MiniFlex XpC

Right-sized XRD solution for automated industrial process control

Rigaku MiniFlex XpC – Xpress Connect is the right-sized, worry-free, scalable X-ray diffractometer for industrial process control.

Rigaku

POWERING NEW PERSPECTIVES

MiniFlex XpC

The right-sized, worry-free, scalable X-ray diffractometer for industrial process control.

The MiniFlex XpC is right-sized for the best performance-to-cost ratio. It is optimized to simplify everyday operations and minimize both the initial cost and the cost of ownership. The intuitive software interface keeps it simple. Rigaku's unique compact X-ray source and large-area detector achieve fast and reliable measurements while requiring minimum maintenance.

The MiniFlex XpC is worry-free. While everyday operations might be simple, we understand that managing process control procedures is nothing but simple. Establishing the test methods, ensuring the integrity of the test, and troubleshooting when an abnormality occurs require expertise in X-ray diffraction (XRD). The MiniFlex XpC's Pro Connect service will provide expert guidance where you need it when you need it.

The MiniFlex XpC is scalable. The universal sample-loading mechanism allows it to be scaled when you need it. You might start with just a sample changer and, later, you can connect your MiniFlex XpC with a belt for fast and fully automated sample processing. The MiniFlex's Xpress Connect allows fast and seamless integration into your existing automation process.

MiniFlex XpC + EasyX software provide analysis procedures tailored to specific industry needs

You can fully customize your analysis procedures and apply a simple analysis, such as a peak position check, or implement an advanced method, such as Rietveld quantitative analysis. Regardless of how complex the procedure is, the **EasyX** software packages the entire procedure into a template and keeps everyday operations easy and simple. You can obtain accurate and reliable results with only three clicks and obtain pass/fail and trend reports at a glance.

Minerals and Mining

Quantify minerals and identify impurities and foreign materials

Battery

Quantify crystalline phases in cathode materials and check the degree of graphitization of anode materials

Metals

Quantify oxidized phases or polymorphs to ensure the high purity of metal raw materials

Cement

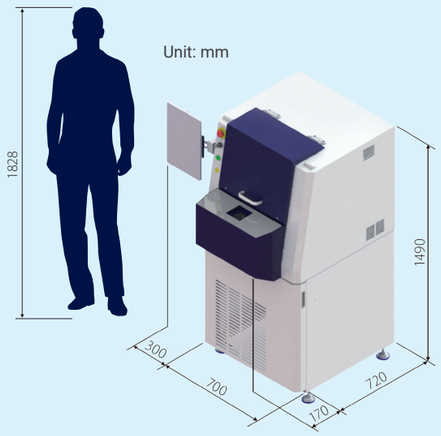
Quantify main components, additives, and impurities at different stages in raw, hot meal, clinker, and cement

Pharmaceuticals

Identify and quantify polymorphs and percent crystallinity

Fast and easy installation

Get started right away with easy installation, EasyX's easy-to-use interface, and Rigaku-provided user training tools, Xpress Start. MiniFlex XpC is plug-and-play and has a small footprint (44% smaller than the competition), requiring minimum space and room construction.

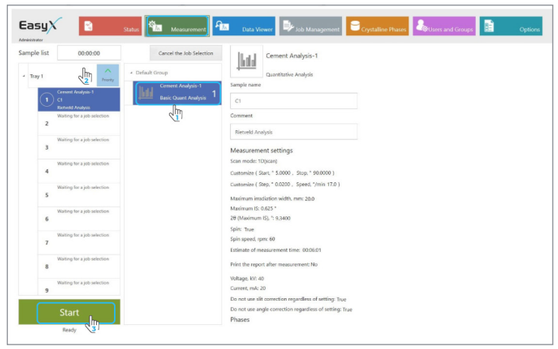


Rugged design

Be worry-free with the rugged design. The XRD components are fully covered, and the sample loading window is closed during measurements, protecting them from a harsh environment.

