Sequential X-ray Fluorescence Spectrometer

XRF-1800
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.
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).

4 [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).

Uniform samples
Glass beads  Powder briquettes  Ingots, liquids, filter paper, etc.

Compound samples, non-uniform samples
Electronic components  Rocks  Rods

Preparation: grinding, pressing, etc.
To investigate non-uniformities

Conventional method (wide-area analysis)
analysis diameter: 10 to 30 mm

Local analysis
analysis diameter: 500 μm to 3 mm

Designated-position analysis
Conducts qualitative/quantitative, or quantitative analysis at a designated position.

Element analysis
Investigates the X-ray intensity and content of specific elements over a designated area. Multiple elements can be analyzed.

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.

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 \((n\geq 2, 3\ldots)\) 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 MgK\(\alpha\) and CaK\(\alpha\) third-order lines overlap on the first-order X-ray profile. The CaK\(\alpha\) third-order lines are displayed more intensely, because the higher-order X-rays are intensified in the higher-order X-ray profile.
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.

### Application Examples

#### Analysis of coated metal sheet

<table>
<thead>
<tr>
<th>Sample</th>
<th>Coating thickness</th>
<th>Zn plating</th>
<th>Film thickness (μm)</th>
<th>Al  (%)</th>
<th>Si  (%)</th>
<th>Cl  (%)</th>
<th>C(HaO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.1</td>
<td>5.7</td>
<td>4.72</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>balanced</td>
<td>16.9</td>
</tr>
<tr>
<td>No.2</td>
<td>12.5</td>
<td>3.40</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>16.0</td>
</tr>
<tr>
<td>No.3</td>
<td>15.0</td>
<td>3.26</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>12.6</td>
</tr>
<tr>
<td>No.4</td>
<td>21.0</td>
<td>3.08</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>15.9</td>
</tr>
<tr>
<td>Metallic (gloss)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.1</td>
<td>10.4</td>
<td>30.2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>balanced</td>
<td>15.1</td>
</tr>
<tr>
<td>No.2</td>
<td>16.8</td>
<td>28.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>16.5</td>
</tr>
<tr>
<td>No.3</td>
<td>17.1</td>
<td>27.8</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>16.7</td>
</tr>
<tr>
<td>No.4</td>
<td>28.6</td>
<td>26.3</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>17.8</td>
</tr>
</tbody>
</table>

#### Analysis of capacitor film

<table>
<thead>
<tr>
<th>Sample</th>
<th>Layer</th>
<th>Element</th>
<th>Density</th>
<th>Quantitative analysis</th>
<th>X-ray quantitative value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>Layer 1</td>
<td>Si</td>
<td>2.35g/cm³</td>
<td>thickness</td>
<td>10Å</td>
</tr>
<tr>
<td></td>
<td>Layer 2</td>
<td>Al</td>
<td>2.70</td>
<td>thickness</td>
<td>content</td>
</tr>
<tr>
<td></td>
<td>Layer 3</td>
<td>Polyester (C3H4O2)</td>
<td>1.39</td>
<td>thickness</td>
<td>6.3 μm</td>
</tr>
<tr>
<td>No.2</td>
<td>Layer 1</td>
<td>Si</td>
<td>2.35g/cm³</td>
<td>thickness</td>
<td>5Å</td>
</tr>
<tr>
<td></td>
<td>Layer 2</td>
<td>Al</td>
<td>2.70</td>
<td>thickness</td>
<td>content</td>
</tr>
<tr>
<td></td>
<td>Layer 3</td>
<td>Polyester (C3H4O2)</td>
<td>1.39</td>
<td>thickness</td>
<td>6.3 μm</td>
</tr>
</tbody>
</table>
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.

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.

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.

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.

### 0-2θ 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.

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.

### Application example for the FeKa of low alloy steel

<table>
<thead>
<tr>
<th>Element</th>
<th>Standard value</th>
<th>With ASC</th>
<th>Without ASC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mn</td>
<td>0.113</td>
<td>0.142</td>
<td>1.717</td>
</tr>
<tr>
<td>P</td>
<td>0.012</td>
<td>0.019</td>
<td>0.254</td>
</tr>
<tr>
<td>Cu</td>
<td>0.033</td>
<td>0.051</td>
<td>0.499</td>
</tr>
<tr>
<td>Ni</td>
<td>0.051</td>
<td>0.057</td>
<td>0.609</td>
</tr>
<tr>
<td>Cr</td>
<td>0.011</td>
<td>0.023</td>
<td>0.299</td>
</tr>
<tr>
<td>Mo</td>
<td>0.011</td>
<td>0.017</td>
<td>0.178</td>
</tr>
<tr>
<td>Ti</td>
<td>0.097</td>
<td>0.084</td>
<td>0.917</td>
</tr>
<tr>
<td>Fe</td>
<td>99.593</td>
<td>99.305</td>
<td>91.056</td>
</tr>
</tbody>
</table>

