Malvern Panalytical
a spectris company

AERIS
USER GUIDE

AERIS
USER GUIDE

EDITION NOTICE: 4023 000 37706, September 2020
This is the original publication of Edition 6 of this document, to be used with the Aeris instrument.

DISCLAIMER

Although diligent care has been used to ensure that the information in this material is accurate, nothing herein can be construed to imply any representation or warranty as to the accuracy, correctness or completeness of this information and we shall not be liable for errors contained herein or for damages in connection with the use of this material. Malvern Panalytical reserves the right to change the content in this material at any time without notice.

COPYRIGHT NOTICE

Malvern Panalytical Ltd.
Grovewood Road, Malvern,
Worcestershire, WR14 1XZ,
United Kingdom

Tel. +44 1684 892456
Fax. +44 1684 892789

Malvern Panalytical B.V.
Lelyweg 1, 7602 EA Almelo,
The Netherlands

Tel. +31 546 534 444
Fax. +31 546 534 598

info@malvernpanalytical.com
www.malvernpanalytical.com

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION

1.1 General

This User Guide gives a description of the hardware and instructions that are related to safety, operation, user maintenance and disposal of these systems:

- 9430 070 99991 Aeris

Before you use this User Guide, make sure that the instrument is installed correctly, the software is set up and the applications are created.

Read this User Guide together with the Aeris instrument suite Quick Start Guide.

For more information, refer to the Aeris instrument suite Help and the XRDMP Creator Help that are supplied with the software.

1.2 Intended use

The Aeris instrument together with the XRDMP Creator is designed as a basic platform for many different applications in analytical X-ray diffraction, in scientific as well as industrial research environments.

It is expected that the system will mostly be used by laboratory or factory personnel.

The system must not be used for purposes other than intended.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1.3 Recommended skill levels

The system may be operated by personnel with various skill levels. A person may only operate the system after adequate training is received for the required skill level.

The skill levels are:

Operator

- Can use the Standard mode.
- Does not need in-depth knowledge of X-ray theory or applications.
- Must have knowledge of the visible hardware, such as how to switch the instrument on/off and how to use the sample loader for loading and unloading samples.

- Must be able to follow instructions on how to measure samples using applications and how to execute pre-defined tests.

Application engineer

- Can use the Advanced mode.
- Must have a thorough knowledge of the analysis process.
- Must have enough knowledge of the hardware to know the limits of what can or cannot be done when using the system.
- Must know how to set up and maintain applications.
- Must know how to develop applications for specific application areas.

System owner

- Can use the Advanced mode.
- Must have enough knowledge to set up and maintain the system, both hardware and software.
- Must have an understanding of the function of the main aspects of the analysis procedure.
- Must have enough knowledge of the hardware to start "safe" actions (not overruling security).
- Must know the actions to take when the system indicates a malfunction.

CHAPTER 2 SAFETY

2.1 Introduction to safety aspects

Read this chapter before you start to use your instrument.

This chapter helps you to maintain and operate the analytical X-ray instrument in accordance with very high safety standards. It gives you information on how to keep the instrument in a safe condition and how to prevent accidents. It is important that you read this information to know the safety aspects of the Malvern Panalytical instrument.

A Malvern Panalytical instrument is fully safe when it is correctly installed and when the instructions in this User Guide are obeyed during operation.

If the safety information in this chapter does not comply with the related local (national or regional) rules, always obey the local rules.

2.1.1 Authorized personnel

NOTE: Authorized Personnel = Person who is trained, educated and authorized by the Malvern Panalytical organization to execute service work to a specified level and product area.

Procedures given in this User Guide can be done by the user. The installation, maintenance and repair procedures of the instrument that are not in this User Guide must only be done by 'Authorized Personnel'.

All repairs, adjustments and alignments to any part of the instrument must obey all applicable local regulations.

2.1.2 Safety guarantee

The Malvern Panalytical safety guarantee is included when a Malvern Panalytical instrument is supplied. It remains covered throughout its life when the instrument is maintained and repaired by Malvern Panalytical service engineers.

WARNING - General Hazard

It is not permitted to make changes or additions to the system if they are not approved.

2.1.3 Alerts and labels

Special alerts that relate to the safety of personnel and/or equipment can be found in this manual. Where it is necessary, alert labels with the applicable symbol are attached to the instrument.

Obey all instructions in the alerts in the manual and on the labels attached to the different parts of the instrument.

Alerts in this manual are shown as follows:

DANGER - Electrical Hazard

Shows an immediately dangerous condition which, if not prevented, can result in death or very serious injury.

(The symbol relates to the specified hazard)

WARNING - Ionizing Radiation

Shows a dangerous condition where there is risk of bad injury.

(The symbol relates to the specified hazard)

CAUTION - General Hazard

Shows a condition that can cause damage to equipment or property, or where there is a risk of small injury.

(The symbol relates to the specified hazard)

NOTE: Gives the user more information about the procedure or system.

2.2 Safety standards

Malvern Panalytical supplies a Declaration of Conformity with all instruments. The Declaration of Conformity is a legal statement by Malvern Panalytical that shows that the responsibilities related to the supplied instrument have been completed. The customer must keep this document with the instrument for its full life cycle.

Another important declaration for users of analytical X-ray instruments is the X-ray Safety Declaration, which is also supplied with all instruments.

The instrument complies with the requirements of the Machine Directive 2006/42/EC and EMC Directive 2004/108/EC and the applicable X-ray safety regulations.

Refer to the applicable standards, normative documents and directives in the Declaration of Conformity and the X-ray Safety Declaration of the instrument.

2.3 Malvern Panalytical's approach

Malvern Panalytical makes and supplies analytical X-ray instruments that obey the applicable international product regulations. As a result, Malvern Panalytical complies with these approaches:

- Specification of the worldwide lowest radiation level: less than 1 µSv/h at 10 cm distance from the outer surface of the instrument.
- Risk calculations and assessments related to the use of the instrument that show that the absorbed dose stays easily within the ICRP (International Commission on Radiological Protection) level for public. This level is 1 mSv/year.
- Overall risk assessment related to the safety of the instrument.
- Instrument design, production and documentation is certified by notified bodies PTB and/or CSA and/or MET. Refer to the Declaration of Conformity and the X-ray Safety Declaration for more information.
- Malvern Panalytical's environmental policy is deployed across the organization. These steps are taken:
  a. Design rules are applied to decrease energy consumption, packaging and weight.
  b. Environmental information is supplied with the instrument for the service engineers and users.
- Emission of sound, made by the instrument during normal operation, complies with the requirements of the Machine Directive.
- Moving parts are safe to operate. Precautions have been taking during the development of the instrument, and there are alert labels on the instrument and in the manuals.

Organizational requirements such as ISO 9001, ISO 14001, radiation safety board inspections and audits make sure that these approaches are obeyed.

2.4 User responsibilities

To keep the instrument at the classified safety level, the user has these responsibilities:

1. The user must make sure that the instrument is correctly installed. The user's site facilities must comply with the specifications in the pre-installation and installation

information, and comply with the applicable safety requirements. The user is also responsible for these installation requirements:

   a. A correct ground (earth) must be available.
   b. The floor or table must be sufficient for the weight distribution of the instrument.

