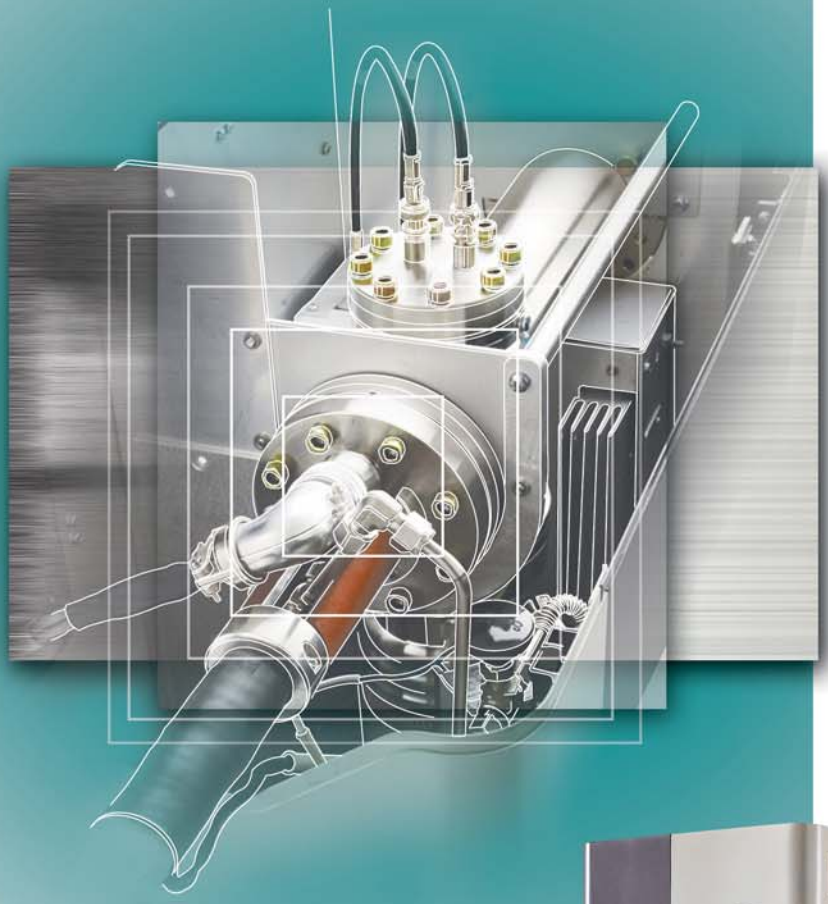
EVOLVED GAS ANALYSIS

MAX300 EGA

PRODUCT NOTE



Extrel
Core Mass Spectrometers

MAX300-EGA

PRODUCT NOTE

Introducing the MAX300-EGA™, the latest system from Extrel® optimized for Evolved Gas Analysis. A part of the MAX300 family, the MAX300-EGA features Extrel's industry-leading 19 mm quadrupole. Combining this mass filter with high-temperature, rapid sampling and the knowledge and experience of a company that has been providing mass spectrometry solutions since 1964, the MAX300-EGA brings the precision, speed and flexibility you need for your evolved gas application.

By coupling a quadrupole mass spectrometer to a thermogravimetric analyzer, or differential scanning calorimeter, the off-gas of the furnace can be characterized, identifying the molecule associated with each mass loss. Using the MAX300-EGA to monitor the outflow of a microreactor, or reaction headspace, researchers can quantify components leaving the system in the gas phase. The MAX300-EGA can provide vital insight into the underlying processes at work in your lab.