Qualitative/quantitative analysis example

<table>
<thead>
<tr>
<th>X-ray current (mA)</th>
<th>X-ray intensity (kcps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>20</td>
<td>200</td>
</tr>
<tr>
<td>30</td>
<td>300</td>
</tr>
<tr>
<td>40</td>
<td>400</td>
</tr>
<tr>
<td>50</td>
<td>500</td>
</tr>
</tbody>
</table>

XRF-1800
Sequential X-ray Fluorescence Spectrometer
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

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Result</th>
<th>Proc-Calc</th>
<th>Line</th>
<th>Net</th>
<th>BG</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>72.8510%</td>
<td>Quant-FP</td>
<td>Si Ka</td>
<td>1728.946</td>
<td>7.307</td>
</tr>
<tr>
<td>Na₂O</td>
<td>12.0833%</td>
<td>Quant-FP</td>
<td>Na Ka</td>
<td>50.450</td>
<td>0.389</td>
</tr>
<tr>
<td>CaO</td>
<td>7.1260%</td>
<td>Quant-FP</td>
<td>Ca Ka</td>
<td>448.911</td>
<td>1.854</td>
</tr>
<tr>
<td>MgO</td>
<td>5.0228%</td>
<td>Quant-FP</td>
<td>Mg Ka</td>
<td>32.835</td>
<td>0.859</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>1.6959%</td>
<td>Quant-FP</td>
<td>Al Ka</td>
<td>47.785</td>
<td>3.544</td>
</tr>
<tr>
<td>K₂O</td>
<td>0.5542%</td>
<td>Quant-FP</td>
<td>K Ka</td>
<td>44.969</td>
<td>1.003</td>
</tr>
<tr>
<td>TiO₂</td>
<td>0.4541%</td>
<td>Quant-FP</td>
<td>P Ka</td>
<td>14.287</td>
<td>1.176</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.1128%</td>
<td>Quant-FP</td>
<td>Fe Ka</td>
<td>14.156</td>
<td>1.351</td>
</tr>
<tr>
<td>TiO₂</td>
<td>0.0459%</td>
<td>Quant-FP</td>
<td>Ti Ka</td>
<td>0.928</td>
<td>0.169</td>
</tr>
<tr>
<td>MnO</td>
<td>0.0430%</td>
<td>Quant-FP</td>
<td>Mn Ka</td>
<td>3.488</td>
<td>0.851</td>
</tr>
<tr>
<td>ZrO₂</td>
<td>0.0110%</td>
<td>Quant-FP</td>
<td>Zr Ka</td>
<td>9.972</td>
<td>15.385</td>
</tr>
</tbody>
</table>

(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

(*) 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.
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

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.

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.

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.

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 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/C, Rh/DW dual target
- **Control Method:** Fully computer controlled, Automatic aging, Programmable for automatic start-up and shutoff
- **Max. Rating:** 60 kV, 150 mA, 4 kW (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 Compartments:** 1. 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 fitting mechanism
- **Sample changer:** 5-sample turret
- **Sample Holder:** 7 for solid samples, 1 for liquid analysis
  - Max. sample size: 51 mm ø. × 38 mm high
- **Primary X-ray Filter:** Automatic changing of five filters (Al, Ti, Fe, Zr, ULT) optional
- **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:** Automatic changing of 10 crystals, bi-directional rotation type
- **Analyzing Crystals:** Lp (200), Fe, Si, Ge IAP at four standard types
  - Lp (220), SX-52, SX-1, SX-14, SX-88, SX-86, SX-76, SX-410 optional
- **Detector:** Scintillation counter (SC) for heavy elements
  - Proportional counter (FPC) for light elements
- **FPC Gas System:** Electronically controlled gas density stabilizer
  - Gas consumption: 0.6 mL/min
- **Goniometer:** 2θ-θ independent drive system
  - Scanning angle range: 5°C. 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°
  - Stopping position repeatability: ±0.0003°/max.
- **Temperature Control 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
  - +0 optional