2. Installation and maintenance must be done by Authorized Personnel.
3. Safety devices must NEVER be bypassed.
4. The user must make sure that persons that use the system are fully instructed in the safety procedures.
5. The user must make sure that when the system is operated, the applicable local safety regulations are obeyed.
6. All X-ray analysis systems must be monitored regularly (based on a local risk assessment) with a suitable X-ray radiation monitor.
7. If the instrument is left unattended in a dangerous condition, do as follows:
   a. Remove the HT (high-tension) key.
   b. Disconnect the instrument from the mains power supply.
   c. Attach a "DO NOT OPERATE" warning notice to all power buttons and mains power switches or connections.
8. When X-rays are generated, the fail-safe X-rays warning lamps must be on. This lamp must be clearly in view to all persons in the area.
9. In some countries, an X-rays warning lamp and the international ionizing radiation sign must be installed on the outer side of the room.
10. After installation or a maintenance/repair procedure is done, the user and the service engineer must make sure that the safety interlocks operate correctly.
11. A Malvern Panalytical service engineer or application specialist can do a remote support session on the instrument to troubleshoot, to examine the system after repair or for application support. Before the remote support session is started, the user must take precautions to make sure that the instrument can be operated safely without local intervention.
12. Although the instrument is made and tested to be safe, maintenance is very important. Information about user maintenance is given in this manual. Other maintenance must be done by Authorized Personnel.

2.4.1 What to do in case of an emergency

If an emergency or a possible exposure to radiation from an analytical X-ray instrument occurs, do as follows:

1. Switch off the instrument and make sure that it cannot be switched on again.

2. Take the necessary medical/remedial first aid steps.
3. Do not take steps to correct the fault that caused the accident and/or exposure.

   NOTE: If there is an X-ray exposure incident, calculation of the absorbed dose is more difficult if the fault is corrected.

4. Put a sign on the instrument to make sure that the instrument will not be used or changed.
5. You must tell these persons about the emergency:
   - The user
   - The (Radiation) Safety officer
   - The local Malvern Panalytical representative
6. If it is an X-ray exposure accident and the exposure is more than the level set in local regulations, refer the exposed person for medical examination.

2.5 General hazards

2.5.1 Ionizing radiation

Protection against ionizing radiation is a safety aspect that is included in the applicable standards. The basic principle is to decrease the radiation near the instrument to a level that is as low as reasonably achievable (ALARA principle).

When the instrument is correctly operated within the specifications, the radiation level at a distance of 10 cm from the outer surface of the instrument is less than 1 µSv/h.

WARNING - Ionizing Radiation

X-rays are dangerous. The instrument generates X-rays which can be dangerous to health if precautions are not taken.

It is important for the health and safety of the user that the instructions given in the instrument manuals are obeyed.

Obey local safety regulations.

2.5.2 Toxic material

The instrument can contain materials that can be hazardous to health. A hazardous substances label is attached to the rear of the instrument. Refer to Figure 2.1.

Unknown samples can contain poisonous material. Take precautions when you touch unknown samples.

For more information, refer to the Safety Data Sheets.

Figure 2.1 *Hazardous substances label*

2.5.2.1 Beryllium

Some items in the instrument contain **beryllium (Be)**.

WARNING - Toxic Material

Beryllium and compounds of beryllium (for example beryllium oxide) are poisonous.

Do not touch, swallow or breathe in beryllium.

Do not get beryllium on your bare skin. Always wear gloves when you touch items that contain beryllium.

If there are dust or fumes of beryllium, use a dust mask and protective clothing.

Disposal of beryllium must obey all applicable local regulations.

Refer to the safety information in this document and the related Safety Data Sheet for more details.

Safety Data Sheet: (https://uqr.to/epa4)

2.5.3 Flammable material

WARNING - Flammable Material

The end-user is at all times responsible for treating (the substances or materials used for fabricating) its samples with all due care and diligence. Malvern Panalytical cannot be held liable for any damage resulting from the use of flammable, combustible or other hazardous substances or materials in (the preparation of) any samples.

2.6 Safety measures

These sections give information about safety measures that are used in the instrument.

2.6.1 HT keyswitch

All instruments have an HT keyswitch. The removable HT key helps the local radiation safety officer to control who uses the system.

To prevent unauthorized use of the system, remove the HT key. A normal mains power is available for other functions.

2.6.2 X-RAYS ON lamps

The X-RAYS ON lamps are on when the instrument generates X-rays. The X-RAYS ON lamps are part of the safety circuit. If one of the lamps is defective, the HT generator cannot be switched on and X-rays cannot be generated.

When the instrument senses that all conditions are safe, the X-RAYS ON lamps come on and X-rays can be generated.

2.6.3 Double independent safety loops

Double independent safety loops are necessary for fail-safe operation of the instrument. For X-ray safety, it is important to do a test of these loops regularly. Record the results of the test.

2.6.4 Xsafe

Xsafe is a safety protection system that gives the user protection against X-rays. This system contains an electronic board that permanently monitors switches in the instrument to make sure that it is safe for X-rays to be generated.

The X-ray tube in an instrument is energized by a high tension power supply. The safety circuits automatically make sure that the high tension and X-rays are immediately switched off if there is a dangerous situation.

To make sure that Xsafe operates correctly, do a test of the operation of the safety switches at least once a year.

NOTE: The Aeris has no visual indication of the Xsafe status.

2.6.5 Motion safety

The user is protected from any harm caused by movements of the goniometer, stages and accessories by a motion safety system.

The motion safety system is integrated in the instrument and ensures that no movements are possible while the cover is open.

2.7 Safe use of the instrument

During normal operation of the instrument with all panels in position, there are no safety risks for the operator.

The next sections show possible safety risks from the instrument during sample handling or with 1 or more panels removed, which is possible during user maintenance.

2.7.1 Location of alerts and hazards

1.		Ionizing radiation: X-RAYS ON lamp

Figure 2.2 Front

1.		Ionizing radiation: X-RAYS ON lamp

Figure 2.3 *Front with open cover*

1.		Ionizing radiation: X-RAYS ON lamp

Figure 2.4 Left

1.		Ionizing radiation: X-RAYS ON lamp	2.	 X-ray beams when energized

Figure 2.5 Right

1.	Ionizing radiation: X-RAYS ON lamp	2.	Toxic material: system contains hazardous substances

Figure 2.6 Rear

1.	Pinch hazard: sample loader door

Figure 2.7 Top

1.		Hand crushing: sample spinner stage

Figure 2.8 *Sample spinner stage*

CHAPTER 3 SYSTEM DESCRIPTION

3.1 Introduction

These industry configurations of the Aeris instruments are available:

- Research edition of Aeris
- Cement edition of Aeris
- Metals edition of Aeris
- Minerals edition of Aeris

The Aeris usually contains these items:

- Aeris cabinet, which is the working environment. The Aeris cabinet has 2 major parts: the radiation enclosure and the electronics and support unit.
- Goniometer as the core of the diffractometer.
- X-ray tube installed on the goniometer in a tube housing.
- Optical components for the incident and the diffracted X-ray beams.
- Sample stage, on which a sample is put so that its characteristics can be measured.
- Detector to measure the intensity of the diffracted X-ray beam.

All these items are given in detail in the next sections.