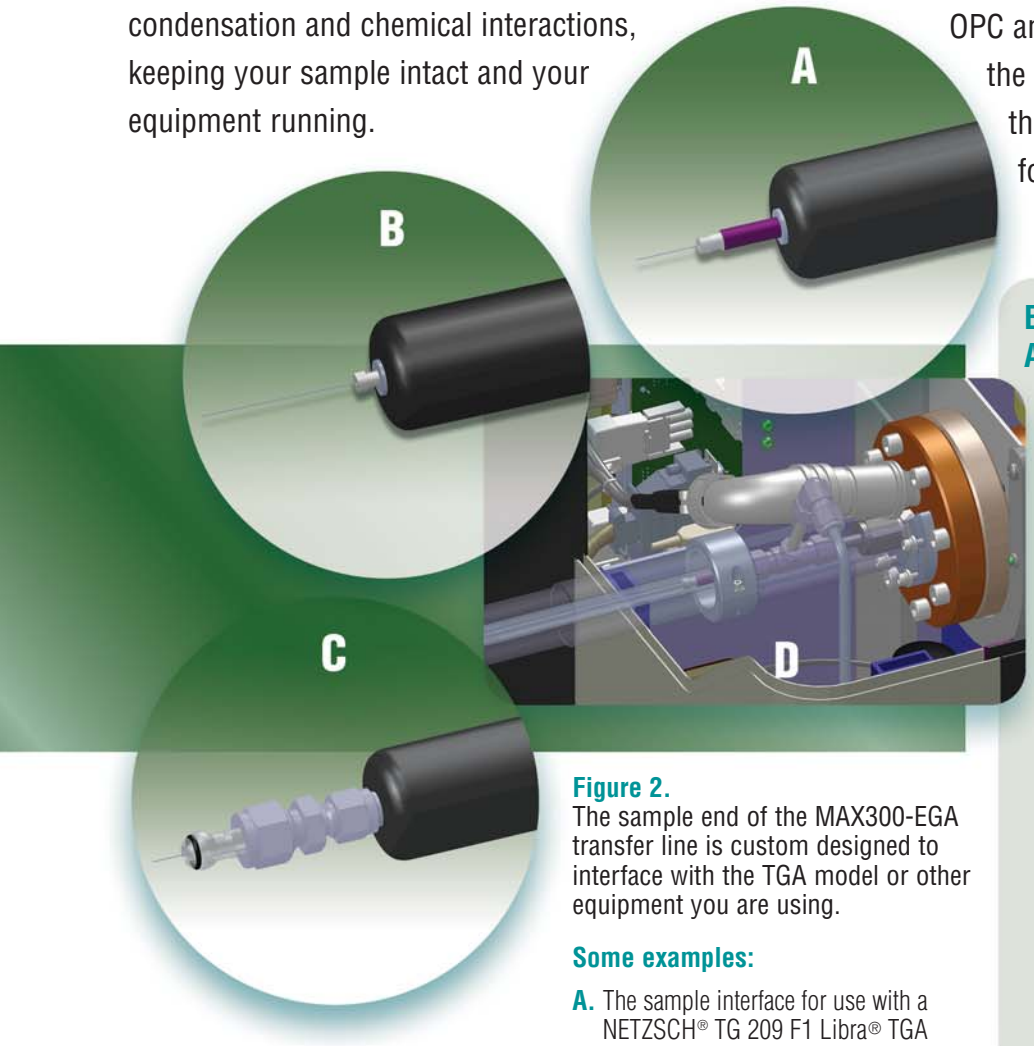
Evolved Gas Analysis (EGA)

Evolved Gas Analysis (EGA) is the analysis of the effluent of analytical equipment and chemical processes. Whether the off-gas is coming from a thermal analyzer or a reaction vessel, the most important consideration is protecting the sample integrity all the way to the mass spectrometer. The inner capillary of the MAX300-EGA's

Figure 1.
The MAX300-EGA, a quadrupole mass spectrometer optimized for Evolved Gas Analysis

low-volume transfer line is made of chemically-inert silica. It is heated to 200°C, standard,* and differentially pumped to rapidly move sample and keep it under vacuum. This prevents condensation and chemical interactions, keeping your sample intact and your equipment running.

In addition to the heated interface, the MAX300-EGA is factory configured for data syncing and sharing. The ability to input and output digital and analog signals, as well as communicate with OPC and serial protocols, means that the Questor5 control software has the flexibility to get you data in the form you need.



