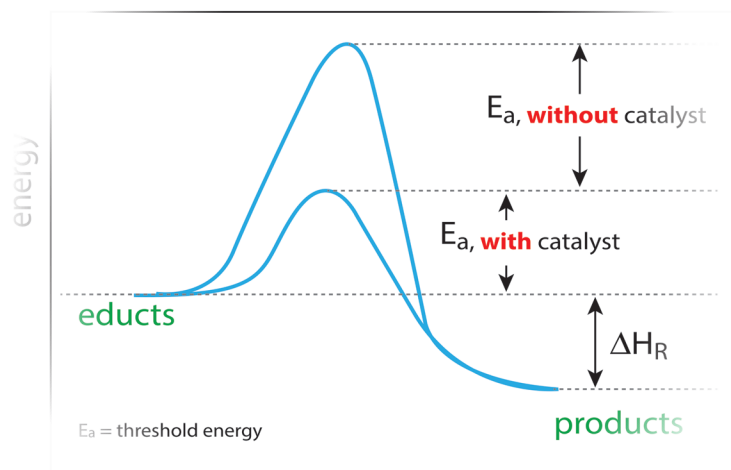


Gas Analysis



CAPABILITIES



Contents

For over 50 years, Extrel has specialized in providing gas analyzers that give great results. In all cases, success depends on two factors:

1. **Effective movement of the gas sample into the analyzer**
2. **Analytical capability of the detector used**

Pressure reducing inlets and multiplexing sample selectors must be specifically matched to the application. Also, the gas analyzer must have the right sensitivity, resolution, and flexibility to deliver the data that is required.

Coupled with the appropriate inlet, quadrupole mass spectrometers offer a range of features that make them ideal for applications as diverse as controlling gas compositions in a vacuum, isotopic ratio determination, and trace volatiles in exhaled breath samples.

This document lays out Extrel's full array of sample inlets and standard mass spectrometers. First, identify the inlet type matching the sample specifications, then choose the proper mass spectrometer based on analytical capabilities. Providing the ideal combination is what has made Extrel a leader in the world of high quality gas analysis instrumentation.

Sample Inlet Options pages 1-4

Gate Valve Options page 1

For sample pressures < 5 Torr

Capillary Options page 2

For sample pressures > 5 Torr

Multiport Stream Selection page 3

Differentially Pumped Inlet page 3

For fast clearing

Automated Pressure Control page 4

For variable pressure samples

Mass Spectrometer Options pages 5-6

MAX300-CAT page 5

High utility gas analyzer with the most compact benchtop footprint

MAX300-LG page 5

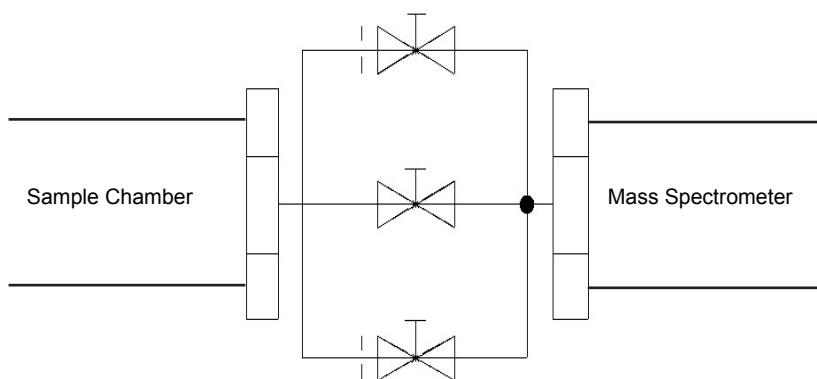
High sensitivity, high precision laboratory gas analyzer

