



Scientific / Metrology Instruments
GC Triple Quadrupole Mass Spectrometer

Solutions for Innovation

JMS-TQ4000GC

UltraQuad™ TQ



JEOL Ltd.

1985

Released the JMS-HX110/110 tandem double-focusing mass spectrometer. Outstanding MS/MS technology has made the JMS-HX110/110 an indispensable tool for many world-class research laboratories.

Evolution of MS/MS Technology



JMS-SX/SX102A



JMS-700T



2010

Matrix-Assisted Laser Desorption/Ionization TOFMS
JMS-S3000 SpiralTOF™ equipped with JEOL's proprietary SpiralTOF ion optics. Expandable to TOFTOF (option).



Innovative GC-Triple QMS Leads to a New Stage of Qualitative and Trace Quantitative Analysis

The JMS-TQ4000GC UltraQuad™ TQ is a GC-Triple QMS that implements JEOL's proprietary MS/MS technology while keeping the superior basic performance of JEOL's GC-QMS. The single quad mode can be used with the same ease of operation and versatility as our conventional single QMS, while the MS/MS mode can be used for a wide range of applications such as qualitative and quantitative analysis of trace components that are difficult to analyze with single QMS.

Evolution of QMS Technology



2003

Started sales of in-house developed QMS JMS-K9, which succeeded the design concept of our AUTOMASS.



JMS-Q1000GC

Highest SCAN sensitivity in its class



JMS-Q1000GC MkII

Further improvement of SCAN sensitivity



JMS-Q1050GC

Equipped with dual filaments



JMS-TQ4000GC UltraQuad™ TQ



JMS-Q1500GC

Implementation of new control software MSPRIMO™

Fusion of **MS/MS** and **QMS** technologies cultivated over many years

- Succession to the excellent basic performance of our single QMS
- Supports a wide range of measurements from fast and high-sensitivity MS/MS mode to single MS mode
- Capable of soft ionization methods (PI, CI, Low-energy EI) to improve the quality of qualitative analysis
- Uses the same control software "MSPRIMO™" and data analysis software "Escrime™" as the single QMS
- Provides easy data analysis with unique optional software
 - Integrated qualitative analysis software: msFineAnalysis iQ
 - Dedicated dioxin analysis software: TQ-DioK

Next-generation triple quadrupole mass spectrometer with advanced MS/MS technology

The JMS-TQ4000GC UltraQuad™ TQ is a next-generation triple quadrupole mass spectrometer equipped with a unique short-collision cell that enables accumulation and instantaneous ejection of ions, while keeping the superior technologies of JEOL's GC-QMS, such as a large, high-precision hyperbolic metal quadrupole with prefilter and high flow differential pumping turbo molecular pump.

High-precision hyperbolic metal quadrupole with prefilter

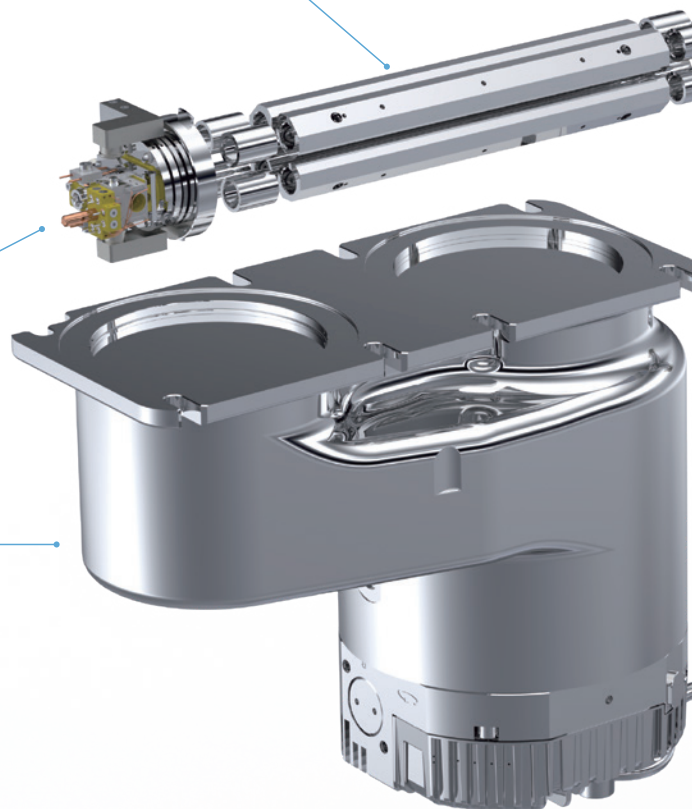
Hyperbolic quadrupoles have excellent ion permeability in the high m/z range and are resistant to ion loss (quench) even when large amounts of ions are introduced. The pre-filter prevents contamination of the quadrupole, which can cause a decrease in resolution and sensitivity.

Inert ion source chamber

The chamber is made of high-quality titanium, an inert material, enabling long-term stable measurement of ultra-trace amounts of components. No parts replacement is required when alternative carrier gases such as hydrogen or nitrogen are used.

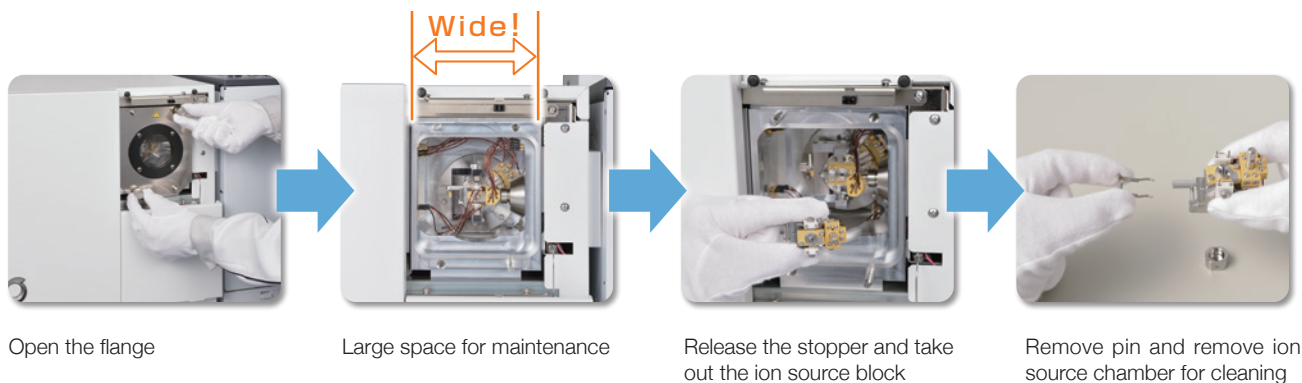
High flow differential displacement turbomolecular pump

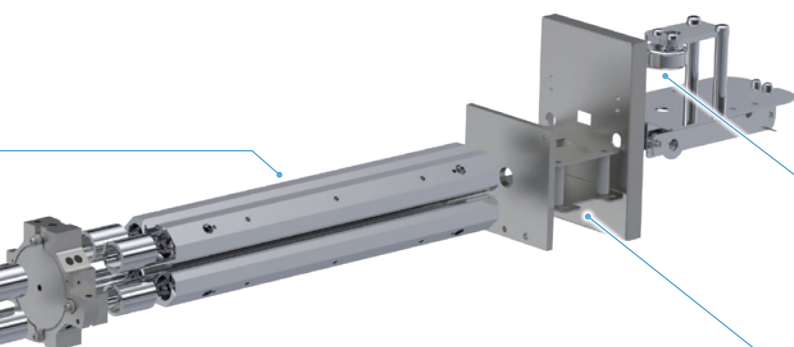
A stable high vacuum is achieved not only by using the largest vacuum pump in its class as a QMS, but also by positioning it in a way that maximizes its performance. The ion source and quadrupole are extremely clean because the introduced substances are quickly exhausted. This also contributes greatly to high sensitivity and high reproducibility.



Easy maintenance without tools

The ion source structure is almost the same as that of the JMS-Q1600GC, and the ion source block can be removed and installed without tools.





Secondary electron multiplier detector

A secondary electron multiplier detector, which is resistant to atmospheric degradation, is installed to maintain high performance for a long period of time.

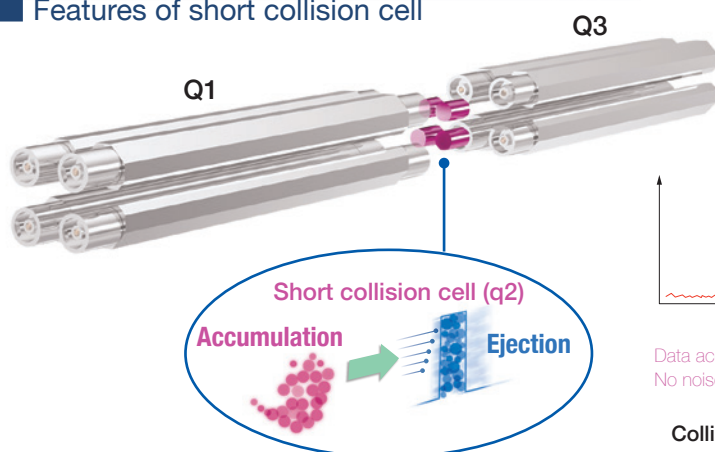
Parallel-plate electrostatic deflector

The deflector introduces only ions into the detector, thus suppressing noise caused by neutral particles.

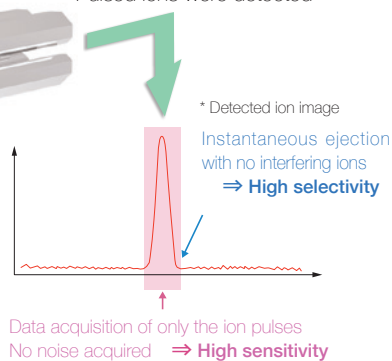
Short collision cell

The short collision cell with a total length of 15 mm allows for accumulation and instantaneous ejection of ions. The accumulation time of each transition can be changed to accommodate a wide range of SRM measurements.

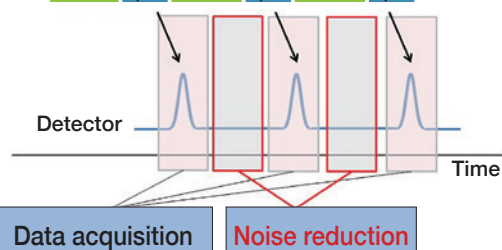
■ Features of short collision cell



Pulsed ions were detected



Collision cell Accumulate Eject Accumulate Eject Accumulate Eject



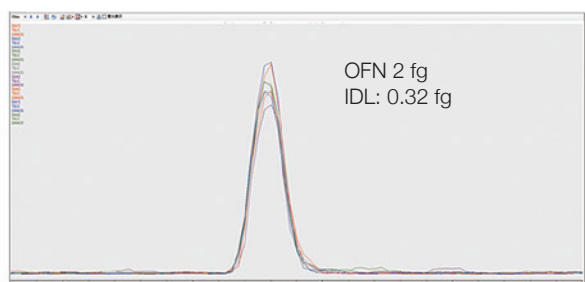
- It is a completely new concept of collision cell that enables the accumulation and instantaneous ejection of ions.
- Only instantaneously ejected ions are detected, thus reducing noise to a minimum.
- Fast switching (up to 1,000 transitions/second), high sensitivity, and high selectivity can be achieved.
- SRM measurement can be performed according to the purpose by controlling the ion accumulation time.

