C142-E020G

SHIMADZU
Excellence in Science

Sequential X-ray Fluorescence Spectrometer

XRF-1800

LAB CENTER XRF-1800

Sequential X-ray Fluorescence Spectrometer

World-first 250 µm Mapping!

Utilizing state-of-the-art technology, including enhanced local analysis technology, originally pioneered by Shimadzu in 1994, in conjunction with superb basic functions, the Lab Center XRF-1800 delivers exceptional reliability, stability, and sensitivity. With complete control, analysis and reporting software, the XRF-1800 is a powerful tool for applications in a wide range of industries.

Features

1. World-first 250 µm mapping for wavelength dispersive analysis
   Optional sample observation by CCD camera.
2. Qualitative/quantitative analysis using higher-order X-rays [Patented]
3. Film thickness measurement and inorganic component analysis for high-polymer thin films with the background FP method
4. Smart, small-footprint design
   Integrated construction of workstation, X-ray tube cooling system, vacuum pump, X-ray generator, and all other units.
5. 4 kW thin-window X-ray tube offers high reliability and long life
6. Tried-and-tested sample loading system [Patented]
   Rapid, stable sample transport system offering easy maintenance.
7. Ultra-fast scanning (300°/min.) for quick and easy qualitative/quantitative analysis
8. Shimadzu's expertise condensed into template and matching functions
9. Full-featured, easy-to-use software

Applications

1. Electronics and Magnetic Materials

Semiconductors, magnetic optical discs, magnets, batteries, PCBs, condensers, etc.

2. Chemical Industry

Organic and inorganic products, chemical fibers, catalysts, paints, dyes, pharmaceuticals, cosmetics, cleansing agents, rubbers, toner, etc.

3. Petroleum and Coal Industry

Petroleum, heavy oils, lubricants, polymers, coal, cokes, etc.

4. Ceramics Industry

Cements, cement raw mix, ceramics, clinkers, limes, clays, glasses, bricks, rocks, etc.

5. Iron and Steel Industry

Pig irons, cast irons, stainless steels, low alloy steels, slugs, iron ores, ferroalloys, special steels, surface-treated steel plates, plating solutions, molding sands, etc.

6. Nonferrous Industry

Copper alloys, aluminum alloys, lead alloys, zinc alloys, magnesium alloys, titanium alloys, noble metals, etc.

7. Environmental Pollutants

Factory waste water, sea water, river water, airborne dust, industry waste, etc.

8. Agriculture and Food Industry

Soils, fertilizers, plants, foods, etc.

9. Paper and Pulp

Coated paper, talc, toner, ink, etc.

Contents

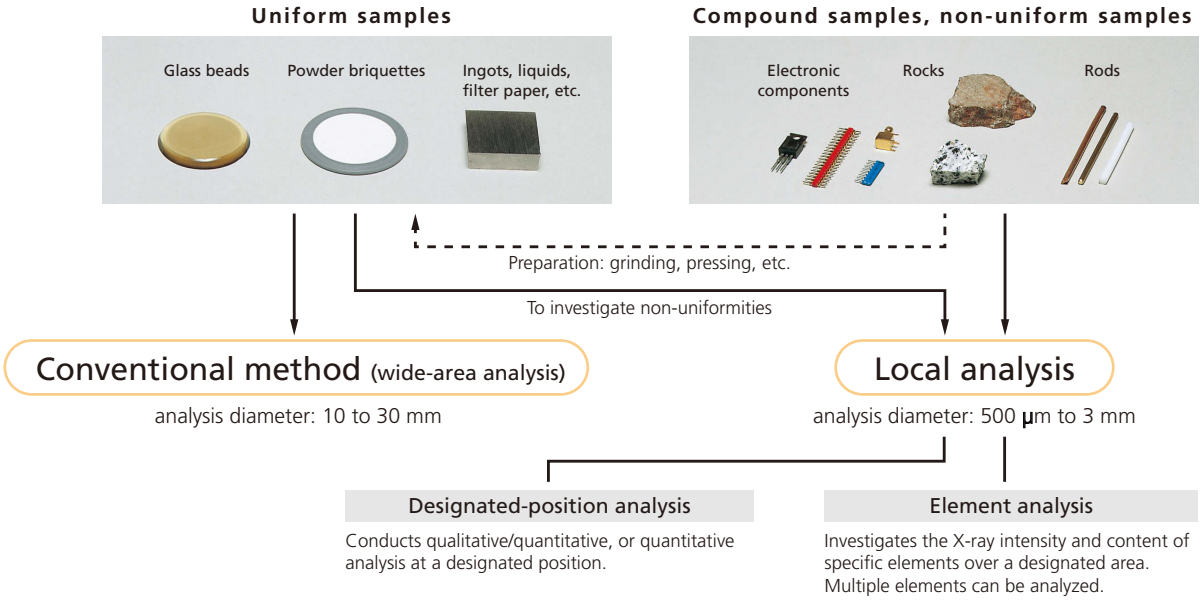
World-first 250 µm Mapping!

[Optional Sample Observation by CCD Camera Possible]

500 µm aperture and smooth data display achieve 250 µm mapping.
Adding the CCD camera produces even more convincing analysis results.

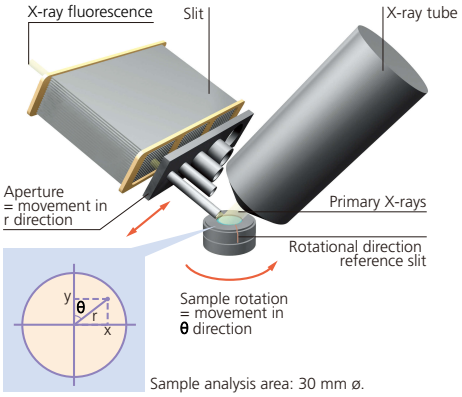
Local Analysis

In addition to the outstanding wide-area analysis performance of the average components over the conventional 10 to 30 mm analysis diameter, the XRF-1800 incorporates the local analysis pioneered by Shimadzu with the XRF-1700 in 1994. These have been further enhanced to permit analysis over a minimum diameter of 500 µm (250 µm displayed diameter).



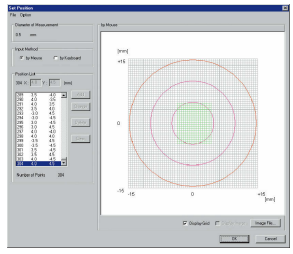
Principle of Local Analysis (Patented)

Perform analysis at any designated position within the 30 mm analysis diameter by using Shimadzu's unique slide-type aperture to control the position in the r direction and by rotating the sample to control the position in the θ direction.



Designating the Analysis Position

Use the local analysis scale (supplied) and the display to designate any position. Alternatively, the analysis position can be designated on the image of the sample area taken with the optional CCD camera.

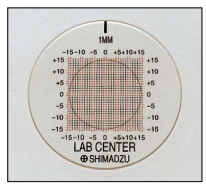


Position designation window

Select the analysis position inside the 30 mm diameter by clicking with the mouse or by entering the coordinates.

Local analysis scale

Align with the sample holder to check the analysis position.

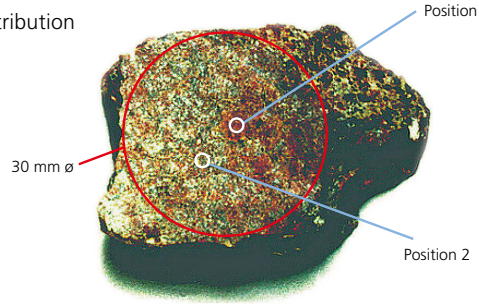


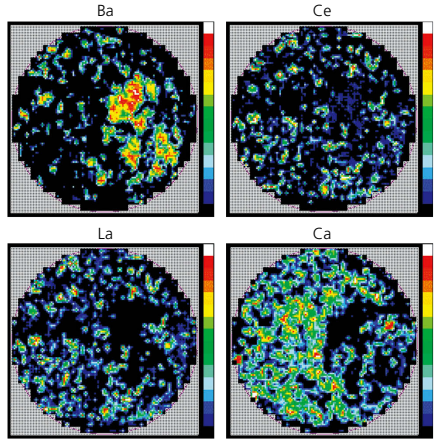
Application Examples

Element Mapping Analysis

250 µm display allows easy data comparison.
For content distribution and intensity distribution analyses of non-uniform samples.

The sample is the rare earth ore Bastnasite.
The red circle indicates the 30 mm-diameter mapping analysis areas.
La and Ce show identical distributions but Ca and Ba exhibit different distributions, indicating that the sample contains at least three different minerals.



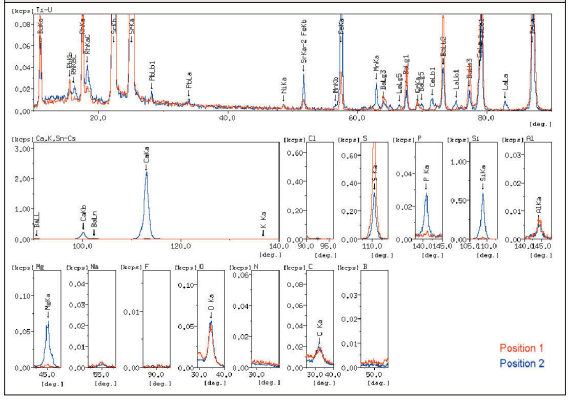


Designated-position Analysis

Excellent sensitivity for light elements and resolution of rare rare earth materials.
For the analysis of abnormal deposits, discoloration or other defects.

This example shows the designated-position analysis at Position 1 and Position 2 on the rare earth ore sample above.
The superimposed display of qualitative analysis results indicates differences in elements other than the mapped elements at the two positions.
Quantitative analysis results obtained by the FP method, using these qualitative analysis results, indicate the composition at each position.

Qualitative analysis results

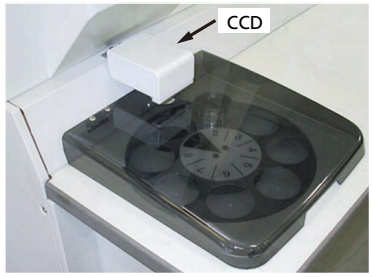


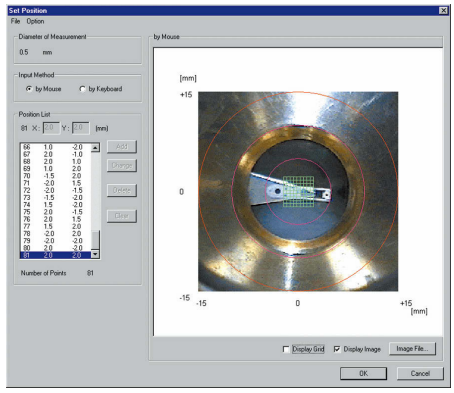
Quantitative analysis results

Compound	Content (%)	
	Position1	Position2
SiO_2	1.526	24.648
Al_2O_3	0.451	0.215
Fe_2O_3	0.797	2.540
MnO	———	0.461
MgO	0.653	6.369
CaO	0.456	29.079
Na_2O	0.672	———
K_2O	0.125	0.066
P_2O_5	———	0.626
SO_3	40.242	10.237
BaO	36.417	14.712
SrO	18.257	7.194
La_2O_3	———	0.947
CeO_2	———	2.615

Position designation using the CCD camera

The analysis position and image can be superimposed by importing an image after positioning the sample holder at the analysis chamber insertion position in the same way as at the sample analysis position.
(Patented)

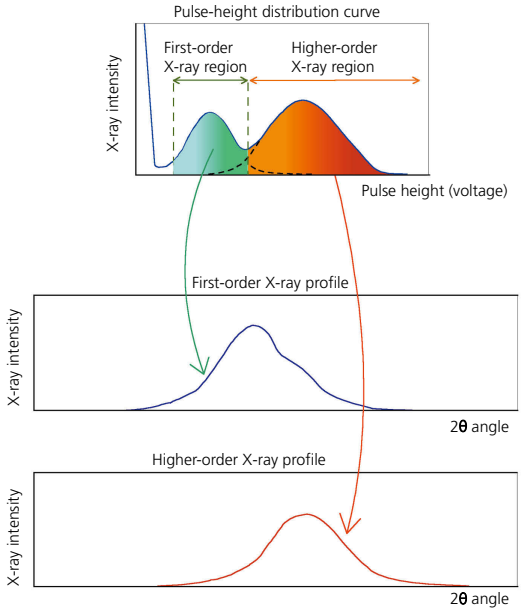




Qualitative/Quantitative Analysis Using Higher-order X-rays (Patented)

The normal first-order X-ray profile and higher-order X-ray profile can be measured simultaneously. More accurate evaluation of higher-order X-rays leads to greater accuracy and reliability when conducting qualitative/quantitative analysis.
During off-line data processing, the first-order X-ray profile and higher-order X-ray profile can be displayed independently or superimposed, to show the effects of the higher-order X-rays at a glance.