3.2 Aeris cabinet

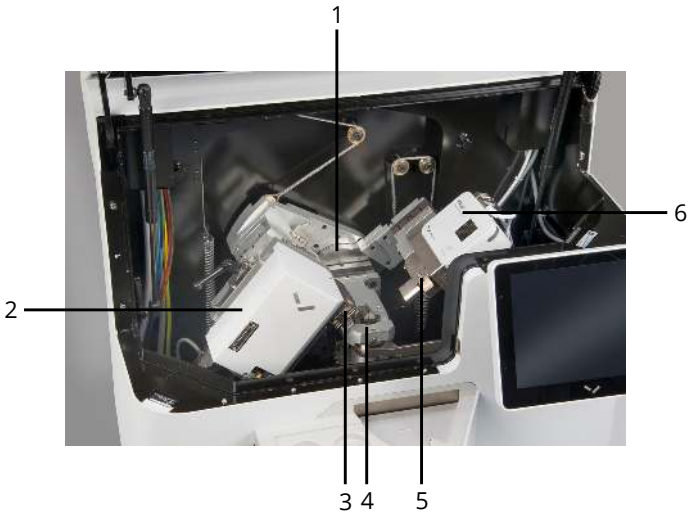
The Aeris cabinet is the working environment for a standard Aeris X-ray diffraction system. The Aeris cabinet has 2 primary parts:

- The front part is the radiation enclosure. Refer to Section 3.3.
- The rear part is the electronics and support unit. Refer to Section 3.4.

1.	Electronics and support unit	2.	Radiation enclosure

Figure 3.1 *Aeris cabinet components*

3.3 Radiation enclosure



1.	Goniometer	4.	Sample stage
2.	Tube housing with X-ray tube	5.	Diffracted beam optical components
3.	Incident beam optical components	6.	Detector

Figure 3.2 *Radiation enclosure components*

The radiation enclosure is made from steel. You can get access to the inner part of the enclosure through the cover at the front of the Aeris cabinet.

The goniometer is the core of the diffractometer. The goniometer radius is 145 mm. The minimum step size for the scattering angle (2θ) is 0.0027°.

The cover has a door lock to prevent accidents. As a safety measure, you cannot open the shutter of the X-ray tube if the cover is not correctly closed and locked. Other safety precautions are that you cannot open the cover when the shutter is open, when a goniometer arm moves, or when the instrument initializes.

The construction agrees with the most rigid limit of X-ray safety standards: the dose rate is less than 1 µSv/h at 10 cm distance from the outside surface of the radiation enclosure.

3.3.1 Tube housing

The tube housing, which is supplied with the Aeris instrument, is designed specially for the Empyrean tube. The tube housing is installed on the incident beam arm of the goniometer. The range to adjust the X-ray tube height is 6 mm.

A shutter assembly is attached to the tube housing.

If the safety circuit is broken during normal operation, the HT generator is automatically switched off.

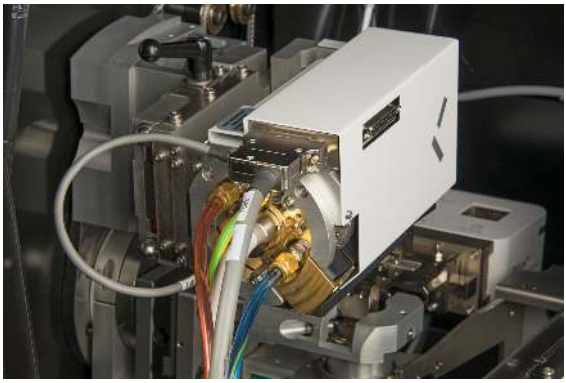


Figure 3.3 *Tube housing*

3.3.2 X-ray tube

The X-ray tube is made of ceramic. The anode is at a maximum of 40 kV above ground potential and is cooled with a glycol mixture of 25 % glycol and 75 % water. Refer to Section 3.4.5.

The X-ray tubes are available with Cu and Co anodes.

The window of the X-ray tube is made of beryllium and is 300 µm thick.

3.3.3 Fixed divergence slit holder

The Fixed Divergence Slit holder (FDS) is an incident beam module that has slots and holders for these items:

- Fixed divergence slits. Refer to Section 3.3.3.1.
- Beta-filters. Refer to Section 3.3.3.2.
- Soller slits. Refer to Section 3.3.3.3.
- Beam masks. Refer to Section 3.3.3.4.

3.3.3.1 Fixed divergence slits

Fixed divergence slits control the divergence of the incident beam. These fixed divergence slits are available:

- Divergence slit 1°
- Divergence slit 1/2°
- Divergence slit 1/4°
- Divergence slit 1/8°
- Divergence slit 1/16°
- Divergence slit 1/32°

3.3.3.2 Beta-filters

These beta-filters are available:

- Beta-filter Fe, to remove the Kβ wavelength of Co radiation.
- Beta-filter Ni, to remove the Kβ wavelength of Cu radiation.

3.3.3.3 Soller slits

Soller slits for optical modules in the incident beam path are available with different distances between their plates. The distance between the plates relates to the axial acceptance of the X-ray beam. These Soller slits are available:

- 0.04 radians
- 0.02 radians

3.3.3.4 Beam masks

Beam masks control the axial width of the incident beam. These beam masks are available:

- Beam mask 23 mm
- Beam mask 20 mm
- Beam mask 13 mm
- Beam mask 2D (supplied with the Debye-Scherrer 2D pack)

3.3.4 Sample stage

These sample stages are available:

- Sample spinner for 51.5 mm sample holders
- Sample spinner for 40 mm sample holders

- Sample spinner for high sample holders
- Anton Paar BTS 500

The sample holder with sample is put on the sample platform. The sample loader moves the sample holder to the sample stage.

Sample holders are available for a number of sample sizes and types.

3.3.5 Detectors

As standard, the PIXcel^{1D} is supplied with the instrument. The PIXcel^{3D} is available as an option.

The detectors are fast X-ray detection systems based on Medipix3 technology. The PIXcel^{1D} can be used in scanning or static line detector (1D) mode. The PIXcel^{3D} can be used in scanning or static area detector (2D) mode, and scanning or static line detector (1D) mode.

A Fixed Anti-scatter Slit (FASS) is installed on the detectors.

The detectors have slots for these items:

- Large Soller slits. Refer to Section 3.3.5.1.
- Large beta-filters. Refer to Section 3.3.5.2.

3.3.5.1 Large Soller slits

The large Soller slits are used with the detector to limit the axial acceptance of the X-ray beam. These Soller slits are available:

- 0.04 radians (half of the opening angle)
- 0.02 radians (half of the opening angle)

3.3.5.2 Large beta-filters

These large beta-filters are available:

- Large beta-filter Fe, to remove the Kβ wavelength of Co radiation.
- Large beta-filter Ni, to remove the Kβ wavelength of Cu radiation.

3.4 Electronics and support unit

The electronics and support unit contains the mains power supply, the measuring and control electronics, and a 300 W, 450 W or 600 W HT generator.

A touchscreen is attached at the front of the diffractometer cabinet.

The electronics and support unit has the mains power switch and cooling system.

On the right of the electronics and support unit is a connector for an external X-RAYS ON lamp.

The left and right panel of the electronics and support unit can be removed to get easy access for service and maintenance.

1. Cooling system

Figure 3.4 *Electronics and support unit components - left*

1.	Peripherals connections	2.	Dust filters

Figure 3.5 *Electronics and support unit components - right*

NOTE: Use the left Ethernet port to connect to the customer network with an Ethernet cable. The right Ethernet port is for Malvern Panalytical service engineers.

3.4.1 X-RAYS ON lamps

4 X-RAYS ON lamps on the top corners of the instrument and 2 more on the inside of the cover give a visual warning when high tension is applied to the X-ray tube.

The X-RAYS ON lamps are 'fail safe' lamps and they are part of the safety circuit. The result is that if one of the lamps fails, no high tension can be applied to the instrument.

The X-RAYS ON lamps must be replaced by a Malvern Panalytical service engineer.

Figure 3.6 *X-RAYS ON lamp on electronics and support unit*

3.4.2 Mains power switch

The location of the mains power switch is at the rear of the instrument. It is used to switch the mains power supply to the instrument on or off.