Superior basic performance

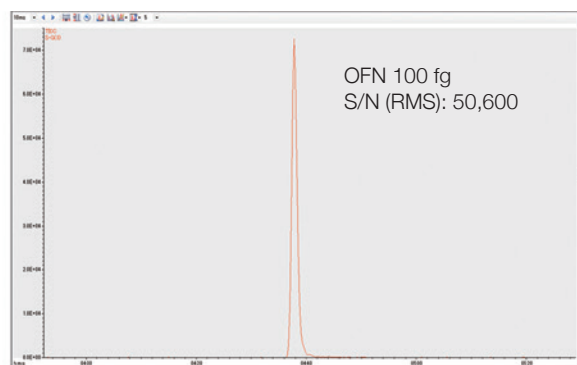
SRM sensitivity

The instrument detection limit (IDL) by SRM with octafluoronaphthalene (OFN) was determined to be 0.32 fg (10 fg injection, $n=8$, high sensitivity mode, m/z 272 \rightarrow 222).

Instrument detection limit ($n=8$)



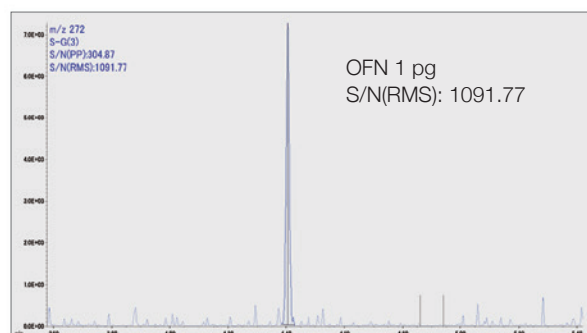
Sensitivity by S/N (OFN 100 fg)



Single scan sensitivity

Single scan sensitivity using OFN (1 pg, m/z 272) is more than 1000 in S/N (RMS).

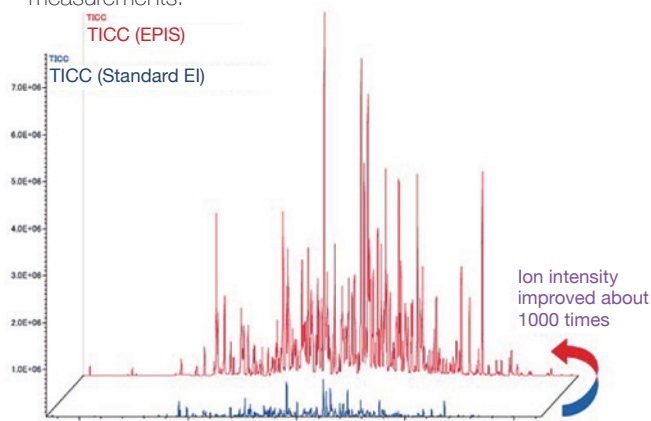
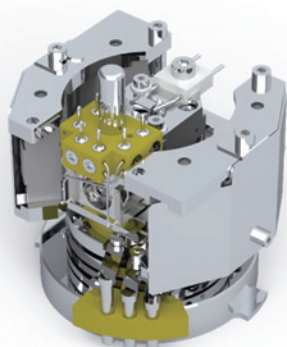
Single scan sensitivity (OFN 1 pg)



High performance ion source EPIS for further sensitivity

High performance EI ion source EPIS with newly designed ion source chamber can be used.

The use of EPIS increases the amount of precursor ion, which contributes to improved detection sensitivity and reproducibility at low concentrations in SRM measurements.



Comparison of SRM sensitivity in EPIS and standard EI source (300 pesticide components, 10 ppb each)

Enhanced qualitative analysis with soft ionization methods and direct analysis

The JMS-TQ4000GC is capable of using soft ionization methods: photoionization (PI) and chemical ionization (CI). In addition, two direct MS probes can be used for EI or CI measurements without the use of GC.

Wide variety of soft ionization methods

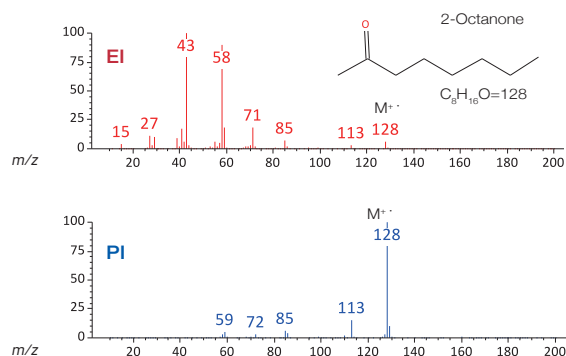
EI is a hard ionization method; therefore, many ions can be observed, but a molecular ion is often not identified. With the JMS-TQ4000GC, PI, CI, and low-energy EI can be selected as soft ionization methods. By producing a molecular ion by the soft ionization method, it can be applied to narrowing down the results of library database searches and MS/MS measurements using this molecular ion information.



PI ion source is attached

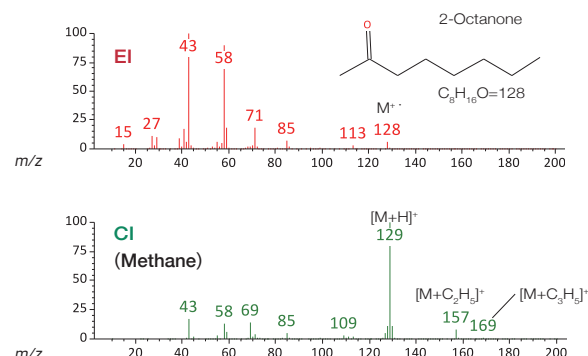
PI ion source (option)

PI is an ionization method that uses vacuum ultraviolet (VUV) light and is available with our EI/PI combination ion source; switching between EI and PI is done only by turning the filament and UV lamp on and off.



CI ion source (option)

In positive ion mode, adduct ions are generated by ion-molecule reactions between reagent gases (methane, isobutane, ammonia) and sample molecules. Negative ion mode is also available.



Two types of direct MS probes

Measurements using a direct MS probe are effective for compounds that are difficult to introduce from GC. Two types of direct MS probes are selectable for the JMS-TQ4000GC, depending on sample form, physical properties, and purpose.



Direct Exposure Probe (DEP)

- A dissolved or dispersed sample in a solvent is applied to the tip of the filament.
- It is suitable for measurement of high-boiling point compounds and thermally unstable compounds.



Direct Insertion Probe (DIP)

- Solid samples can be measured by placing them directly into the glass sample tubes.
- It is suitable for measurement of high-boiling point compounds and insoluble compounds.

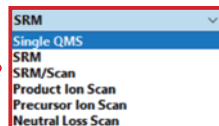
Smart instrument control software "MSPRIMO™"



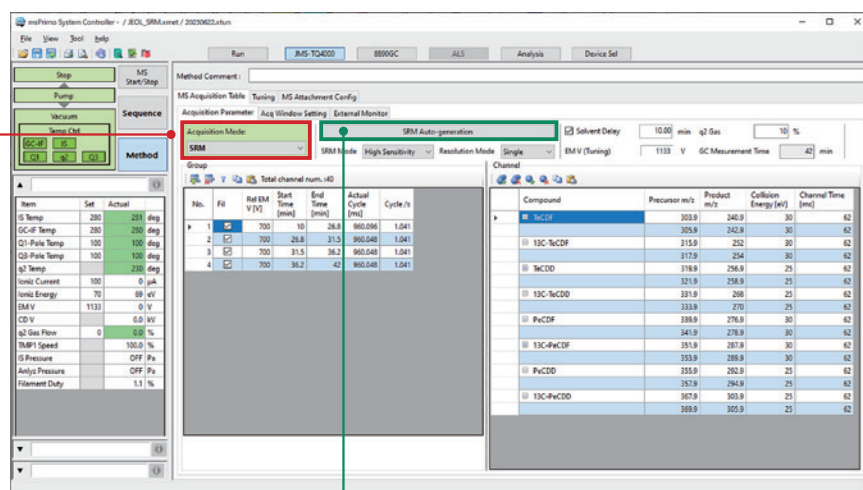
GUI designed for ease of use

All measurement parameters such as GC and MS conditions are integrated in a single window.

Measurement mode



The measurement mode can be easily set according to the analysis purpose.



SRM mode

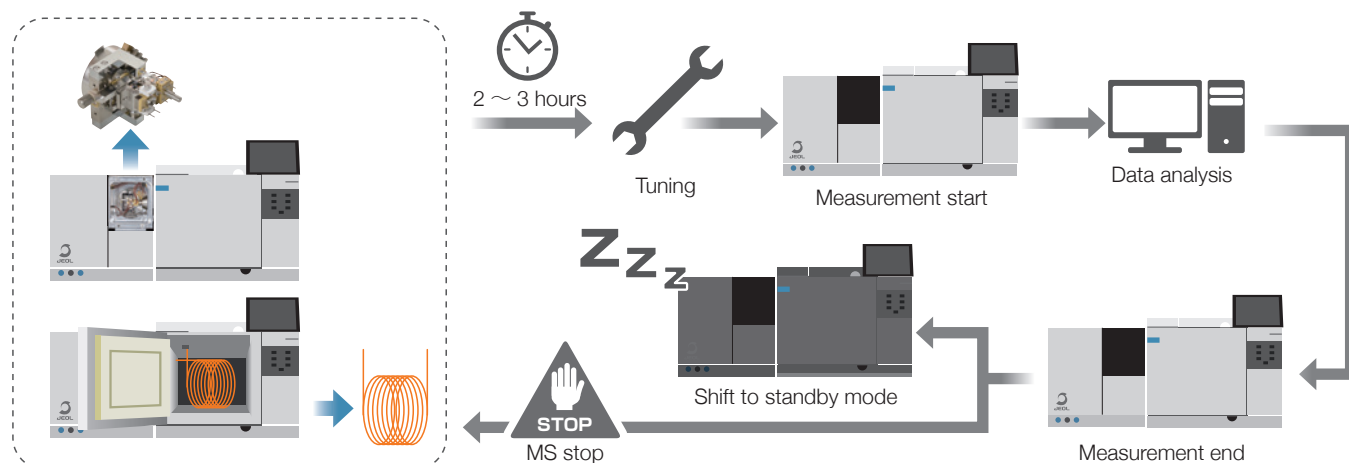
The SRM mode used for qualitative and quantitative analysis of trace constituents can be selected from several modes, such as the high-speed mode and the high-sensitivity mode, depending on the purpose of the analysis. Furthermore, a different ion accumulation time can be set for each transition to improve sensitivity and ensure a wide dynamic range.



The tuning window, GC condition setting window, etc. are displayed by switching tabs on the main window.

Multi-function sequencing function for improved operational efficiency

The MSPRIMO™ has a function of multi-functional sequencing that allows for instrument control, measurement, and analytical work instructions. The work start time can be set, allowing for flexible work scheduling. Automation of daily analysis tasks such as instrument shutdown after measurement, tuning at arbitrary positions during continuous measurement, and quantitative analysis of measured data improves operational efficiency.



SRM measurement in 2 steps

It takes only two steps from SRM condition setting to measurement

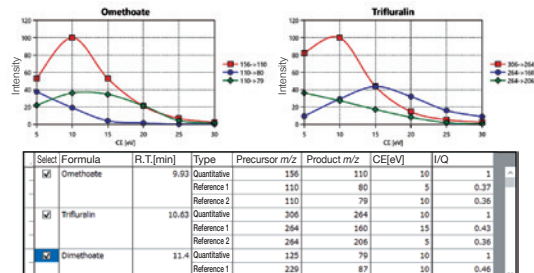
Step 1 Creation of measurement conditions

In quantitative analysis, quantitative analysis conditions are the basis for creating measurement conditions. SRM data files for various compounds, such as pesticides, are provided. Optimal SRM analysis conditions for unregistered compounds can be easily determined by using the SRM optimization tool.