Easy-to-use interface

Implement worry-free daily operations with the easy-to-use interface. The EasyX software keeps everyday operations easy and simple while allowing testing methods to be customized and automated.

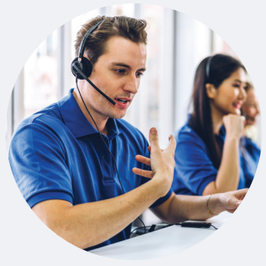


Right-size your process control

Rigaku's unique low-power* and compact X-ray generator, combined with the **D/teX Ultra250 1D detector** with the largest sensor in this class** provides the performance you need at lower initial and running costs compared to traditional higher power XRDs.

*** 800 W, 33% less power consumption compared to the conventional 1200 W**

**** 67% larger sensor compared to the competition**



Worry-free operation

Take advantage of our on-demand application service and enjoy worry-free XRD operation. The **Pro Connect** service can be your expert partner, on call when you need it, providing troubleshooting, method development, and user training.

Be ready for future needs with scalable automation

Xpress Connect design allows you to add different automatic sample changer sizes or integrate your system with full-scale automation systems. You can scale your process in the future without upfront commitment.

Full-scale automation

External sample changer integration

Reasons to choose the MiniFlex XpC for your process control needs

Low cost of ownership

Full-size XRD systems with non-powder measurement options or a high-power X-ray source are often overkill for process control. They take up more space, and their higher-power X-ray generator increases the maintenance cost compared to a more compact XRD. Rigaku's MiniFlex XpC is the **right-sized solution**, optimized for industrial process control, where you need accurate results quickly at a low cost.

Accurate and reliable results in minutes

The MiniFlex XpC's **low cost and compact design** do not compromise performance. You can get accurate and reliable results in minutes.

It uses an 800 W X-ray generator (33% lower power consumption compared to conventional 1200 W) without compromising the X-ray intensity by shortening the X-ray source to detector distance and using a large detector sensor (+67% sensor size compared to the competition) to maximize the usable amount of X-rays. This optimization is made possible by Rigaku's unique compact X-ray generator and the D/teX Ultra250 detector, which has the largest active area in the market for process control diffractometers.

Minimum infrastructure requirements

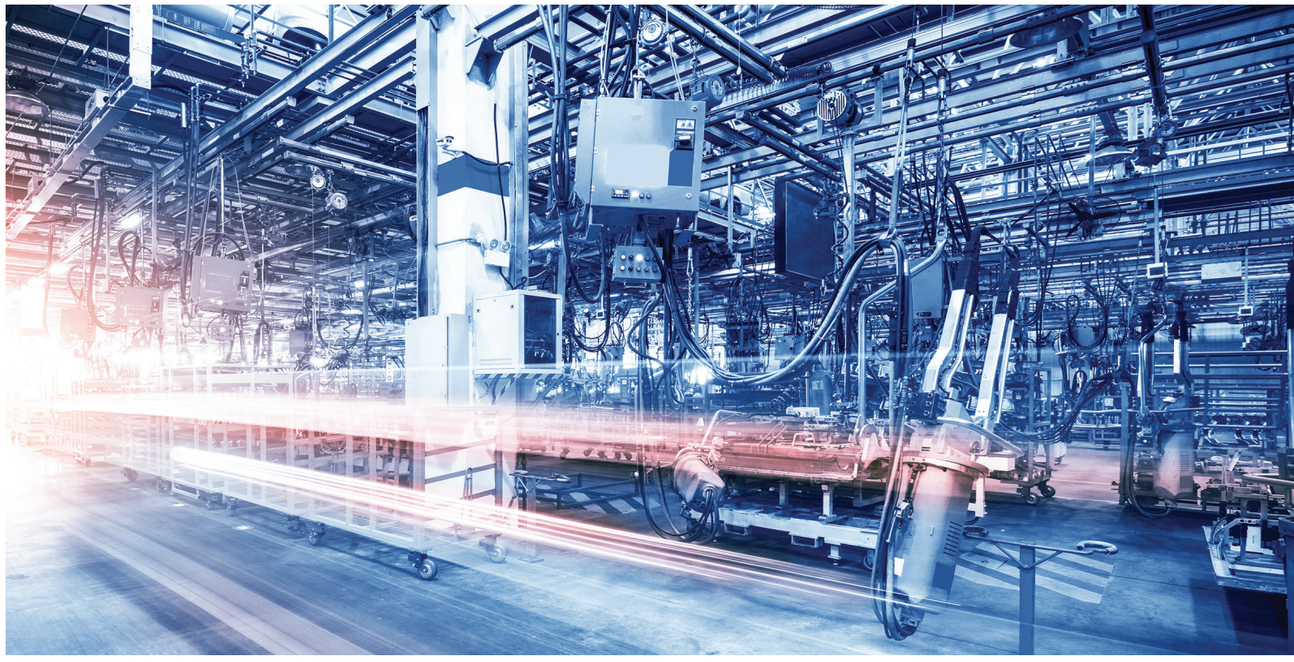
Is your existing system reaching the end of its lifetime? Is your plant changing the process, requiring additional testing methods right now? Replacing or introducing a new XRD can be an overwhelming process, but it doesn't need to be. Rigaku MiniFlex XpC's **Xpress Start** design is plug and play, requiring no special preparation of the room if you are replacing your existing system. It is smaller than conventional XRD; thus, it requires no additional space or utilities.

