

# myOSL4000 4-Element OSL Automation



**Operating instructions**



Freiberg Instruments



# Imprint



Freiberg Instruments

## **Manufacturer:**

Freiberg Instruments GmbH  
Delfter Straße 6  
09599 Freiberg  
Email:  
support@freiberginstruments.com



## **Editing and design:**

Ingenieurbüro Hannweber GmbH  
Bertolt-Brecht-Allee 24  
01309 Dresden E-Mail: info@ib-hannweber.de

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The original operating instructions are not subject to the manufacturer's modification service.

This original instruction manual is part of the technical documentation of the machine in accordance with the Machinery Directive 2006/42/EC, Annex VII Part A and has been prepared based on EN ISO 20607:2019.

# Revision history

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# 1 Allgemeines

## 1.1 Handling of the operating instructions



These operating instructions are part of the technical documentation of the machine. It contains the necessary information for use as well as warnings about existing residual risks.

**Randbemerkung** Additional information such as documents or further chapters is referred to in marginal **remarks**.

**Sketches**  
**Drawings** The sketches and drawings contained are not scaled. Further technical information is attached in the Annex.

The following requirements apply to the handling of the operating instructions:

- Keep the owner's manual accessible to all users.
- Keep the operating instructions in full and legible condition at all stages of the machine's life.
- Read and understand the operating instructions before working with the machine for the first time.
- Consult the operating instructions whenever there are uncertainties when handling the machine.
- Contact the manufacturer if you notice any discrepancies or are unclear when reading the owner's manual.

## 1.2 Target groups

If hints are intended for only one target group, the target group is indicated as a marginal remark.

The operating instructions are written for the following target groups:

**User** All persons who handle the machine, regardless of their respective qualifications or the type of application.

**Operator** An operator is responsible for the protection of employees at work and the prevention of accidents in accordance with the requirements of the laws, regulations and accident prevention regulations of the employers' liability insurance associations.

**Assistant** An assistant

- carries out simple work on the machine under the constant supervision of operators or specialists.
- must be familiarized by the supervisor with the residual risks in the planned work area and the correct behavior.
- may not be used on the machinery until it has understood the content of the instructions and the instructions for safe working and is able to comply with applicable specifications.

**Operator** One operator

- can operate the machine safely after a briefing.
- must be supervised by a supervisor who carries out regular instruction and checks and is available in the event of extraordinary incidents.
- must be able to read the general part of the instructions and understand the contents.

**Specialist** A specialist

- has professional training and sufficient experience to independently carry out complicated or residual risk work.
- must be able to correctly assess upcoming work with regard to feasibility, risks and hazards as well as the necessary aids. She has to understand complex plans and descriptions and obtain missing, required detailed information.
- requires a supervisor to assist them in procuring the necessary technical aids. It must be able to check the intended condition of an installation and, if necessary, restore it.
- may also be a person qualified for examination according to TRBS 1203. This specialist fulfils special requirements for the testing of certain hazards with regard to electrical, explosions, pressure, etc.

For work on the electrical equipment, only electricians according to DGUV regulation 3 may be used.

### 1.3 Warnings

Warnings draw attention to residual risks when using the machine and guide you on how to avoid them.

Warnings are presented as follows:



#### **DANGER**

##### **Nature and source of the hazard**

Consequences of disregarding the danger

This warning refers to a hazard with a high degree of risk which, if not avoided, will result in death or serious injury.

- ▶ Escape/Measures to ward off danger
- ▶ further measure



#### **WARNING**

##### **Nature and source of the hazard**

Consequences of disregarding the danger

This warning refers to a hazard with a medium level of risk which, if not avoided, may result in death or serious injury.

- ▶ Escape/Measures to ward off danger
- ▶ further measure



#### **CAUTION**

##### **Nature and source of the hazard**

Consequences of disregarding the danger

This warning refers to a hazard with a low risk level which, if not avoided, will result in a minor or moderate injury.

- ▶ Escape/Measures to ward off danger
- ▶ further measure

## 1.4 Enumerations and sequences

Action steps to be performed are displayed as a numbered list. The sequence of steps must be followed.

1. Step 1
2. Step 2
  - ▶ Reaction/consequence of an operating action

Result of an operating action

Enumerations without mandatory order are presented as a list of bullet points, e.B. in the case of safety instructions:

- Point 1
- Point 2

## 1.5 Identification of the machine

Name of the machine:	myOSL4000
Function:	Evaluation of dosimeters and extinguishing of radiant energy
Type:	4-element automation
Year of construction:	2020
Manufacturer:	Freiberg Instruments GmbH
Address:	Delfter Straße 6 09599 Freiberg
Telephone:	03731 419540
Email:	support@freiberginstruments.com
Website:	www.freiberginstruments.com

# 2 Safety

## 2.1 Intended use



Please note all the following notes.

The machine was designed and built to evaluate dosimeters and, if necessary, to extinguish the stored radiant energy.

The machine is fed with the dosimeters in magazines manually by the operator via the door for feeding. After starting by the operator, the dosimeters are processed fully automatically according to the recipe specifications.

Optically stimulated luminescence (OSL) measurements in applications such as: radiation protection, medical dosimetry, experimental physics, environmental research, personal dosimetry. The machine may only be operated with blue LEDs in the wavelength range of 480 nm. The myOSL4000 must be connected as intended in accordance with the operating instructions.

In addition to its intended use, the design and manufacture of the machine also took into account reasonably foreseeable **misuses**.

If, after the EC declaration of conformity has been drawn up, changes are made to the machinery, the manufacturer shall not be liable for the consequences of accidents and for damage which can be attributed to those changes, unless such changes have been authorised by the manufacturer or carried out himself.

The use of the machine is only permitted in the commercial sector.

## 2.2 Prohibited use



Please note that any deviation from the intended use can cause hazards.

In the design of the machine, only the intended use was taken into account. All protective measures are designed in such a way that the risks arising are reduced according to the current state of the art.

In particular, the following is not provided for and is therefore inadmissible:

- Use with LEDs other than those intended
- Use of the machine with more than 10 magazines
- Feeding the machine with dosimeters or magazines other than those intended.
- Operation of the machine in a defective or damaged condition.
- Intervention in the hazardous areas of the machine.
- Operation of the machinery without the intended protective devices.
- Operation of the machine with bridged or manipulated control parts.

- Operation of the machine without prior knowledge of the operating instructions.
- Operation of the machine in a potentially explosive atmosphere.
- Operation of the machine with open control cabinet.
- Use of the machinery or equipment as an ascent aid.

### 2.3 Restrisiken

The machine was built according to the state of the art and according to recognized safety-related rules. Nevertheless, hazards can arise during use.

Residual risks for specific work are listed in the respective chapter.



#### **DANGER**

##### **Danger to life due to electrical voltage**

Due to the contact with live parts, there is the possibility of an electric shock.

- ▶ The device and the associated connection cables must be checked regularly and demonstrably.
- ▶ Any visible damage to the electrical equipment must be repaired immediately by a qualified specialist.
- ▶ Work on the electrical equipment of the device or the associated measurement setup may only be carried out by authorized and specially qualified specialists.



#### **DANGER**

##### **Risk of injury due to unexpected start-up**

Unexpected start-up can lead to serious danger for people who are in hazardous areas of the machine.

- ▶ Acknowledgement buttons may only be operated when the operator has convinced himself of a secure danger area.