Example of SRM information of pesticides

Formula	R.T.[min]	Type	Precursor m/z	Product m/z	CE[eV]	I/Q
Acetochlor	17.21	Quantitative	146	131	15	1
		Reference 1	223	132	25	0.61
		Reference 2	146	130	25	0.89
Acrinathrin	23.47	Quantitative	208	181	10	1
		Reference 1	181	152	20	0.92
		Reference 2	208	180	10	0.17
Aldrin	18.35	Quantitative	263	193	25	1
		Reference 1	263	228	25	0.93
		Reference 2	293	222	25	0.5
Allethrin 1	18.93	Quantitative	123	81	5	1
		Reference 1	123	95	10	0.51
		Reference 2	136	108	10	0.45

SRM optimization tool

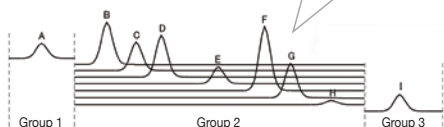


Step 2 SRM measurement

SRM measurement conditions are automatically generated from the quantitative analysis conditions. The peak dependent SRM (p.d.SRM) enables optimal grouping settings for highly sensitive analysis. It is possible to set up more than 100 transitions per group, which enables simultaneous multi-component analysis with a single sample injection.

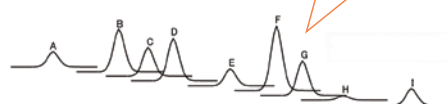
Conventional SRM

If there are many measurement components, the integration time per transition is too short to provide sufficient sensitivity.



p.d.SRM

It automatically sets the grouping time according to the retention time of the peaks, so a more sensitive analysis can be expected.



1 Startup of MS

Heating of the ion source, interface, and Q-pole after evacuating the vacuum.

3 Measurement of calibration standard solution

After each sample is measured, analysis is performed and the results are output.

4 Creation of calibration curve

Creating a calibration curve from the measurement results of the standard

6 Setting of methodSet

the instrument to a low energy-consumption condition.

2 MS tuning

MS tuning to be performed after 2 hours.

3 Correction of retention time

Correct the retention time from the measurement results of any standard solution.

5 Measurement of real sample solution

Calculate the quantitative value using a calibration curve. *

7 Stop of MS

Cool the ion source, interface, and Q-poles and stop the MS.

	Executed	Wait Mode	day	h:m	Procedure	Method File	Vial No.	Data Folder	Comment
1	<input type="checkbox"/>	Nothing		00:00	MS Start	JEOL_SRM.xmet			
2	<input type="checkbox"/>	Interval		02:00	MS Tuning	JEOL_SRM.xmet			
3	<input type="checkbox"/>	Nothing		00:00	Analysis	JEOL_SRM.xmet	1	C:\ProgramData\JEOL\Primo\sys1\User\Result\Standard 1.JDQ	
4	<input type="checkbox"/>	Nothing		00:00	Analysis	JEOL_SRM.xmet	2	C:\ProgramData\JEOL\Primo\sys1\User\Result\Standard 2.JDQ	
5	<input type="checkbox"/>	Nothing		00:00	Analysis	JEOL_SRM.xmet	3	C:\ProgramData\JEOL\Primo\sys1\User\Result\Standard 3.JDQ	
6	<input type="checkbox"/>	Nothing		00:00	Create Cal-C...	JEOL_SRM.xmet			
7	<input type="checkbox"/>	Nothing		00:00	Analysis	JEOL_SRM.xmet	4	C:\ProgramData\JEOL\Primo\sys1\User\Result\Sample A.JDQ	
8	<input type="checkbox"/>	Nothing		00:00	Analysis	JEOL_SRM.xmet	5	C:\ProgramData\JEOL\Primo\sys1\User\Result\Sample B.JDQ	
9	<input type="checkbox"/>	Nothing		00:00	Analysis	JEOL_SRM.xmet	6	C:\ProgramData\JEOL\Primo\sys1\User\Result\Sample C.JDQ	
10	<input type="checkbox"/>	Nothing		00:00	Analysis	Waiting.xmet			
11	<input type="checkbox"/>	Nothing		00:00	MS Stop	Waiting.xmet			

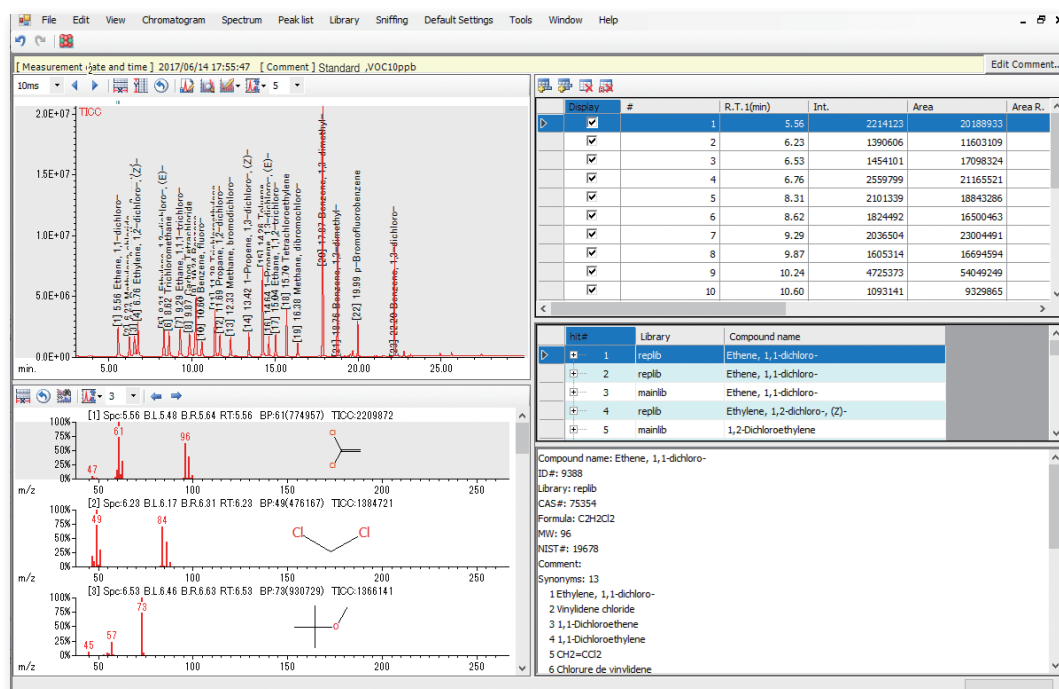
(*) Process items can be added or edited at any position during continuous measurement.

"Escrime™"- Easy-to-use analysis software

Escrime™ is the standard data processing software for qualitative analysis and quantitative analysis.

Qualitative Analysis

TIC and RI chromatograms, mass spectra, and library search results for SCAN measurement data are displayed on a single window. In addition, library spectra can be overlaid on the mass spectrum, making it easy to confirm the validity of the search results.



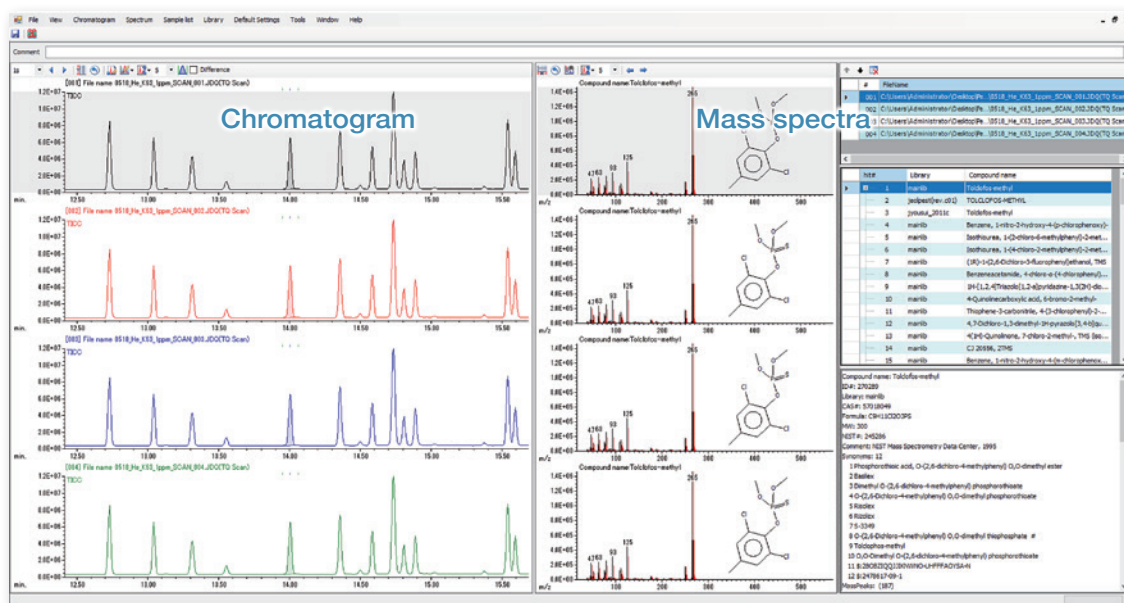
chromatogram

Peak List and
Analysis Results

mass spectra

library search results

Multiple data display is useful to compare chromatograms among multiple data. It is easy to check for peak detection, mass spectra, and differences in peak area values.



library search
results

Multiple
Chromatograms
and mass spectra.
Side-by-side
display

Multicomponent Simultaneous Quantitative Analysis

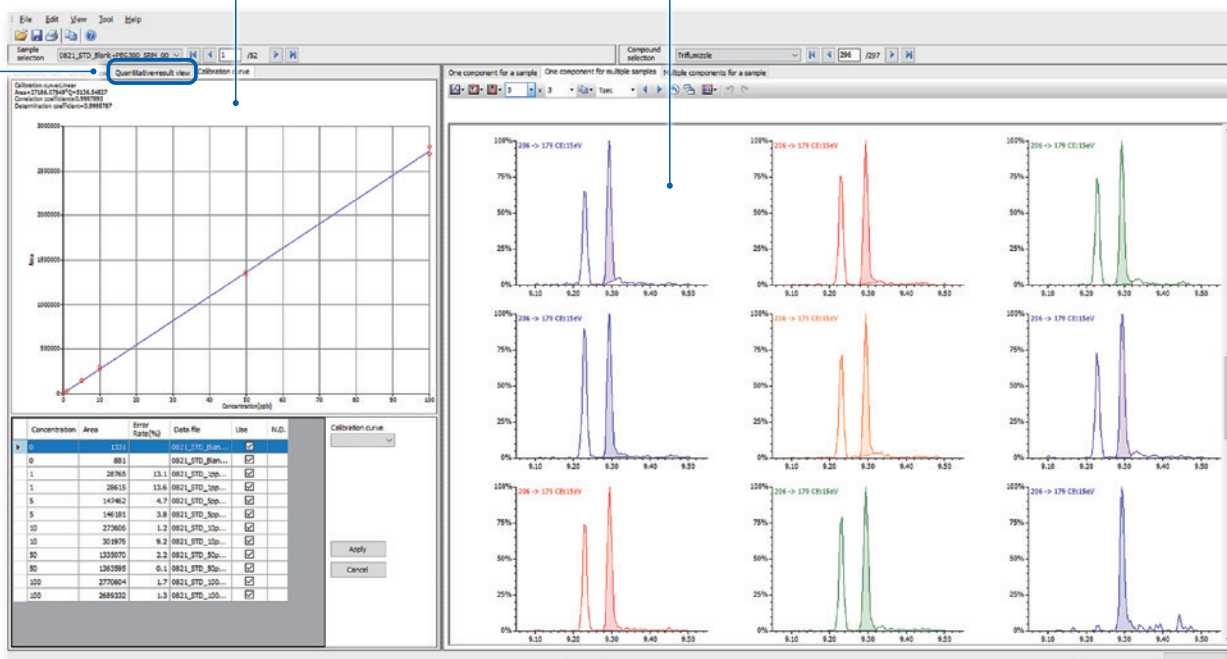
Integrating multiple data chromatograms, calibration curves, and area value information on a single window has greatly improved the efficiency of analysis work, such as comparing all samples and changing peak areas all at once.