What is a higher-order X-ray profile?

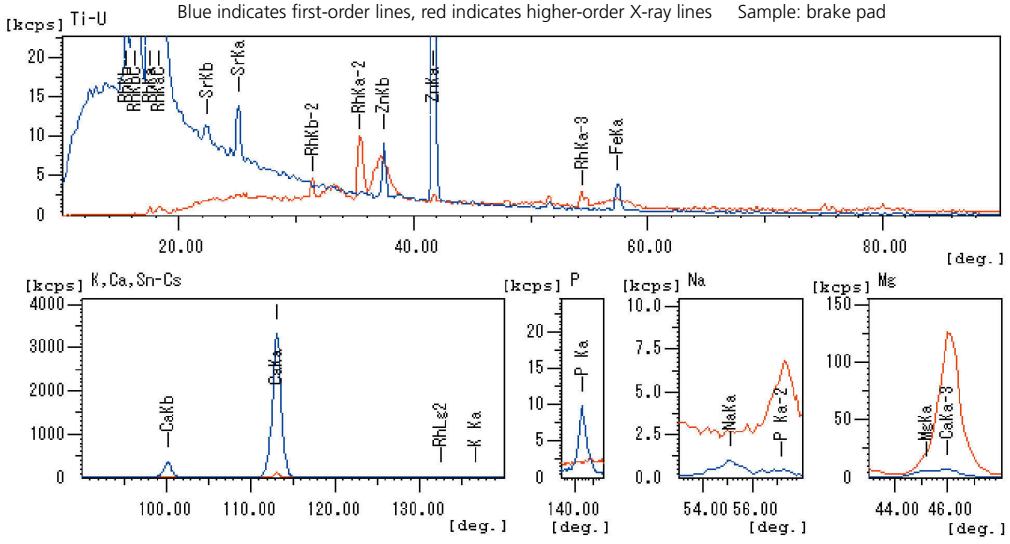


X-ray fluorescence from the sample is separated into spectral components by an analyzing crystal according to the Bragg's equation ($2d\sin\theta=n\lambda$) and counted by the detector. During spectral separation, higher-order lines (n≥2, 3…) enter the detector in addition to the target first-order X-ray wavelengths (n=1).
In an attempt to eliminate the effects of the higher-order X-rays, only X-rays within the first-order X-ray region in the pulse-height distribution curve (left) are normally counted.
However, if the higher-order X-rays have a high intensity, their effect cannot be ignored and they form superimposed peaks that appear in the first-order X-ray profile, making it impossible to correctly identify the peaks or evaluate intensity.
Therefore, the higher-order region X-rays are measured as the higher-order X-ray profile and the first-order region X-rays are simultaneously measured as the first-order X-ray profile. This enables comparison of the higher-order X-ray profile and first-order X-ray profile so that the effects of the higher-order X-rays can be easily investigated.

Comparison of first-order X-ray and higher-order X-ray profiles

The MgKα and CaKα third-order lines overlap on the first-order X-ray profile.
The CaKα third-order lines are displayed more intensely, because the higher-order X-rays are intensified in the higher-order X-ray profile.

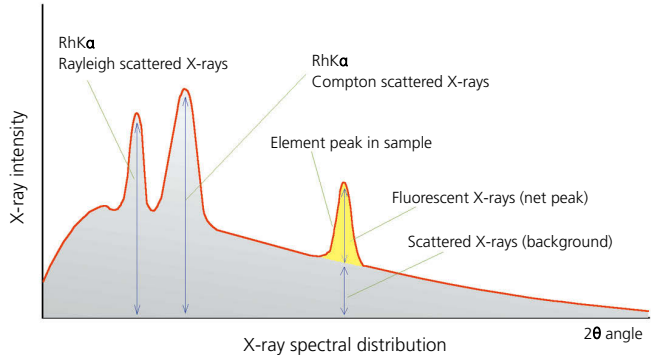
Blue indicates first-order lines, red indicates higher-order X-ray lines Sample: brake pad



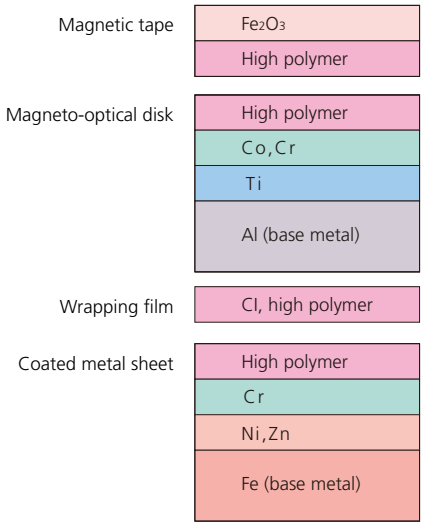
Film Thickness Measurement and Inorganic Component Analysis for High-Polymer Thin Films with the Background FP Method (Patented)

The theoretical intensity of the Compton scattering line is used as the high-polymer thin film information for analysis.
Hydrogen information that cannot be analyzed with fluorescent X-rays can be calculated using the Compton scattering/Rayleigh scattering intensity ratio.

Background FP is a method that adds scattered (background) X-ray intensity calculations to the fluorescent X-ray (net peak) intensity calculations of the conventional FP method.
The film thickness of a high-polymer film sample can be measured by calculating the X-ray intensity of one type of scattered X-rays, the RhKα Compton scattered X-rays, because the Compton scattering intensity is inversely proportional to the sample density and directly proportional to the sample thickness.



X-ray spectral distribution

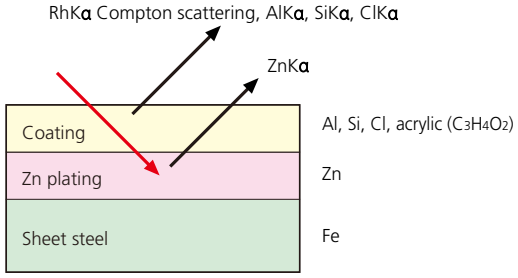


Examples of applied samples

Application Examples

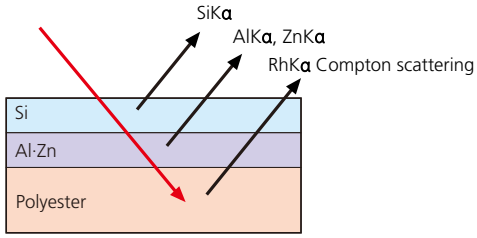
Analysis of coated metal sheet

Sample		Coating thickness					Zn plating
		Film thickness (μm)	Al (%)	Si (%)	Cl (%)	$C_3H_4O_2$	Film thickness (μm)
Clear	No.1	5.7	—	4.72	—	balanced	16.9
	No.2	12.5	—	3.40	—		16.0
	No.3	15.0	—	3.26	—		12.6
	No.4	21.0	—	3.08	—		15.9
Metallic (gloss)	No.1	10.4	30.2	—	3.11	balanced	15.1
	No.2	16.8	28.0	—	2.88		16.5
	No.3	17.1	27.8	—	2.90		16.7
	No.4	28.6	26.3	—	2.82		17.8



Analysis of capacitor film

Sample	Layer	Element	Density	Quantitative analysis	X-ray quantitative value
No.1	Layer 1	Si	2.35g/cm³	thickness	10Å
	Layer 2	— Al Zn	— 2.70 7.14	thickness content content	246Å 2.37% balanced
	Layer 3	Polyester ($C_{10}H_8O_4$)n	1.39	thickness	6.3 μm
No.2	Layer 1	Si	2.35g/cm³	thickness	5Å
	Layer 2	— Al Zn	— 2.70 7.14	thickness content content	230Å 2.30% balanced
	Layer 3	Polyester ($C_{10}H_8O_4$)n	1.39	thickness	6.3 μm



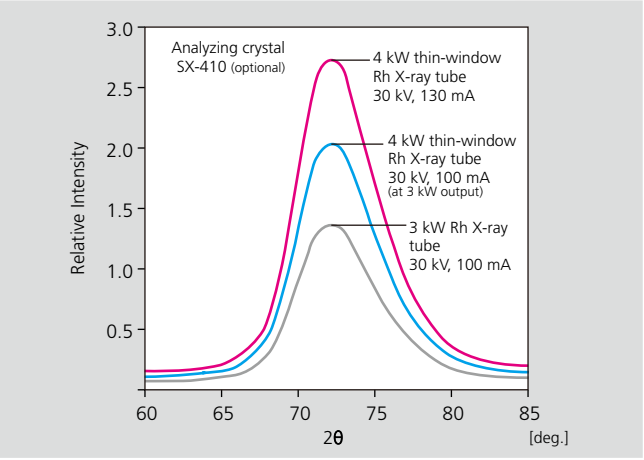
Superb Basic Functions

LAB CENTER achieves significantly enhanced sensitivity due to an optical system designed according to theoretical calculations. Multiple hardware controls, such as crystal replacement and goniometer control, are conducted simultaneously and rapidly. These excellent basic functions meet a variety of analytical needs.

4kW thin-window X-ray tube

The system features a highly reliable X-ray tube with an average life exceeding five years. It achieves more than double the sensitivity to light elements compared to conventional 3 kW X-ray tubes.

- Shimadzu's unique 4 kW thin-window X-ray tube and 140 mA high-current X-ray generator are installed as standard to enhance sensitivity to all elements.
- The sensitivity to Be and other light elements is dramatically improved by approximately a factor of two.



Comparison of BeKα spectra for various X-ray tube types

Filter changer (5 primary X-ray filter types)

- Five types of primary X-ray filters are installed as standard. These allow trace analysis by reducing characteristic X-rays, continuous X-rays, and impure scattered X-rays from the X-ray tube.

Filter	X-ray tube	Effective spectra
Zr	Rh	RhKα – CdKα
Ni	Rh, Cr	ZnKα – AsKα, PbLα, BiLα
Ti	Cr	CrKα – FeKα
Al	Rh	RhLα, CdLα
OUT		

Select high/low evacuation and air purge rates

- Effective for the analysis of fragile powders or thin films.

He purging (optional)

- Used for the analysis of liquid samples.
- Newly developed purger ensures faster, more reliable atmosphere purging.

Accurate temperature control

- Highly accurate temperature controller maintains the interior of the unit at 35 ±0.3˚C.

Vacuum stabilizer

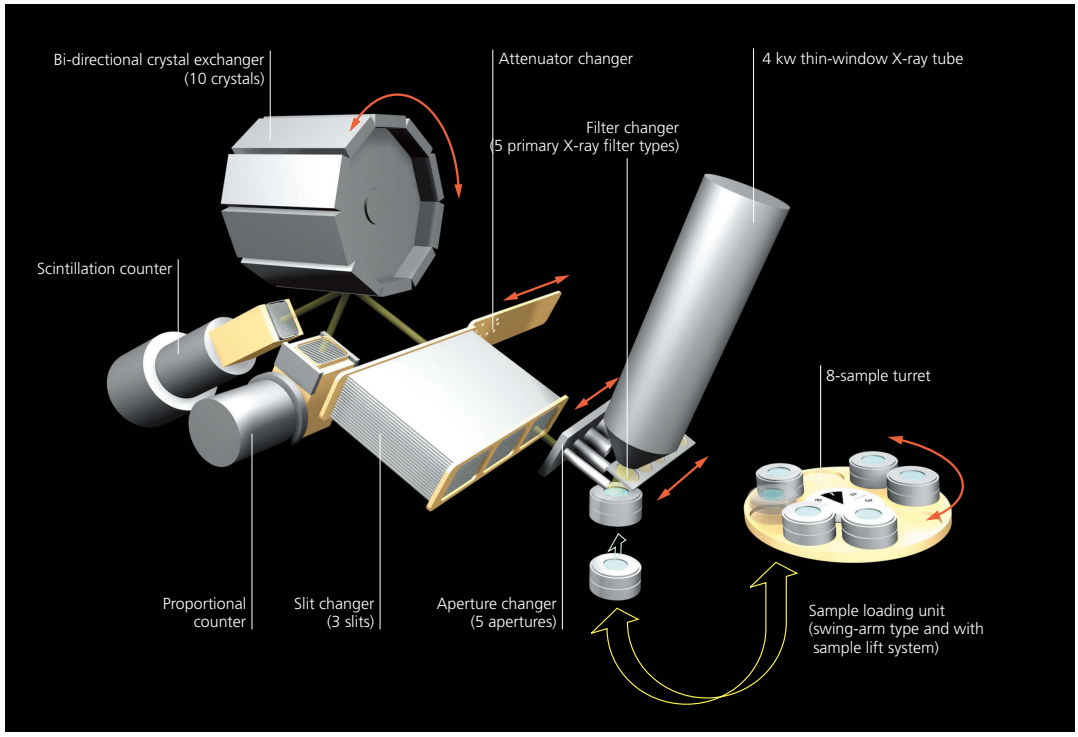
- A vacuum stabilizer is installed to enhance reproducibility for light elements. The first of its type in the world, it was originally developed by Shimadzu for the Simultaneous X-ray Fluorescence Spectrometer.