The switch has 2 positions:

- **I**: Connects the mains power supply to the instrument.
- **O**: Disconnects the mains power supply from the instrument.

Figure 3.7 *Mains power switch*

3.4.3 Touchscreen

1.	X-rays warning	3.	Power button
2.	HT keyswitch	4.	USB connection

Figure 3.8 *Touchscreen*

If the instrument is not used for 2 minutes, it goes into standby mode. The touchscreen shows the standby mode screen. Tap the touchscreen once to exit the standby mode.

3.4.3.1 Power button

When you press the Power button, the instrument switches to the ON condition. In this condition, all instruments systems except the HT supply are in operation.

When you press the Power button again, the instrument switches to the OFF condition.

3.4.3.2 HT keyswitch

When you turn the HT keyswitch clockwise, the HT generator goes on. If the instrument is energized and the safety loops are closed, the HT generator is automatically set to its power settings. Refer to Table 3.1.

When the HT generator is in the ON condition, the indicators are as follows:

- The **kV** and **mA** indicators on the touchscreen show the settings.
- The 4 X-RAYS ON lamps on the corners of the instrument are on.

When you turn the HT keyswitch counter-clockwise, the HT generator goes off.

The HT keyswitch is also used to reset the Xsafe system. Refer to Section 7.3.1.

If the HT key is removed from the instrument and an unsafe condition is sensed, you cannot switch the high tension on again.

NOTE: The HT key can be removed and kept in a safe place.

3.4.4 HT generator

The electronics and support unit contains a very stable HT generator. The output power is 300 W, 450 W or 600 W. The stability of the high voltage and the anode current are < 0.01 % per 10 % mains fluctuation.

Table 3.1 *HT generator power settings*

Power (W)	kV	mA
300	40	7.5
300 (*)	30	10
450 (*)	30	15
600	40	15

(*) Made for legislation in specific countries.

3.4.5 Cooling system

The cooling system of the Aeris uses a glycol mixture to cool the anode of the X-ray tube. The cooling system includes a flow meter and a temperature sensor for the coolant.

If the flow becomes less than 0.6 L/min, the HT generator will switch off. To prevent this, make sure that you never have a blocked exhaust outlet and that the pressure and flow are always in their specified range.

3.4.6 Sample changer

An optional 6-position sample changer can be installed at the front of the instrument. Samples can be put on the 6 sample positions. Do not put a sample on the loading position.

1. Loading position

Figure 3.9 *Aeris with a 6-position sample changer*

3.5 Aeris in automation

The Aeris can be used in automation with other instruments. For example, in combination with these Malvern Panalytical XRF instruments:

- Zetium
- Axios FAST with a VRC Sample Changer

A conveyor belt is used to move samples between the Aeris and/or an XRF instrument and/or an automatic sample preparation machine. A special version of the 6-position sample changer is necessary.

An automation environment can be set up by Malvern Panalytical or by a third party. Refer to the Aeris Automation Manual for more information about the hardware and software interfaces. The initial installation of the Aeris must always be done by Authorized personnel.

3.6 Accessories

Many different accessories are available for safe operation and maintenance of the Aeris X-ray diffraction system.

- Silicon disk
- Bottle of oil

- Chamois leather
- Set of tools

CHAPTER 4 OPERATE THE INSTRUMENT

4.1 Introduction

The system must be installed by a Malvern Panalytical service engineer and agree with the specifications in the Aeris Pre-installation Manual.

If it is necessary to move the instrument, refer to the Aeris Pre-installation Manual for the requirements about storage, transport and installation.

If you are not sure, always contact your local Malvern Panalytical representative.

NOTE: If the instrument is used in a regulated environment, some software actions are traced. Procedures such as log in and log out are different and you must enter an electronic signature for specified user actions.

4.1.1 Environmental conditions

The Aeris diffractometer can be used in an industrial environment as well as in a research laboratory. To make sure that you get a stable operation of the Aeris, the instrument location must agree with these environmental conditions:

- The room temperature must be +15 °C to +30 °C.
- The temperature variation in the room must be less than 1 °C per 30 minutes.

Before you start to collect diffraction data, make sure that the Aeris is at a stable temperature. We recommend a warm-up time of 1 hour.

Make sure that the sample has the same temperature as the instrument. We recommend that you store the samples that will be measured in a short time in the radiation enclosure.

4.2 Switch on the instrument

1. If the sample changer is installed, make sure that at least 1 sample position is free.
2. Turn the mains power switch at the rear of the instrument to **I**.
3. Make sure that the cover is closed.
4. Press the Power button to switch on the instrument.

   The green light on the Power button comes on, the touchscreen comes on, the cover is locked, and the instrument starts the initialization.

5. Turn the HT keyswitch clockwise to switch on the HT generator.

   The high tension starts up automatically, the X-RAYS ON lamps on the corners of the cabinet and on the inside of the cover come on, and the HT generator is automatically set to its power settings. Refer to Table 3.1. The HT values are shown on the touchscreen.

   NOTE: The instrument can only initialize when the cover is closed.

4.3 Switch off the instrument

1. Press the Power button to switch off the instrument.
2. Turn the HT keyswitch counter-clockwise to switch off the HT generator.
3. If the instrument will be switched off for a long period of time, you can also switch off the mains power supply.

4.4 Go to Advanced mode

1. On the touchscreen, press the Menu button  .
2. Press **Advanced mode**.
3. Enter the password.

   NOTE: The default password is “panalytical”. The password is case-sensitive.

4. Press **OK**.

4.5 Change optical components

This option is only available in Advanced mode.

Measurement programs with an  icon use different optical components than the ones that are currently installed in the instrument. If you select a measurement program with this icon, you must change the optical components when you start the measurement. After you press **Start**, the change optical components screen shows automatically.

1. Press **Unlock cover**.
2. Open the cover.
3. Exchange the optical components that have an  icon with the optical components that are given in the Specified column.

   When you select the optical component on the touchscreen, its position in the optical path is shown.

4. Press **Continue**.

4.6 Manage data

4.6.1 Export results

1. On the touchscreen, press the Menu button  .
2. Press **Data management**.
3. If you want to export files to a USB stick, put a USB stick in the instrument.
4. If you want to export files to a network drive, create a shared folder. Refer to Section 4.6.5.
5. In the **Export to folder "XRD data" on** field, select the USB stick or shared folder that you want to export the results to.
6. Select the files that you want to export.
7. If necessary, select the **Remove files from Aeris after copying** check box.
8. Press **Copy results**.

4.6.2 Import programs

When you import a measurement program for which you must change the instrument configuration, this measurement program is only shown in Advanced mode and not in Standard mode.

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Data management**.
4. Go to the **Import programs** tab.
5. If you want to import files from a USB stick, put a USB stick in the instrument.
6. If you want to import files from a network drive, create a shared folder. Refer to Section 4.6.5.
7. If you want to import measurement programs, do as follows:
   a. In the **Source** field, select the USB stick or shared folder that you want to import the results from.
   b. Select the files that you want to import.
   c. Press the upper **Import programs** button.

8. If you want to import analysis programs, do as follows:
   a. In the **Source** field, select the USB stick or shared folder that you want to import the results from.
   b. From the **Analysis programs** drop-down list, select the folder that you want to import the analysis programs from.
   c. Press the lower **Import programs** button.

   NOTE: If you import analysis programs, the analysis programs that are currently installed on the Aeris are overwritten.