Calibration curve

- Displays a calibration curve for the chromatogram of a displayed component
- Enables selection of concentration data and recalculation

Display of chromatograms for multiple samples on a single component

- Number of rows and columns can be freely set for easy comparison of chromatograms between samples.
- Peak area can be changed individually or in batches with a simple mouse operation



List of quantitative results

- Area values, quantitative values, and I/Q ratios* can be checked.

* Area ratio of reference ion (I) and quantitation ion (Q)

Multiple standard templates are available

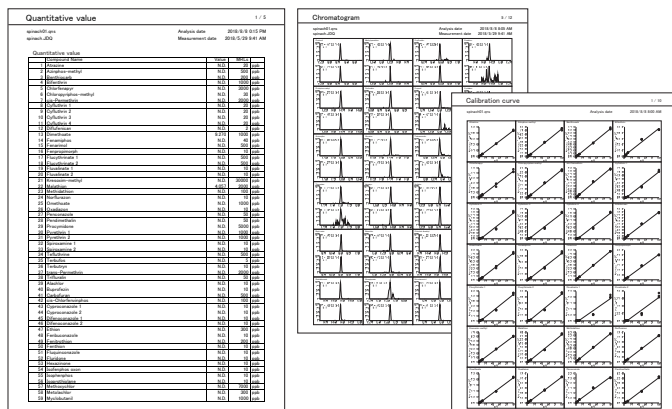
Templates are registered for reports consisting of component names, result values (undetected or detected values), and reference values.

Multiple templates are also registered for chromatograms and calibration curves, which can be selected according to the application.

Templates can be customized

Report templates can be customized.

Tables of quantitative values, chromatograms, calibration curves, etc. can be set at any position.



Output of quantitative results to xml format

The results of quantitative analysis can be output in xml f format, so it is easy to arrange them using other software.

For example, GC-MS results can be extracted from the xml file and reported in Excel® together with measurement results from other instruments using the customer's template.

Excel is a trademark of Microsoft Corporation in the USA and elsewhere Microsoft Corporation in the USA and other countries.

Simultaneous analysis of multiple components

with easy, fast and high sensitivity

Analysis of Pesticide Residues

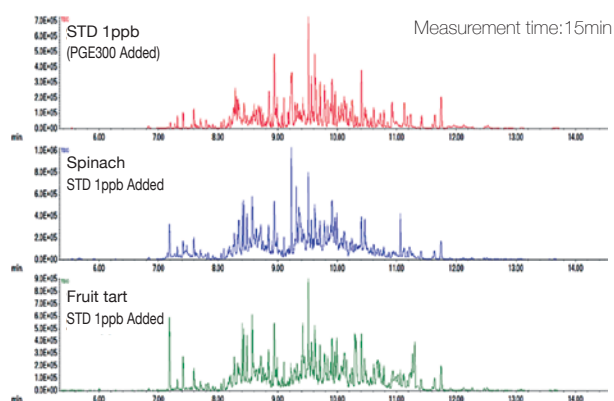
In quantitative analysis of samples containing many matrices, the most significant advantages of using GC-MS/MS are its high selectivity and high sensitivity.

The JMS-TQ4000GC provides an advantage for the rapid analysis of pesticide residues in foods for which regulation values have been established, as well as for the analysis of pesticides in waters with widely differing regulation values for each pesticide.

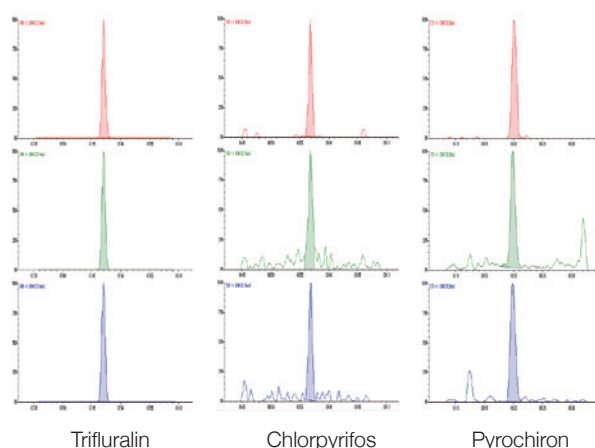
Rapid analysis of pesticide residues in food

The JMS-TQ4000GC is capable of fast SRM measurements of up to 1000 transitions per second, and even when Fast GC conditions are applied to simultaneous analysis of multiple components, sufficient sensitivity and stable chromatograms can be obtained. It was possible to detect 292 pesticides in the standard pesticide mixture and actual samples (spinach and fruit tart extracts) with sufficient sensitivity at 1 ppb using the Fast GC condition with a 15 minute measurement time.

TIC chromatograms of 292 pesticides (1 ppb) using Fast GC conditions



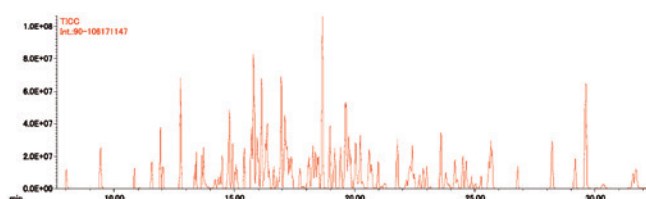
Extracted ion chromatograms of pesticides in each sample



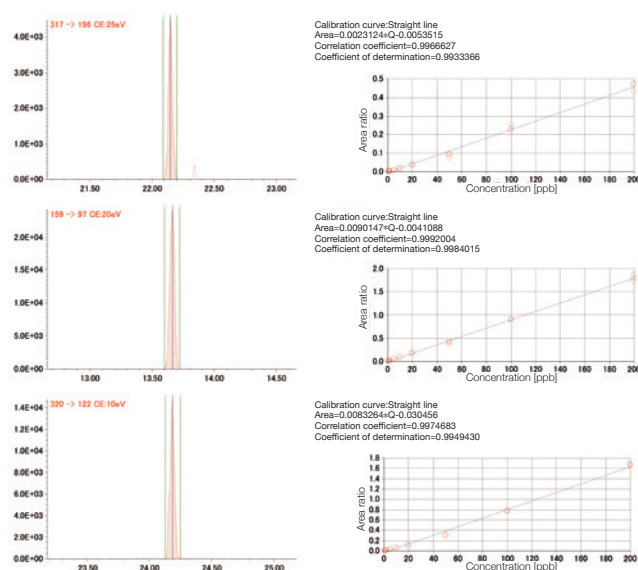
Pesticides for Water Quality Control

The JMS-TQ4000GC can set the ion accumulation time for each transition in the SRM measurement, and can be used for analysis requiring a wide dynamic range. Simultaneous analysis of 137 pesticides for Water Quality Control showed that chlornitrofen (CNP) at 0.5 ppb (500-fold enrichment value against a target value of 0.1 µg/L) was detectable with sufficient sensitivity, and good linearity was obtained from 0.5 ppb to 200 ppb.

TIC chromatograms of 137 pesticides



Extracted ion chromatogram (0.5 ppb) and calibration curve



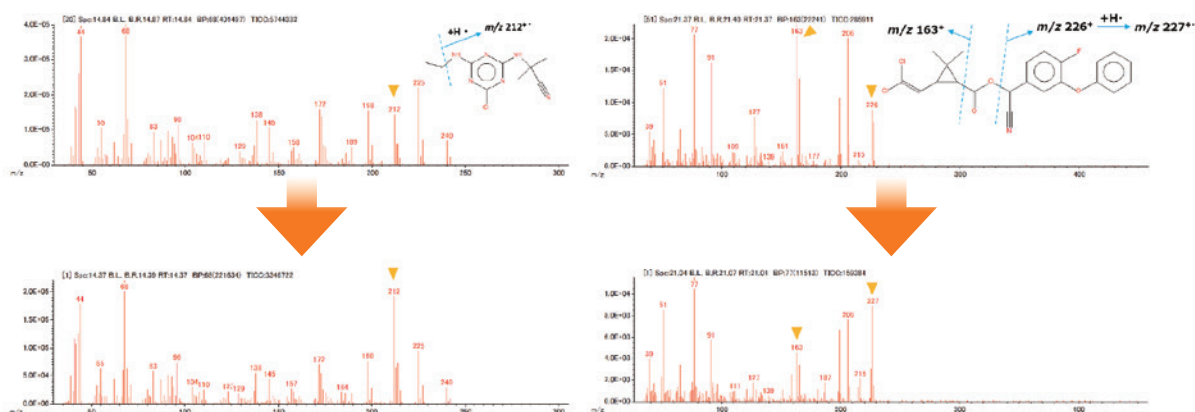
Notice ! Application of alternative carrier gases

Recently, the use of alternative carrier gases such as hydrogen gas and nitrogen gas has been increasing due to the global shortage of helium gas. The ion source chamber of JEOL's TQMS is made of inert material, high-purity titanium. Highly sensitive qualitative and quantitative measurements are possible with each alternative carrier gas only by changing the measurement conditions.

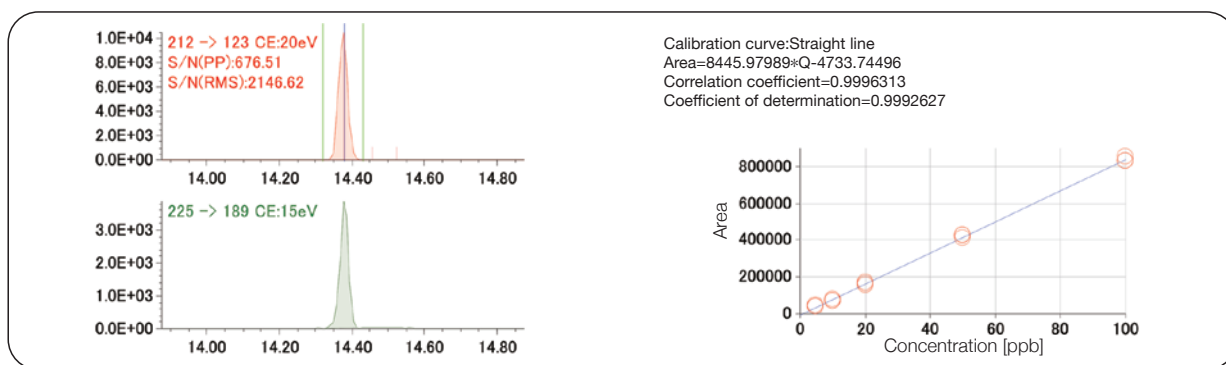
Analysis of Pesticide Residues in Food Using Hydrogen Carrier Gas

When hydrogen gas is used as a carrier gas, reactions may occur in the GC inlet or ion source chamber, and some compounds are known to show different spectral patterns than when helium gas is used. Even if the spectral pattern changes, it is stable and allows good quantitative measurements.