New optical system design

- Reducing the distance from the X-ray tube to the sample and the distances from the sample to the aperture and the primary slit enhances sensitivity to all elements by approximately a factor of 2 (compared to previous models).

Principle and Construction

When the sample is irradiated by X-rays from the X-ray tube, the component atoms of the sample emit further X-rays, which radiate outside the sample. These X-rays, known as X-ray fluorescence, have a wavelength that is characteristic of the element. Consequently, investigation of the X-ray wavelength allows qualitative analysis of the sample. Also, as the fluorescent X-ray intensity is proportional to the concentration of the element, quantitative analysis is possible by measuring the X-ray intensity at the characteristic wavelength of each element.



Aperture changer (5 apertures)

(Patented)

- The five uniquely shaped apertures (500 µm, 3, 10, 20, 30 mm θ.) permit sensitive analysis of small-diameter samples. Optional sample masks are available to suit the apertures.

Slit changer (3 slit types)

- Three slit types are installed in the instrument: standard slits, high-resolution slits for ultra-light elements, and high-sensitivity slits to eliminate superimposition of spectra.

Attenuator changer

- Reduces the sensitivity to about 1/10 for the analysis of high-concentration samples when the count exceeds the linear counting range.

Vacuum stabilizer

- Ten analyzing crystals (elements) can be mounted to handle all elements from ultra-light elements to heavy elements.
- Bi-direction rotation achieves rapid changeover in the minimum time possible.

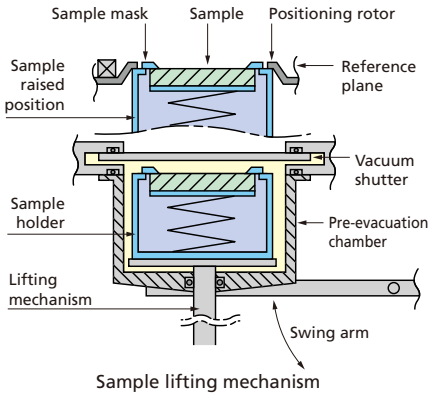
θ-2θ independently driven goniometer

- As the analyzing crystals and detectors can be freely combined, LiF-SC (Ti to U) and LiF-FPC (K to V) combinations can be achieved with the single standard LiF.
- The offset between the analyzing crystal and detector is adjusted automatically to set the optimal diffraction conditions.
- Stable drive system with excellent stopping position repeatability.

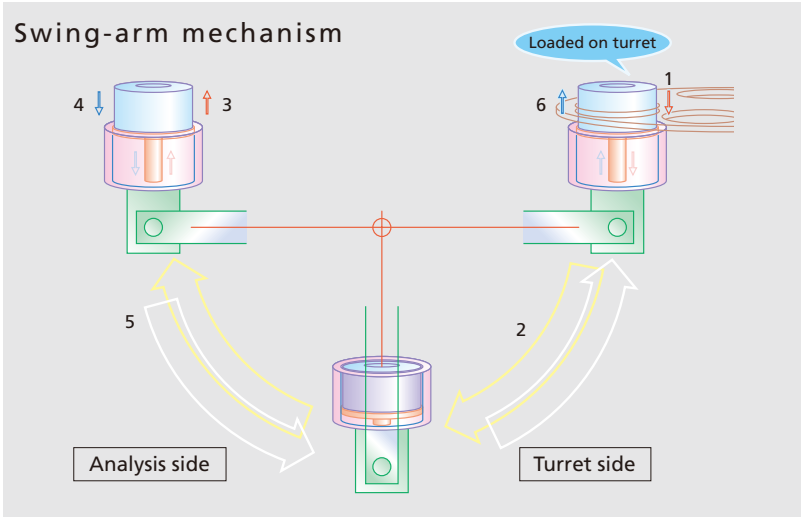
Tried-and-tested Sample Loading System (Patented)

[Shimadzu's unique swing-arm system eliminates transport problems.]

Even when a powder sample accidentally breaks and overflows into the pre-evacuation chamber, it does not contaminate the evacuated analysis chamber.
Returning the pre-evacuation chamber to the sample loading side allows cleaning of the pre-evacuation chamber while the power is turned on.



Sample lifting mechanism



Movements of the swing-arm mechanism

1. The sample holder descends into the pre-evacuation chamber.
2. The swing-arm mechanism moves the pre-evacuation chamber to the analysis side in a single movement.
3. When pre-evacuation is complete, the vacuum shutter opens and the sample holder is lifted to the sample raised position.
4. The sample holder descends into the pre-evacuation chamber after analysis is complete.
5. After the vacuum shutter closes and ambient air fills the pre-evacuation chamber, the swing-arm mechanism moves the pre-evacuation chamber to the turret side in a single movement.
6. The sample holder moves back into the turret from the pre-evacuation chamber.

Rapid loading by swing arm and lifting mechanism

- Simple and reliable drive mechanism with few drive axes.
- Sample travels from the turret position to the analysis position in just two movements: a vertical movement and a swing movement.
- As the swing mechanism is external to the analysis chamber, the sample holder never moves laterally through the vacuum.

Sample holder

- The sample lifting mechanism achieves excellent repeatability.
- Sample holders for local analysis incorporate a reference slit to correctly set the sample orientation. (Utility model patent)

Eight-sample turret for high productivity

- Sample changeover occurs in the lower part of the turret to allow safe sample changeover at any time without stopping operation.
- The turret can rotate in either direction to move to the changeover position in the minimum time possible.
- The optional 40-sample auto sample feeder (ASF-40) permits the analysis of a large number of samples.

Pre-evacuation chamber

- The small, airlock-equipped, pre-evacuation chamber can be quickly evacuated to achieve rapid pre-evacuation.

Detector and Counter Circuits Offer Excellent Long-term Stability and Extract Maximum X-ray Tube Performance

Detector and counter circuits achieve superior long-term stability and low gas flow due to the highly accurate gas density stabilizer.
Automatic sensitivity control (ASC) fully exploits the 4 kW thin-window X-ray tube performance across the range from trace elements to major components.

Scintillation counter (SC)

- The SC is located inside the evacuated spectrometer to eliminate absorption by air and the spectrometer materials. The short optical path achieves high sensitivity. Also the vacuum environments prevent the degradation of the scintillator (NaI).

Proportional counter (FPC)

- The FPC window is made of a long-life high-polymer film. The cassette system allows simple replacement without detriment to optical system reproducibility.
- The highly accurate, electronically controlled gas density stabilizer lowers running costs by reducing the PR gas flow rate to 5 mL/min. and requires no filament cleaning or other mechanisms. It is timer controlled at instrument startup and shutdown.
- The low PR gas flow rate eliminates almost all filament contamination. The cartridge system allows easy replacement after a long period of use.

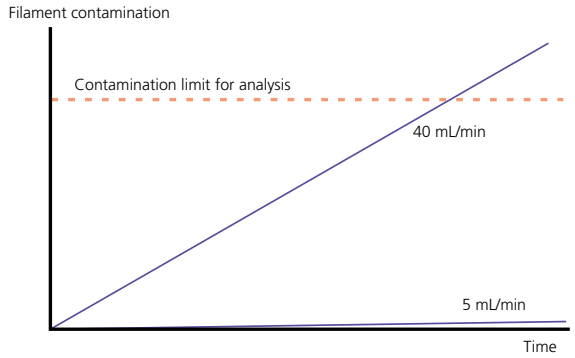
Automatic Sensitivity Control (ASC) System (Patented)

- The detector system misses counts in the spectral lines of major component elements during 4 kW full-power analysis, such that split peaks occur and the original intensity cannot be obtained. In such cases, the Automatic Sensitivity Control (ASC) system automatically sets the attenuator or reduces X-ray tube current in the region where miscounting occurred, and repeats analysis in the linear counting range. The re-analyzed X-ray intensities are sensitivity compensated and synthesized on the display.

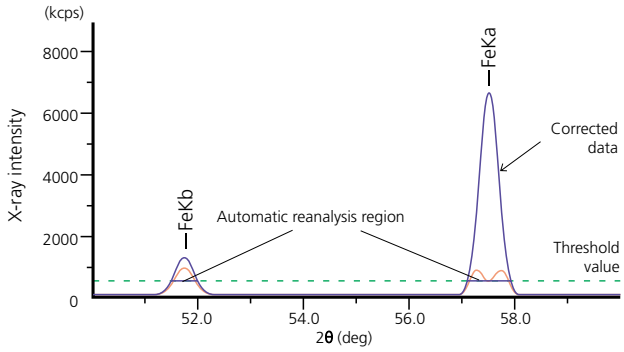
- The ASC system measures the major component spectral lines in the sensitivity region where linearity is guaranteed. Other elements and trace elements are analyzed at 4 kW full power to obtain accurate X-ray intensity and qualitative analysis results. Consequently, quantitative FP analysis based on this data also yields accurate quantitative results.

High counting rate

- The wide linearity range and the peak-shift compensation function achieve more accurate analyses.



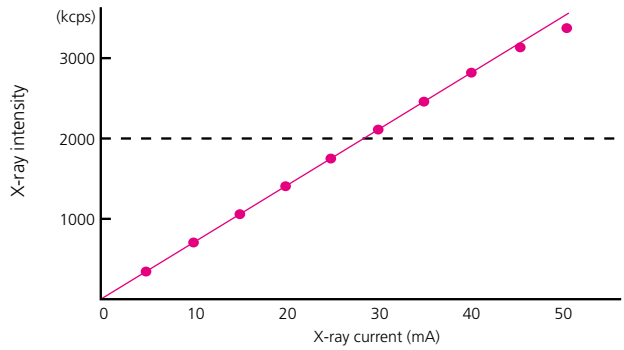
Relationship between PR gas flow rate and filament contamination



Application example for the FeKa of low alloy steel

	Standard value	With ASC	Without ASC
Mn	0.113	0.142	1.717
P	0.012	0.019	0.254
Cu	0.033	0.051	0.499
Ni	0.051	0.057	0.609
Cr	0.011	0.023	0.299
Mo	0.011	0.017	0.178
Ti	0.057	0.084	0.917
Fe	99.593	99.305	91.056

Qualitative/quantitative analysis example



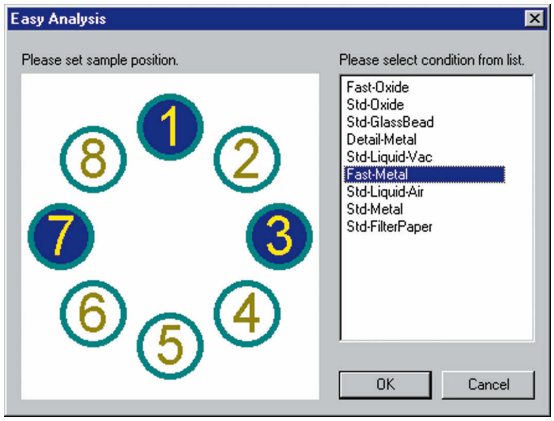
TiKα counting linearity using FPC

Ultra-fast Scanning (300°/min.) Offers Quick and Easy Qualitative/Quantitative Analysis

Simple operations rapidly yield analysis results

Simple analysis

- Simple operations for the qualitative identification of all elements (Be to U) (*) and quantitative analysis by the FP method that requires no standard samples.