VeraSpec-HRQ page 6

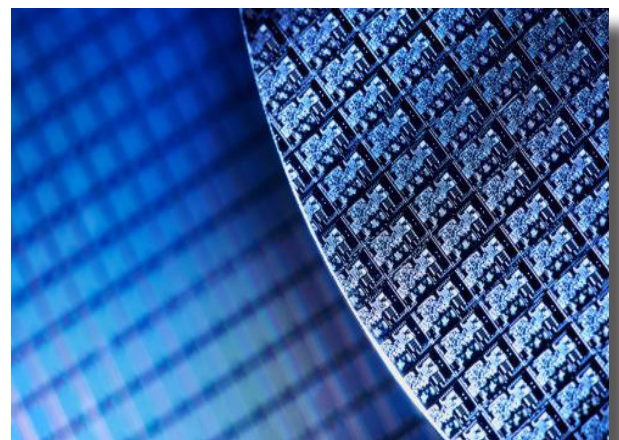
High resolution quadrupole mass spectrometer

Fixed Pressure Inlets

- Gate Valve for sample pressures $< 1 \times 10^{-4}$ Torr
 - For close-mounting to vacuum chamber
 - DN 40 CF (2-3/4") mounting flange
 - Manual or pneumatically operated
 - Chamber and mass spectrometer separable from pumping station for ease of installation
- Gate Valve with a Bypass for sample pressures between 1×10^{-4} and 5 Torr
 - For close-mounting to vacuum chamber
 - DN 40 CF (2-3/4") mounting flange
 - One or two discreet bypass paths equipped with pressure reducing orifices
 - A variety of orifices are available. Examples are:
 - 0.0001 to 0.002 Torr - 1500 micron
 - 0.002 to 0.03 Torr - 400 micron
 - 0.03 to 0.5 Torr - 100 micron
 - 0.5 to 5 torr - 30 micron
 - Manual or pneumatically operated with automatic switch-over between ranges
 - Chamber and mass spectrometer separable from pumping station for ease of installation



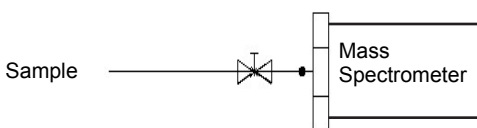
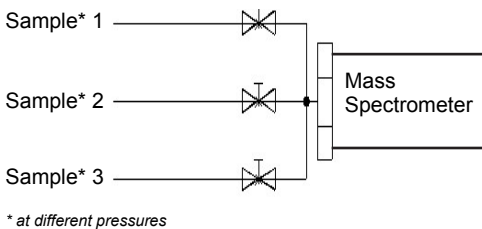
Gate Valve/Bypass Inlet Diagram



Applications

- Vacuum chamber diagnostics, outgassing, bakeout, pump performance, contaminants
- Vacuum processing
- Leak detection
- Plasma enhanced, low pressure, and metal organic chemical vapor deposition, reactive ion etching

- Capillary: 5-1000 Torr
 - Sized to allow sampling from a range of fixed pressures, from 5 to 1000 Torr absolute
 - Options for one, two, or three capillaries entering the inlet flange
 - Standard and custom capillary lengths available
 - Heated and unheated options available

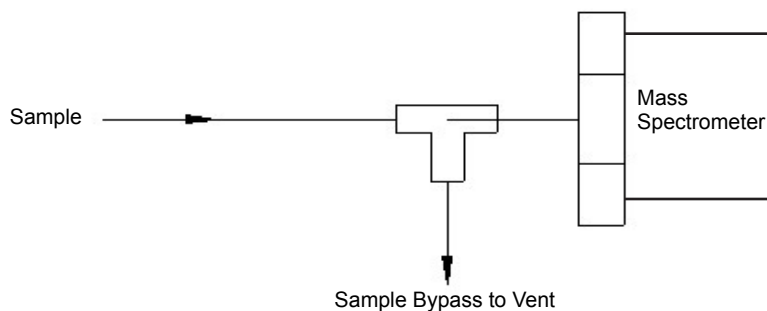


Capillary Inlet Diagram

Applications

- Multipoint process sampling
- Upstream and downstream comparison
- Optimized for evolved gas analysis from TGA equipment
- Chemical vapor deposition, metal organic chemical vapor deposition, atomic layer deposition

- Direct Inlet with Bypass: Measuring from a flowing gas at, or above, atmospheric pressure
 - Short capillary built into chamber inlet flange
 - Bypass tee mounted on inlet flange
 - Heated and unheated options available