**CAUTION**

**Risk of injury due to slipping, tripping and falling**

Cables or wires of the media supply can cause tripping hazards.

- ▶ Cable and media lines must be laid in such a way that there is no impairment of the operating and transport routes.

2.4 Sicherheitskennzeichnungen



The safety markings must be kept in a complete and legible condition for the entire service life of the machinery.

Explanation

Anbringungsort

Warning of electrical voltage

electrical equipment



Even when the main switch is switched off under voltage

electrical equipment

Warning against optical radiation

LEDHousing/ Reader



2.5 Personal protective equipment

No personal protective equipment is required for normal operation of the machine.

## 2.6 Not-Halt-Befehlsgerät



In the event of hazardous situations or malfunctions of safety-relevant components, you must immediately stop the machine by triggering the emergency stop command device.

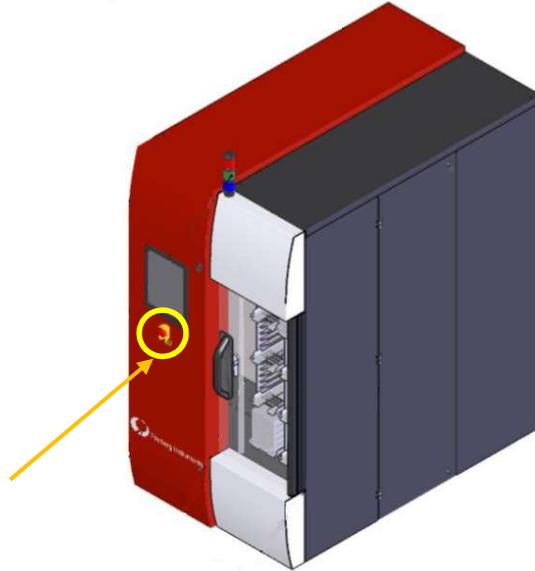


Figure 1- Location des Emergency Stop Command Devices

After the Emergency Hal command device is triggered, behave as follows:

1. Inform your supervisor.
2. The supervisor commissions a specialist to determine the defect or defect.
3. If the specialist detects hazards or unclear operating conditions caused by the triggering of the emergency stop command device, these must be eliminated professionally.
  - ▶ Document any defects or defects found.
  - ▶ Document all maintenance measures.
4. The specialist shall restore the intended condition.

The machine can be operated again.

## 2.7 Behaviour in the event of disturbances



The safety functions of the machinery must be regularly checked for their intended function.

In case of malfunctions, behave as follows:

### Chapter 2.6

1. Immediately operate the emergency stop command devices.
2. Inform your supervisor.
3. Do not release the machine for operation until the fault has been professionally eliminated and the intended condition of the machine has been restored.

You may eliminate faults independently and then continue operations if:

- no hazards can arise,
- it is not necessary to override protective devices,
- no safety instructions are disregarded,
- the operating mode is not changed.

Disturbances to be eliminated independently are:

- Materialstau,
- fallen parts.

2.8 Protective devices

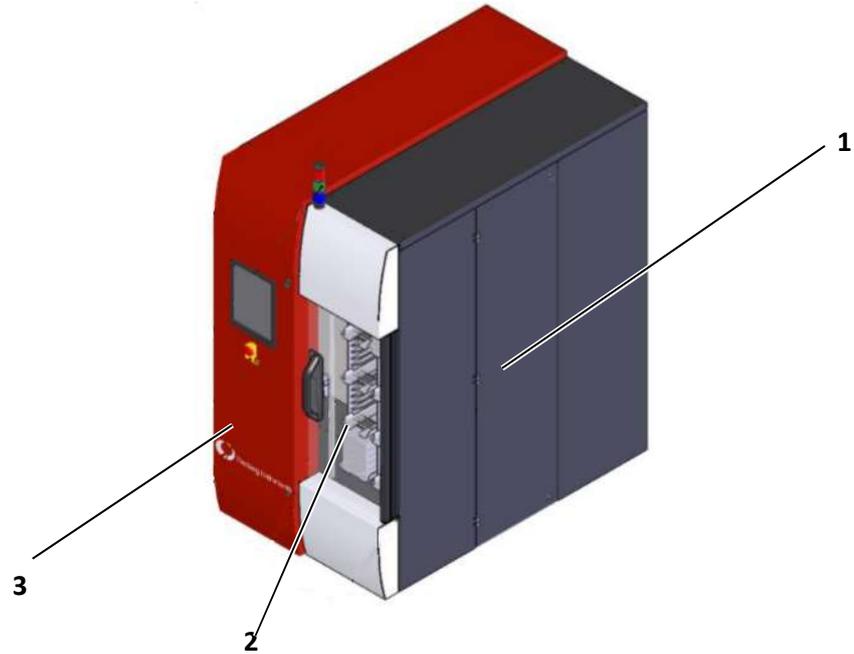


Figure 2: Location of the guards

Pos.	Description
1	Access doors (on both sides with security sensor)
2	Operator door made of safety glass with interlock and safety sensor
3	Housing made of sheet steel

2.9 Security

Safety functions are machine functions whose failure leads to an unacceptable risk to the safety and health of persons.

**CalculationSecurity Functions**

In order to ensure the quality requirements of these functions, the EN ISO 13849-1 standard was used in the design. In the accompanying document calculation of safety functions, the achieved quality is proven.

Safety functions must be regularly checked for their intended function. In the event of malfunctions, the machine must be immediately taken out of operation by operating the emergency stop control devices.

The machinery may not be released for operation again until a specialist:

- eliminates the malfunction and
- has then restored the intended state.

## 2.10 Instruction of users



For each activity on the machine, you need the necessary qualifications as well as instruction.

Unauthorized persons may only enter the protected area of the machine if accompanied by a specialist.

Before working on the machine for the first time, the following points must be observed:

- Each user must be instructed with the help of the safety-relevant information from the operating instructions.
- The instruction must take place regularly, at least annually.

Areas of responsibility and responsibilities of users must be clearly defined.

The training of users must contain the following safety information:

- safe handling of the machine
- existing residual risks based on the warnings
- basic rules on occupational safety and accident prevention
- Protective measures and safety and health marking
- Warneinrichtungen
- Escape and rescue routes
- Application of protective devices
- prohibited intervention in the hazardous areas of the machine
- Correct behaviour in hazardous situations

If you have any questions or problems that cannot be clarified during the instruction or individual life phases of the machine, please contact the manufacturer.

## 2.11 Notes for operators



For necessary work involving residual risks and for the procedure in the event of accidents, an operating instruction must be drawn up and placed in an easily accessible place on the machinery.



Due to operator-specific circumstances, additional hazards may arise, which must be checked by the operator's risk assessment.

**Operator** Appropriate means of assistance and security must be provided and used to carry out the necessary work.

The operator is obliged to provide users with the necessary personal protective equipment in its intended condition. The correct use of personal protective equipment must be regularly checked by the responsible superiors.

**Safety Data Sheets** Safety data sheets shall be provided for the materials and consumables used on the machine.

**10.4** Specialists also need the relevant documents with further information about the machine. These documents must be accessible at all times.

**ASR A2.2  
Measures against  
fires** Means of firefighting must be available in sufficient quantities. Fire extinguishers or extinguishing agents are assigned by the manufacturer to one or more fire classes according to suitability.