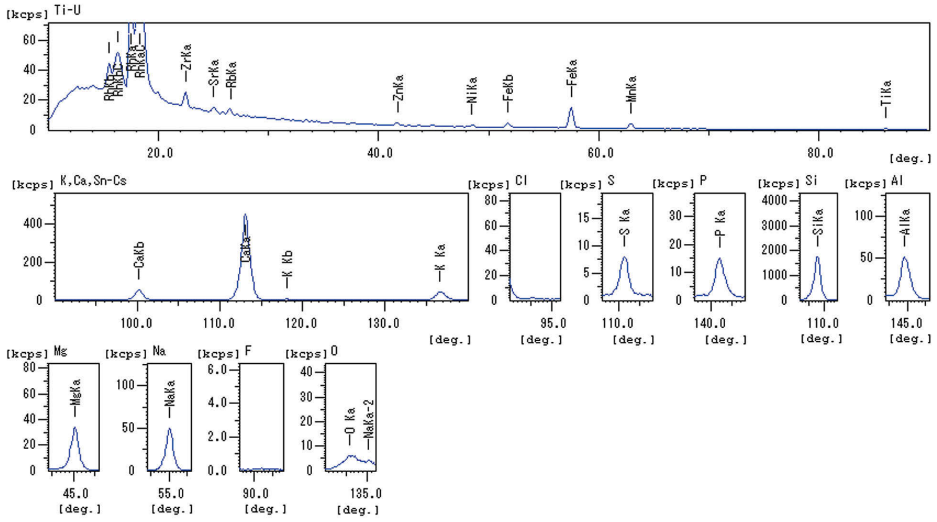


Simple analysis procedure

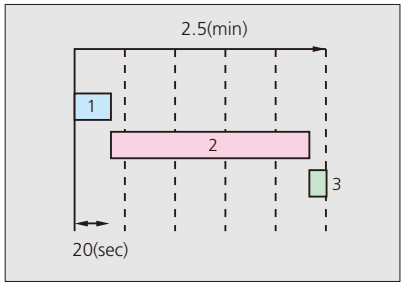
Click with the mouse to designate the turret position.
Qualitative identification of all elements and quantitative analysis by the FP method.
Conditions can be selected to suit the compound form, sample form, and analysis time.

Ultra-fast qualitative/ quantitative analysis

- Ultra-fast qualitative function (300°/min.) permits qualitative identification of elements Be to U and FP quantitative analysis to be completed in just two and a half minutes.



Qualitative analysis results for glass



1. Qualitative analysis of heavy elements (Ti to U)
2. Qualitative analysis of light elements (Be to Sc)
3. Result display of FP method and quantitative analysis

Analysis time chart

Quantitative Results

Analyte	Result	Proc-Calc	Line	Net	BG
SiO2	72.8510%	Quant-FP	Si Ka	1728.946	7.307
Na2O	12.0833%	Quant-FP	Na Ka	50.450	0.389
CaO	7.1260%	Quant-FP	Ca Ka	448.911	1.854
MgO	5.0228%	Quant-FP	MgKa	32.835	0.859
Al2O3	1.6959%	Quant-FP	Al Ka	47.785	3.544
K2O	0.5542%	Quant-FP	K Ka	44.969	1.003
P2O5	0.4541%	Quant-FP	P Ka	14.287	1.178
Fe2O3	0.1128%	Quant-FP	Fe Ka	14.156	1.351
TiO2	0.0459%	Quant-FP	Ti Ka	0.928	0.169
MnO	0.0430%	Quant-FP	MnKa	3.488	0.851
ZrO2	0.0110%	Quant-FP	Zr Ka	9.972	15.385

Qualitative/quantitative analysis example

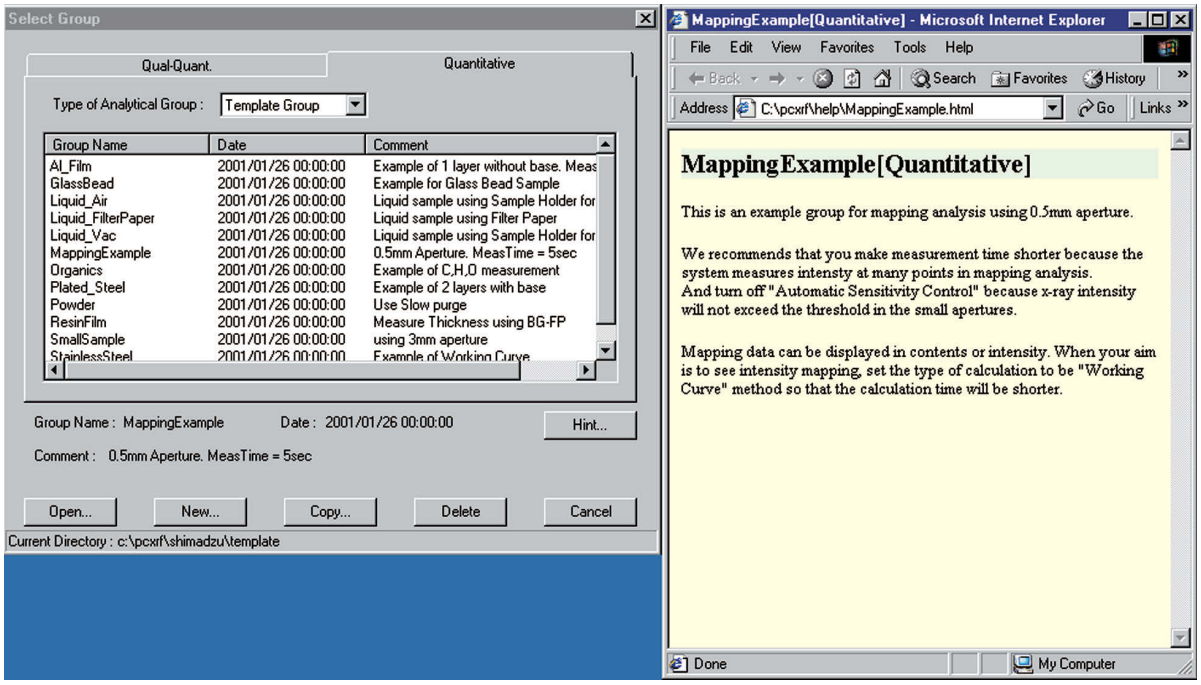
(*) Optional analyzing crystals required to analyze elements Be to N.

Shimadzu's Expertise Condensed into Template and Matching Functions

Template Conditions and comprehensive matching functions simplify setting of conditions and analysis operations.

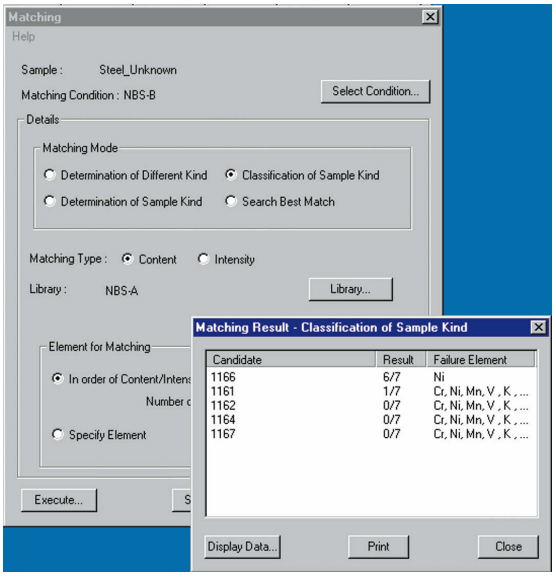
Template Conditions

- Optimal conditions can be created based on prepared conditions for sample forms including liquids, powders, solids, metals, and oxides.
- Help information for creating conditions appears on each template to ensure error-free operation.



Four matching functions

1. **Determination of different sample**
   The unknown sample is compared to reference sample values to evaluate if they are of the same kind.
2. **Classification of sample**
   The element reference values and tolerances for multiple samples are stored and used to identify the unknown sample.
3. **Determination of sample**
   The element content range for multiple samples are stored and used to identify the unknown sample.
4. **Search best match**
   Reference values for multiple samples are stored and the sample with the reference value with the smallest difference to the unknown sample is found.



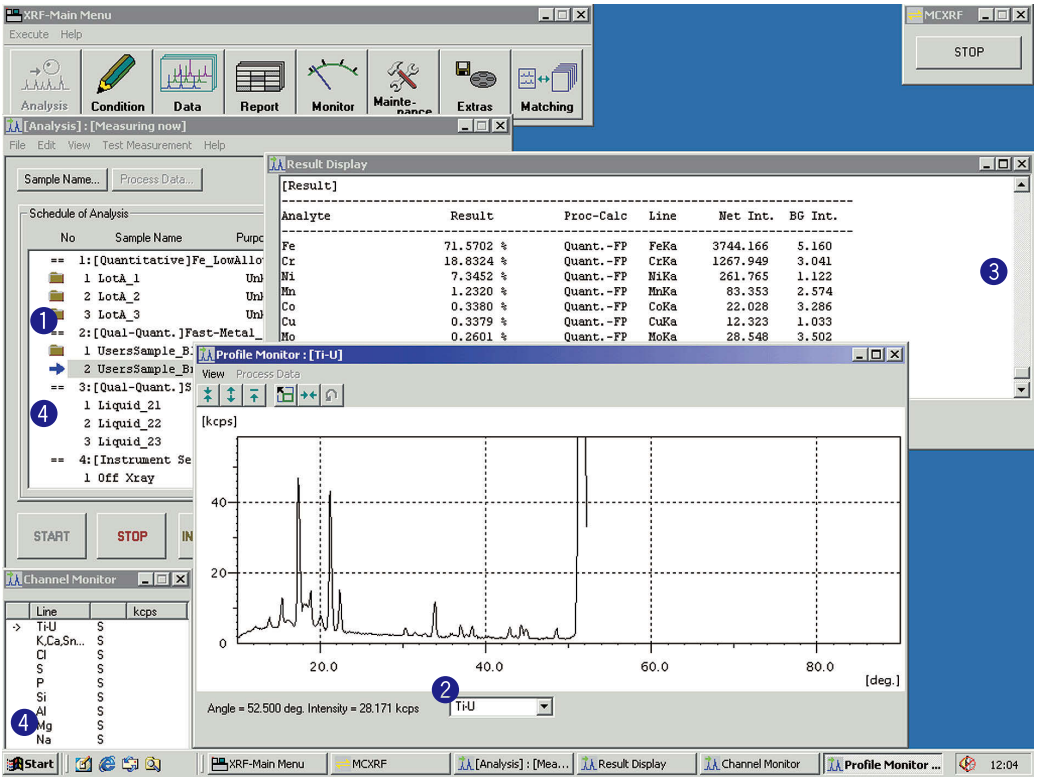
Example matching calculation results

Full-featured, Easy-to-use Software

[Straightforward operations]

The Full-featured, easy-to-use software is based on expertise gained developing wavelength dispersive and energy dispersive models.

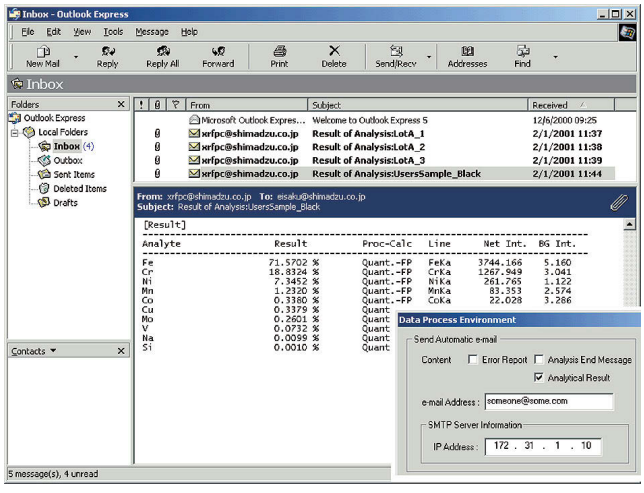
Total operation



1. Data processing commences immediately after sample analysis.
2. All analysis channels for which analysis is complete can be displayed in addition to the currently displayed analysis channel.
3. Analysis results are displayed, and Analysis results can be reviewed for confirmation.
4. The currently analyzed sample and elements can be checked at a glance.

Network and automatic E-mail functions

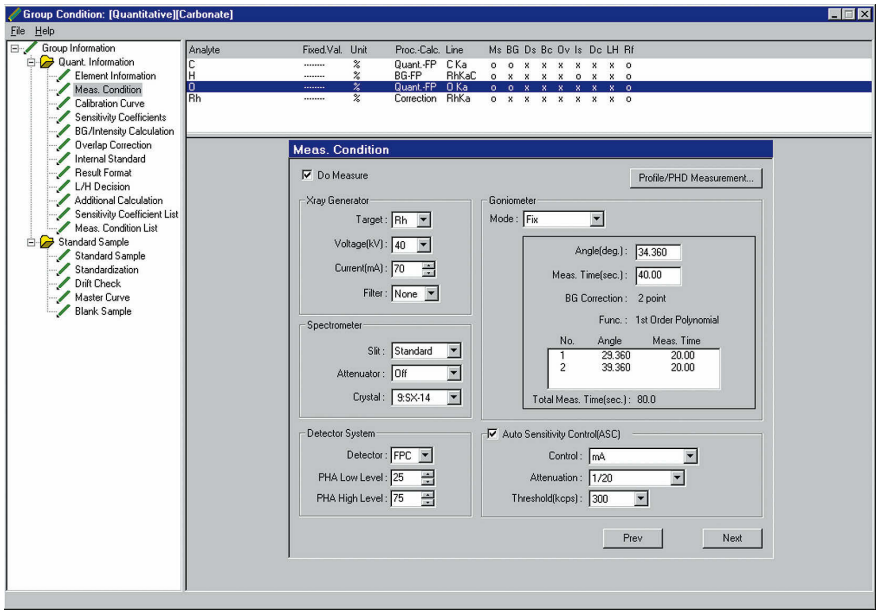
- Data sharing over a LAN (Local Area Network).
- E-mail notification functions allow analysis completion notification, analysis result transmission, and error notification to a designated E-mail address.