4.6.3 Delete programs

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Data management**.
4. Go to the **Delete programs** tab.
5. Select the programs that you want to delete.
6. Press **Delete**.

4.6.4 Delete results

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Data management**.
4. Go to the **Delete results** tab.
5. Select the results that you want to delete.
6. Press **Delete results**.

4.6.5 Create a shared folder (optional)

1. Make sure that the Aeris gets an IP address from a network or use a router between the PC and Aeris.
2. Create a folder on the PC that you want to export files to or import files from.
3. Right-click on the folder and select **Share with > Specific people**.
4. Add your account. The **Permission Level** must be **Owner** or **Read/Write**.
5. Click **Share**.
6. Click **Done**.
7. On the Aeris, go to Advanced mode. Refer to Section 4.4.

8. Press the Menu button  .
9. Press **Minimize**.
10. Open the File Explorer.
11. In the navigation pane, press and hold **Network**.
12. If the message **Network discovery is turned off shows**, press **OK**. You do not have to turn on network discovery.
13. Press **Map network drive**.
14. In the **Drive** field, select a letter.
15. In the **Folder** field, enter the path to the folder: "\\<PC name>\<folder name>".
16. Select the **Reconnect at sign-in** and **Connect using different credentials** check boxes.
17. Press **Finish**.
18. Enter your user name and password.
19. Select the **Remember my credentials** check box.

    NOTE: When you select this check box you do not have to enter your user name and password every time the instrument has been switched off, but every user on the instrument can access your shared folder.

20. Press **OK**.

4.6.6 Collect log files

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Minimize**.
4. On the Start menu, start IMS.
5. Go to **Scenarios > Run**.
6. Select **Collect logs**.
7. Press **Open**.
8. If you want to save the log files on a USB stick, put a USB stick in the instrument.
9. From the **Destination** drop-down list, select the drive type you want to save the log files to.
10. Press **Select**.
11. From the **Choose drive** drop-down list, select the drive. If no drives are shown, press **Refresh drives**.
12. In the **Specify folder** field, enter the location where the files must be saved.

13. Press **Collect logs and configuration**.

4.6.7 Change the PC name

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Minimize**.
4. On the Start menu, start IMS.
5. Go to **Scenarios > Run**.
6. Select **ComputerName**.
7. Press **Open**.
8. In the **New computer name** field, enter the new name.
9. Press **Set new computer name**.

4.6.8 Change the IP address

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Minimize**.
4. On the Start menu, start IMS.
5. Go to **Scenarios > Run**.
6. Select **IP configuration**.
7. Press **Open**.
8. Go to **Configure IP settings**.
9. If you want to get the current IP address, press **Get current settings**.
10. If you want to set a static IP address, do as follows:
    a. In the **IP address** field, enter the IP address.
    b. In the **Subnet mask** field, enter the subnet mask.
    c. In the **Default gateway** field, enter the default gateway.
    d. Press **Set static IP address**.
11. If you want to get a dynamic IP address, press **Set dynamic IP address**.

4.6.9 Back up data

1. Go to Advanced mode. Refer to Section 4.4.

2. Press the Menu button  .
3. Press **Minimize**.
4. Back up system data as follows:
   a. On the Start menu, start IMS.
   b. Go to **Scenarios > Run**.
   c. Select **Backup and restore**.
   d. Press **Open**.
   e. Press **Create backup**.
   f. If you want to make a backup on a USB drive, insert a USB drive in the instrument.
   g. In the **Backup to copy** field, select the backup.
   h. In the **Destination** field, select **USB drive** or **Specify folder path**.
   i. Press **Select**.
   j. Select the USB drive or specify the folder path.
   k. Press **Copy backup**.
   l. Close IMS.
5. Save copies of measurement programs as follows:
   a. Put a USB stick in the instrument.
   b. Open the File Explorer.
   c. Go to **C:\PANalytical\Data Collector\Programs**.
   d. Copy all XRDMP files to the USB stick.
6. Save copies of analysis programs as follows:
   a. Put a USB stick in the instrument.
   b. Open the File Explorer.
   c. Go to **C:\PANalytical\RoboRiet\RRC**.
   d. Copy all RRC files and RoboRietSettings.ini to the USB stick.
7. Save the IP address of the LAN port as follows:
   a. On the Start menu, start IMS.
   b. Go to **Scenarios > Run**.
   c. Select **IP configuration**.
   d. Press **Open**.
   e. Go to **Configure IP settings**.
   f. Write down the IP settings of the LAN port.

8. Save a copy of the INI file as follows:

   NOTE: This step is only for Aeris in automation.

   a. Put a USB stick in the instrument.
   b. Open the File Explorer.
   c. Go to **C:\PANalytical\Uai**.
   d. Copy Uai.ini to the USB stick.

4.6.10 Restore data

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Minimize**.
4. Restore system data as follows:
   a. On the Start menu, start IMS.
   b. Go to **Scenarios > Run**.
   c. Select **Backup and restore**.
   d. Press **Open**.
   e. Press **Restore**.
   f. From the **Backup source** field, select the correct source.
   g. Click **Select**.
   h. Select the backup file from that source.
   i. Press **Load File Info**.
   j. Press **Restore backup**.
   k. Close IMS.
5. Import measurement programs and analysis programs. Refer to Section 4.6.2.
6. Change the IP setting of the LAN port. Refer to Section 4.6.8. Use the value written down in the back up procedure. Refer to Section 4.6.9.
7. Copy the INI file back as follows:

   NOTE: This step is only for Aeris in automation.

   a. Put a USB stick in the instrument.
   b. Open the File Explorer.
   c. Copy Uai.ini from the USB stick to **C:\PANalytical\Uai**.

4.7 Change the PreFIX sample stage

Only application engineers and system owners are permitted to change the sample stage.

1. Press the Power button to switch off the instrument.
2. If you want to install the Anton Paar BTS 500, remove the sample loader arm. Refer to Section 4.7.1.
3. Manually move the arms of the goniometer to a position where you have easy access to the PreFIX lock screw.
4. Loosen the PreFIX lock screw of the PreFIX stage interface with the 6 mm Allen key.

Figure 4.1 *Loosen the PreFIX lock screw*

5. Disconnect the sample stage connector from the front panel of the instrument.
6. Carefully lift the sample stage out of the PreFIX mounting position and remove it from the instrument.
7. Move the new sample stage in position until it has a good fit in the PreFIX mounting position on the goniometer and make sure that the detector cables are not caught below the sample stage.

   NOTE: The Anton Paar BTS 500 is easier to install if it is in the sample loading position. Refer to Figure 5.1.

8. Tighten the PreFIX lock screw with the 10 Nm torque wrench to lock the sample stage in position.

Figure 4.2 *Tighten the PreFIX lock screw*

9. If the BTS 500 is installed, make sure that it is in the measuring position. Refer to Figure 5.4. The goniometer cannot initialize if the BTS 500 is in the sample loading position.
10. Connect the sample stage connector to the front panel of instrument.
11. If the sample spinner stage is installed, install the sample loader arm. Refer to Section 4.7.2.
12. Press the Power button to switch on the instrument.

4.7.1 Remove the sample loader arm

It is necessary to remove the sample loader arm before you install the Anton Paar BTS 500.

Figure 4.3 *Sample loader arm*

1. Remove the 4 screws from the sample loader arm.

Figure 4.4 *Remove these screws*

2. Carefully remove the sample loader arm.

4.7.2 Install the sample loader arm

It is necessary to install the sample loader arm when you use the sample spinner stage.