# 3 Description of the machine

## 3.1 Construction

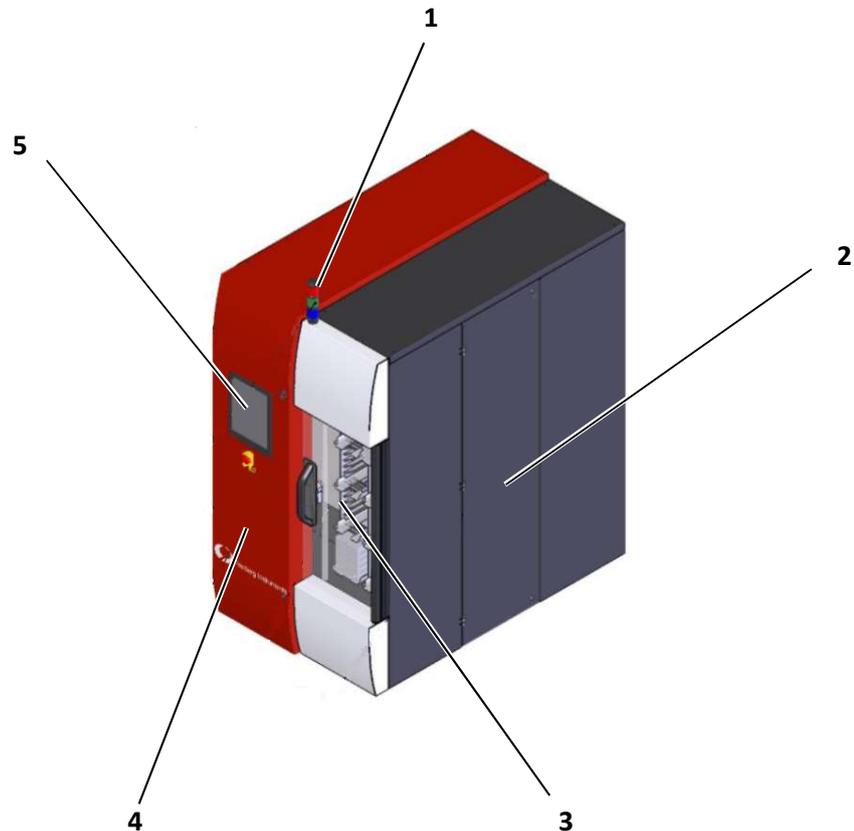


Figure 3: Construction **error! Reference source could not be found.**

Pos.	Description
1	Signalleuchte
2	Zugangstür Readerseite
3	Access door for loading with rear box shelf
4	Schaltschrankzugang
5	User interface
-	two 4-element OSL readers (not shown)
-	Spindle drive magazine and dosimeter transport (not shown)
-	Adjustable machine feet, transport rollers (not shown)
-	Access door magazine page (not shown)

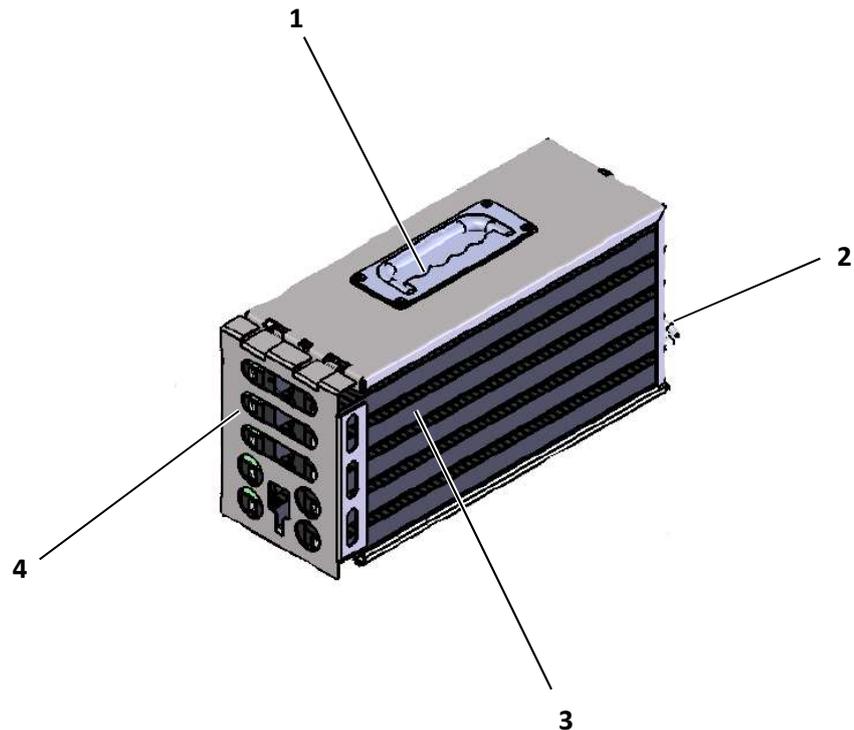


Figure 4: Structure of a magazine

Pos.	Description
1	Klappgriff
2	Handle
3	10 magazines with 50 dosimeters each
4	removable front protection

### 3.2 Description

The machine is used to stimulate optically stimulated luminescence and to analyze the radiation emitted. Among other things, suitable dosimeters can be brought to luminesce in order to infer by analyzing the light on the amount of radioactive radiation that was exposed to the dosimeter.

The myOSL4000 is a machine that can evaluate many dosimeters in a short time.

The dosimeters to be tested are inserted into the machine in magazines with 50 dosimeters each. The feeding of the dosimeters to the measuring devices is automated. With the help of the control, the process is started automatically according to recipe specifications. Empty magazines are provided for ejection of the dosimeters. The doors are operated via the user interface, the machine statuses are displayed and the machine is started.

The sorting takes place in two separate magazines. After completion of the measurement, the magazine is pushed out with the dosimeters and can be removed.

### 3.3 Operating and display devices

#### 3.3.1 Overview

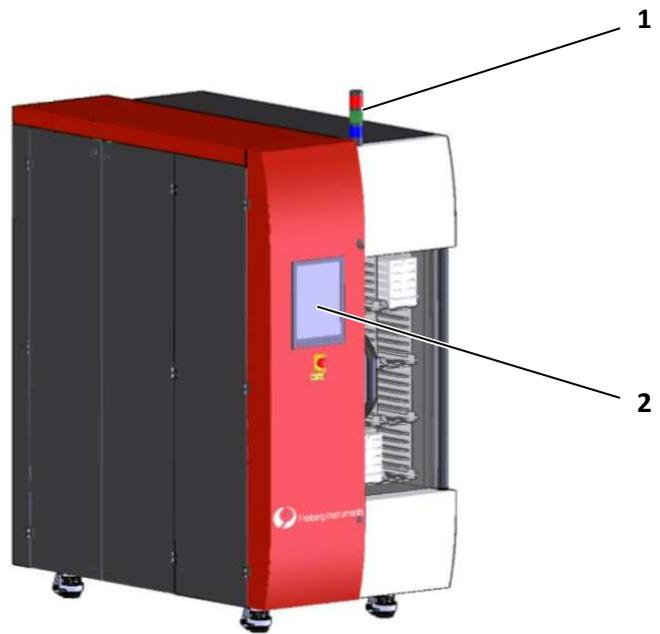


Figure 5- Control and display device

Pos.	Bedien-/Anzeigeeinrichtung	Function
1	Signalleuchte	Display of the machine status
2	User interface	Status indicators and service mode

3.3.2 Lampenturm

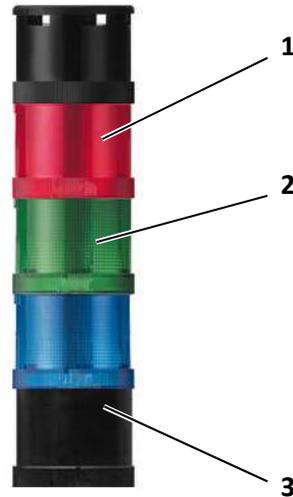


Figure 6: Lamp tower

Pos.	Colour	Description
1	Red	There is a malfunction, the machine is not in a working condition.
2	Green	Normal operation - The machine is in the operational state.
3	Blue	Signals the measurement.