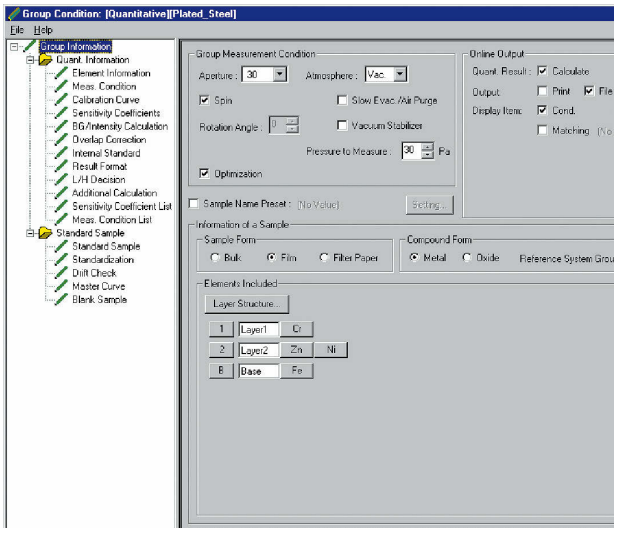
Setting the Conditions

Total display

- The operation tree, element list, and operation screens are displayed simultaneously for easy, immediate viewing of the required information.

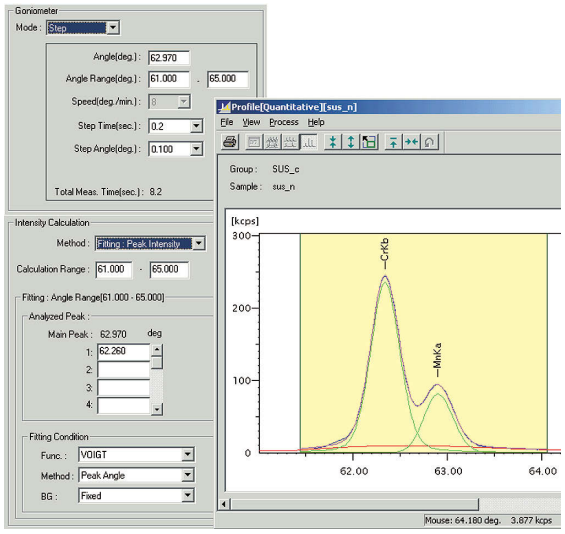


Film



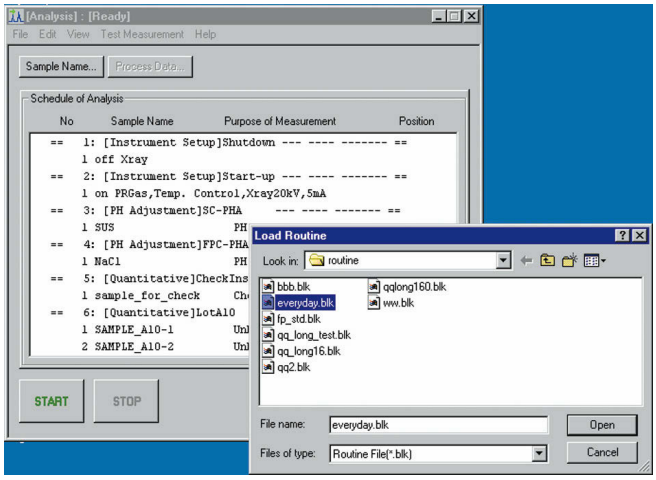
- Multi-layer thin films can be set (up to 10 layers, up to 100 components).
- Film composition is clearly displayed.
- Thickness calculation simulation investigates whether the sample can be calculated as a film sample.
- The BG-FP method can be used for film analysis to achieve quantitative analysis using standard samples with a different form from the target unknown sample.

On-line fitting



- Integrated intensity or fitting intensity can be used as the quantitative intensity. This is effective when the peak half-width value differs according to the sample.
- Data processing displays the profile of elements for which the integrated intensity has been measured, allowing parameter review and re-analysis.

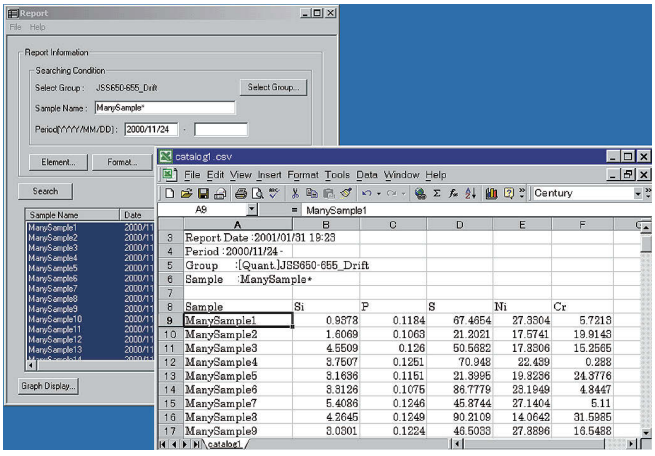
Convenient and Easy to Use



Routine analysis

Convenient sample registration

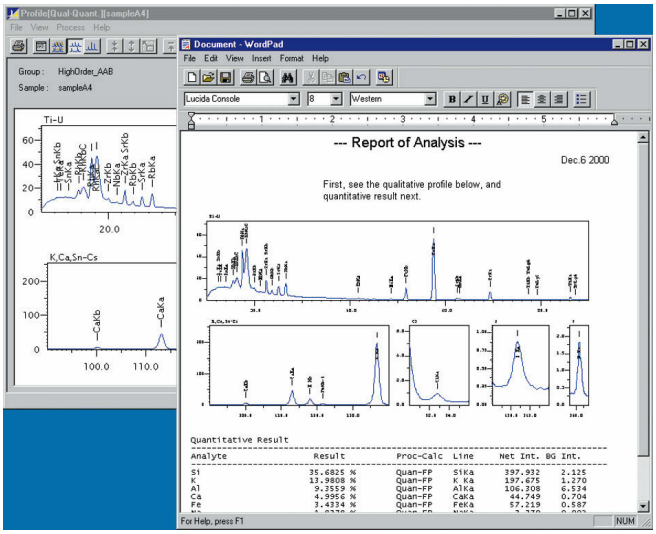
- Sample name entry is unnecessary after the sample name and analysis conditions have been entered once. (Routine analysis) Simple sample name entry using serial numbers.
- System starting and stopping and automatic PHA calibration can be registered in a schedule for automatic operation.



Sample combination of tabulation and spreadsheet software

Report generation

- Qualitative/quantitative data and quantitative data can be searched and analysis results displayed in tabular form.
- Tabulated results can be output in CSV format for editing with Excel (*) or some other spreadsheet software.



Sample combination of data processing and WordPad

Profile display

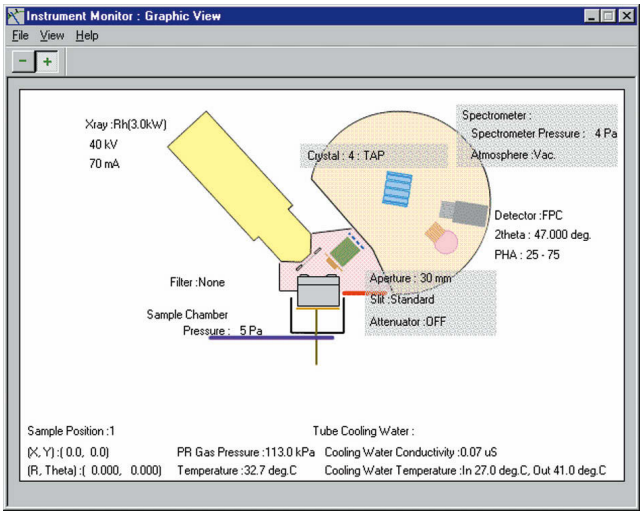
- Double or triple column layout printing and landscape or portrait format are possible, according to the screen display.
- A profile image can be copied for display by other applications.

Easy Maintenance

The reliable LAB CENTER maintenance functions ensure the system is always in peak condition.
The instrument status is monitored on the workstation screen to allow adjustment of all parts.

Continuous monitoring system

- The control system continuously monitors the instrument status, such that it can be instantly checked on the display. If a fault occurs in the instrument, the location, cause, and remedy are immediately displayed on the warning and error screen.
- The operation status is recorded automatically to facilitate rapid countermeasures.



Continuous monitoring system

X-ray tube cooling water monitoring

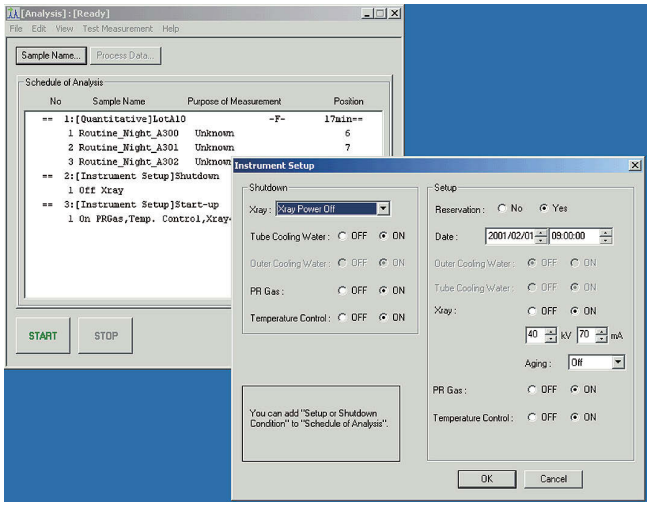
- To maximize X-ray tube life, the flow rate, electrical conductivity, inlet and outlet water temperatures, and water levels (warning level, X-ray shutoff level) are continuously monitored to notify of alarms immediately.

Automatic operation

- Automatic shutoff after analysis and timer-controlled automatic system start-up offer reliable unmanned operation of the system.

Self diagnosis

- Self-diagnosis is conducted for eight mechanical systems: filter, spin, aperture, collimator, attenuator, crystal changer, goniometer, and sample loading / sample discharge.



Automatic operation system

Automatic PHA adjustment

- Automatic PHA adjustment for SC and FPC can be conducted using dedicated samples. This adjustment maintains the instrument in peak condition for analysis.

Diagnosis via e-mail

- The error status, instrument options, and software version information can be transmitted when a fault occurs in the instrument. Accurate diagnosis reduces instrument downtime.