1. Put the sample loader arm in the correct position. Use the 2 locating pins.

Figure 4.5 *Locating pins*

2. Install the 4 screws of the sample loader arm. Refer to Figure 4.4.

CHAPTER 5 MEASURE SAMPLES

5.1 Measurement overview

These steps are necessary to do a measurement:

1. Prepare the sample.
2. Put the sample on the loading position on the sample changer.

CAUTION - General Hazard

Do not push the sample loader arm forward to prevent damage and incorrect alignment of the sample loader arm.

If necessary, switch off the instrument and then switch it on again to set the sample loader arm back to the calibrated position.

3. Select a measurement program from the drop-down list, or make a measurement program in the XRDMP Creator and import the measurement program in the Aeris. Refer to Section 4.6.2. Refer to the XRDMP Creator Help.

   NOTE: Measurement programs are only shown in the list if they can be done with the stage that is currently installed.

4. Start the measurement. Refer to the Aeris instrument suite Quick Start Guide.

   NOTE: For 2D measurements, the data preview is not shown on the touchscreen. Export the result to a PC. Refer to Section 4.6.1.

After the data is collected, you can see the measurement results on the touchscreen. If analysis programs are installed, you can see the Rietveld quantification results on the touchscreen.

CAUTION - General Hazard

Make sure that samples are installed safely. Loose samples and sample holders can damage the diffraction system.

Powders that fall out of a sample holder can cause contamination of the instrument.

WARNING - Flammable Material

The user is always responsible to use its samples, and its materials to prepare these samples, very carefully and correctly.

Malvern Panalytical is not legally responsible for damage that is caused by flammable samples, or by other hazardous materials in the samples or that are used when the samples are prepared.

NOTE: If the instrument is used in a regulated environment, some software actions are traced. Procedures such as log in and log out are different and you must enter an electronic signature for specified user actions.

5.2 Do a measurement with the Anton Paar BTS 500

1. Install the Anton Paar BTS 500. Refer to Section 4.7.
2. Select the sample holder that is applicable for the measurement.
3. Adjust the height of the BTS 500. Refer to Section 5.2.1.
4. Prepare the sample. Refer to the Anton Paar Instruction Manual BTS 150/500 Benchtop Heating Stages.
5. Make sure that the BTS 500 is switched off and that the current temperature of the stage is the same as the ambient temperature. Refer to the Anton Paar Instruction Manual BTS 150/500 Benchtop Heating Stages.
6. Hold the BTS 500, and carefully lift the stage to the sample loading position. Refer to Figure 5.1. The stage is automatically locked in this position.
7. Loosen the screws of the BTS 500 drawer. Refer to Figure 5.2.
8. Open the drawer.
9. Put the BTS 500 sample holder on the sample table. Refer to Figure 5.3.
10. Close the drawer.
11. Tighten the screws of the drawer.
12. Hold the BTS 500, and carefully move the stage down to the measuring position. Refer to Figure 5.4.
13. Set the correct temperature on the BTS 500. Refer to the Anton Paar Instruction Manual BTS 150/500 Benchtop Heating Stages.
14. Select a measurement program from the drop-down list, or make a measurement program in the XRDMP Creator and import the measurement program in the Aeris. Refer to Section 4.6.2. Refer to the XRDMP Creator Help.

15. Start the measurement. Refer to the Aeris instrument suite Quick Start Guide.

    After the data is collected, you can see the measurement results on the touchscreen. If analysis programs are installed, you can see the Rietveld quantification results on the touchscreen.

    NOTE: For 2D measurements, the data preview is not shown on the touchscreen. Export the result to a PC. Refer to Section 4.6.1.

16. When the measurement is done, switch off the BTS 500 heater and wait for the stage to cool down before you remove the sample. Refer to the Anton Paar Instruction Manual BTS 150/500 Benchtop Heating Stages

5.2.1 Align the sample height

When you do this procedure, the precision between the sample loading position and the measuring position is ± 30 µm. If you want a higher precision, do the fine height adjustment. Refer to Section 5.2.2.

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button .
3. Press **Manual control**.
4. Press **Unlock cover**.
5. Make sure that the BTS 500 is switched off and that the current temperature of the stage is the same as the ambient temperature. Refer to the Anton Paar Instruction Manual BTS 150/500 Benchtop Heating Stages.
6. Hold the BTS 500, and carefully lift the stage to the sample loading position. The stage is automatically locked in this position.

Figure 5.1 *Anton Paar BTS 500 in the sample loading position*

7. Loosen the screws of the BTS 500 drawer.

Figure 5.2 *Loosen the screws of the drawer*

8. Open the drawer.
9. Put an empty BTS 500 sample holder on the sample table.

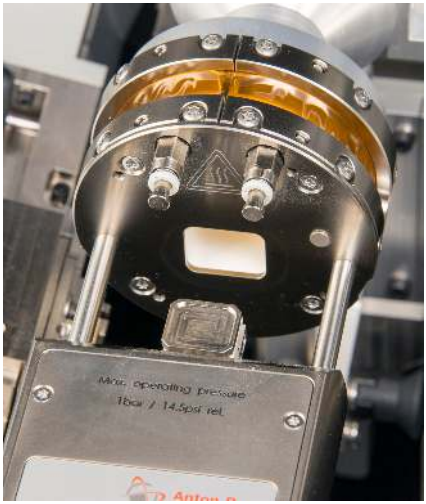
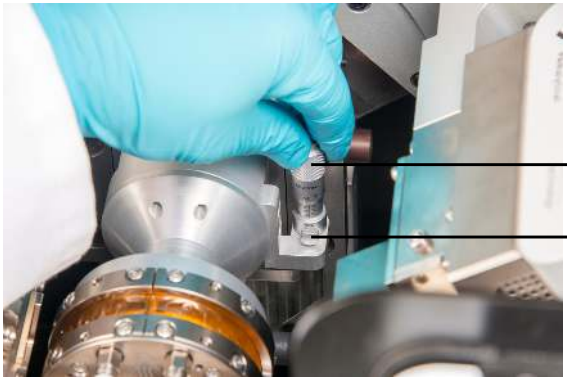


Figure 5.3 *Empty BTS 500 sample holder on the sample table*

10. Close the drawer.
11. Tighten the screws of the drawer.
12. Hold the BTS 500, and carefully move the stage down to the measuring position.

Figure 5.4 Anton Paar BTS 500 in the measuring position

13. If the micrometer screw is locked, turn the locking screw counter-clockwise to unlock the micrometer screw.



1.	Micrometer screw	2.	Locking screw

Figure 5.5 Micrometer screw and locking screw on the BTS 500

14. Turn the micrometer screw to move the stage to 6 mm. This is the initial position for the height adjustment.
15. Close the cover.
16. Do a short measurement to find the peak position of the Bragg reflection from a sample holder with the predefined measurement program **BTS height alignment** and the automatic analysis routine **BTS**. Refer to the Aeris instrument suite Quick Start Guide.
17. Write down the measured peak position.

18. Compare the measured peak position with the reference position.

Table 5.1 *Reference peak positions for the sample holders of the Anton Paar BTS 500*

	Nickel sample holder, 0.8 mm thick	Nickel sample holder, 0.2 mm thick	Nickel sample holder, flat	Ceramic sample holder
Reference position, °2θ	43.85 ± 0.02	44.32 ± 0.02	44.45 ± 0.02	42.72 ± 0.02

19. If the measured peak position is the same as the reference position, turn the locking screw clockwise to lock the micrometer screw.
20. If the measured peak position is not the same as the reference position, do as follows:
    a. If the measured peak position is below the reference position, turn the micrometer screw clockwise to move the stage up.
    b. If the measured peak position is above the reference position, turn the micrometer screw counter-clockwise to move the stage down.
    c. Do steps 16 to 19 again until the measured peak position is the same as the reference position.
21. Record the height adjustment of the BTS 500 for future reference.

