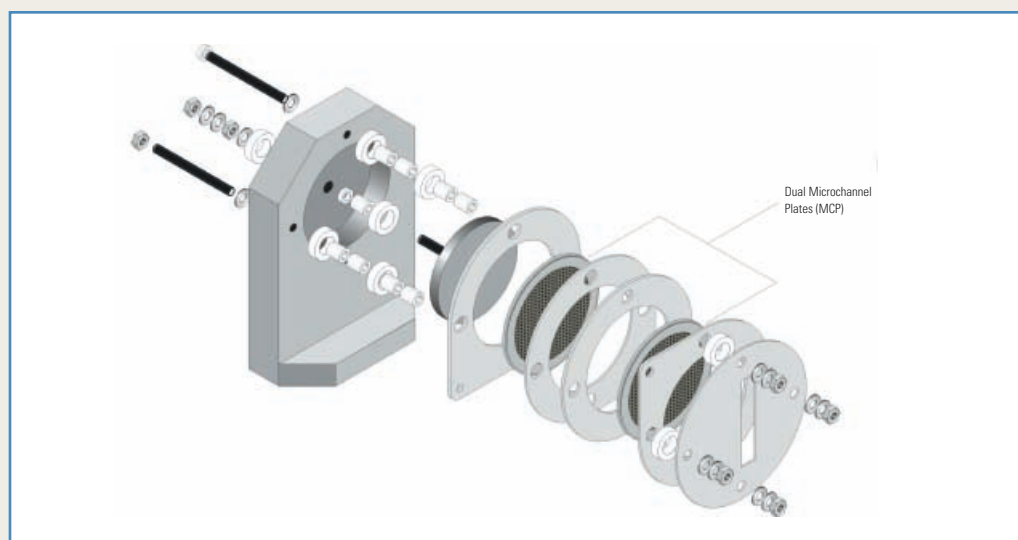
The Sentinel  $\delta$ B mass spectrometer also benefits from a variable ion energy supply that allows the mass range to be adjusted to match the VOCs that are selected for analysis. The benefit from this is that the width of the peak is maximized which guards against drift effects.

In order to maintain the optimum peak profile and provide maximum sensitivity, dual microchannel plates (MCP) have been selected as the standard secondary electron multiplier configuration. This arrangement permits the MCPs to be operated at a relatively low voltage which extends their useful life and improves signal to noise ratio.

The measured signal is processed by modern, surface-mount electronics and the calculated concentrations are stored in battery-backed 'flash' memory that can be accessed directly using a variety of industry standard protocols.



**Magnetic Sector Mass Spectrometer**



**SEM Detector Assembly**

All the above drawings are included in the Wizard interactive manual

## Thermo Scientific Sentinel $\delta$ B – Environmental Mass Spectrometer

General Specifications	
Measurement Method	Scanning Magnetic Sector Mass Spectrometer
Mass Range @ 1,000 V Ion Energy	1 – 150 atomic mass units
Mass Range @ 500 V Ion Energy	1 – 300 atomic mass units
Lower Detection Limit	10 ppb typical, may vary with gas matrix
Precision @ 10 ppm (typical)	All readings within 0.5 ppm of calibrated value (24 hrs)
Stability (typical)	Better than 10% relative over 1 month (no calibration)
Analysis Time (typical)	0.3 – 1.0 seconds per gas component (configurable by software)
Ambient Temperature	12°C – 25°C (12°C – 35°C optional)
Dimensions (standard config.)	1.5 m x 0.7 m x 0.65 m (300 Kg approximately)
Power (standard config.)	115/230 VAC, consumption 1500 VA
Area Classification Options	General Purpose, Z-purged division 2 (optional), X-purged division 1 (optional), CENELEC/ATEX Zone 1, IIC T3 (optional)
Maximum Number of Components	Not limited by software
Maximum Number of Peaks per Component	Not limited by software
Maximum Number of Derived Values	Not limited by software
Maximum Number of Methods	Not limited by software
Maximum Number of Sequences	Not limited by software
Maximum Number of Analog Inputs & Outputs	No Fixed Limit
Maximum Number of Digital Inputs & Outputs	No Fixed Limit
Maximum Number of Trend Windows	No Fixed Limit
Maximum Number of Sample Streams	249
Directly Supported Protocols	Modbus, Siemens 3964, Siemens 3964R, VGCP, PVGCP, DDE, OPC
Additional Available Protocols	Modbus+, Allen Bradley DH, Allen Bradley DH+, Profibus
Serial Connections	RS232/422/485

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