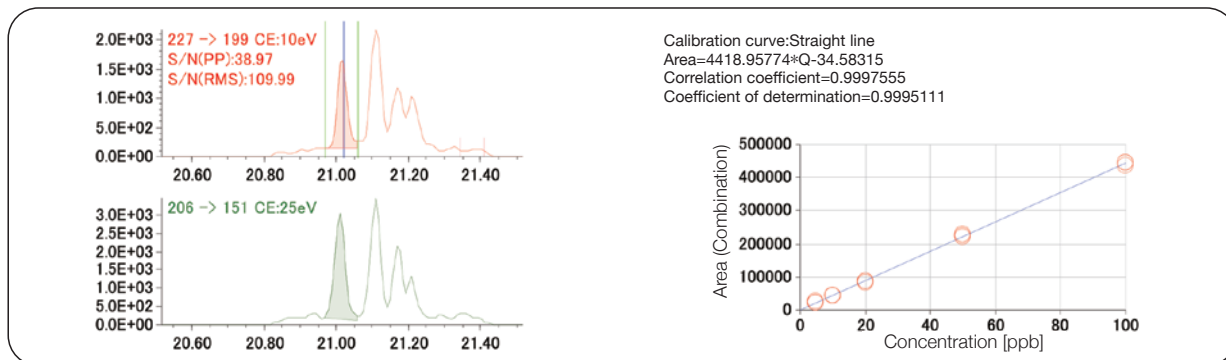
(Upper: helium gas, Lower: hydrogen gas)



The results of the measurement using SRM conditions optimized for hydrogen carrier gas showed that 308 out of 329 pesticides showed good reproducibility with CV values within 20%. The correlation coefficient (r) of the calibration curve was 0.999 or higher for 249 pesticides, and 0.994 for acetamiprid, which had the lowest correlation coefficient. The linearity of the calibration curve was confirmed to be acceptable. Although the spectral pattern is variable, good results can be obtained with the choice of quantitation ions.



EIC and calibration curve for Cyanazine 5 ppb

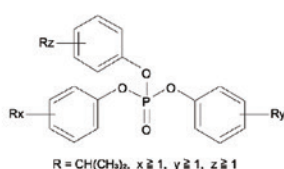


EIC and calibration curve for Cyfluthrin 5 ppb

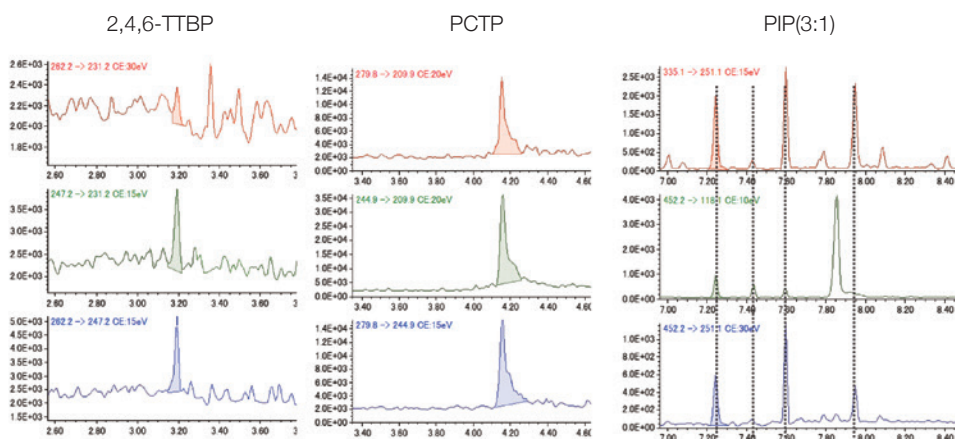
A new innovation in trace qualitative analysis

Simultaneous analysis of controlled substances for TSCA and RoHS

Some substances require non-detection (N.D.) under the U.S. TSCA regulations. SRM measurement with the JMS-TQ4000GC is very suitable for detection down to very low concentrations. This time, a simultaneous quantitative analysis of three TSCA-regulated substances and four RoHS2 substances contained in power supply components was done. The results showed that all target components were detected in the sample, and PIP(3:1), for which non-detection is the regulation value, was detected at approximately 30 ppb.



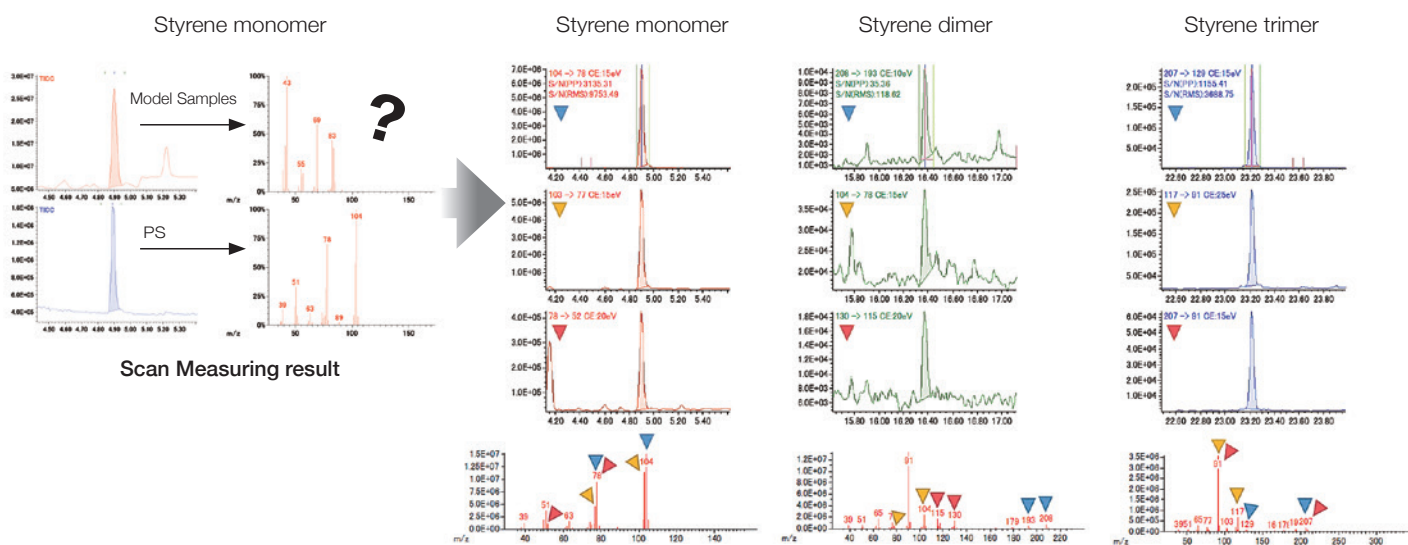
Ingredient name	Quantitative value
2,4,6-TTBP	0.51
PCTP	11.87
PIP(3:1)	0.031 (Total)
DIBP	0.27
DBP	0.43
BBP	0.37
DEHP	0.64



TSCA regulated substances detected in power supply components

Microplastics (MPs) Analysis

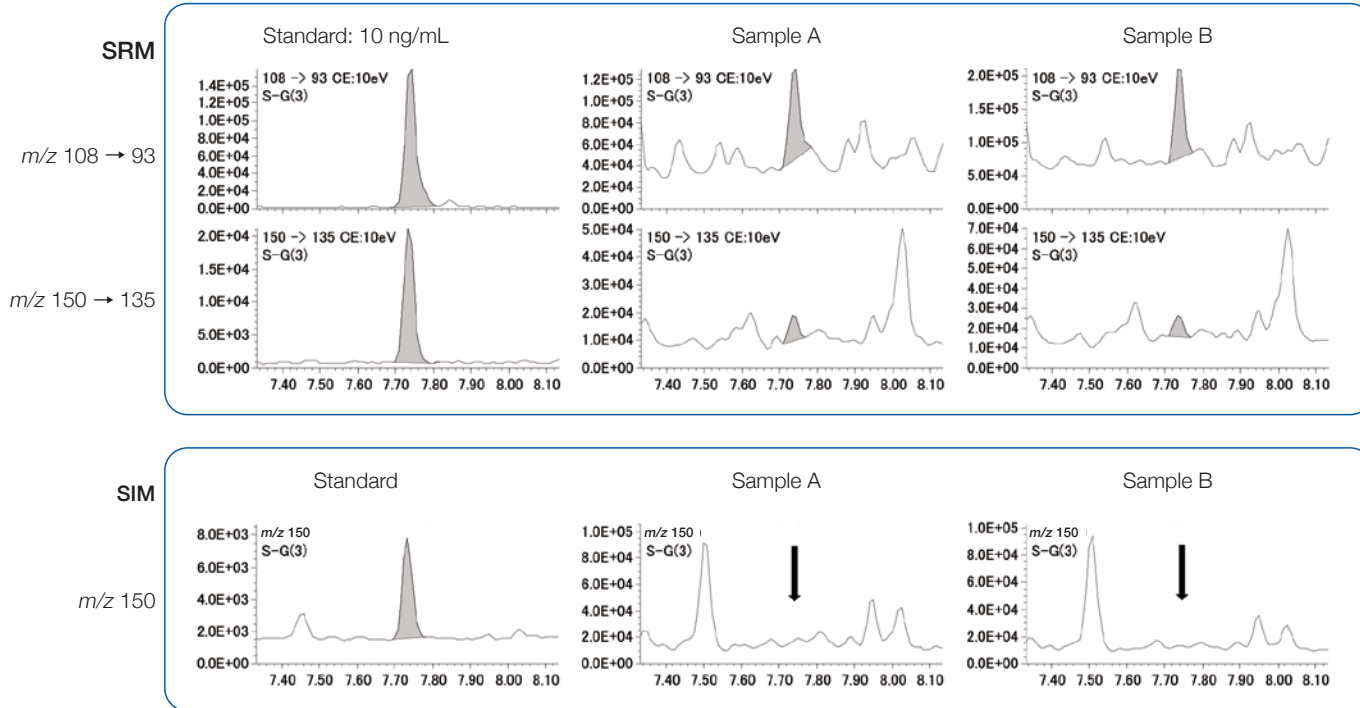
The identification of MPs is very important for identifying the source of contamination. SRM measurements are suitable for detecting specific polymers contained in trace amounts by pyrolysis GC-MS because of the measurements high selectivity. Here, polypropylene (PP) with a trace amount of polystyrene (PS) was measured as a model sample. The presence of PS was difficult to confirm with the Scan measurement, but was confirmed with the SRM measurement.



SRM measurement results of model samples

Off-flavor Analysis in Food

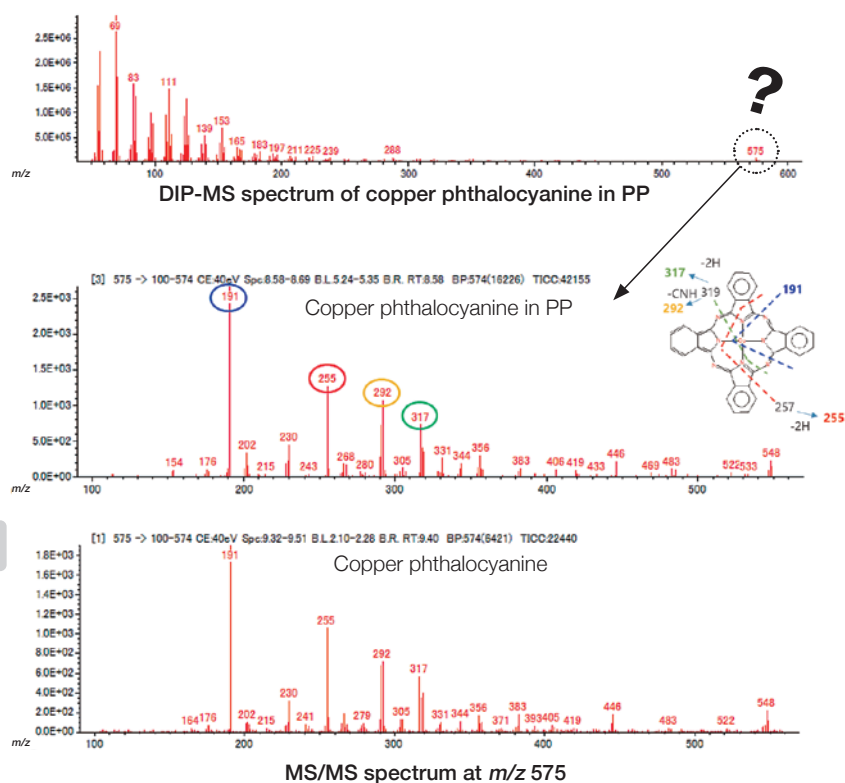
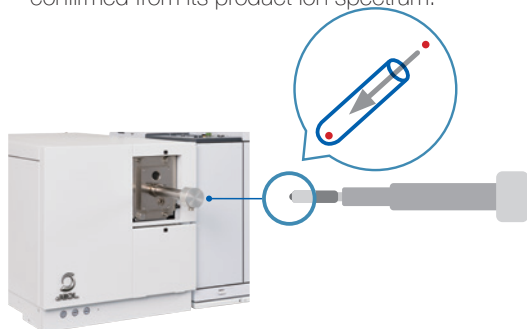
In the case of a sample containing many contaminants, such as food, separation of the target compounds and the contaminants may be insufficient simply by optimizing the GC conditions. Here, 2-MIB, which is a mold odor-causing substance in food at the human olfactory threshold level, was analyzed by the JMS-TQ4000GC. As a result, 2-MIB was detected with high sensitivity in the SRM measurement, while it was difficult to detect in the SIM measurement.