No expertise required

Are you worried about a lack of in-house expertise? When introducing a new XRD, you need to establish the testing method and train the operators. It can be daunting if you don't have an in-house expert. Our **Pro Connect** service is designed to help you in that situation. It provides training for the operators and necessary method development or adjustment to guarantee a smooth start. If your needs change in the future, or you need to troubleshoot your process, you can always use the **Pro Connect** service and work with a Rigaku XRD application specialist.

Simple operation

The **EasyX** software keeps everyday operations easy and straightforward while allowing testing methods to be customized and automated. You can obtain accurate and reliable results with only three clicks. **EasyX** also automatically generates pass/fail at-a-glance and trends reports.



Rugged design

The MiniFlex XpC uses components tested and proven robust over the years by its family members, such as the MiniFlex and the SmartLab diffractometers. To adapt to the potentially harsh environment of industry process control, the MiniFlex XpC's XRD components are fully covered, and the sample loading window is closed during measurements, protecting them from dust and other contaminations.

External sample changer

The MiniFlex XpC can be equipped with a field-upgradable external sample changer compatible with industry-standard 51.5 mm and 40 mm diameter sample holders.

Fully scalable and automatable

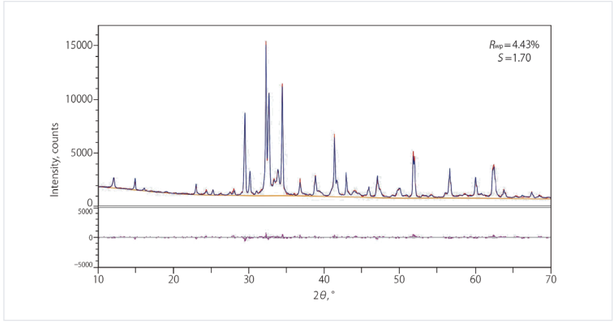
When acquiring a new diffractometer, you might not be ready to commit to fully automating your process control analysis. You might not need automation right now, but what about five years from now? In a rapidly changing environment, it is hard to predict the future.

Rigaku's MiniFlex XpC can grow with your process. With its **Xpress Connect** interface, you can start with a standalone configuration, then add an automatic sample changer later, and ultimately, you can integrate the MiniFlex XpC with your automation system when you are ready. You don't need to commit to the scale of automation when installing the system.