Direct Inlet with Bypass Tee Diagram

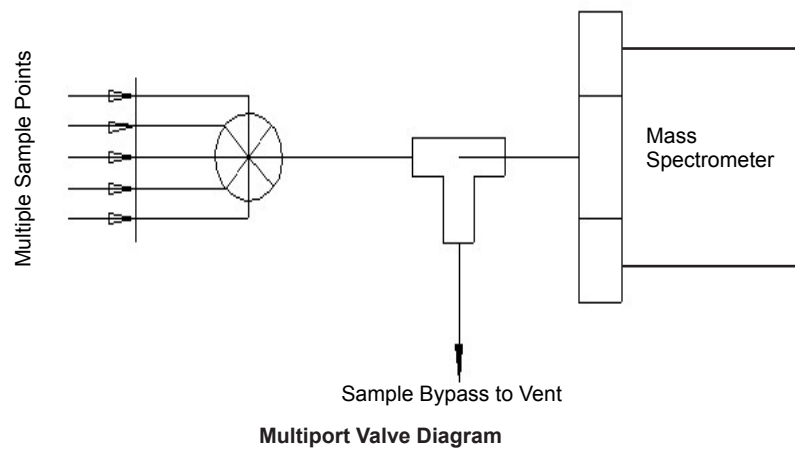
Applications

- Thermal analysis/TGA-MS
- Analysis of flowing gas streams
- Chemical vapor deposition, metal organic chemical vapor deposition, atomic layer deposition

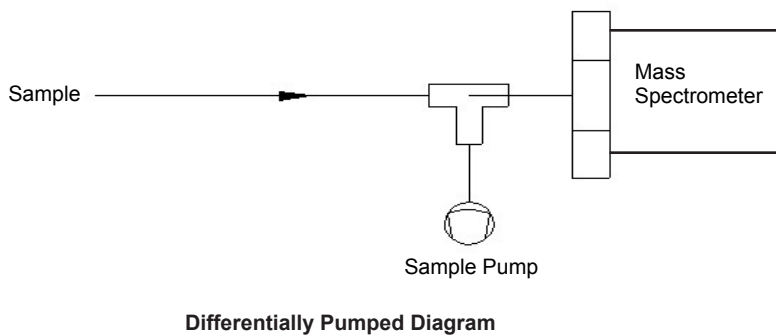
- Multiport stream selection for measuring from several points of a flowing gas at, or above, atmospheric pressure
 - Multiport valves available, from 4 to 32 ports
 - Used with direct inlet and bypass tee
 - Heated and unheated options available

Applications

- Pharmaceutical reactors
- Bioreactors
- Multipoint gas purity
- Air quality measurements
- Multi-stage process monitoring



- Differentially Pumped Inlet for fast clearing
 - Versions available for thermogravimetric and evolved gas analysis
 - Typical transit times $\ll 1$ second
 - Heated or unheated options available