Specifications

X-ray Generator	
X-ray Tube	4 kW, thin-window, Rh target, end-window construction Optional: Rh/Cr, Rh/W dual target
Control Method	Fully computer controlled Automatic aging Programmable for automatic start-up and shutoff
Max. Rating	60 kW, 140 mA, 150 mA (option)
Output Stability	±0.005% for +15% to -10% input fluctuation
Protective circuits	Overvoltage, overcurrent, overloading, abnormal input voltage, abnormal cooling water, abnormal interlocks on operation panels Optional: high-frequency inverter power supply (Note 1)

X-ray Tube Cooling Unit	
Method of Heat Exchange	Dual-tube cooling water circulation
Cooling Water	Purified with built-in ion exchange resin

Spectrometer	
Sample Compartment	X-ray irradiation from above the sample Sample rotation at 60 rpm (50/60 Hz) Direction of rotation: set either direction (1-degree units)
Sample Loading Unit	Swing arm with sample lifting mechanism
Sample Changer	8-sample turret
Sample Holder	7 for solid samples,1 for local analysis Max. sample size: 51 mm ø. × 38 mm high
Primary X-ray Filter	Automatic changing of five filters (Al, Ti, Ni, Zr, OUT)
Aperture	Automatic changing of five apertures (500 mm, 3, 10, 20, 30 mm ø.)
Primary Slit	Automatic changing of three types (Standard, high-resolution, high-sensitivity)
Attenuator	Automatic ON-OFF control (attenuation: approx. 1/10)
Analyzing Crystal Changer	Automatic changing of 10 crystals; bi-directional rotation type
Analyzing Crystals	LiF (200), PET, Ge TAP as four standard types LiF (220), SX-52, SX-1, SX-14, SX-88, SX-98, SX-76, SX-410 optional
Detector	Scintillation counter (SC) for heavy elements Proportional counter (FPC) for light elements Aluminum deposited 0.6 µm thick film window Cartridge type filament
FPC Gas System	Electronically controlled gas density stabilizer Gas consumption: 5 mL/min.
Goniometer	θ, 2θ independent drive system Scanning angle range: SC: 0° to 118° (2θ) PC: 7° to 148° (2θ) 2θ scanning speed Maximum speed: 1200°/min. Continuous scanning speed: 0.1° to 300°/min. Step scanning: 0.002° to 1.0° Stopping position repeatability: ±0.0003°max.
Temperature Control	35°C±0.3°C
Evacuation System	Vacuum stabilizer Coupled rotary pump (with oil mist filter) Pre-evacuation selectable at high or low speed Air purging selectable at high or low speed Spectrometer atmosphere: vacuum or air He optional

Counting/Control Unit	
Pulse Height Analyzer	θ-2θ, PHA operation, peak shift correction, automatic PHA adjustment, dead-time correction
Detector High Voltage Supply	500 to 1,000 V for SC 1,500 - 2,500 V for FPC
Counting Linearity	1,000 kcps for SC; 2,000 kcps for PC
Scaler, timer	Max. counting capacity 2^{32}-1, 0.1 to 3000 sec.
Control Method	Multitasking control by 32-bit computer

*1 Maximum Rating: 60 kV, 150 mA, 4 kW
Output Stability: ±0.005% for +21% to -10% input fluctuation
Other specifications as standard.

Workstation Hardware	
Computer	IBM-PC/AT, or compatible
Operating system (OS)	Windows 7
Main Memory	128 MB
Hard disc	20 GB, or more.
Floppy disc	3.5 inch, 1.44 MB
Display	17 inch (1024 × 768 pixels)
Network function	Ethernet
Printer	Color printer Laser printer (optional)

Software	
Local Analysis	Position designation (quantitative, qualitative) Mapping (intensity distribution, quantitative distribution)
Template Conditions	Conditions provided for sample form and compound form
Simple Analysis	High-, standard-, and low-speed analysis, metals and oxides
Routine Analysis	
On-line Help	
Quantitative Analysis	Fundamental parameter (FP) method Background FP method Up to 100 components for bulk samples Up to 10 layers and 100 components for film samples Calibration curve method (linear and quadratic); automatic selection of 5 divisions Off-line re-calculation Matrix correction by 4 types of multilinear regression Matrix correction coefficient calculation by the SFP method Measurement of peak intensity and integrated intensity Thickness calculation simulation
Qualitative Analysis	Higher-order X-ray profile functions Automatic sensitivity control (ASC) Smoothing, background correction, peak pick, automatic qualitative determination, peak separation by function fitting, background fitting at up to 16 points (linear, quadratic, cubic functions, Lorentz function, spline function, hyperbolic function), peak editing (addition/deletion of peaks, element spectra marking, listing of probable elements for unknown peaks), overlaid processing of up to 8 samples, scale change (2θ angle, wavelength, energy, linear and logarithmic X-ray intensity)
Qualitative/ Quantitative Analysis	Bulk and thin-film samples
Tabulation	Daily report, monthly report, statistical processing, output as ASCII file, control chart output
Automatic Mail Functions	Analysis completion notification, error notification, analysis result transmission

Maintenance	
Instrument Status Monitoring	X-ray tube output, analyzing crystal, sample compartment pressure, 2θ angle, X-ray tube cooling water (electrical conductivity, inlet/outlet water temperatures)
Automatic Recording of Operation Status	
Automatic Start and Shutoff	X-ray tube power, X-ray tube cooling water, PR gas, temperature control
Automatic PHA (pulse height analyzer) adjustment	
Self Diagnosis	

Standard Accessories			
FPC filament Unit	1	Ion exchange resin (1 L)	1
FPC Window	2 as a set	Vacuum pump oil (4 L)	1
Samples for instrument	1 set	High-voltage insulation grease	1
adjustment Tools	1 set	Vacuum grease	1
		Spare parts	1 set

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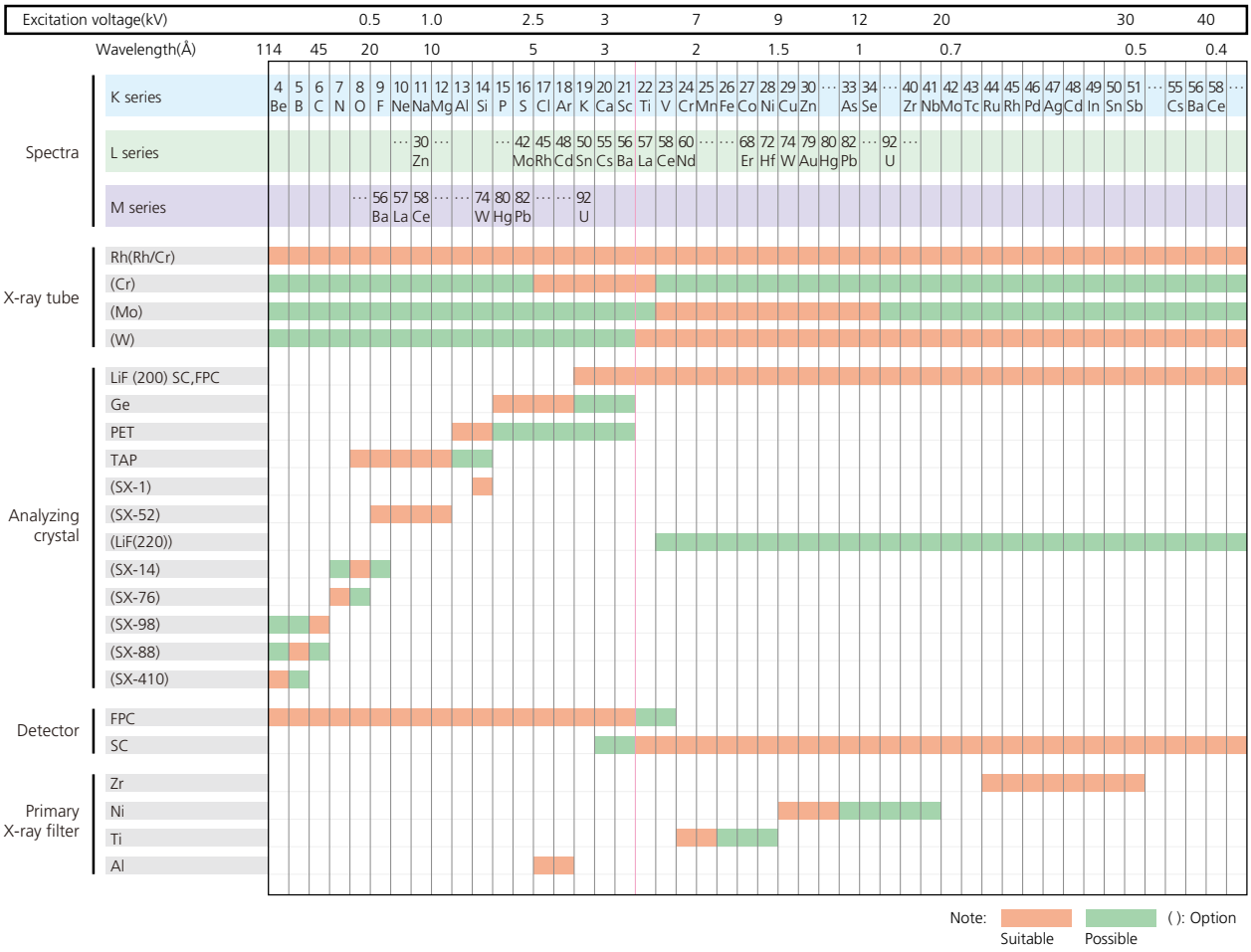
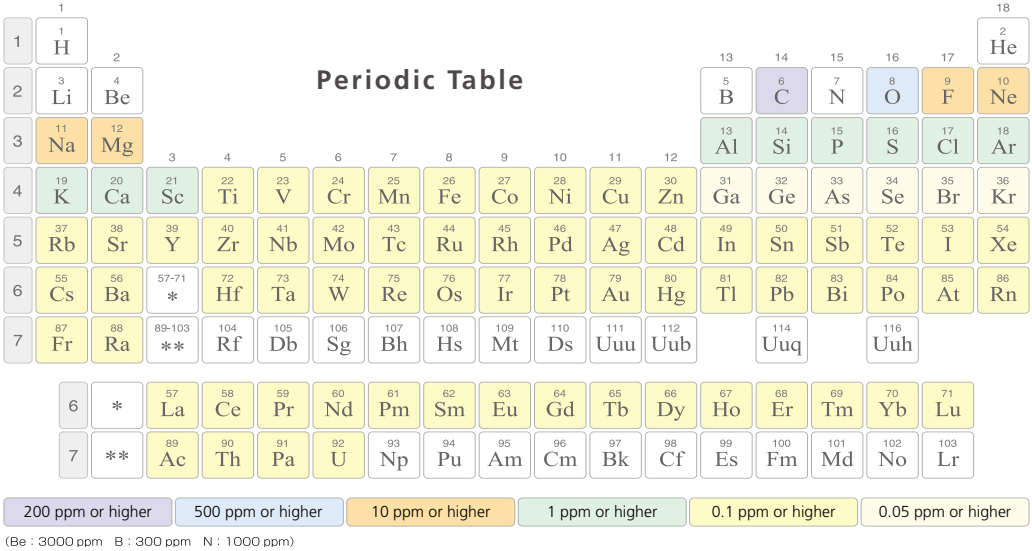
*Additionally noted company names and product names are the trademarks or registered trademarks of the respective companies.
*The notations™ and ® are not used in this document.
The appearance and specifications of all products in this catalog may be changed without notice.

Combinations of X-ray Tube, Analyzing Crystal, and Detector

The table shows conditions suitable for the analysis of various elements.



Detection Limits



Lower Limits of Detection

● Steel (ppm)

Element	Lower Limit of Detection	Monochromator Crystal	Sample	Pretreatment	Integration Time
$_{5}$B	64	SX-88	Stainless steel	Mirror finish	100 s
$_{6}$C	80	SX-98	Low-alloy steel	Zirconia No. 80*	40 s
$_{9}$F	45	SX-52	Slag	Briquette press	40 s

* Belt polishing machine

● Catalyst (ppm)

Element	Lower Limit of Detection	Monochromator Crystal	Sample	Pretreatment	Integration Time
$_{45}$Rh	6	LiF	Cordierite	Briquette press	60 s
$_{46}$Pd	5				
$_{78}$Pt	2.6				

● Liquids (ppm)

Element	Lower Limit of Detection	Monochromator Crystal	Sample	Pretreatment	Integration Time
$_{12}$Mg	3	TAP	Oil	Drip on filter paper	200 s
$_{24}$Cr	0.5	LiF	Standard solution	Drip on filter paper	100 s
$_{33}$As	0.06	LiF	Face lotion	Solution method	200 s
$_{82}$Pb	0.005	LiF	Standard solution	Collection on ion exchange filter paper	40 s

● Coatings (μg/cm²)

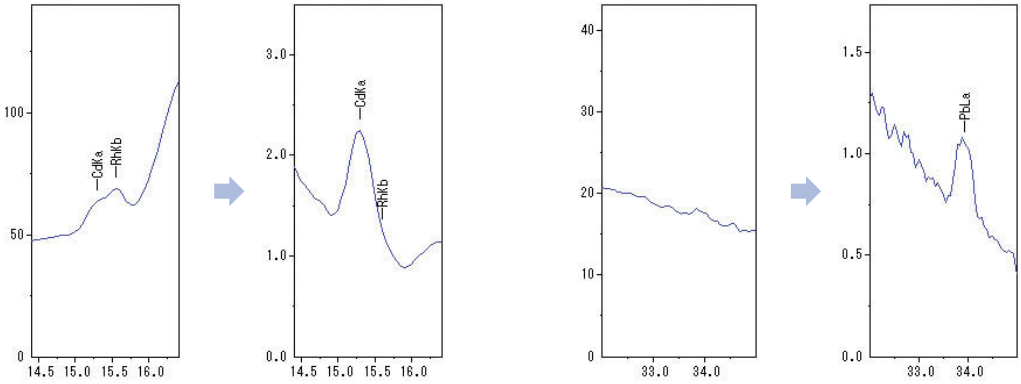
Element	Lower Limit of Detection	Monochromator Crystal	Sample	Pretreatment	Integration Time
$_{25}$Mn	0.011	LiF	Atmospheric dust	Filter collection	40 s
$_{28}$Ni	0.008				
$_{82}$Pb	0.05				