MiniFlex XpC in action – example data

Distinguishing polymorphs

Quantitative analysis of clinker

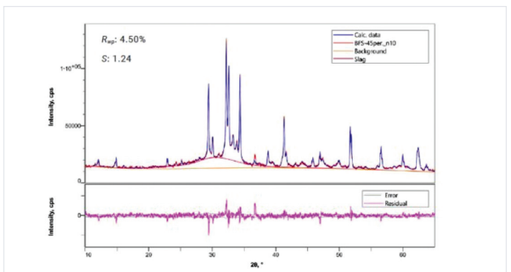


Different polymorphs can affect the durability, hydration characteristics, and thermal behaviors of cement products. Their quantities can affect the final product's quality. In this example, the MiniFlex XpC obtained high-count-rate data suitable for Rietveld refinement and quantified all phases with polymorphs separated in just five minutes.

Crystalline phase	Quantitative value (mass%)
Alite-M3 (C_3S)	51.6
Alite-M1 (C_3S)	15.9
Total Alite	67.5
Belite-β (C_2S)	13.3
Aluminate Cubic (C_3A)	1.5
Aluminate Ortho (C_3A)	0.9
Total Aluminate	2.4
Ferrite (C_4AF)	10.6
Lime (CaO)	0.2
Periclase (MgO)	4.4
Arcanite ($K_2(SO_4)$)	0.6
Aphthitalite ($K_3Na(SO4)_2$)	0.5
Langbeinite ($K_2Mg_2(SO_4)_3$)	0.3

Excellent repeatability

Quantitative analysis of blast furnace slag cement



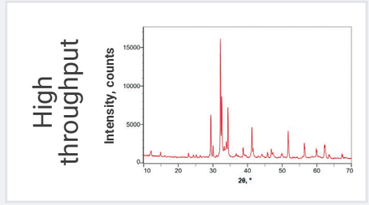
The ratio of all components in slag cement affects the strength and durability of the final cement products and is often monitored in the production process. In this example, the quantities of all components in blast furnace slag cement were analyzed using the MiniFlex XpC to test the reproducibility of the analysis results. The results show excellent reproducibility of less than 0.2 standard deviation for trace, minor, and major phases.

Components	Concentration (mass%) (n=10)	Standard deviation 1σ, n=10 (3 σ)
Alite-M3 (C_3S)	25.0	0.2 (0.6)
Alite-M1 (C_3S)	11.3	0.2 (0.6)
Total Alite	36.4	0.2 (0.6)
Belite-β (C_2S)	6.8	0.2 (0.6)
Belite-α' (C_2S)	1.2	0.1 (0.3)
Total Belite	8.0	0.2 (0.6)
Aluminate Cubic (C_3A)	1.4	0.1 (0.3)
Aluminate Ortho (C_3A)	1.8	0.1 (0.3)
Total Aluminate	3.2	0.2 (0.6)
Ferrite (C_4AF)	5.1	0.1 (0.3)
Lime (CaO)	0	0
Portlandite ($Ca(OH)_2$)	0	0
Gypsum ($CaSO_4(H_2O)_2$)	0.5	0.1 (0.3)
Bassanite ($CaSO_4(H_2O)_{0.5}$)	1.2	0.1 (0.3)
Anhydrite ($CaSO_4$)	0	0
Periclase (MgO)	0	0
Calcite ($CaCO_3$)	0	0
Langbeinite ($K_2Mg_2(SO_4)_3$)	0.3	0.1 (0.3)
Blast furnace slag*	45.2	0.2 (0.6)

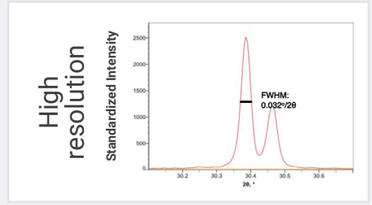
* Amount of BFS added: 45.0 mass%

Proven performance

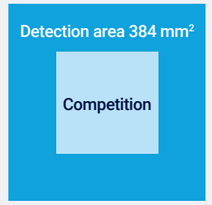
The D/teX Ultra250 detector's large-detection-area (+67% sensor size compared to the competition) achieves fast, high-resolution, and reliable measurements without compromising data quality while requiring minimum maintenance.