#### Counting/Control Unit
- **Pulse Height Analyzer:** 2θ-θ PHA operation, peak shift correction, automatic PSF adjustment, dead-time correction
- **Detector High Voltage Supply:** 500 to 1,000 V for SC
  - 1,500 to 2,500 V for FPC
- **Counting Linearity:** 1,000 keps for SC, 2,000 keps for PC
- **Scaler, timer:** Max. counting capacity 256×, 1 to 3000 sec.
- **Control Method:** Multitasking control by 32-bit computer

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

#### Software
- **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)
- **Quantitative/Qualitative Analysis:**
  - Bulk and thin-films 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 Recoring 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 (11) 1
- **FPC Window:** 2 as a set
  - Vacuum pump oil (4 L) 1
- **Samples for instrument:** 1 set
  - High voltage insulation greases 1
- **Scaler, timer adjustment:** 1
  - Vacuum grease 1
  - Spare parts 1 set

*Windows and Windows 7 are registered trademarks of Microsoft Corporation (USA) in the United States and other countries.
*Additionally noted company names and product names are the trademarks or registered trademarks of the respective companies.
*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.

### Table: Combinations of X-ray Tube, Analyzing Crystal, and Detector

<table>
<thead>
<tr>
<th>Excitation voltage (kV)</th>
<th>0.5</th>
<th>1.0</th>
<th>2.5</th>
<th>3</th>
<th>7</th>
<th>9</th>
<th>12</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength (Å)</td>
<td>1.14</td>
<td>4.5</td>
<td>2.0</td>
<td>1.0</td>
<td>0.7</td>
<td>1.5</td>
<td>1.0</td>
<td>0.7</td>
<td>0.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Spectra

<table>
<thead>
<tr>
<th>X-ray tube</th>
<th>K series</th>
<th>L series</th>
<th>M series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li, Be</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C, N, O</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Zn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cl, Ar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K, Ca</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na, Mg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Al, Si</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P, S, Cl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe, Co, Ni</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu, Zn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sn, Sb, As</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ba, La, Ce</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eu, Gd, Tb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy, Ho, Er</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yb, Lu</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### X-ray tube

- LiF (200) SC, FPC
- Ge
- PET
- TAP
- SX-1
- SX-52
- SX-14
- SX-76
- SX-88
- SX-410

### Analyzing crystal

- FPC, SC
- TAP
- SX-1
- SX-52
- SX-14
- SX-76
- SX-88
- SX-410

### Detector

- FPC
- SC
- TAP

### Primary X-ray filter

- Zr
- Ni
- Ti
- Al

### Detection Limits

#### Periodic Table

- 200 ppm or higher
- 500 ppm or higher
- 10 ppm or higher
- 1 ppm or higher
- 0.1 ppm or higher
- 0.05 ppm or higher

---

**Note:** ( ): Option
## Lower Limits of Detection

### Steel (ppm)

<table>
<thead>
<tr>
<th>Element</th>
<th>Lower Limit of Detection</th>
<th>Monochromator Crystal</th>
<th>Sample</th>
<th>Pretreatment</th>
<th>Integration Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>64</td>
<td>SX-88</td>
<td>Stainless steel</td>
<td>Mirror finish</td>
<td>100 s</td>
</tr>
<tr>
<td>C</td>
<td>80</td>
<td>SX-98</td>
<td>Low-alloy steel</td>
<td>Zirconia No. 80*</td>
<td>40 s</td>
</tr>
<tr>
<td>F</td>
<td>45</td>
<td>SX-52</td>
<td>Slag</td>
<td>Briquette press</td>
<td>40 s</td>
</tr>
</tbody>
</table>

### Catalyst (ppm)

<table>
<thead>
<tr>
<th>Element</th>
<th>Lower Limit of Detection</th>
<th>Monochromator Crystal</th>
<th>Sample</th>
<th>Pretreatment</th>
<th>Integration Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>45Rh</td>
<td>6</td>
<td>LiF</td>
<td>Cordierite</td>
<td>Briquette press</td>
<td>60 s</td>
</tr>
<tr>
<td>46Pd</td>
<td>5</td>
<td>LiF</td>
<td>Atmospheric dust</td>
<td>Filter collection</td>
<td>40 s</td>
</tr>
<tr>
<td>76Pt</td>
<td>2.6</td>
<td>LiF</td>
<td>Plastic sheet</td>
<td>Lathe cutting</td>
<td>40 s</td>
</tr>
</tbody>
</table>