3.4 Modes



Only specialists are allowed to change the operating modes of the machine.

**Assistant Operator**

Assistants or operators may use the machine in the following operating modes:

- Automatic

**Specialist**

All other operating modes may only be used by specialists.

Mode	Work	Exporting
Automatic	Inserting/removing the magazines	Assistant
Einrichtbetrieb	Einrichtarbeiten	Specialist (setter)
Maintenance operation	Maintenance work	Specialist (Maintenance Technician)



# 4 Specifications

## 4.1 Metrics

Length:	1.746 mm
Width:	1.053 mm
Height:	2.045 mm

## 4.2 Anschlusswerte

Mains connection:	110 V AC/230 V AC
Control voltage:	50/60 Hz
Vorsicherung:	16 A

## 4.3 Ambient conditions

The machine is only used in an environment with the following conditions:

Einsatztemperaturbereich:	15 to 30 °C
Humidity:	10 to 60%, non-condensing

The machine is intended for use in a closed building.

### 4.3.1 Arbeitsplatzbeleuchtung

#### ASR A3.4Lighting

The machine does not have its own lighting equipment. The operator must ensure adequate workplace lighting, the following principles:

Workspace	Illuminance
Traffic areas and corridors with vehicle traffic	150 lx
Insertion/removal of magazines	300 lx
Write, read, data processing	500 lx

### 4.3.2 Luftschallemission

With regard to airborne noise emission, observe the following limit values:

A-weighted emission sound pressure level (idle)	<80 dB(A)
---	-----------

If an average noise level > 85 dB(A) occurs throughout the room due to the interaction of several machines and systems, the workplace must be marked as a noise area.
---

## 4.4 Interfaces to the operator



Possible hazards at the interfaces between the machine, the entire plant and the working environment must be considered by the operator as part of a risk assessment.



The main circuits of the machine do not have their own overcurrent protection devices. The machine may only be connected via the mains plug to a power supply with sufficient fuse, which switches off the voltage in the event of a fault.

**IN 60204-1:2018** The operator must professionally integrate the electrical equipment into the electrical equipment of the entire system in accordance with EN 60204-1:2018.

The connection of the equipment to the operator network and its control system must comply with the specifications of the equipment manufacturers and the plant manufacturer.

**Chapter 10.4** Please note the technical documentation of the machine and the technical data of the electrical equipment included in the scope of delivery.

Furthermore, the following are regarded as interfaces to the operator's necessary transports and equipment:

- Chapter 4.3.1** • Sufficient workplace lighting
- Chapter 4.2** • Electrical supply with sufficient protection
- Feeding and returning of magazines

# 5 Transport and storage

## 5.1 Transport



Suitable specialists must be commissioned to transport the machine.



### WARNING

#### Risk of injury due to loss of stability

The machine may slip, tilt or fall during transport or after parking.

- ▶ Use only the appropriate means of transport and means of transport for the available loads.
- ▶ When picking up the load, use the designated anchor points.
- ▶ Pay attention to the center of gravity.
- ▶ Secure machine parts against tipping during transport and after parking.

The machine is a fixed system. During the intended use, their relocation is neither necessary nor intended.

If it is necessary to replace components or to move the machine or partial machines, observe the applicable safety and accident prevention regulations when transporting machines.

**Storage** It is not intended to store the machine or individual assemblies.

**Chapter 10.4** If you have to remove partial machines from the machine due to changes in the process flow and temporarily store them, please note the information in the operating instructions of the respective manufacturer.

# 6 Installation and commissioning

## 6.1 List

The following points must be observed:

- Recording of the machine on the intended anchor points and the center of gravity.
- Setting up the machine on a sufficiently load-bearing and horizontal levelled foundation.
- Secure the machine against tipping after installation.

You can proceed with the removal of the transport fuses.

## 6.2 Removal of transport fuses

The machine contains transport fuses that must be removed before commissioning.

- The fuse in the box rule (Figure 7) must be removed by Allen key

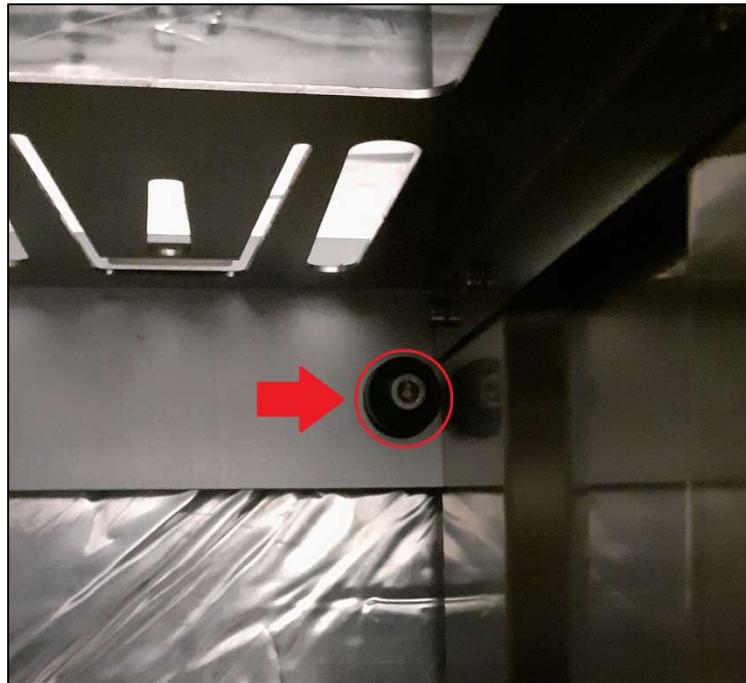


Figure 7: Fuse Box Shelf

- The plasticization of the indexers (Figure 8) shall be removed by hand.

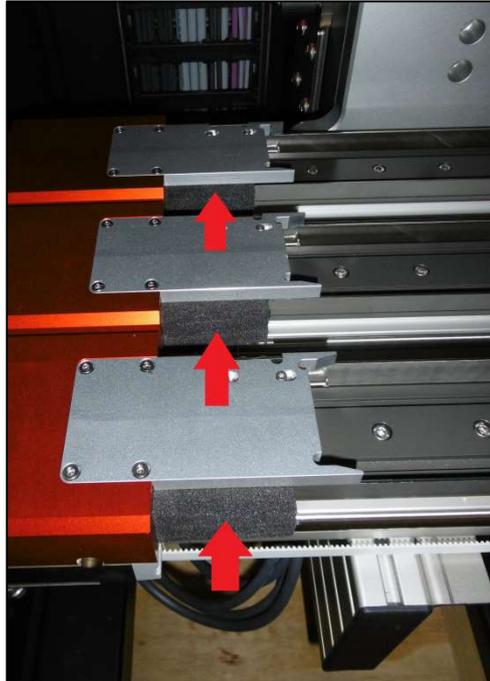


Figure 8: Backup Indexer

- The black locking lever of the Z-axis (Figure 9) must be opened (but not removed) by hand from both sides.