Detection of 2-MIB in standard solutions and actual samples (tofu)

Identification of pigments by DIP-MS/MS

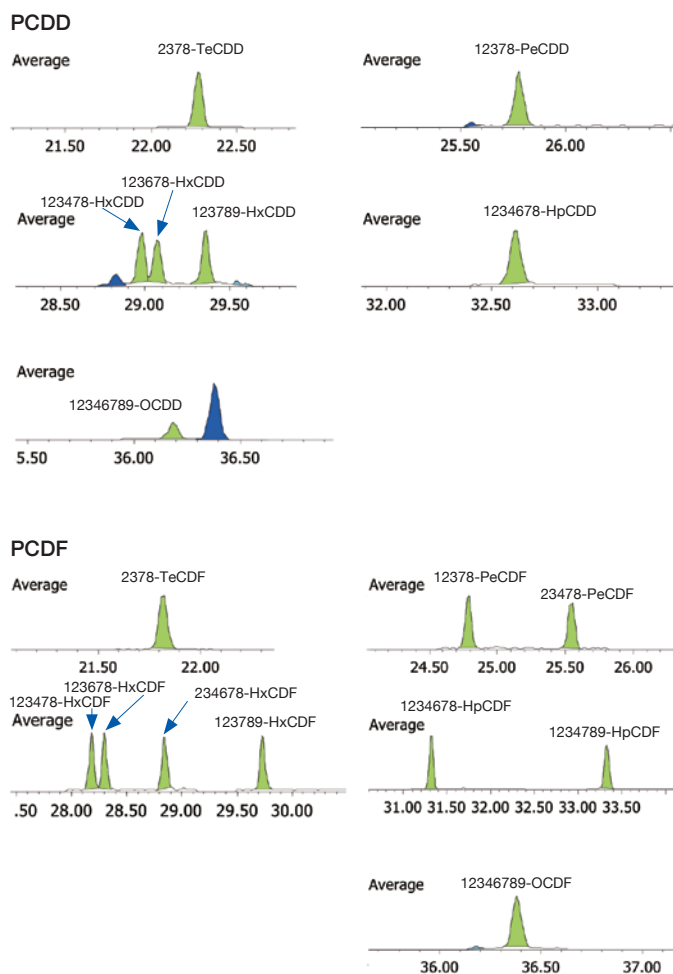
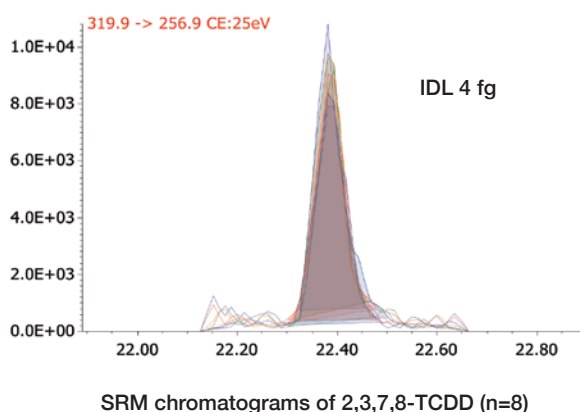
When a sample including many compounds is measured by DIP-MS, a complex mass spectrum is obtained, making it difficult to identify each compound. DIP-MS/MS, on the other hand, provides a spectrum of a specific ion, making it easy to confirm a particular compound. Here, copper phthalocyanine in polypropylene (PP) was analyzed; whereas the presence of copper phthalocyanine was unclear by DIP-MS, it was clearly confirmed by DIP-MS/MS. Furthermore, structural information was confirmed from its product ion spectrum.



The Expansion of Application for Trace Quantitative Analysis

Analysis of Dioxins

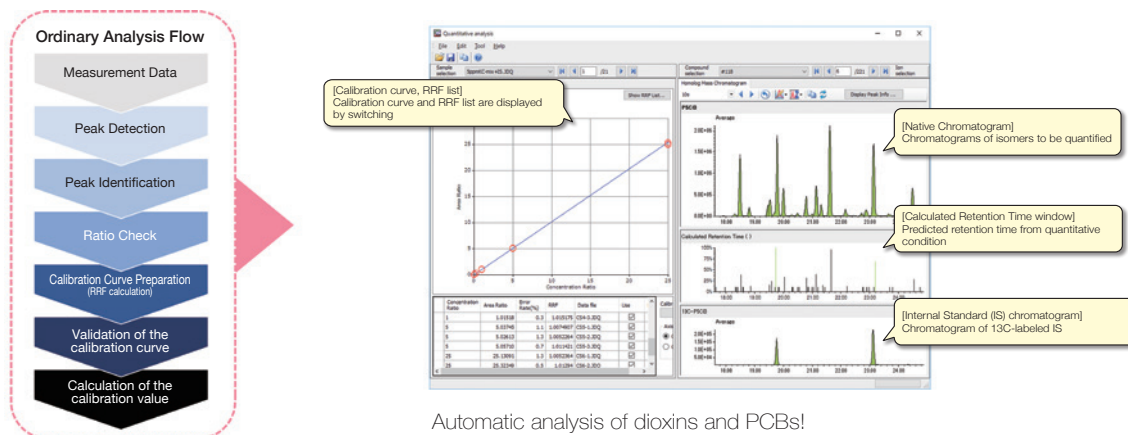
For the analysis of dioxins, a high-resolution SIM method using GC-SectorMS is generally used. The JMS-TQ4000GC, on the other hand, can be used for quantitative analysis of trace constituents as well as GC-SectorMS. TQ-DioK, a dedicated analysis software for dioxins and PCBs that is compatible with SRM measurement data, provides an analysis environment comparable to the well-established dioxin analysis software "DioK".



Averaged SRM chromatograms of PCDD and PCDF
(Tetra-Hepta: 0.025 pg/ μ L, Octa: 0.05 pg/ μ L)

■ Dedicated quantitative analysis software for dioxins and PCBs "TQ-DioK"

TQ-DioK is a quantitative analysis software dedicated to dioxins and PCBs that supports SRM data. The functions of DioK, the dedicated quantitative analysis software for dioxins, can now be used with the same ease of operation as Escrip™, which is the standard quantitative analysis software for the JMS-TQ4000GC. Most of the required specialized quantitative analysis work is automatically done, which significantly reduces the time required for analysis.



Automatic analysis of dioxins and PCBs!
Easy quantitative analysis of dioxins and PCBs for anyone!

High-sensitivity analysis with single-mode

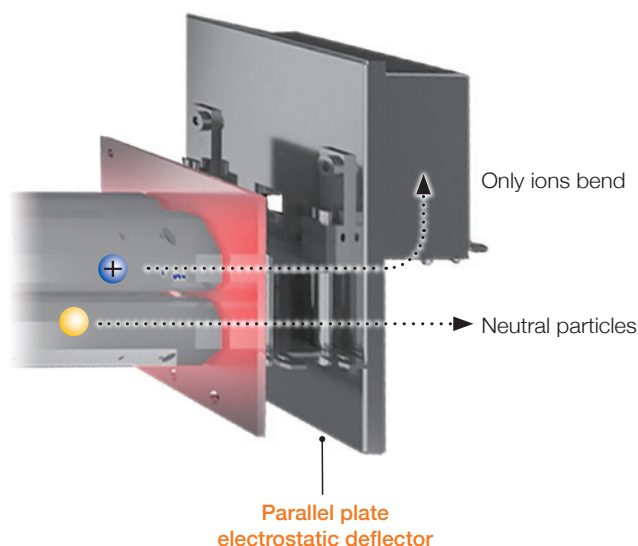
In general, the sensitivity of GC-MS/MS in single mode is inferior to that of single QMS due to the longer distance from the ion source to the detector. However, the single mode of the JMS-TQ4000GC can obtain results comparable to a single QMS for the following reasons:

Reason 1

The high-precision large hyperbolic quadrupole has excellent ion permeability. In addition, the collision cell is designed to allow ions to pass through in a very short time, and minimizes ion loss.

Reason 2

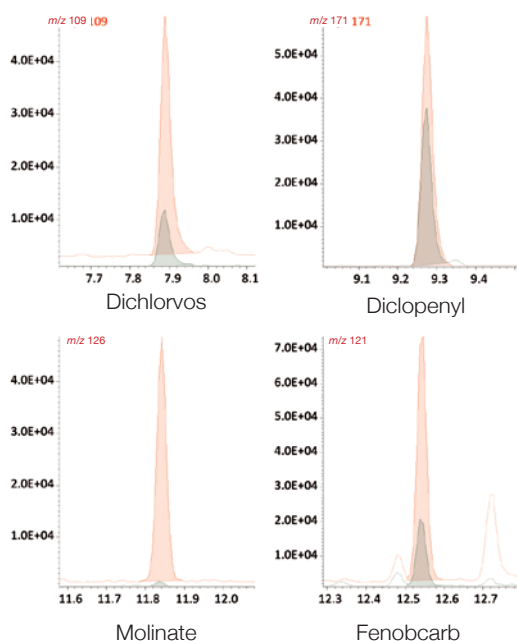
The parallel plate electrostatic deflector installed in front of the detector eliminates neutral particles and introduces only ions into the detector. As a result, significant noise reduction is realized.



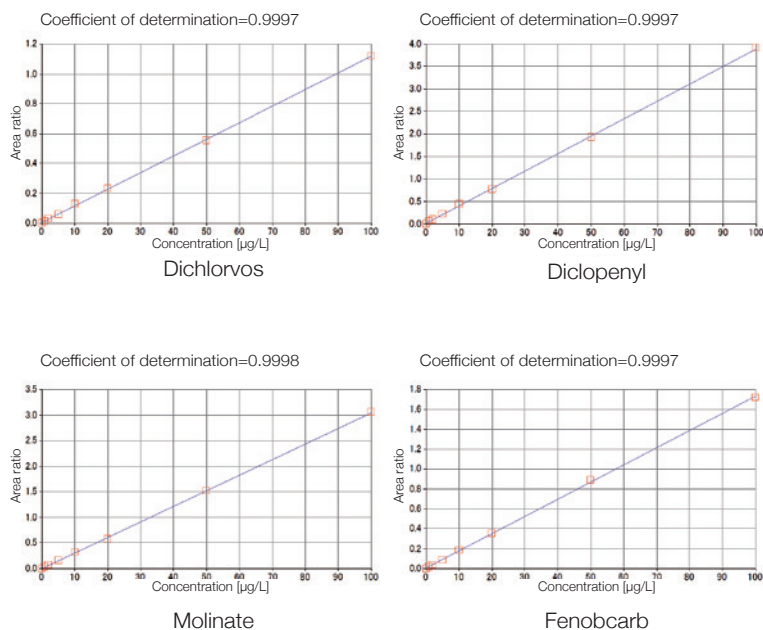
SIM Analysis for Pesticides in Water

SIM measurement in the single mode of the JMS-TQ4000GC provides results equivalent to single QMS. If there are many contaminants, more reliable analysis can be achieved by switching to SRM measurement.