*300 and 400°C options available

Figure 2.
The sample end of the MAX300-EGA transfer line is custom designed to interface with the TGA model or other equipment you are using.

Some examples:

A. The sample interface for use with a NETZSCH® TG 209 F1 Libra® TGA

B. The sample interface for use with a TA Instruments® Q5000IR TGA

C. The sample interface for use with a PerkinElmer® Pyris™ 1 TGA

D. The transfer line is designed to eliminate cold spots and pull sample quickly into high vacuum

Evolved Gas Analysis Applications:

- **Thermogravimetric-Mass Spectrometry (TGA-MS)**
  - Pharmaceuticals
  - Materials Science
  - Plastics
- **Microreactors/ Continuous Flow Systems**
- **Reaction Monitoring**
- **Organic Chemistry**
  - Natural Product Analysis
  - Synthesis Studies
- **Pilot Scale Process/R&D**
- **QA/QC**

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TGA-MS

Thermogravimetric analysis (TGA) is a powerful approach to the study of the thermal behavior of solid and liquid samples. The interface of TGA with a quadrupole mass spectrometer allows researchers to characterize and quantify the compounds in the off-gas in real-time along with each mass loss.

The MAX300-EGA comes equipped to import a start-of-heating signal from the TGA for easy data syncing and features a chemically-inert transfer line designed to guard against condensation and chemical interactions; it keeps the sample hot and under vacuum all the way to the ionizer.

Applications:

- **Materials Science**
  - Composites
  - Coatings
  - Adhesives
- **Pharmaceuticals**
  - Solvent Content
  - Formulations
  - Excipients
- **Plastics**
  - Elastomers
  - Thermoplastics