Figure 9- Fuse Z-Axis

You can now prepare the machine for commissioning.

### 6.3 Commissioning



Before the first commissioning, the machine is set up and connected by specialists from the manufacturer.

Put the machine into operation as follows:

1. Before the first start-up, check whether all tools and external parts have been removed from the machine.
2. Activate all safety and protective devices.
  - ▶ Check their functionality.
3. Connect all media lines (electrical) according to the existing circuit diagrams.

You can now put the machine into operation.

#### 6.3.1 Network configuration of the included devices

The network configuration of all devices contained in the machine is already configured correctly during the initial commissioning. This can only be checked in the event of a malfunction.

Device	Function	Parameter	Value
Automation Board	IP Automat	Connection String	172.29.59.x*:10001
4-Element device 1	IP Reader 1	Connection String	172.29.62.x*:10001
4-Element device 2	IP Reader 2	Connection String	172.29.62.x*:10001
Code reader	Barcode	HOW port	COM3
Safety Control	MUSH-ROOM	Connection String	172.29.59.10x*:502
IPC	Internal Industrial PC	IP address	172.29.59.20x*
		Subnet	255.255.0.0
		Standardgateway	172.29.1.1

\* This value corresponds to the last digit of the respective module serial number (to be found on the type plate sticker) and is individual for each machine.

#### 6.3.2 Network configuration of an external IPC

In order for an external computer (IPC) to communicate with the machine through the internal IPC, the external IPC must receive a static IP address in the range 172.29.0.1 - 172.29.255.254. If it is integrated into a company network, it is recommended to implement the connection via a 2nd Ethernet adapter in order to physically separate the company network and the internal machine network.

# 7 Operation of the machine

## 7.1 Safety instructions for operators



In hazardous situations and in the event of malfunctions of safety-relevant components, the machine must be stopped immediately by triggering an emergency stop command device.

The operator must check the intended condition of the machinery before starting the work.

**Chapter 2.8** The machinery may only be operated if all protective devices are fully present, checked and functional.

## 7.2 Turn the machine on and off



Before starting the machine, make sure that hazards from machine movements or process-related malfunctions are excluded.

Before each machine is switched on, carry out a visual inspection for the intended condition of the machine. Control:

**Chapter 2.6** • Not-Halt-Befehlsgerät

**Chapter 2.8** • Protective devices

If you notice defects in the machine, inform the manufacturer.

- Have the defect remedied professionally.
- Document the maintenance measures.

**Turn on** Turn on the machine as follows:

1. Plug the machine into the power supply.
2. Press the main switch.

**Switch off** Turn off the machine as follows:

1. Press the main switch.
2. Remove the machine from the power supply.

## 7.3 Bedienschritte



Clean the machine at regular intervals, depending on the degree of contamination, in accordance with Chapter 7.4.

### 7.3.1 Automated feeding of the dosimeters

1. Request a door opening via the control panel.
2. Open the security door.
3. Place the boxes to be processed, the magazines filled with the dosimeters, as well as a box with empty magazines, in the box shelf provided for this purpose and close the security door.
  - ▶ The machine scans the box shelf to determine the occupancy of boxes/magazines. The barcode of the boxes is read in at the same time.
4. Using the external control software or the panel, enter the type of box to be processed and the measurement sequences.
  - ▶ The speaker shelf moves to the 1st magazine position to read the data matrix code.
  - ▶ The magazine-Datamatrixcode is read in.
  - ▶ The pull-out mechanism pulls the magazine out of the box and brings it into the removal position for the first dosimeters to be processed.
  - ▶ The lifting mechanism lifts the dosimeter out of the magazine.
  - ▶ The feed mechanism of the readers transfers the dosimeters into the measuring device.
  - ▶ The data matrix code of the dosimeter envelope is read in.
  - ▶ The measurement starts.
  - ▶ At the same time, the box shelf moves to the position of the 1st empty magazine, and the empty magazine is placed in the storage position for dosimeters to be sorted.
  - ▶ The second empty magazine is moved to the appropriate position.
  - ▶ After completion of the measurement, the dosimeter is output back to the storage position (formerly withdrawal position).
  - ▶ The magazine is moved to the removal position for the next dosimeter and the dosimeter is pulled out.
  - ▶ If necessary, the already measured dosimeter is placed in the sorting magazine.
  - ▶ After processing the 50 dosimeters (with full occupancy of the magazines), the magazine is issued in the box and the next magazine is moved in.

see Chapter 7.3.2

### 7.3.2 Messystem started

- ▶ The dosimeter provided by automation is fed into the reader.
- ▶ The shutter, which causes a light shielding, closes.
- ▶ At the same time, the RFID chip of the dosimeter card is read.
- ▶ The background of the detector is read (0.03 s).
- ▶ The reference signal is read.
- ▶ The dosimeter card is pulled out of the case and brought to the 1st reading position and read out.
- ▶ The 4 reading positions are approached one after the other.
- ▶ The deletion position is approached ( the 4 elements are deleted atthe same time).
- ▶ The 4 reading positions are approached and read one after the other (determination of the residual value for the next measurement)
- ▶ Depending on the result, a repetitiontakesplace.
- ▶ The residual value is written to the RFID chipof the dosimeter card.

## 7.4 Software 4EA-Studio

The 4-element OSL automation can be controlled by the 4EA-Studio-Software.

### 7.4.1 Installation

The 4EA-Studio-Software is already installed on the integrated PC. A copy is also available on the USB stick that comes with the device.

### 7.4.2 Starting the application

The application can be launched by double-clicking the 4EA Studio - link (Figure 10) on the computer's desktop. After launching the software, the main view is displayed (Figure 11).



Figure 10: 4EA Studio Link on desktop

### 7.4.3 User interface

The 4EA Studio software is divided into the "Job Management", "Device Status", "Box Details", "Messages/Errors", "Processing Queue" and "Service" sections. Each category is described in the following chapters.

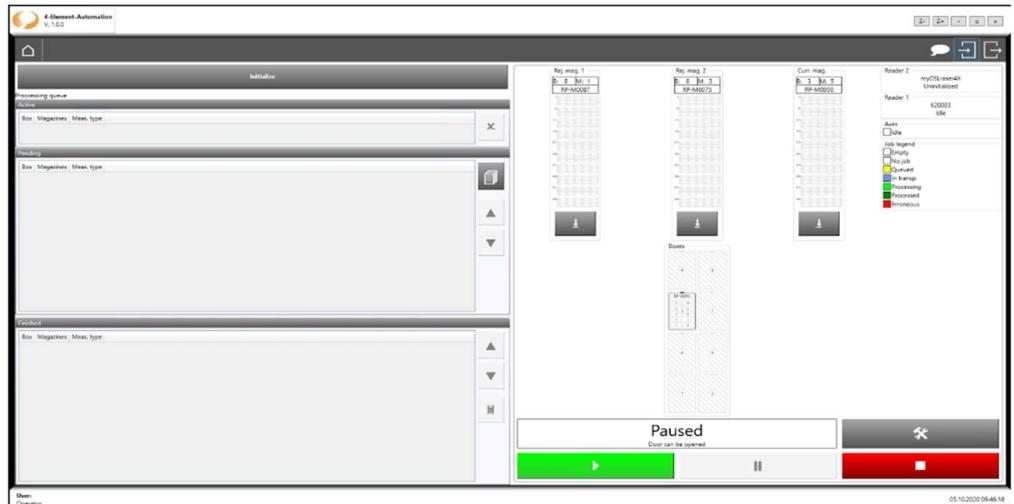


Figure 11: Main View

### 7.4.4 Log in / Log out

After starting the software and as long as no other user is logged in, the user "Operator" is always logged in. To enroll a higher-level user, you can use the login button in the upper-left corner of the main window (Figure 12).