SIM chromatogram of pesticides in water (1 ppb)



Calibration curve (1 - 100 µg/L)



Integrated Qualitative Analysis Software

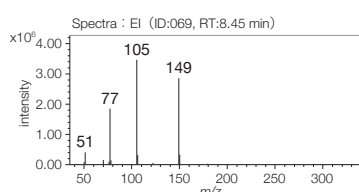
"msFineAnalysis iQ" (optional)

msFineAnalysis iQ is an automated integrated qualitative analysis software that combines library search using EI mass spectra and molecular weight confirmation using soft ionization mass spectra. This software improves the accuracy of compound identification compared to conventional library search-only analysis. It also performs automatic analysis according to the analysis workflow, and is effective in reducing analysis processing time and leveling the analysis process. msFineAnalysis iQ is compatible with single scan data by JMS-TQ4000GC.

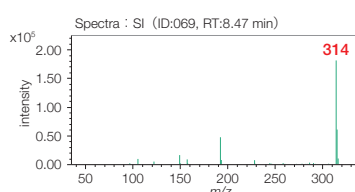
Risks in qualitative analysis of only library searches

The EI method is widely used in GC-MS analysis because of its extensive commercial spectrum database. On the other hand, molecular ions may not be confirmed because of the hard ionization method.

In the example shown here, molecular ion cannot be confirmed by the EI mass spectrum. However, the top five candidates in the library search results have a match factor of more than 800, which could lead an analyst to identify the compound as candidate 1. However, it can be concluded that candidate 2 is most likely this compound since the soft ionization mass spectrum shows an ion at m/z 314. Thus, it is very important to confirm molecular ions by soft ionization data in qualitative analysis.



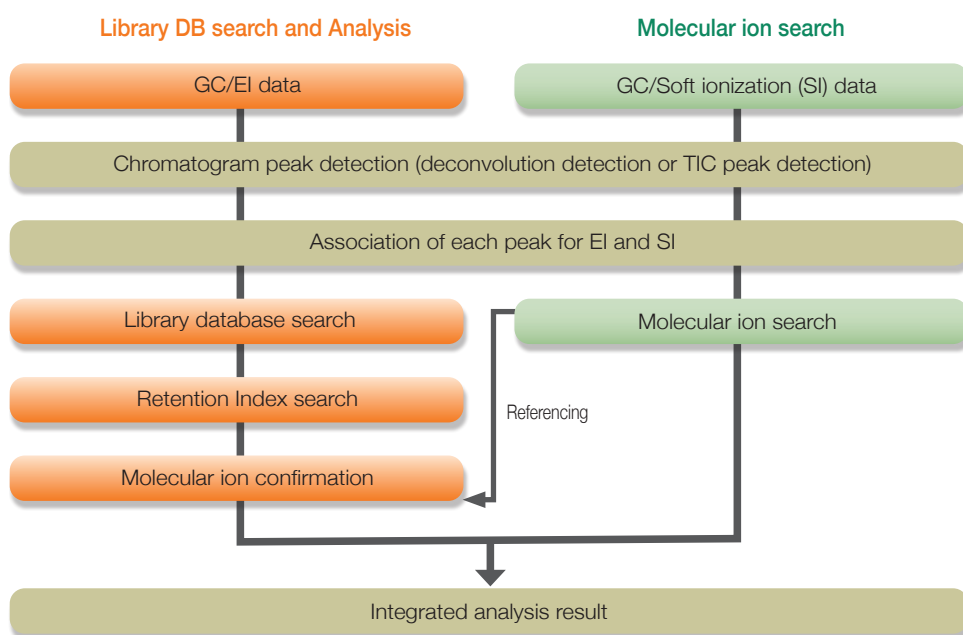
EI mass spectra of component A



Soft ionization mass spectra of component A

#	Library Name	M.F.	Formula	MW
1	2,2'-(Ethane-1,2-diylbis(oxy))bis(ethane-2,1-diyl) dibenzoate	828	C ₂₀ H ₂₂ O ₆	358
2	Diethylene glycol dibenzoate	821	C ₁₈ H ₁₈ O ₅	314
3	Benzoic acid, 2-(3-nitrophenyl)ethyl ester	810	C ₁₅ H ₁₃ N O ₄	271
4	1,3-Dioxolane, 2-(methoxymethyl)-2-phenyl-	802	C ₁₁ H ₁₄ O ₃	194
5	3,6,9,12-Tetraoxatetradecane-1,14-diyl dibenzoate	800	C ₂₄ H ₃₀ O ₈	446

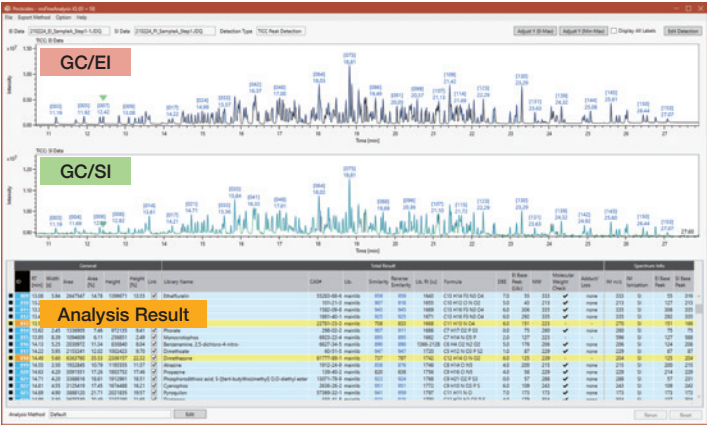
Library search results for component A Top 5 candidates



Work Flow of Integrated Analysis

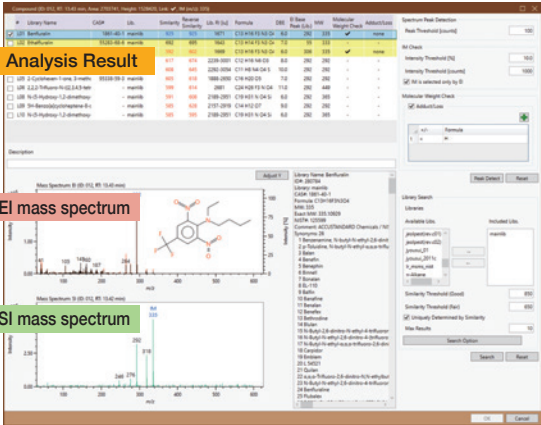
Example of integrated qualitative analysis

Integrated Analysis Result Window



Chromatogram info. Integrated Analysis Result (Library DB search and Molecular ion analysis) Spectrum info.

Individual Analysis Window



EI mass spectrum

SI mass spectrum

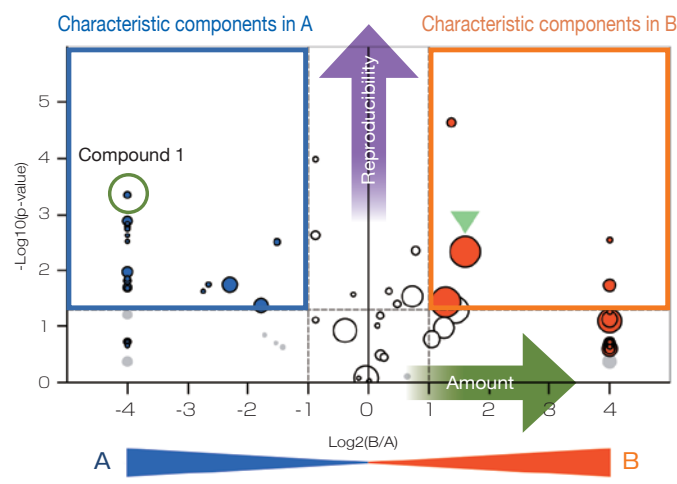
The chromatograms of EI and soft ionization (SI), automatically extracted spectral information for each peak, and integrated analysis results based on library search and molecular ion information are displayed and color-coded to facilitate intuitive understanding of confidence levels. Each mass spectrum can be displayed by double-clicking any line in the list, and the results of library search and molecular ion analysis can be confirmed and reanalyzed. Only EI data can be analyzed.

Difference Analysis

msFineAnalysis iQ supports difference analysis, which is becoming increasingly demanding. Simply set the EI data of the samples to be compared, and the software automatically extracts the difference components and performs qualitative analysis. The analysis results are displayed as a plot diagram and a list for easy visual assessment.

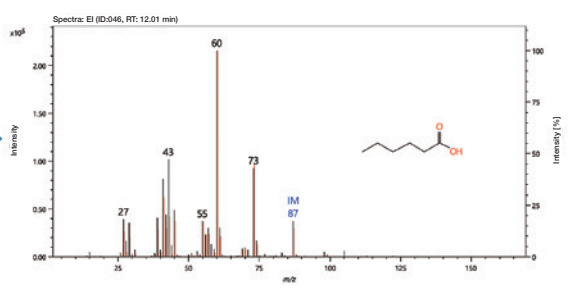
As an example of this analysis, a difference analysis was performed for two natural rubber samples A and B. The volcano plots made it easy to visualize and analyze the unique components of each sample.

Volcano Plot



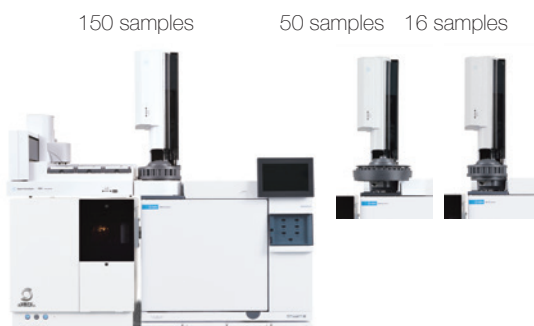
Analysis results for component 1

#	Compound	CAS#	Lib.	Similarity	Similarity (Reverse)	Lib. R[1][u]	Formula	DBE	EI Base Peak (Lib.)	Mw
L01	Hexanoic acid	142-62-1	replib	835	855	990	C ₆ H ₁₂ O ₂	1.0	60	116
L02	Hexanoic acid	142-62-1	mainlib	832	851	990	C ₆ H ₁₂ O ₂	1.0	60	116
L03	Hexanoic acid	142-62-1	replib	831	851	990	C ₆ H ₁₂ O ₂	1.0	60	116
L04	Hexanoic acid	142-62-1	replib	827	837	990	C ₆ H ₁₂ O ₂	1.0	60	116
L05	Pentanoic acid, 3-methyl-	105-43-1	replib	807	859	947	C ₈ H ₁₆ O ₂	1.0	60	116



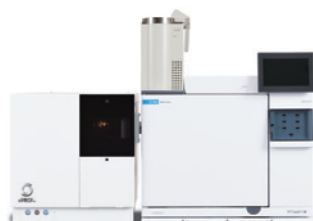
Combination with Sample Introduction Equipment

to expand the application range



Autosampler for liquid samples

Available in 16, 50, and 150 samples. The photo shows the injector + tray for 150 samples. High speed and high precision liquid sample injection is possible, supporting highly accurate quantitative analysis.



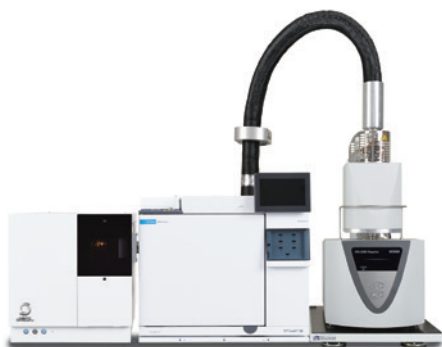
Pyrolyzer GC-MS System for Pyrolysis, Thermal Extraction, and Evolved Gas Analysis

The Pyrolyzer GC-MS System is a powerful tool for the analysis of volatile compounds by pyrolysis or thermal extraction.