Sample: NIST SRM 2688 (Clinker)
Measurement time: 3 min



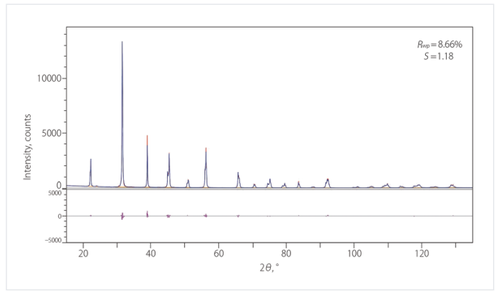
Sample: NIST SRM 660c (LaB6)
FWHM: 0.032°



Large sensor 1D detector
D/teX Ultra250

Analyzing crystal structure

Lattice parameter analysis of barium titanate

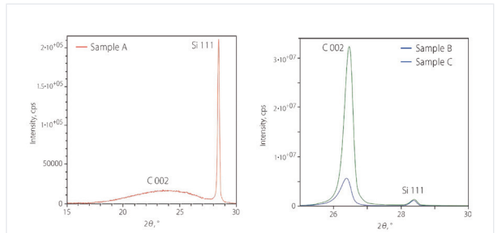


a (Å)	c (Å)	c/a ratio
3 .99525	4 .03494	1.00993

The crystal structure of barium titanate can affect its ferroelectric properties and needs to be checked when synthesizing raw materials later used for electronic devices. In this example, the MiniFlex XpC automatically ran a scan and calculated the lattice parameters, a and c, and the c/a ratio by fitting the entire XRD pattern.

Analyzing crystal structure

Degree of graphitization analysis of Li-ion battery anode material



Sample	d value (Å)	Crystallite size (Å)	Graphitization degree
A	3 .44	14	0
B	3 .371	575	0 .76
C	3 .363	1587	0 .85

Graphitization of the carbon anode can improve cycling stability and capacity of lithium-ion batteries. In this example, the MiniFlex XpC automatically ran a scan and calculated the degree of graphitization for three different carbon samples, demonstrating a wide range of graphitization can be measured by this technique.

EasyX – 3 easy steps

Easy-X is the software user interface designed for industrial users, making sample analysis easier than ever before. You can obtain results with only three clicks.

For routine analysis, all operators need to do is select samples and recipes and run the test. The results are automatically reported within minutes. The underlying analysis template is prepared by an XRD specialist beforehand. Easy-X streamlines the operation and analysis. It also provides the user with on-spot measurement results, analysis trends, and statistics over time.

Three clicks on touchscreen

Only 3 clicks to measure, analyze, and report

Powered by SmartLab Studio II (SLS II)

SLS II-built recipes to automate complex analysis, including Rietveld, lattice parameter, crystallite size, etc.

Pass and fail test results in one view

Pass and fail test results in one view for easy process monitoring and reporting

Trend tracking

Trend tracking for troubleshooting and predicting potential problems

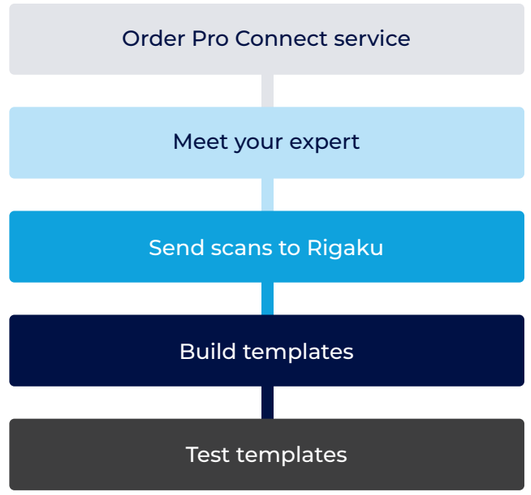
User-level permission control

User-level permission settings for data management and to control access to instrument parameters

On-demand X-ray experts - Pro Connect

You don't need to hire or become an X-ray expert to use XRD for process control. Take advantage of Pro Connect, our on-demand application service.