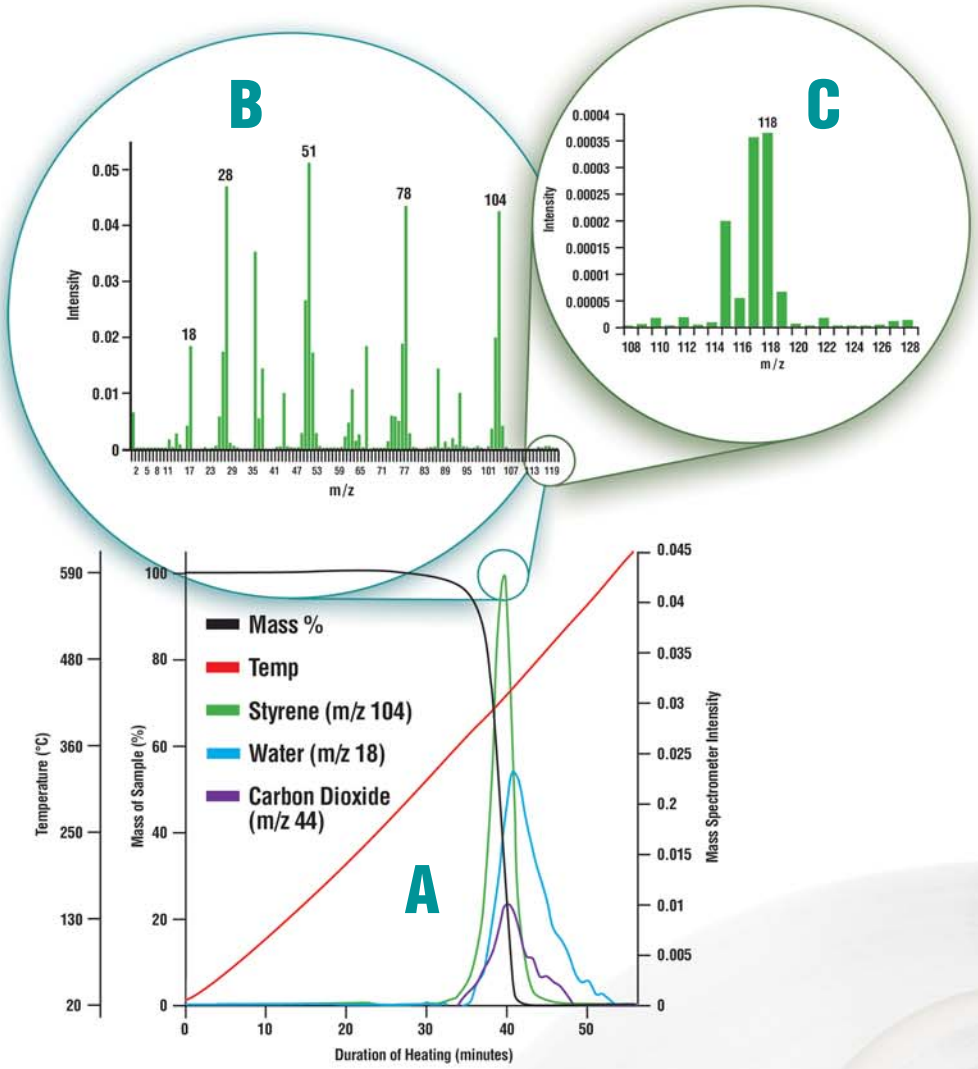

Figure 3.
The thermal decomposition of polystyrene

A. Mass loss data from the TGA shown with the intensity trends from the mass spectrometer. Water and carbon dioxide are shown leaving the sample along with styrene.

B. The mass spectrum of the evolved gas captured at 39.75 minutes. The peaks at m/z 18, 44, and 104 are from water, carbon dioxide, and styrene, respectively.

C. A portion of the mass spectrum, rescaled. The peaks at m/z 115-128 are from a styrene molecule still bound to a methyl group that has broken off of the parent molecule.

Reaction Monitoring

Understanding the dynamic composition of the gases released by continuous flow systems can reveal the mechanisms at work within the experiment. When energy or a reagent is added to a reaction, changes to the off-gas can occur instantaneously. The MAX300-EGA has the speed and sensitivity to detect even small shifts in the evolved fraction as they occur, allowing the researcher to characterize unknown samples, quantify solvent composition, and pinpoint reaction kinetics. The heated transfer line can interface with a wide array of equipment, and signals and data can be imported into the mass spectrometer for trending and calculation, or exported for manipulation on another platform.

Applications:

- **Microreactor/Continuous Flow Monitoring**
- **Headspace Analysis**
- **Organic Chemistry**
  - **Synthesis Studies**
- **R&D**
- **Catalysis Research**
- **Pilot Scale Process**

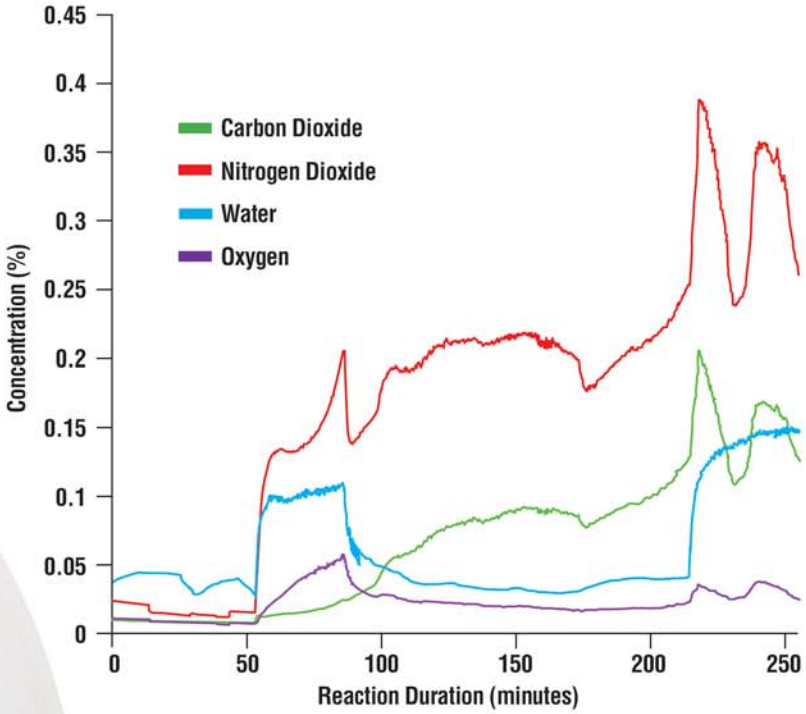

Figure 4.
Changes in the off-gas reveal events in the reaction vessel as they occur

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The MAX300-EGA

The MAX300-EGA features the precision, speed and flexibility of the Extrel MAX300 family, optimized for evolved gas analysis.