5.2.2 Fine height adjustment

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Manual control**.
4. Press **Unlock cover**.
5. Make sure that there is no sample holder on the sample table in the BTS 500.
6. Hold the BTS 500, and carefully move the stage down to the measuring position. Refer to Figure 5.4.
7. If the micrometer screw is locked, turn the locking screw counter-clockwise to unlock the micrometer screw. Refer to Figure 5.5.
8. Turn the micrometer screw to move the stage to 7 mm.
9. Press the Menu button  .
10. Press **Minimize**.
11. Start **IMS Client**.
12. Wait for the client to connect.

13. Go to **Scenarios > Run**.
14. Select **Stage height alignment**.
15. Press **Open**.
16. Follow the instructions on the screen to change the instrument configuration.
17. Close the cover.
18. Press **Start measurement**.
19. When the measurement is done, press **Reset maximum to actual**. The **Full beam intensity (cnts)** is used as a reference intensity for the stage height alignment.
20. Press **Unlock cover**.
21. Open the cover.
22. Turn the micrometer screw to move the stage to 6 mm.
23. Close the cover.
24. Press **Start measurement**.
25. If the **Actual intensity (cnts)** is 50 ± 5 % of the **Full beam intensity**, turn the locking screw clockwise to lock the micrometer screw.
26. If the **Actual intensity** is not 50 ± 5 % of the **Full beam intensity**, do as follows:
    a. If the **Actual intensity** is less than 50 ± 5 % of the **Full beam intensity**, turn the micrometer screw counter-clockwise to move the stage down.
    b. If the **Actual intensity** is more than 50 ± 5 % of the **Full beam intensity**, turn the micrometer screw clockwise to move the stage up.
    c. Do steps 25 and 26 again until the **Actual intensity** is 50 ± 5 % of **Full beam intensity**.
27. Remove the beam attenuator Cu 0.2 mm from the fixed divergence slit before you continue with a measurement.

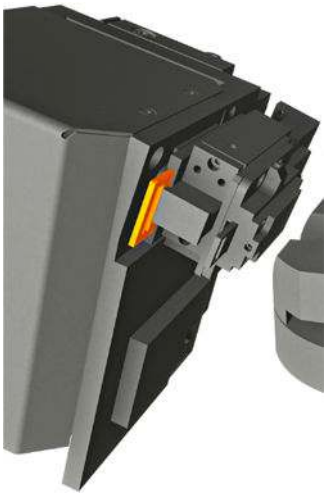


Figure 5.6 *Location of the beam attenuator*

CHAPTER 6 USER MAINTENANCE

6.1 Introduction

Follow the safety precautions of this User Guide when you do any of these procedures. Refer to Chapter 2.

WARNING - General Hazard

If the system is in an unsafe condition and you go to a different room, do as follows:

Disconnect the system from the mains power supply.

Put a warning notice on the instrument.

Remove the HT key.

To make sure that the system operates satisfactorily, the user must do some preventive maintenance procedures at specified intervals.

Table 6.1 *Maintenance schedule*

Maintenance procedure	Maintenance interval	Reference
Test of the safety integrity	1 month	Refer to Section 6.2.
Clean the instrument	3 months	Refer to Section 6.3.
Clean the sample loader and spinner	When necessary	Refer to Section 6.4.
Clean the sample changer	Not necessary in a standard environment or 3 months in a dusty environment	Refer to Section 6.5.
Examine the coolant level	2 weeks	Refer to Section 6.7.
Fill the cooling system	When necessary	Refer to Section 6.8.
Replace the dust filters	When necessary in a standard environment or 3 months in a dusty environment	Refer to Section 6.9.
Do a test of the X-ray tube switch	1 year	Refer to Section 6.10.
Set the fine calibration offset	When necessary	Refer to Section 6.11.

6.2 Test of the safety integrity

This test is necessary to make sure that the HT keyswitch and safety loops work correctly and to move the related switches.

1. Make sure that the instrument and HT generator are switched on.
2. Turn the HT keyswitch counter-clockwise to switch off the HT generator.
3. After 5 seconds, turn the HT keyswitch clockwise to switch on the HT.

6.3 Clean the instrument

1. Clean the outer side of the instrument with a moist cloth.
2. Clean the inner side of the instrument with a clean dry brush or with a vacuum cleaner.

6.4 Clean the sample loader and spinner

1. Remove the dust from the sample loader and spinner with a small vacuum cleaner.

6.5 Clean the sample changer

NOTE: This procedure is only necessary for instruments with a sample changer that are installed in a dusty environment.

1. Press the Power button to switch off the instrument.
2. Remove the dust cover from the sample changer.
3. Clean the sample changer with a vacuum cleaner.
4. Examine the gripper for possible wear.
5. With a Torx T10 screwdriver, remove the 6 screws from the top and bottom of the front panel.

Figure 6.1 *Location of the screws*

6. Remove the front panel of the sample changer.
7. Clean the inside of the sample changer with a vacuum cleaner.
8. Install the front panel of the sample changer with the 6 screws.
9. Put the dust cover on the sample changer.

6.6 Remove the panels

1. Put your hand in the recess on the panel and pull the panel away from the instrument.

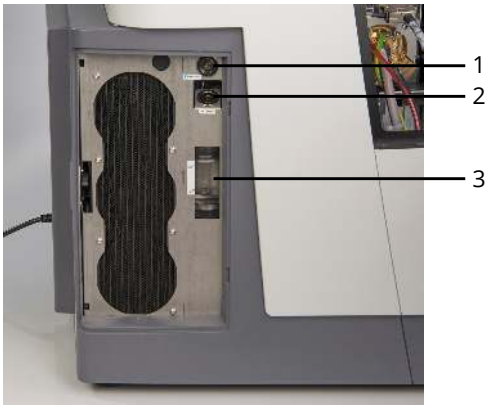
Figure 6.2 *Remove the panel*

6.7 Examine the coolant level

1. Remove the left panel. Refer to Section 6.6.
2. Examine the level of the coolant in the coolant reservoir. Refer to Figure 6.3.
3. If the level of the coolant is below the **HIGH** mark, fill the cooling system. Refer to Section 6.8.

6.8 Fill the cooling system

The cooling system is a closed-loop system that uses a glycol mixture to cool the anode of the X-ray tube.



1.	Vent plug	3.	Coolant reservoir
2.	Fill plug		

Figure 6.3 *Cooling system*

1. Remove the left panel. Refer to Section 6.6.
2. Remove the vent plug from the air vent with a 6 mm Allen key.

Figure 6.4 *Vent plug*

3. Remove the fill plug from the filler opening with a 6 mm Allen key.

Figure 6.5 *Fill plug*

4. Fill the coolant reservoir with **demineralized water** up to the **HIGH** mark.

   NOTE: The coolant reservoir is only filled with the glycol mixture during installation.

Figure 6.6 *Fill the coolant reservoir*

5. Install the fill plug and vent plug.
6. Install the left panel.

6.9 Replace the dust filters

1. Press the Power button to switch off the instrument.
2. Remove the right panel. Refer to Section 6.6.
3. Remove the dust filters.

Figure 6.7 *Remove the dust filters*

4. Install the new dust filters.
5. Install the right panel.
6. Press the Power button to switch on the instrument.

6.10 Do a test of the X-ray tube switch

A test tool is necessary to do this test. Refer to Figure 6.8.