● RoHS, Heavy Metal Regulations (ppm)

Element	Lower Limit of Detection	Monochromator Crystal	Sample	Pretreatment	Integration Time
$_{17}$Cl	1.5	Ge	Plastic sheet	None	20 s
$_{24}$Cr	4.9	LiF	Steel	Lathe cutting	100 s
	11	LiF	Copper alloy	Lathe cutting	40 s
$_{35}$Br	0.6	LiF	Plastic sheet	None	20 s
$_{48}$Cd	11	LiF	Copper alloy	Lathe cutting	40 s
	14	LiF	Solder	Lathe cutting	120 s
$_{80}$Hg	23	LiF	Zinc	Lathe cutting	40 s
$_{82}$Pb	4.2	LiF	Steel	Lathe cutting	40 s
	14	LiF	Copper alloy	Lathe cutting	40 s
	4.9	LiF	Solder	Lathe cutting	40 s

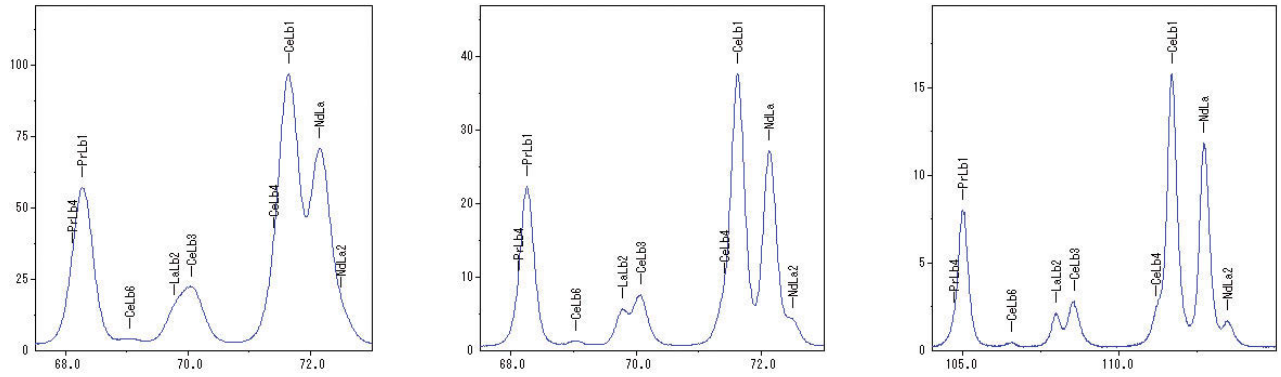
Application: Primary Filter, High-Resolution Slit, and High-Resolution LiF220 Monochromator Crystal

- Inserting the primary filter reduces the interference lines (X-ray tube Rh scattered radiation) and background, improves the S/N ratio, and detects clear spectra.



No Zr filter → Zr filter inserted　　No Ni filter → Ni filter inserted

- The high-resolution slit and LiF220 can separate multi-spectra.

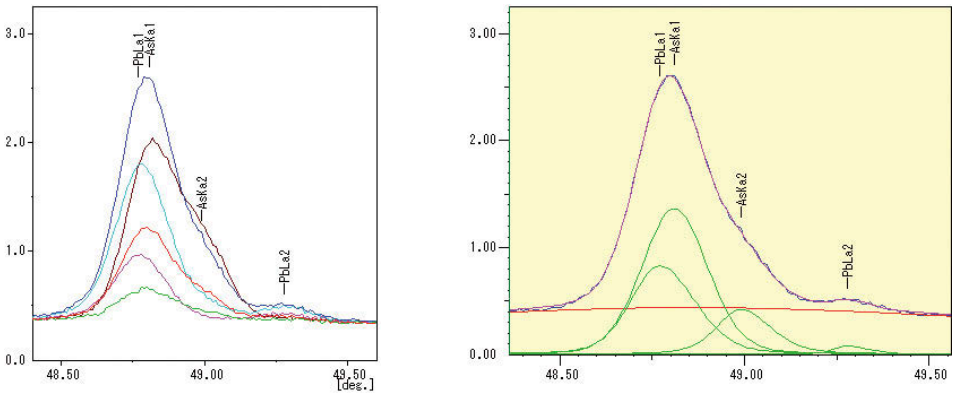


Standard Slit
LiF200 Monochromator Crystal (Standard)

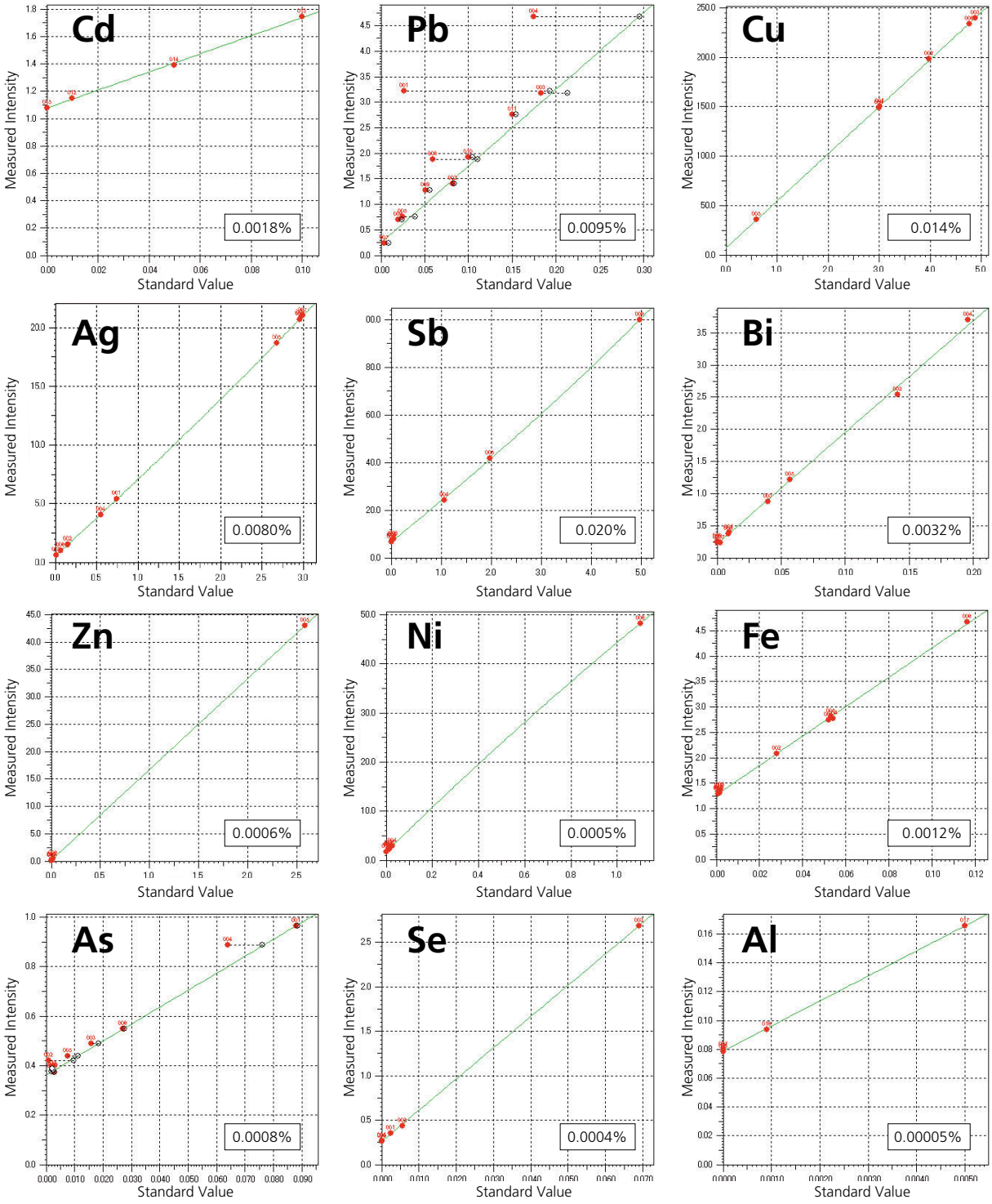
High-Resolution Slit
LiF200 Monochromator Crystal (Standard)

High-Resolution Slit
LiF220 Monochromator Crystal (Optional)

- Software peak separation calculations can be used to determine the individual intensities. PbLα_1, AsKα_1, AsKα_2, PbLα_2 are separated.



Application: Calibration Curves for Solder

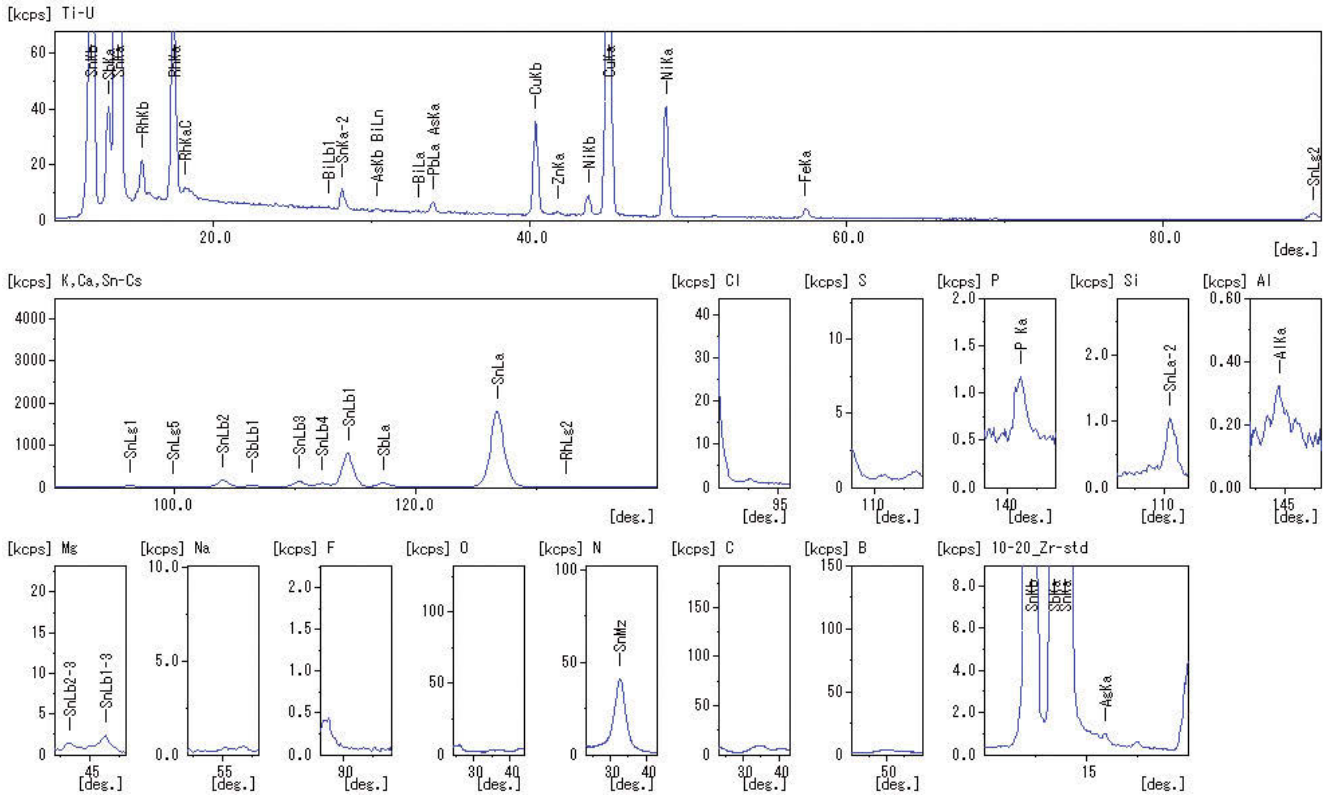


- Values in frames at bottom-right indicate accuracy
- Correction for coexisting elements achieves more accurate quantitation.