Manufactured by Frontier Labs Inc.

Multi-Shot Pyrolyzer EGA/PY-3030D

Auto-Shot Sampler PY-2020E



TG/DTA-MS System for Thermal Analysis and Evolved Gas Analysis

TG/DTA-MS allows you to observe weight loss, endothermy, and exothermy when samples are continuously heated, and to analyze the evolved gases.

NETZSCH STA 2500 Regulus



Multifunction Autosampler

A multifunction autosampler can automate liquid injection, headspace (HS), solid-phase microextraction (SPME), and solid-phase extraction (SPE), as well as dispensing and dilution of liquid samples.

Combined with GC-MS, sample measurements can be performed with continuous pretreatment.

CTC PAL RTC

Specifications

■ MSMS basic unit [MS-60040BU]

Ion source	El
	Ionization energy 10~200 eV
	Chamber temperature 100~300 °C
Analyzer	High-precision hyperbolic quadrupole mass filter
	Plug-in prefilter system
Detector	Conversion dynode/multiple electron detection
	Detection of positive/negative ion
Evacuation system	A large, high-efficiency differential evacuation system TMP: 1 unit
Evacuation rate:	Ion source: 200 L/s or equivalent
	Analyzer: 200 L/s or equivalent
	5.1 m ³ /h rotary pump (configured separately, operating at 50 Hz)
Gas supply system	Mass flow controller Maximum flow rate: 5 SCCM (N ₂)
Collision cell	Gas-tight quadrupole ion guide
	Maximum collision energy 100 eV
	Collision gases N ₂ , He, Ar, Xe
	Potential barrier type accumulation method
Deflector	Parallel flat electrostatic deflector
Acquisition mode	
Single QMS	Scan, SIM, Scan/SIM
MS/MS	SRM, Scan/SRM, Product ion scan, Precursor ion scan, Neutral-loss scan
Mass range	4~1070 u
Resolution	2000 or more (half width @ <i>m/z</i> 614)
SRM speed	1000 times/sec
IDL (Instrument detection limit*) for EI	IDL < 4 fg
	(OFN 10 fg, <i>m/z</i> 272 → 222, n=8)

* This IDL value assumes the use of JEOL auto injector such as the MS-02070ASN.

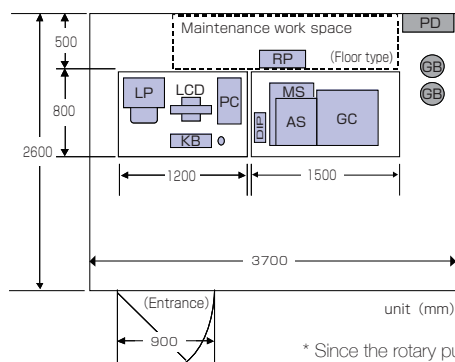
■ Gas Chromatograph [MS-62171AGC]

Column oven	
Temperature range	Room temperature +4 to 450 °C
Influence of atmosphere temperature	< 0.01 °C per degree
Heating program	Up to 20 steps settable
Maximum heating rate	120 °C/min
Inlet	Split/Splitless
Pressure setting range	0 to 680 kPa
	(column diameter of 0.2 mm or more)
Pressure setting unit	0.0068 kPa (0.001 psi)
Maximum temperature	400 °C
Total flow	0~500 mL/min (N ₂),
	0~1250 mL/min (H ₂ , He)
Turn top inlet	Included as standard

Installation Requirements

Power supply voltage	For MS: AC 100 V (Single phase 50 Hz/60 Hz) 15 A One outlet with 3 pins
	For GC: AC 200 V (Single phase 50 Hz/60 Hz) 20 A Switchboard 1-line or One outlet with 3 pins
	Voltage fluctuation within ±10%
Installation room	Room temperature: 15 to 30 °C
	Room temperature fluctuation: within ±3 °C
	Humidity: 20 to 70% (no condensation)
Gases	Carrier gas: He gas (99.9999% purity or higher, hydrocarbon content 0.5 ppm or less)
	Collision gas: Nitrogen gas (99.9999% purity or higher)
Grounding	Type D (100Ω or less) grounding is required
Ventilator	5 m ³ /min or better

Example of the installation layout with the standard configuration



Code	Name
MS	MS basic unit
GC	Gas chromatograph
PC	PC
LCD	Display
KB	Keyboard
LP	Laser printer
RP	Rotary pump
PD	Power distribution board
GB	Gas cylinder
DIP	DIP/DEP power supply for direct insertion/exposure probes
AS	GC Auto Sampler

* Since the rotary pump is placed on the floor and connected to a hose from the back of the MS, it is necessary to leave a space for routing the hose behind the installation base.

* The cable for connecting the MS main unit and the PC is 1.7 m long.

Lineup of JEOL's Mass Spectrometers

GC-MS



Gas Chromatograph Quadrupole Mass Spectrometer
JMS-Q1600GC UltraQuad™ SQ-Zeta

The JMS-Q1600GC is a 6th generation gas chromatograph quadrupole mass spectrometer with a pre-filtered high-precision hyperbolic quadrupole. It achieves best-in-class IDL ≤ 5 fg (OFN) and is used in various fields such as environmental, food, and material fields, taking advantage of its high sensitivity and robustness.

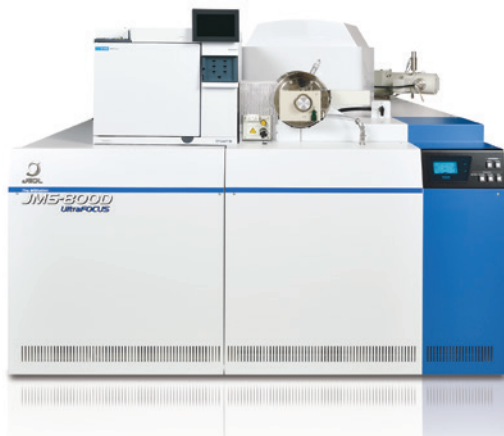
The use of a high-performance EI ion source (EPIS) or a photoionization source (optional) expands the range of measurements. The integrated qualitative analysis software msFineAnalysis iQ makes it easy to analyze data according to user needs.



Gas Chromatograph Time-of-Flight Mass Spectrometer
JMS-T2000GC AccuTOF™ GC-Alpha

The JMS-T2000GC AccuTOF™ GC-Alpha is a GC/High-Resolution TOFMS. Two types of multi-ionization ion sources-EI/FI/FD source and EI/PI source-are available. Soft ionization (SI) methods such as FI and PI can produce molecular ions from unknown compounds and facilitate the elucidation of their molecular formula. The new unknown compounds structure analysis software “msFineAnalysis AI” integrates EI and SI data, and proposes chemical structures even for compounds not registered in mass spectral libraries by using advanced AI technologies.

MALDI-TOFMS, LC-MS



Gas Chromatograph Double Focusing Mass Spectrometer
JMS-800D UltraFOCUS™

The JMS-800D is a gas chromatograph double-focusing mass spectrometer optimized for the measurement of dioxins and polychlorinated biphenyls (PCBs) and related substances, which are environmental pollutants measured at very low concentrations by using HRGC/HRSIM mode.

It has various functions to improve productivity and reduce maintenance costs.



Matrix-Assisted Laser Desorption/Ionization
Time-of-Flight Mass Spectrometer
JMS-S3000 SpiralTOF™-plus 2.0

The JMS-S3000 has evolved into SpiralTOF™-plus 2.0 with greatly improved mass imaging capabilities. Leading the state-of-the-art in analytical technology, the JMS-S3000 meets the ever-changing research needs for a wide range of fields such as synthetic polymers, materials science, and biomacromolecules.

The JMS-T100LP is a simple, robust, and all-round atmospheric pressure ionization time-of-flight mass spectrometer.

In addition to the Electrospray (ESI) ion source, the most widely used ion source for LC/MS, JEOL's proprietary ionization technologies, DART™ (Direct Analysis in Real Time) and Cold Spray, provide solutions for a wide range of analyses.



Atmospheric Pressure Ionization Time-of-Flight Mass Spectrometer
JMS-T100LP AccuTOF™ LC-Express

No worries in case of unexpected power outage

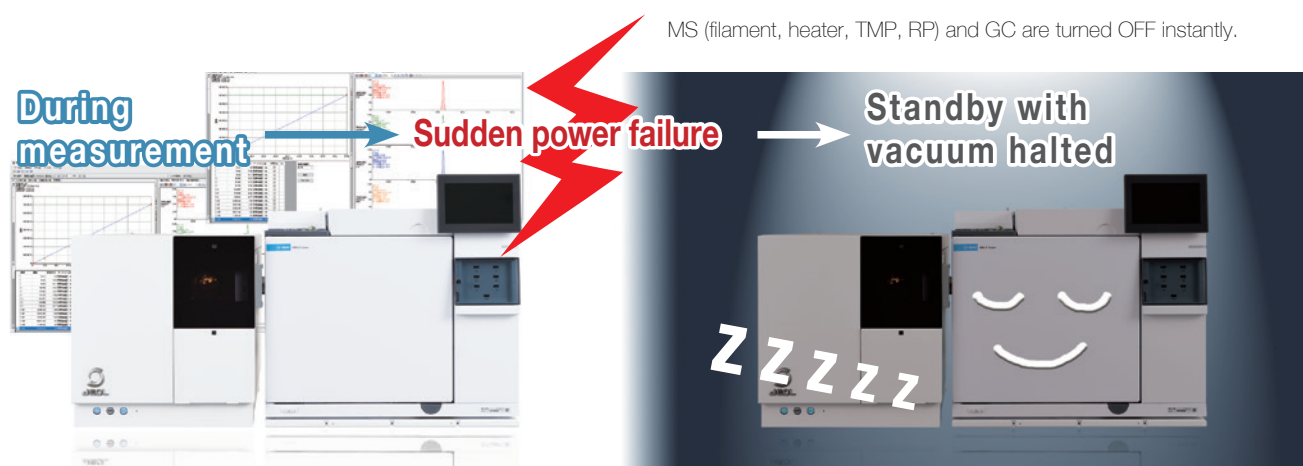
The fail-safe system ensures that the mass spectrometer will stop safely in the event of an unexpected power failure.

1. No contamination due to oil backflow

The vacuum section is designed to slowly return to atmospheric pressure in the event of a power failure, preventing oil from flowing back into the MS analyzer from the rotary pump and contaminating it.

2. No trouble due to automatic start-up

No trouble occurs because the system does not automatically start up after power is restored.



Certain products in this brochure are controlled under the "Foreign Exchange and Foreign Trade Law" of Japan in compliance with international security export control. JEOL Ltd. must provide the Japanese Government with "End-user's Statement of Assurance" and "End-use Certificate" in order to obtain the export license needed for export from Japan. If the product to be exported is in this category, the end user will be asked to fill in these certificate forms.



3-1-2 Musashino Akishima Tokyo 196-8558 Japan Sales Division Tel. +81-3-6262-3561 Fax. +81-3-6262-3577
www.jeol.com ISO 9001 • ISO 14001 Certified

• AUSTRALIA & NEW ZEALAND • BELGIUM • BRAZIL • CANADA • CHINA • EGYPT • FRANCE • GERMANY • GREAT BRITAIN & IRELAND • INDIA • ITALY • KOREA • MALAYSIA • MEXICO • RUSSIA
• SCANDINAVIA • SINGAPORE • TAIWAN • THAILAND • THE NETHERLANDS • UAE (Dubai) • USA

▼ Local office



No.2053I393C(Bn)