You can work with Rigaku XRD experts when you need to change your analysis procedures, troubleshoot the analysis process, or prepare for new products to test. That is the Pro Connect service. It can be your expert partner, on call when you need it.



Specifications

X-ray Generator	
Output	800 W
Tube voltage	20 – 40 kV (1 kV step)
Tube current	2 – 20 mA (1 mA step)
X-ray tube	Cu
Tube cooling method	Water cooling (Built-in unit or external installation*)

* Can be combined with a separately installed water chiller prepared by the user (Please contact Rigaku).

Computer	
PC with built-in device	Windows® 10 Pro 64 bit Touch panel display (Can be combined with external PC)

Windows® is a registered trademark of Microsoft Corporation in the United States and/or other countries.

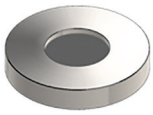
Detector		
D/teX Ultra250	Sensor	Semiconductor strip sensor
	Effective area	384 mm^2 (19.2 mm × 20 mm)
	Strip width	75 µm
	Maximum count rate	>2 .5 × 10^8 cps (global), 1 × 10^6 cps/strip

Goniometer	
System	θ-θ type sample horizontal goniometer
Goniometer radius	150 mm
Minimum step angle	θs: 0.00125°, θd: 0.00125°
Movable axis for measurement	θs /θd linked, θs /θd alone
Divergence slit	Operates in constant irradiation width variable mode at low angles to match the sample size Operates in fixed slit width mode at high angles
Soller slit	5.0° (Standard), 2.5° (Option)

Installation Condition		
Power	Main body	1φ, AC200 – 230 V±10%, 50/60 Hz±1%, 6.5 A
	Air-cooled cyclic water delivery unit	1φ, AC200 – 230 V±10%, 50/60 Hz±1%, 5.7/6.8 A
Ground wire	D class grounding, Grounding resistance 100 Ω or less (use dedicated grounding)	

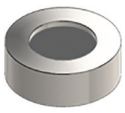
Sample holder size

Sample holder - 51.5 mm
Outer diameter: 51.5 mm
Inner diameter (without bottom): 35 mm
Height: 8.6 mm



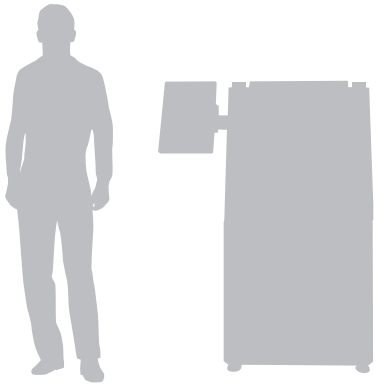
Sample holder - 51.5 mm with bottom
Outer diameter: 51.5 mm
Inner diameter (with bottom): 24 mm
Depth: 0.5 mm
Height: 8.6 mm

Sample holder - 40 mm
Outer diameter: 40 mm
Inner diameter (without bottom): 35 mm
Height: 14 mm



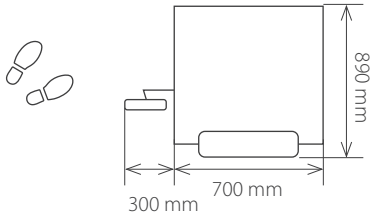
Sample holder - 40 mm with bottom
Outer diameter: 40 mm
Inner diameter (with bottom): 24 mm
Depth: 0.5 mm
Height: 14 mm

Footprint



Minimal installation requirements

- Small footprint
- Only power plug needed
- No compressed air needed
- Built-in PC and touch panel operation
- Built-in water chiller unit



Height 1490 mm
Main system: ~ 250 kg
Water supply: ~ 50 kg

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