· Pb (Lα) As (Kα) ← Overlap correction

· As (Kβ) Bi (Ln) ← Overlap correction

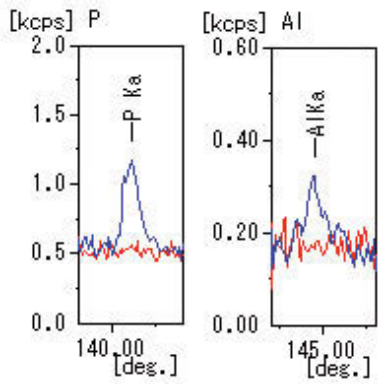
Qualitative / Quantitative Analysis of the Solder



Result					
Analyte	Result	Proc-Calc	Line	Net Int.	BG Int.
Sn	89.5262%	Quant.-FP	SnLa	1782.782	9.283
Sb	4.7866%	Quant.-FP	SbLa	97.995	11.123
Cu	4.3754%	Quant.-FP	CuKa	183.047	2.068
Ni	0.9738%	Quant.-FP	NiKa	39.653	1.296
Fe	0.1350%	Quant.-FP	FeKa	3.236	0.856
Pb	0.0645%	Quant.-FP	PbLa	1.847	2.773
Ag	0.0456%	Quant.-FP	AgKa	0.497	0.493
As	0.0267%	Quant.-FP	AsKb	0.374	3.268
Zn	0.0233%	Quant.-FP	ZnKa	1.134	1.901
Bi	0.0229%	Quant.-FP	BiLa	0.674	2.853
P	0.0110%	Quant.-FP	P Ka	0.663	0.506
Al	0.0089%	Quant.-FP	AlKa	0.189	0.117

Quantitative Analysis Results by the FP method

P : 110 ppm Al : 50 ppm



Trace spectrum of Al and P

Optional Accessories

Sample Preparation for X-ray Fluorescent Analysis

Type of sample	Sample	Treatment	Sample holder	Purpose of Treatmant
Solid	Iron, cast iron Steel High alloy steel Ferroalloy	— Cut — Polish with emery paper —	Solid sample holder	Surface smoothing
	Copper alloy Aluminum alloy	— Cut ——— Lather ———	Solid sample holder	
	Amorphous substance	— Centrifugal casting — Polish/lathe —	Solid sample holder	
Powder	Metal powder Chemicals High polymers Plants	— Grind ——— Briquet ———	Solid sample holder	Density uniforming and surface smoothing
	Ceramic materials Ores Soils Deposits Oxides	— Grind ——— Melt ———	Solid sample holder	Elimination of mineralogical differences and elimination of the effects of matrix elements due to dilution.
Liquid	Oil Water	——— No treatment ———	Liquid sample holder	(No treatment)
	Oil, Water	——— Drop on filter paper —— Dry	Solid sample holder with filter holder	Solidifying
	Water — Collect on iron exchange filter paper — Dry Settle/concentrate on DDTC — Dry			Concentrating and solidifying

Optional Accessories for Sample Preparation

MP-35-02 Briquet Press

(P/N 210-15062-02)

Briquet sample using a cup or a ring.

Operation	Automatic
Press	Hydraulic
Maximum pressure	35 tons
Pressure setting	Arbitrary with a valve
Method	Place the sample in the cup or the ring and press it.
Press head	Plane type
Power requirements	3ø 200 V ± 10 %, 50/60 HZ, 3 A
Dimensions and weight	500^{W} x 500^{D} x $1,210^{H}$ mm, 240 kg

Flat press head

Briquetting Cup (No. 9)

(P/N 200-34844-59) 500pcs./set

Used for briquetting powder samples.

Materials	Steel
Dimensions	36.7 ø. x 11.3 mm high

Cup

Sample produced

Sample Polishing Machine (P/N 085-50201-12)(with dust collector)

Used to polish metal samples.

Power requirements	3 ø 200 V ± 10%, 4 A
Dimensions and weight	560^{W} x 750^{D} x 995^{H} mm, 165 kg
Endless polishing belt	915 mm long and 100 mm wide (No. 136)

The following endless polishing belt set (10 pcs./set) is also required

Zirconia No. 80
(Not applicable to determination of Al and Zr.)

(P/N 085-35122-05)

Briquetting Ring

Made of aluminum (P/N 202-82397-53) 500 pcs./set
Made of vinyl chloride resin (P/N 212-21654-02) 500 pcs./set

The vinyl chloride resin rings are used for silicate samples, while the aluminum rings are used for other, such as cement.

Dimensions	35 mm ø. and 5 mm thick

Sample Holders

Solid Sample Holder (P/N 212-20890-01)

Note: For a mask of a different material or diameter, contact us or your local distributor. Masks of smaller diameters are available for samples smaller than the standard.

Mask diameter	30 mm ø
Mask material	Stainless steel as standard; titanium and aluminum optional.
Dimensions	64 mm ø., 43 mm high
Maximum sample size	51 mm in diameter and 38 mm in height.

Sample Holder for Local Analysis (P/N 212-20890-02)

Exclusively used for local analysis. The masks for the solid sample holder are all applicable.

Mask diameter	30 mm ø
Mask material	Stainless steel as standard; titanium and aluminum optional.
Dimensions	64 mm ø., 43 mm high
Maximum sample size	51 mm in diameter and 38 mm in height.

Solid Sample Holder Masks

Solid sample holder masks are available to suit various sample sizes and analysis aims.

Mask diameter	5, 10, 15, 20, 25, 30 mm ø.
Materials	Al, Ti, Ni, Cu, Zr, Mo, stainless

Sample Holders

Liquid Sample Holder (for air or helium atmosphere)

(P/N 202-86996-03)

Holds a liquid sample, such as river water, factory waste water, general waste water, chemical treatment waste water, and plating solution, to be analyzed with an atmosphere of air or helium.

Mylar, 6 µm thick (P/N 202-86501-56) (500 sheets/set)
Material of inner container: Fluoro-resin
Material of outer container: Stainless steel
Dimensions: 64 mm ø., 43 mm high

Liquid Sample Holder (for vacuum atmosphere)

(P/N 205-11179)

Used for analyzing a liquid sample in a vacuum. The beryllium irradiation surface maintains an unchanging liquid surface to ensure high analysis stability.

Mask material	Titanium as standard
Inner container material	Fluoro-resin and stainless steel With air-bleed.
Outer container material	Stainless steel
Dimensions	64 mm ø., 43 mm high

Inner container : P/N 205-15110
6mm mylar (P/N 202-86501-56) (500 sheets/set)

To enhance productivity, the method recommended is to use multiple inner containers (P/N 205-15110) in the single outer container designated for each group of analyses.

Outer container (P/N 205-11179)

Inner container (P/N 205-15110)

Optional Accessories

Spotting Filter Paper, Ion Exchange Filter Paper, and Holder

Drop a liquid sample on the filter paper, dry, and analyze.
Filter paper (P/N 210-16043-50) (50 sheets/set)

- Three ion exchange filter papers are available. Ion exchange filter paper is used for pH adjustment and concentration of liquid samples.
  A solid sample holder and a Fluolo-resin filter paper holder (P/N 205-15030) are required to use this filter paper.

Filter paper
(P/N 210-16043-50)

Holder
(P/N 205-15030)

Ion exchange filter paper
(P/N 210-16167-01, 03)

ASF-40 Autosample Feeder with 40-sample Turret (P/N 212-21100-92)

Convenient for the automatic analysis of many samples.

- Up to 40 samples can be loaded.
- Permits unmanned operation at night.
- Built into the instrument table. Occupies no extra space.
- Power supply from main instrument.

RKE1500B-V-G2-SP Cooling Water Circulator

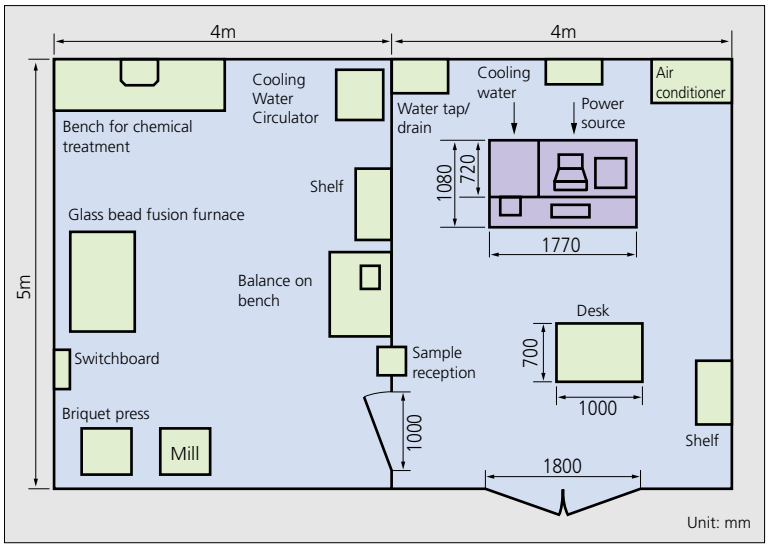
(P/N 239-15049-02)

Cooling capacity	5.3 kW
Cooling method	Forced air cooling and refrigeration
Power requirements	3ø 200 V ±10%, 10A
Dimensions and weight	W400 × D850 × H966 mm, 100 kg (including water tank, with castors)

Note: As the RKE1500B-V-G2-SP generates about 4.5 kW heat, it must be installed away from the XRF-1800.

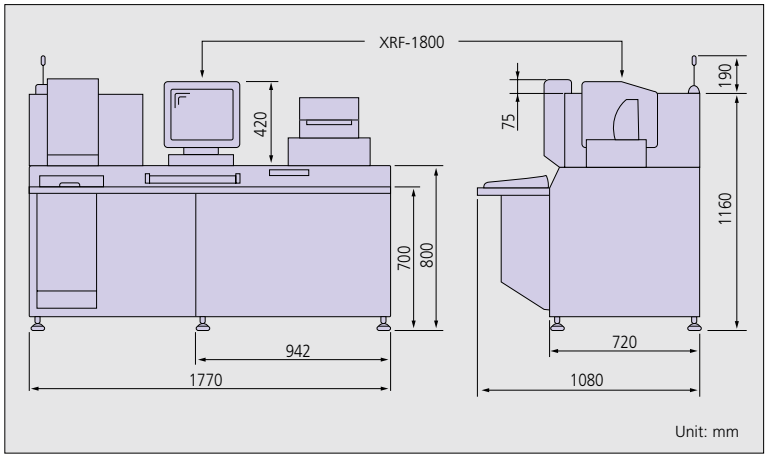
Laboratory Requirements

Installation example



Note: The entrance of the lab should be more than 1,100 wide and 1,700 mm high. If it is less wide than 1,100 mm, dismount the table to make its depth about 720 mm.

External Dimensions



Dimensions	W1770 × D1080 × H1350 mm
Weight	760 kg (including workstation)

Laboratory

Temperature	18 to 28°C
Humidity	Below 75%
Vibration	Unnoticeable
Space	3 × 4 m or larger

Heat generation

XRF-1800	2.3 kw

Power requirements

X-ray	1ø, 200/220V + 15% to -10%, 50/60 Hz ● 4 kW X-ray tube: 75A for maximum tube current of 140 mA Note: High-frequency inverter type (option) 1ø, 200V +21% to -10%, 50/60 Hz ● 4kW X-ray tube: 40A for maximum tube current of 150 mA
System	1ø, 200/220 V ± 10%, 50/60 Hz, 20A
Grounding	Independent grounding line, less than 30 W

Cooling Water

X-ray tube	For cooling the X-ray tube
Cooling water	7 liters of distilled water, replaced every 4 to 6 months Fill into X-ray tube cooling unit tank.
External cooling water	For cooling the X-tube cooling water and high-pressure tank.
Water quality	Tap water or industrial water of the same quality.
Supply pressure	0.15 MPa to 0.3 MPa (1.5 to 3.0 kgf/cm^2)
Drain	Free flow

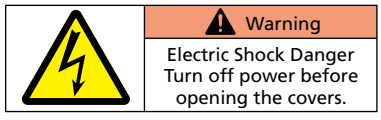
	Water temp	Flow rate (3 kW)	Flow rate (4 kW)
Flow rate/ temperature	10°C	3 L/min	4 L/min
	20	4	5.5
	30	8	10
Faucet	1/2" valve 14 mm OD hose nipple		

Note: No external cooling water is required if the optional Cooling Water Circulator is used.

PR Gas

Flow rate	5 mL/min. Pressure release valve is provided. Please prepare the PR gas in the customer.

Notice:
Since X-rays are used in the XRF-1800, check all local laws and regulations in advance.



Important safety items are indicated by warning labels.

Shimadzu Corporation
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Printed in Japan 3655-06434-30AIT