Applications

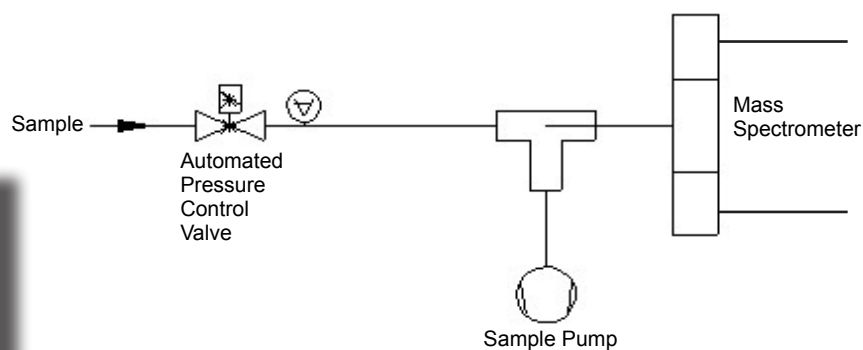
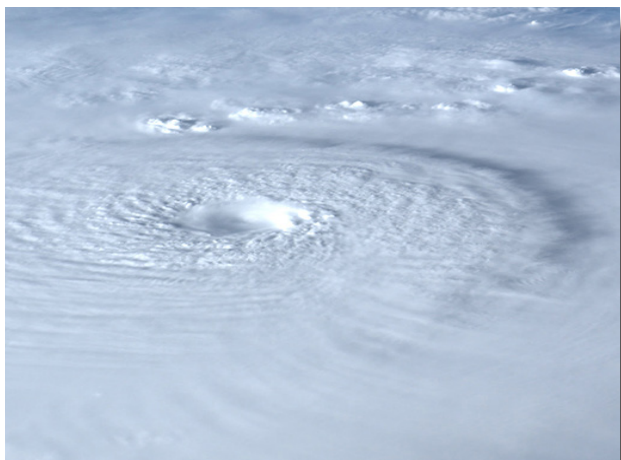
- Thermal analysis/TGA-MS
- Bioreactors
- Ambient pressure process gas analysis
- Combustion analysis

Variable Pressure Inlets

- Active pressure control for varying sampling pressures over the range 5 Torr-Atmosphere
 - Actively maintains constant pressure within the mass spectrometer as the sample pressure changes
 - Utilizes a separate sample pump
 - Multiport sample selection available

Applications

- Pharmaceutical drying
- Bioreactors
- Pump down monitoring
- Altitude studies



Variable Pressure Inlets

Mass Spectrometer Models

The MAX300-CAT, MAX300-LG, and VeraSpec-HRQ gas analyzers accommodate various levels of research complexity. Each unit can be enhanced with different options of mass range and detector, customized to the requirements of the application. Contact an Extrel representative to discuss which mass spectrometer and inlet are the right choice for your application:

- **MAX300-CAT Benchtop Gas Analyzer**

The MAX300-CAT is a small footprint benchtop gas analyzer, suitable for dynamic gas samples in a wide range of applications.

- Mass range options: 1-100, 300 Dalton
- Quadrupole rod diameter: 6 mm
- Quantitative analysis rate: 1-5 seconds/component
- Number of components: Unlimited
- Detection limits*:
 - Faraday only configuration: 10 ppm
 - Electron multiplier: 50 ppb
- Precision (% RSD)**: 0.5
- Stability/precision over 30 days continuous analysis (% RSD): 1.5



MAX300-CAT Benchtop Laboratory Gas Analyzer

- **MAX300-LG Laboratory Gas Analyzer**

The MAX300-LG mass spectrometer is the best option where precision, repeatability, and absolute quantitative measurements are key.

- Mass range options: 1-100, 300, 500 Dalton
- Quadrupole rod diameter: 19 mm
- Quantitative analysis rate: 0.1 seconds/component
- Number of components: Unlimited
- Automated detector switching within a single scan
- Detection limits*:
 - Electron multiplier: 10 ppb
 - Membrane inlet option (MIMS): 0.01 ppb
- Precision (%RSD)**: 0.25
- Stability/precision over 30 days continuous analysis (% RSD): 0.5



MAX300-LG Laboratory Gas Analyzer

* Matrix dependent

** Based on the analysis of 1% argon

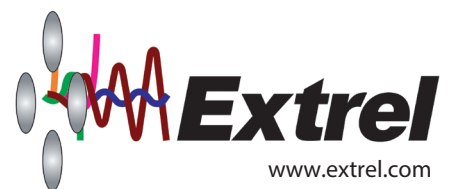
- VeraSpec-HRQ High Resolution Quadrupole Mass Spectrometer

The VeraSpec-HRQ delivers exceptional flexibility, resolution, ion transmission, and abundance sensitivity for the fine isotopic analysis of low molecular weight gases.

- Mass range options: 1-50, 250 Dalton
- Quadrupole rod diameter: 19 mm
- Resolution: 4000 M/ Δ M FWHM at m/z 2
- Abundance sensitivity: 10^7



VeraSpec-HRQ High Resolution Quadrupole Mass Spectrometer



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