System Highlights

- **Heated transfer line**
  - Length: 2 m
  - 200°C standard
  - 300 and 400°C options available
- **Mass analyzer**
  19 mm quadrupole filter
- **Operating frequency**
  1.2 MHz
- **Mass range**
  1-200 amu standard
  - 1-300, and 1-500 amu options available
- **Detectable components**
  Any gas or vapor with a molecular weight or fragment ion within the mass range
- **Dynamic range**
  Can measure components from 100% to 10 ppb*
- **Ionizer**
  Disposable EI source
  - Plug and Play for ease of maintenance
  - Filaments: One active and one spare with automatic switchover

* As documented on trace analysis of benzene in air

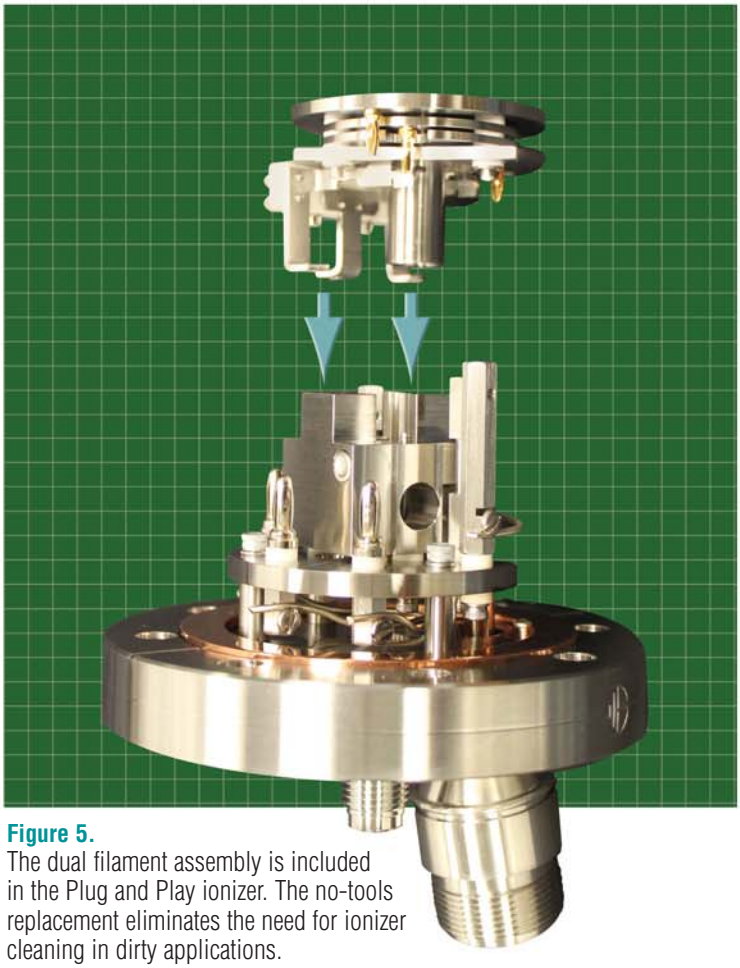

Figure 5.
The dual filament assembly is included in the Plug and Play ionizer. The no-tools replacement eliminates the need for ionizer cleaning in dirty applications.