We recommend that you make an annual test report. If the safety switch test fails, please contact your local Malvern Panalytical representative.

Figure 6.8 *Test tool*

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button .
3. Press **Minimize**.
4. Start **IMS Client**.
5. Wait for the client to connect.
6. Go to **Scenarios > Run**.
7. Select **X-ray tube switch test**.
8. Press **Open**.
9. Press **Prepare the instrument**.
10. Follow the instructions on the screen. Make sure that you put the test tool in the correct position. Refer to Figure 6.9.

    If the position of the X-ray tube is too low to insert the test tool, manually lift the X-ray tube and insert the test tool. We recommend that you do this with 2 persons.

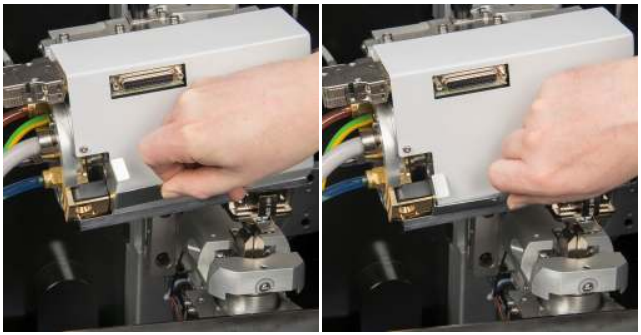


Figure 6.9 *Put the test tool behind the X-ray tube switch*

6.11 Set the fine calibration offset

This procedure is only necessary if the measured angles are not the same as the theoretical angles. When you do this procedure, the 2θ-angle and ω-angle are set to a new position.

1. Go to Advanced mode. Refer to Section 4.4.
2. Press the Menu button  .
3. Press **Minimize**.
4. Start **IMS Client**.
5. Wait for the client to connect.
6. Go to **Scenarios > Run**.
7. Select **Goniometer - Axes fine calibration offset**.
8. Press **Open**.
9. Follow the instructions on the screen.

6.12 Consumable materials

Table 6.2 *Consumable materials for maintenance*

Quantity	Description	Ordering code
1	Multipurpose oil	5322 734 00009
2	Dust filters	5332 000 02021

CHAPTER 7 TROUBLESHOOTING

7.1 Introduction

This chapter gives the most common problems with the system and their solutions.

If a problem is not in this chapter, or if the solution did not remove it, collect all relevant information about the problem and contact your local Malvern Panalytical service organization.

If possible, a Malvern Panalytical service engineer uses remote support to find a solution for the problem. During a remote support session, your aid can be necessary. If a remote support session did not remove the problem, a service visit can be necessary.

7.2 Instrument does not switch on

Table 7.1 *Possible causes for instrument does not switch on*

Cause	Solution	Reference
The instrument is not switched on.	Switch on the instrument.	Refer to Section 4.2.
A fuse has blown.	Contact your local Malvern Panalytical service organization.	

7.3 HT generator does not switch on

If the HT generator does not switch on, there is usually a problem in the safety circuit.

Table 7.2 Possible causes for HT generator does not switch on

Cause	Solution	Reference
HT keyswitch is in the OFF position.	Turn the HT keyswitch clockwise.	Refer to Section 3.4.3.2.
A fuse has blown.	Contact your local Malvern Panalytical service organization.	
Someone tried to open the cover of the radiation enclosure when the shutter on the tube housing was open.	Open the cover, close it correctly, reset Xsafe, and then switch the HT generator on again.	Refer to Section 7.4.2.
The coolant flow stopped during a measurement, or the coolant flow is less than 0.6 L/min.	1. Make sure that there is enough coolant in the reservoir. 2. Make sure that the hoses are not compressed and do not have kinks.	Refer to Section 6.8.
1 or more of the X-RAYS ON lamps is defective: • 1 or more of the X-RAYS ON lamps on the corners of the instrument. • 1 or more of the X-RAYS ON lamps on the inside of the cover of the instrument. • External X-RAYS ON lamp.	 Contact your local Malvern Panalytical service organization. Contact your local Malvern Panalytical service organization. Contact your local Radiation Safety Officer.	
The X-ray tube is defective. It shows flashes during the start-up procedure or its filament is broken.	Contact your local Malvern Panalytical service organization.	

7.3.1 Reset Xsafe or the motion safety system

When the Xsafe system or the motion safety system is activated, do as follows:

1. Make sure that the cover is closed.
2. Turn the HT keyswitch counter-clockwise to switch off the HT generator.
3. Turn the HT keyswitch clockwise to switch on the HT generator.

7.4 Shutter does not open

The shutter on the tube housing closes automatically if the safety circuits are not closed correctly.

Table 7.3 Possible causes for shutter does not open

Cause	Solution	Reference
HT generator does not switch on.		Refer to Section 7.3.
Cover lock does not lock.	Open the cover, close it correctly.	Refer to Section 7.4.1.
Cover is not closed correctly.	Open the cover, close it correctly.	Refer to Section 7.4.2.

7.4.1 Cover lock does not lock

When the software sends a command to open the shutter, the system automatically locks the cover by magnetic cover locks. These cover locks make sure that you cannot open the shutter when the cover is open. Microswitches monitor the operation of the magnetic cover locks to make sure that the system is safe.

If a cover lock does not lock correctly, the microswitch monitors this. The shutter will not open and a message is sent to the software.

Correct this as follows:

1. Open the cover.
2. Close the cover correctly.

7.4.2 Cover is not closed correctly

If a person tries to open the cover when the shutter is open, one or more of the microswitches in the safety loop monitors this. This causes the HT generator to switch off automatically.

Correct this as follows:

1. Open the cover.
2. Close the cover correctly.
3. Reset Xsafe. Refer to Section 7.3.1.

CHAPTER 8 DISPOSAL INSTRUCTIONS

8.1 WEEE Directive

The instrument complies with the WEEE Directive (Waste of Electrical and Electronic Equipment), identified by this alert symbol on the instrument:

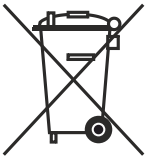


Figure 8.1 *WEEE directive alert symbol*

The function of the European WEEE Directive is to decrease the quantity of waste from electrical and electronic equipment, and to decrease the hazardous substances of this waste to protect human health and the environment.

8.2 Hazardous substances

When you dispose of hazardous materials, obey all applicable and local regulations to prevent damage to the environment. You can also send the hazardous materials back to Malvern Panalytical for disposal. Use a recorded shipping method.

On the instrument, the hazardous materials are identified with a label. Refer to Figure 2.1.

If you are not sure about the correct disposal procedure, contact your local Malvern Panalytical representative.

8.2.1 Beryllium

Some items in the instrument contain **beryllium (Be)**.

WARNING - Toxic Material

Beryllium is poisonous. Do not touch or breathe in beryllium.

For more information, refer to the toxic material section in the Safety chapter.

Refer to the Safety Data Sheet for the disposal procedure: (https://uqr.to/epa4).

8.2.2 X-ray tube

The windows of the Empyrean tubes contain **beryllium (Be)**.

For disposal instructions, refer to the Tube Instruction Manual supplied with the X-ray tube.

Figure 8.2 *Empyrean tube - beryllium window*

8.2.3 Detector

The windows of the PIXcel detectors (PIXcel^{3D}, PIXcel^{1D}) contain **beryllium (Be)**.

Figure 8.3 *PIXcel^{3D} detector - beryllium window*

Figure 8.4 *PIXcel^{1D} detector - beryllium window*

INDEX