### Liquids (ppm)

<table>
<thead>
<tr>
<th>Element</th>
<th>Lower Limit of Detection</th>
<th>Monochromator Crystal</th>
<th>Sample</th>
<th>Pretreatment</th>
<th>Integration Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>12Mg</td>
<td>3</td>
<td>TAP</td>
<td>Oil</td>
<td>Drip on filter paper</td>
<td>200 s</td>
</tr>
<tr>
<td>24Cr</td>
<td>0.5</td>
<td>LiF</td>
<td>Standard solution</td>
<td>Drip on filter paper</td>
<td>100 s</td>
</tr>
<tr>
<td>33As</td>
<td>0.06</td>
<td>LiF</td>
<td>Face lotion</td>
<td>Solution method</td>
<td>200 s</td>
</tr>
<tr>
<td>82Pb</td>
<td>0.005</td>
<td>LiF</td>
<td>Standard solution</td>
<td>Collection on ion exchange filter paper</td>
<td>40 s</td>
</tr>
</tbody>
</table>

### Coatings (μg/cm²)

<table>
<thead>
<tr>
<th>Element</th>
<th>Lower Limit of Detection</th>
<th>Monochromator Crystal</th>
<th>Sample</th>
<th>Pretreatment</th>
<th>Integration Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>25Mn</td>
<td>0.011</td>
<td>LiF</td>
<td>Atmospheric dust</td>
<td>Filter collection</td>
<td>40 s</td>
</tr>
<tr>
<td>26Ni</td>
<td>0.008</td>
<td>LiF</td>
<td>Plastic sheet</td>
<td>Lathe cutting</td>
<td>100 s</td>
</tr>
<tr>
<td>28Pb</td>
<td>0.05</td>
<td>LiF</td>
<td>Plastic sheet</td>
<td>None</td>
<td>20 s</td>
</tr>
</tbody>
</table>

### RoHS, Heavy Metal Regulations (ppm)

<table>
<thead>
<tr>
<th>Element</th>
<th>Lower Limit of Detection</th>
<th>Monochromator Crystal</th>
<th>Sample</th>
<th>Pretreatment</th>
<th>Integration Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>35Cl</td>
<td>1.5</td>
<td>Ge</td>
<td>Plastic sheet</td>
<td>None</td>
<td>20 s</td>
</tr>
<tr>
<td>39Cr</td>
<td>4.9</td>
<td>LiF</td>
<td>Steel</td>
<td>Lathe cutting</td>
<td>100 s</td>
</tr>
<tr>
<td>35Br</td>
<td>11</td>
<td>LiF</td>
<td>Copper alloy</td>
<td>Lathe cutting</td>
<td>40 s</td>
</tr>
<tr>
<td>40Cd</td>
<td>0.6</td>
<td>LiF</td>
<td>Plastic sheet</td>
<td>None</td>
<td>20 s</td>
</tr>
<tr>
<td>40Hg</td>
<td>14</td>
<td>LiF</td>
<td>Solder</td>
<td>Lathe cutting</td>
<td>120 s</td>
</tr>
<tr>
<td>40Pb</td>
<td>14</td>
<td>LiF</td>
<td>Copper alloy</td>
<td>Lathe cutting</td>
<td>40 s</td>
</tr>
<tr>
<td></td>
<td>4.9</td>
<td>LiF</td>
<td>Solder</td>
<td>Lathe cutting</td>
<td>40 s</td>
</tr>
</tbody>
</table>
**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.

![Graphs showing the effect of inserting filters](image)

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

![Graphs showing the effect of changing slit and monochromator crystal](image)

- Software peak separation calculations can be used to determine the individual intensities. PbLα1, AsKα1, AsKα2, PbLα1 are separated.
Application: Calibration Curves for Solder

- Values in frames at bottom-right indicate accuracy
- Correction for coexisting elements achieves more accurate quantitation.
**Qualitative / Quantitative Analysis of the Solder**

![Graph showing qualitative analysis results.](image)