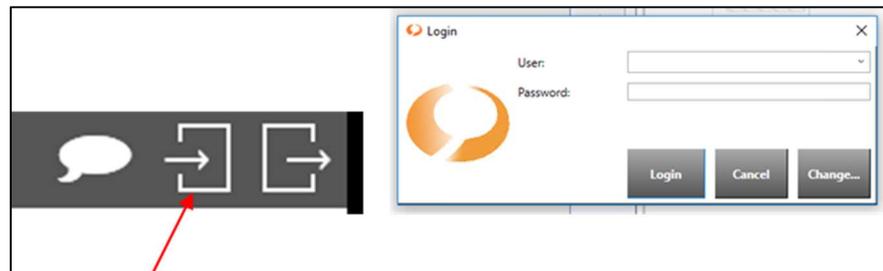


Figure 12: User Login

### 7.4.5 Initialization

The Initialize button starts initializing the device. First, the activated readers are initialized and then all axes of automation are referenced. After successful initialization, the system is in the pause state, the memory is in the parking position and the doors are unlocked.

## 7.4.6 Gerätestatus

The device status displays all important information.



Figure 13: Device Status

## 1. Indexer-Status

- Displays loaded magazines + scanned magazine numbers
- Status of the dosimeters in the magazines

## 2. Boxstatus

- existing boxes + scanned box numbers
- One click opens the window with the box details

## 3. Leserstatus

- Displays installed readers and their status

## 4. Hauptbedienfeld

**Run button:** Starts the device and starts processing the created jobs.

**Pause button:** Stops the current movement and puts the device in a pause state.

**Stop button:** Instantly stops every movement of the device. **Initialization of the device is then required.**

**Inspector:** Displays the current status of the device.

#### 7.4.7 Home-Taste

Clicking on the Homebutton (Figure 14) will always take you back to the main window.



Figure 14: Home Button

#### 7.4.8 Verarbeitungswarteschlange

In this part of the main view, you can view the scheduled, currently active, and already completed jobs (Figure 15).

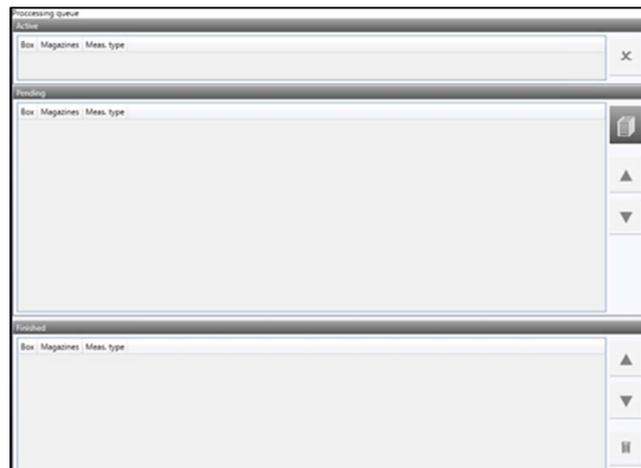


Figure 15: Processing Queue

Clicking the button at the top right takes you to the Job Management window (Figure 16).

## 7.4.9 Order management

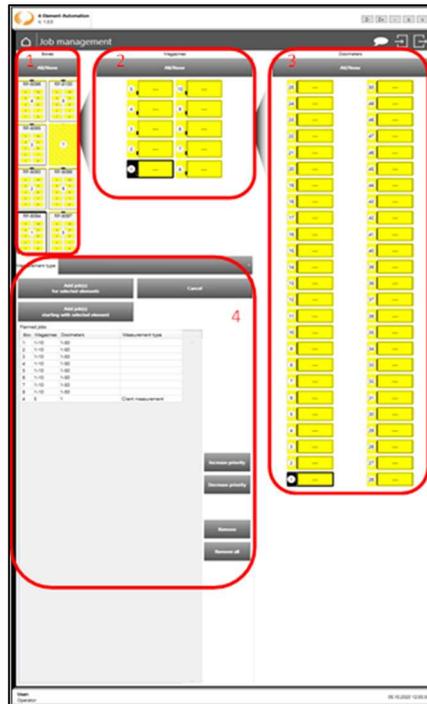


Figure 16: Order management

In this window, the orders for the measurements to be processed are created. To create an order, one of the 8 boxfields must first be selected(1). Selecting the box opens the window in which the magazine can be selected (2). If more than one box is selected, no separate selection of magazines can be made, then all magazines of the selected boxes are processed one after the other. If you want to measure only a specific dosimeter, select the box first and then the magazine. The corresponding dosimeter can then be selected in the third window (3).

All boxes, magazines and dosimeters can be selected or deselected with the "All / None" button.

4:

Under Measurement type, the measurement type can be selected. There are three types:

- Kundenmessung:
- Bleaching and validation:
- Kalibrierzyklus:

The "Add job for selected item(s)" button adds the selection to the waiting list. The Add Jobstart with Selected Item button is active only when a specific dosimeter is selected. In this case, all dosimeters that follow the selected one will be added to the waiting list.

The Cancel button cancels the selection completely.

The order of the jobs to be executed can also be changed during the execution of the machine with the two buttons "Increase priority" and "Reduce priority". The task that comes first is processed next.

### 7.4.10 Messages

The appropriate button (Figure 17) takes you to the message window (Figure 18). All error messages or informational messages with date and time stamp are displayed here. Confirmed messages can be filtered with the selection in the upper part.



Figure 17 Opening the Message Window

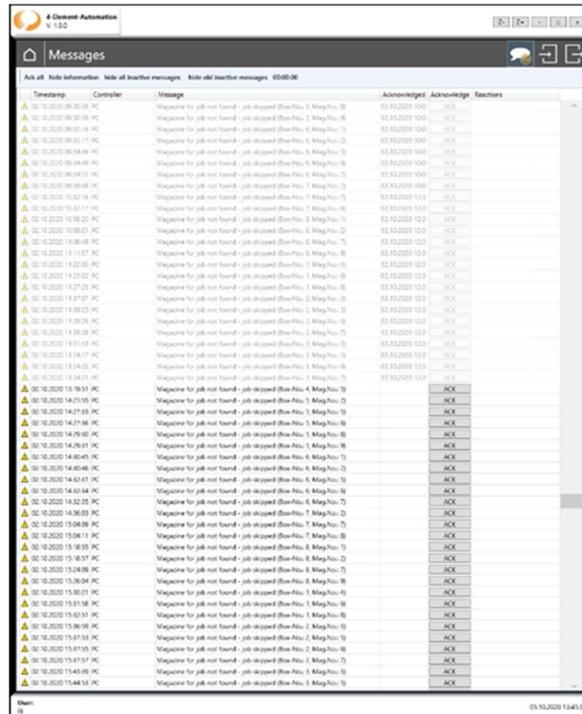


Figure 18: Message Window

### 7.5 RemoteControl (JSONoverEthernet)

Communication takes place via JSON packets over a TCP/IP connection (socket). The FourElementAutomationPC software acts as a server.