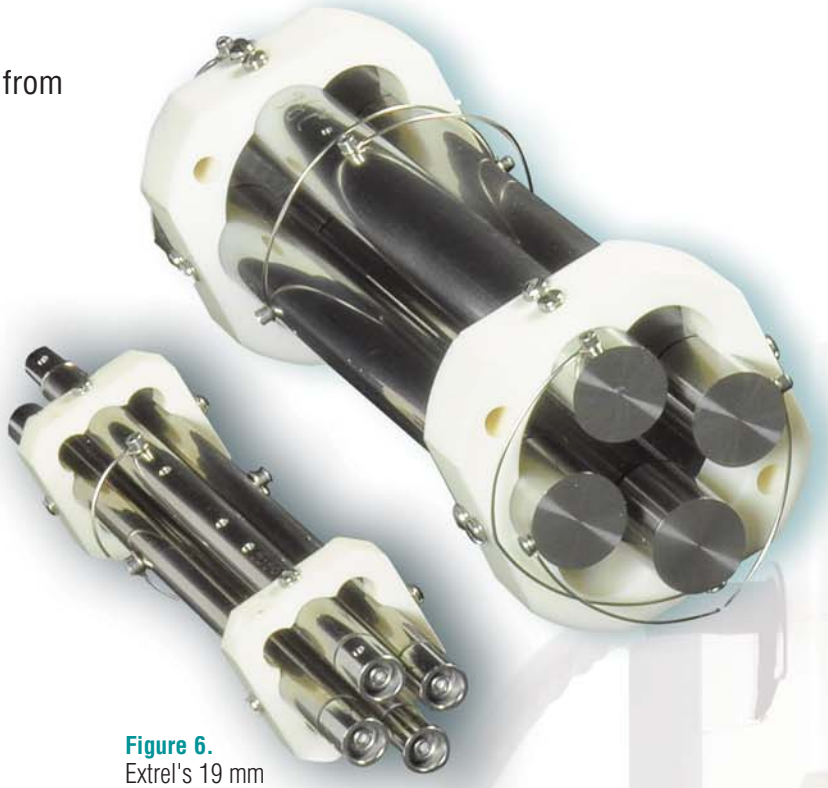

Figure 6.
Extrel's 19 mm quadrupole next to a 6 mm mass filter

The Extrel Questor5 Software

Powerful and intuitive, Questor5 is the perfect tool for gathering the qualitative or quantitative data you need.

System Highlights

- **Platform**
  Software runs on Windows® XP and Windows 7 Operating Systems
- **Extensive compound library**
  - NIST and other 3rd party database formats also supported
- **Configured standard for start-of-heating input**
- **Security**
  Meets government requirements for 21 CFR part 11
- **Quantitative analysis**
  - Analysis Rate: 400 milliseconds per component
  - Precision: ± 0.0025 absolute*
  - Stability: ± 0.005 absolute, over 30 days*
  - Flexible method design
    - Unlimited components
- **Sequence mode**
  Fully automated calibration, or Start-of-Batch
- **External communications**
  Ethernet, digital I/O, analog I/O, OPC, modbus serial