**Quantitative Analysis Results by the FP method**

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Result</th>
<th>Proc-Calc</th>
<th>Line</th>
<th>Net Int.</th>
<th>BG Int.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sn</td>
<td>89.5263%</td>
<td>Quant-FP</td>
<td>SnKa</td>
<td>1782.782</td>
<td>9.283</td>
</tr>
<tr>
<td>Sb</td>
<td>4.7866%</td>
<td>Quant-FP</td>
<td>SbLa</td>
<td>97.995</td>
<td>11.123</td>
</tr>
<tr>
<td>Cu</td>
<td>4.3754%</td>
<td>Quant-FP</td>
<td>CuKa</td>
<td>183.047</td>
<td>2.068</td>
</tr>
<tr>
<td>Ni</td>
<td>0.9738%</td>
<td>Quant-FP</td>
<td>NiKa</td>
<td>39.653</td>
<td>1.296</td>
</tr>
<tr>
<td>Fe</td>
<td>0.1350%</td>
<td>Quant-FP</td>
<td>FeKa</td>
<td>3.236</td>
<td>0.856</td>
</tr>
<tr>
<td>Pb</td>
<td>0.0645%</td>
<td>Quant-FP</td>
<td>PbLa</td>
<td>1.847</td>
<td>2.773</td>
</tr>
<tr>
<td>Ag</td>
<td>0.0456%</td>
<td>Quant-FP</td>
<td>AgKa</td>
<td>0.497</td>
<td>0.493</td>
</tr>
<tr>
<td>As</td>
<td>0.0267%</td>
<td>Quant-FP</td>
<td>AsKb</td>
<td>0.374</td>
<td>0.268</td>
</tr>
<tr>
<td>Zn</td>
<td>0.0233%</td>
<td>Quant-FP</td>
<td>ZnKa</td>
<td>1.134</td>
<td>1.901</td>
</tr>
<tr>
<td>Bi</td>
<td>0.0229%</td>
<td>Quant-FP</td>
<td>BiLa</td>
<td>0.674</td>
<td>2.853</td>
</tr>
<tr>
<td>P</td>
<td>0.0110%</td>
<td>Quant-FP</td>
<td>PKa</td>
<td>0.663</td>
<td>0.506</td>
</tr>
<tr>
<td>Al</td>
<td>0.0089%</td>
<td>Quant-FP</td>
<td>AlKa</td>
<td>0.189</td>
<td>0.117</td>
</tr>
</tbody>
</table>

**Trace spectrum of Al and P**

![Trace spectrum showing Al and P results.](image)
Optional Accessories

Sample Preparation for X-ray Fluorescent Analysis

<table>
<thead>
<tr>
<th>Type of sample</th>
<th>Sample</th>
<th>Treatment</th>
<th>Sample holder</th>
<th>Purpose of Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid</td>
<td>Iron, cast iron steel High alloy steel Ferroalloy</td>
<td>— Cut — Polish with emery paper —</td>
<td>Solid sample holder</td>
<td>Surface smoothing</td>
</tr>
<tr>
<td></td>
<td>Copper alloy Aluminum alloy</td>
<td>— Cut — Lather —</td>
<td>Solid sample holder</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amorphous substance</td>
<td>— Centrifugal casting — Polish/lathe —</td>
<td>Solid sample holder</td>
<td></td>
</tr>
<tr>
<td>Powder</td>
<td>Metal powder Chemicals High polymers Plants Ceramic materials Ores Soils Deposits Oxides</td>
<td>— Grind — Briquet —</td>
<td>Solid sample holder</td>
<td>Density uniforming and surface smoothing</td>
</tr>
<tr>
<td>Liquid</td>
<td>Oil, Water</td>
<td>— Grind — Briquet —</td>
<td>Solid sample holder</td>
<td>Elimination of mineralogical differences and elimination of the effects of matrix elements due to dilution</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>— Grind — Briquet —</td>
<td>Liquid sample holder</td>
<td>( No treatment )</td>
</tr>
</tbody>
</table>

Optional Accessories

MP-35-02 Briquet Press
(P/N 210-15062-02)
Bioket 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**
- 3 ø 200 V ± 10%, 4 A

**Dimensions and weight**
- 500ø x 500ø x 1,210H mm, 240 kg

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

**Power requirements**
- 3 ø 200 V ± 10%, 4 A

**Dimensions and weight**
- 500ø x 75ø x 995ø 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 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

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.