Grundlegender Kommunikationsaufbau Client -> Server:

1. Client: Send command (client can generate UID and check it in the response message)
2. Server: Send confirmation (ACK or NACK)
3. Server: send result data if necessary
4. Server: Done (FIN or FINERR) send

Each message contains a parameter "ID", which identifies the command (e.B CMeasureElement) and a parameter "VER", which indicates the version of the command (for later use, extension, etc.).

For double values, NaN values are represented as null.

Example:

1. Client sends:

```
{"ID": "CMeasureElement", "VER": "1.0", "GUID": "e5ca04a6-a95a-4c6e-85fb-5599c14452cb", "RD": 1, "CP": 3, "XT": null, "XS": null}
```

2. Server sends confirmation:

```
{"ID": "RAck", "VER": "1.0", "CMD": "CMeasureElement", "GUID": "e5ca04a6-a95a-4c6e-85fb-5599c14452cb"}
```

3. Server sends result data

```
{"ID": "RMeasureElement", "VER": "1.0", "RD": 2, "CP": 3, "Signal": 1, "Quality": null, "XTeff": 6, "Peff": 7}
```

4. Server sends "Done"

```
{"ID": "RFin", "VER": "1.0", "CMD": "CMeasureElement", "GUID": "e5ca04a6-a95a-4c6e-85fb-5599c14452cb"}
```

Available commands Client->Server:

Command (Client->Server)	Answer (Server->Client)
	"ID": "RAck", "CMD": "commandname",

	<p>"GUID": "command-GUID"</p> <p>Meaning: Message acknowledged</p>
	<p>"ID": "RNAck",</p> <p>"CMD": "commandname",</p> <p>"GUID": "command-GUID"</p> <p>Meaning: Message rejected (e.g. parameter error)</p>
	<p>"ID": "RFin",</p> <p>"CMD": "commandname",</p> <p>"GUID": "command-GUID"</p> <p>Meaning: Message command finished</p>
	<p>"ID": "RFinErr",</p> <p>"CMD": "commandname",</p> <p>"GUID": "command-GUID"</p> <p>Meaning: Message command aborted</p>
<p>"ID": "CAddJob"</p> <p>"BPN":5, // Box position number : int</p> <p>"BTY": "Client measurement", // measurement type : string</p> <p>"MPN": [1], // magazine position numbers : int[]</p> <p>"DP": [1,2,3] // dosimeter position numbers : int[]</p> <p>"UseRD1": true, // Use reader/device 1</p> <p>"UseRD2": false, // Use reader/device 2</p>	<p>"ID": "RAddJob",</p> <p>"JobId": "job-GUID",</p> <p>"UseRD1": true, // Use reader/device 1</p> <p>"UseRD2": false, // Use reader/device 2</p>
<p>"ID": "CBleachElements",</p> <p>"RD": 2, // Reader number : int</p> <p>"BT": 5, // Bleaching time [s] : double</p> <p>"P": 4, // Bleaching power [mW] : double</p>	<p>"ID": "RBleachElements",</p> <p>"RD": 1, // reader number : int</p> <p>"BTeff": 1.0, // Eff. bleaching time [s] : double</p> <p>"Peff": 1.0, // Eff. Bleaching power [mW] : double</p> <p>"Orientation": 0 // 0=None, 1=Top, 2=Bottom, 3=Both/Error : byte</p>
<p>"ID": "CDecreaseJobPriority",</p> <p>"JobId": "job-GUID"</p>	
<p>"ID": "CDetectElement",</p>	<p>"ID": "RDetectElement",</p>

<p>"RD":2, // Reader number : int  // Detects QR code on the element (!)</p>	<p>"RD": 1, // reader number : int "ElementIdentifier": "abc", // Detected identifier : string</p>
<p>"ID": "CGetIrradiationTime", "RD":2, // Reader number : int "Dose":0.15, // Irradiation dose [mSv] : double  // Gets the calculated irradiation time</p>	<p>"ID": "RGetIrradiationTime", "RD": 1, // reader/device number : int "TIME": 5.26, // Calculated irradiation time [s] : double</p>
<p>"ID": "CGetJobList",</p>	<p>"ID": "RJobList" "ActiveJob": { "BPN":5, // Box position number : int "BTY": "Client measurement", // measurement type : string "MagazineJobs": [ { "MPN":1, // magazine position number : int "DP": [1,2,3] // dosimeter position numbers : int[] }, { "MPN":2, "DP": [3,4,5], "State":2, // 0=None, 1=Waiting, 2=Running, 3=Finished, 4=Aborted : int "UseRD1": true, // Use reader/device 1 : bool "UseRD2": true, // Use reader/device 2 : bool }], "JobId": "8937e640-0d4c-44e5-9342-df8416a768dd" // string "State":2, // 0=None, 1=Waiting, 2=Running, 3=Finished, 4=Aborted : int }, "WaitingJobs": []</p>
<p>"ID": "CIncreaseJobPriority", "JobId": "job-GUID"</p>	
<p>"ID": "CInit",</p>	
<p>"ID": "CIrradiateElements",</p>	

<pre>"RD":2, // Reader/device number : int "Dose":0.15, // Irradiation dose [mSv] : double  // Irradiates the loaded dosimeter</pre>	
<pre>"ID": "CLoadDosimeter", "MTR":3, // Magazine tray number (indexer) : int "DP":2, // Dosimeter position number : int "RD":2, // Reader number : int</pre>	<pre>"ID": "RLoadDosimeter", "BXID": "B020000011", // Box-Identifier : string "BPN":5, // Box position number : int "MPN":1, // Magazine position number : int "MTR":3, // Magazine tray number (indexer) : int "MID": "RP-M0064", // Magazine identifier : string "DP":2, // Dosimeter position number : int "RD":2, // Reader number : int "BID": null, // Dosimeter badge identifier : string "CID": null, // Dosimeter card identifier : int? "YEAR": null, // Year : byte? "MONTH": null, // Month : byte? "STATUS": null, // Status : byte? "ECF1": null, // Element correction factor : double? "ECF2": null, // Element correction factor : double? "ECF3": null, // Element correction factor : double? "ECF4": null, // Element correction factor : double? "RES1": null, // Element residual factor : double? "RES2": null, // Element residual factor : double? "RES3": null, // Element residual factor : double? "RES4": null, // Element residual factor : double? "TSW": null // Timestamp of last RFID write : DateTime? }  (this answer is sent automatically when dosimeter is loaded)</pre>
<pre>"ID": "CLoadParameters", "Parameters": [ { "Name": "pname", // parameter name : string</pre>	<pre>"ID": "RLoadParameters", "Parameters": [ { "Name": "pname", // parameter name : string</pre>