*Based on the analysis of a 1% argon sample

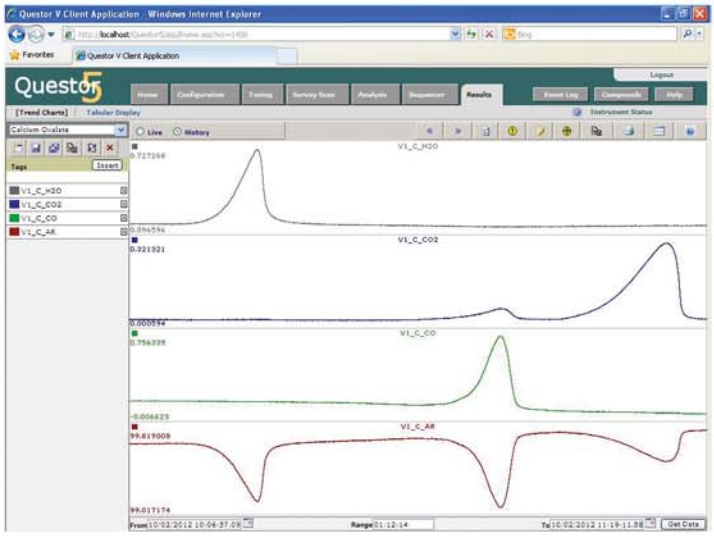

Figure 7.
Quantitative trending in real time

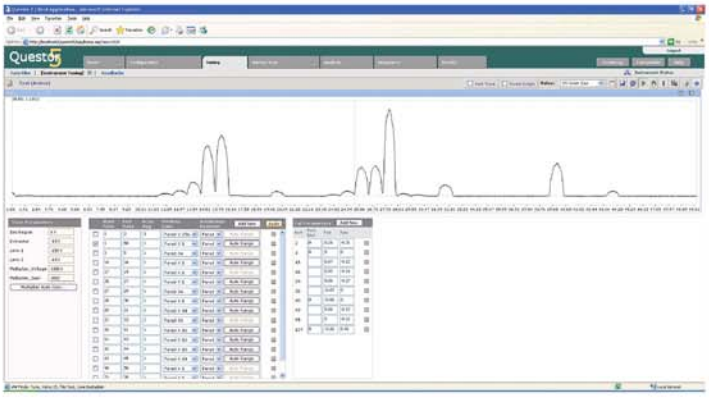

Figure 8.
Scan the entire mass range in seconds

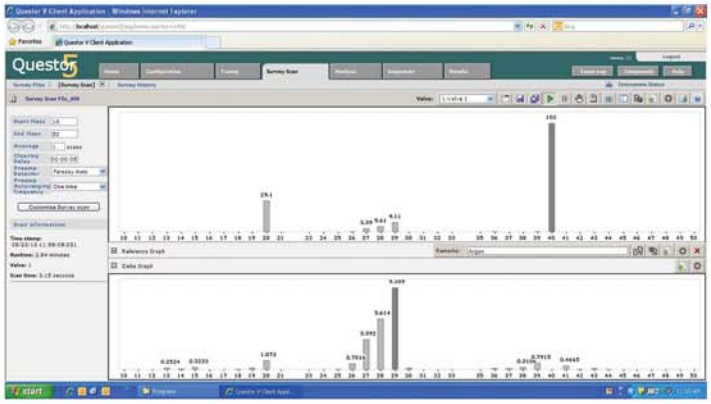

Figure 9.
Survey the off-gas for unknown compounds, match their spectra against the built-in library

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Application and Service Support

Since 1964 Extrel has worked hand-in-hand with analytical researchers and understands that each application has its own unique demands. Extrel has experienced salespeople, application scientists, and service engineers ready to provide support and solutions to customers worldwide.

System Overview

- **Mass Spectrometer for Evolved Gas Analysis**
  - 19 mm quadrupole filter
  - Mass range options: 1-200, 1-300, 1-500 amu
  - Qualitative characterization
  - Quantitative analysis
- **Evolved Gas Analysis applications**
  - Thermogravimetric Analysis-Mass Spectrometry (TGA-MS)
  - Pharmaceuticals
  - Materials science
  - Microreactors/continuous flow systems
  - Organic synthesis studies
  - Natural product analysis

Installation Requirements

- **Recommended power supply**
  - 110 VAC, 50/60 Hz, 10 A circuit
  - 220 VAC 50/60 Hz, 10 A circuit
- **Output power**
  - Nominal: 700 W
  - Maximum: 770 W
- **Ambient temperature**
  - 55-80°F (13-27°C)
- **Relative humidity**
  - 0-90% noncondensing
- **Area classification**
  - General purpose
- **Analyzer weight**
  - Approximately 165 lbs (75 kg)
- **Analyzer dimensions**
  - Height: 23.5" (60 cm)
  - Width: 26.5" (68 cm)
  - Depth: 19.0" (49 cm)

Extrel Core Mass Spectrometers
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QUALITY SYSTEM CERTIFICATION ISO 9001:2008
QUALITY MANAGEMENT SYSTEM CERTIFIED BY DNV
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