<table>
<thead>
<tr>
<th>Mask diameter</th>
<th>30 mm ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mask material</td>
<td>Stainless steel as standard; titanium and aluminum optional.</td>
</tr>
<tr>
<td>Dimensions</td>
<td>64 mm ø, 43 mm high</td>
</tr>
<tr>
<td>Maximum sample size</td>
<td>51 mm in diameter and 38 mm in height.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Mask diameter</th>
<th>30 mm ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mask material</td>
<td>Stainless steel as standard; titanium and aluminum optional.</td>
</tr>
<tr>
<td>Dimensions</td>
<td>64 mm ø, 43 mm high</td>
</tr>
<tr>
<td>Maximum sample size</td>
<td>51 mm in diameter and 38 mm in height.</td>
</tr>
</tbody>
</table>

Solid Sample Holder Masks

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

<table>
<thead>
<tr>
<th>Mask diameter</th>
<th>5, 10, 15, 20, 25, 30 mm ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mask material</td>
<td>Al, Ti, Ni, Cu, Zr, Mo, stainless</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Mylar, 6 μm thick</th>
<th>(P/N 202-86501-56) (500 sheets/set)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material of inner container</td>
<td>Fluoro-resin</td>
</tr>
<tr>
<td>Material of outer container</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Dimensions</td>
<td>64 mm ø, 43 mm high</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Mask material</th>
<th>Titanium as standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner container material</td>
<td>Fluoro-resin and stainless steel With air-bleed</td>
</tr>
<tr>
<td>Outer container material</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Dimensions</td>
<td>64 mm ø, 43 mm high</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Inner container (P/N 205-15110)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6mm mylar (P/N 202-86501-56) (500 sheets/set)</td>
</tr>
</tbody>
</table>

XRF-1800
Sequential X-ray Fluorescence Spectrometer 25
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 Fluoro-resin filter paper holder (P/N 205-15030) are required to use this filter paper.

**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)

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling capacity</td>
<td>5.3 kW</td>
</tr>
<tr>
<td>Cooling method</td>
<td>Forced air cooling and refrigeration</td>
</tr>
<tr>
<td>Power requirements</td>
<td>3Ø 200 V ±10%, 10 A</td>
</tr>
<tr>
<td>Dimensions and weight</td>
<td>W400 × D850 × H966 mm, 100 kg (including water tank, with castors)</td>
</tr>
</tbody>
</table>

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

External Dimensions

Laboratory

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>18 to 28°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>Below 75%</td>
</tr>
<tr>
<td>Vibration</td>
<td>Unnoticeable</td>
</tr>
<tr>
<td>Space</td>
<td>3 x 4 m or larger</td>
</tr>
</tbody>
</table>

Heat generation

<table>
<thead>
<tr>
<th>Model</th>
<th>Power (kw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XRF-1800</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Power requirements

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray</td>
<td>1a, 200/220V ±15% to -10%, 50/60 Hz</td>
</tr>
<tr>
<td></td>
<td>4 kW X-ray tube: 75A for maximum tube current of 140 mA</td>
</tr>
<tr>
<td></td>
<td>Note: High-frequency inverter type (option)</td>
</tr>
<tr>
<td></td>
<td>1a, 200V ±21% to -10%, 50/60 Hz</td>
</tr>
<tr>
<td></td>
<td>4 kW X-ray tube: 40A for maximum tube current of 150 mA</td>
</tr>
<tr>
<td></td>
<td>System: 1a, 200/220 V ±10%, 50/60 Hz, 20A</td>
</tr>
<tr>
<td>Grounding</td>
<td>Independent grounding line, less than 30 W</td>
</tr>
</tbody>
</table>

Cooling Water

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray tube</td>
<td>For cooling the X-ray tube</td>
</tr>
<tr>
<td></td>
<td>Cooling water: 7 liters of distilled water, replaced every 4 to 6 months</td>
</tr>
<tr>
<td></td>
<td>Water temp Flow rate/temperature</td>
</tr>
<tr>
<td></td>
<td>10°C Flow rate 3 L/min; 4 L/min</td>
</tr>
<tr>
<td></td>
<td>30°C Flow rate 8 L/min; 10 L/min</td>
</tr>
<tr>
<td>Water quality</td>
<td>Tap water or industrial water of the same quality</td>
</tr>
<tr>
<td>Supply pressure</td>
<td>0.15 MPa to 0.3 MPa (1.5 to 3.0 kgf/cm²)</td>
</tr>
<tr>
<td>Drain</td>
<td>Free flow</td>
</tr>
<tr>
<td>Faucet</td>
<td>1/2” valve</td>
</tr>
<tr>
<td></td>
<td>14 mm OD hose nipple</td>
</tr>
</tbody>
</table>

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

PR Gas

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow rate</td>
<td>5 mL/min. Pressure release valve is provided.</td>
</tr>
<tr>
<td></td>
<td>Please prepare the PR gas in the customer.</td>
</tr>
</tbody>
</table>

Important safety items are indicated by warning labels.

Warning

Important safety items are indicated by warning labels.

XRF-1800
Sequential X-ray Fluorescence Spectrometer

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