<pre> "Value": "pvalue", // parameter value : string }]         </pre>	<pre> "Value": "pvalue", // parameter value : string }]         </pre>
<pre> "ID": "CMaterialStatus"         </pre>	<pre> "ID": "RMaterialStatus", "Boxes": [ { "BP": 2, // box position number : int "BXID": "B0996" // box identifier : string }], "Magazines": [ { "MPN": 1, // magazine position number : int "BP": 2, // box position number : int "BXID": "B0996", // box identifier : string "MID": "M0972" // magazine identifier : string }], "MeasurementMagazine": { "MPN": 7, "BP": 2, "BXID": "B0996", "MID": "M0376" }, "RejectMagazine1": null, "RejectMagazine2": null         </pre>
<pre> "ID": "CMeasureElement", "RD": 2, // Reader number : int "CP": 1, // Card position 1-4 (element) : int "XT": 0.5, // Excitation time [s] : double "XS": 1 // Excitation source : int         </pre>	<pre> "ID": "RMeasureElement", "RD": 2, // Reader number : int "CP": 1, // Card position 1-4 (element) : int "Signal": 13.583, // Signal : double "DarkCounts": 3.612, // DarkCounts : double "Quality": 0.98, // Quality : double "XTeff": 0.5, // Excitation time eff. [s] : double "Peff": 100, // Excitation power eff. [mW] : double "Pmin": 100, // Min. power [mW] : double "Pmax": 100, // Max. power [mW] : double "NBins": 4, // Number of bins : UInt32 "N": 0.5, // Fit offset (Y0) : double "M": 0.5 // Fit slope : double         </pre>

<pre>"ID": "CMeasureRefLight", "RD": 2, // Reader number : int  // measures ref. light and dark counts</pre>	<pre>"ID": "RMeasureRefLight", "RD": 2, // Reader number : int "CP": 1, // Card position 1-4 (element) : int "RefLightCounts": 13.583, // ref. light. counts : double "DarkCounts": 3.612, // dark counts : double</pre>
<pre>"ID": "CPause"  // initiates the pause state</pre>	
<pre>"ID": "CProbeElementDecay ", "RD": 2, // Reader number : int "CP": 1, // Card position 1-4 (element) : int "Accumulations": 5, // Accumulations : int "OnTime": 1, // On time : double "OffTime": 1, // Off time : double "P": 2, // Power [mW] "ReadoutInterval": 1 // Readout interval [s] : double</pre>	<pre>"ID": "RProbeElementDecay" "RD": 2, // Reader number : int "CP": 1, // Card position 1-4 (element) : int "AccumulationsEff": 5 // effective accumulations : int "DecayTime": 0.5, // Decay time [µs] : double "DecayQuality": 0.7, // Decay quality : double "StartValue": 0.7, // Plateau value before decay : double "SignalData": // signal data array : double[] {   1,   3 }</pre>
<pre>"ID": "CReadParameters" "Parameters": [ {   "Name": "pname", // parameter name : string   "Value": "pvalue", // parameter value : string }]</pre>	<pre>"ID": "RReadParameters" "Parameters": [ {   "Name": "pname", // parameter name : string   "Value": "pvalue", // parameter value : string }]</pre>
<pre>"ID": "CRemoveJob", "JobId": "job-GUID"</pre>	
<pre>"ID": "CRemoveJobs"</pre>	
<pre>"ID": "CStartAuto"</pre>	
<pre>"ID": "CStatus"</pre>	<pre>"ID": "RStatus", "Status": "Stopping" // status : string "LastError": // Last error if status is "Error" or "Estop"</pre>

	<pre>{   "SId":10, // Source controller id : int   "MId":1010, // Message id : int   "Text":"abc" // Message text : string }, "AutomationSerial":"abc" // automation board serial no. : string "Device1Serial":"abc" // device 1 serial no. : string "Device2Serial":"abc" // device2 serial no. : string "Device1IsIrradiator":false // device 1 is irradiator : bool "Device2IsIrradiator":false // device 2 is irradiator : bool  (server sends automatically if the status has changed)  Valid values for 'Status' are: NotConnected, NotInitialized, Initializing, Ready, Starting, Automatic, Pausing, Paused, Stopping, Stopped, SEstop, Error, Service  Source (controller): 0=PC Application, 1=PC device communication, 10=Automation board, 100 =4-Element device 1 200 = 4-Element device 2</pre>
<p>"ID": "CStop"</p>	
<p>"ID":"CUnloadDosimeter",  "MTR":3, // magazine tray/indexer number :  int  "RD":1, // reader number : int  "ERR":false, // Error during processing marker  (for visualization) : bool</p>	<p>"ID":"RUnloadDosimeter",  "MTR":3, // magazine tray/indexer number : int  "MID":"abc", // magazine identifier : string  "RD":1, // reader number : int  "DP":44 // dosimeter position number : int</p>
<p>"ID":"CWriteElementData",  "RD":2, // Reader number : int  "CID":null, // Dosimeter card identifier :  UInt32</p>	<p>"ID":"RWriteElementData",  "RD":2, // Reader number : int  "BID":null, // Dosimeter badge identifier : string  "CID":null, // Dosimeter card identifier : UInt32</p>

<pre>"YEAR":null, // Year : byte "MONTH":null, // Month : byte "STATUS":null, // Status : UInt16 "ECF1":null, // Element correction factor : double "ECF2":null, // Element correction factor : double "ECF3":null, // Element correction factor : double "ECF4":null, // Element correction factor : double "RES1":null, // Element residual factor : dou- ble "RES2":null, // Element residual factor : dou- ble "RES3":null, // Element residual factor : dou- ble "RES4":null // Element residual factor : double }</pre>	<pre>"YEAR":null, // Year : byte "MONTH":null, // Month : byte "STATUS":null, // Status : UInt16 "ECF1":null, // Element correction factor : double "ECF2":null, // Element correction factor : double "ECF3":null, // Element correction factor : double "ECF4":null, // Element correction factor : double "RES1":null, // Element residual factor : double "RES2":null, // Element residual factor : double "RES3":null, // Element residual factor : double "RES4":null, // Element residual factor : double "TSLW":null // Timestamp of last RFID write : DateTime }</pre>
---	---

7.5.1 Other parameters

Parameter	Possible states	Description
XS	0 = TILT-LED 1 = Straight-LED	This makes the recipe parameter Gainsettings[0]. ReadLED overwritten.
Gai- numschal- tung	Gain level 0 to 3 (only with normal measurement, not with decay measurement)	<p>There are 4 gain levels in the standard measurement, which are activated one after the other as soon as the specified limit of 3000000 counts is exceeded.</p> <p>It starts with Gain 0.</p> <p>Gain 0 = Tilt-LED mit 100 mW Gain 1 = Tilt-LED mit 10 mW Gain 2 = Straight-LED mit 0,3 mW Gain 3 = Straight-LED mit 0,03 mW</p> <p>Stimulation time before switching: &lt;100 µs</p> <p>Dead time between switching off and on of the PMT: Gain-ChangeWaitTime + detection Darkbefor = 3.1s</p> <p>Decay measurement: There is no gain switching, it is always measured with the recipe stored in the setting.</p> <p>ReadPower = 100 mW OnTime_s = 0,0002 OffTime_s = 0,0004 NrPulses = 50000 Readoutinterval_s = 5E-06</p>
Signal		$= ((\text{TotalCounts} - \text{DarkBefore}) * \text{sensitivityAdjustmentFactor}) + \text{deviceOffset}$ <p>(for PMT variant deviceOffset=0)</p> <p>"sensitivityAdjustmentFactor" and "DeviceOffset", are the device parameters that can be set via settings file.</p>
Nbins		Number of channels over which the measured value was formed, without settling time.
XTeff		Effective measuring time without settling time
M (Fit amplitude)		Slope
N (Fit slope)		Seed
Darkbefor		"DarkBefore" is the DarkCountsvalue that is transmitted via JSON.

		<p>Determined directly before the actual measurement</p> <p>The number of values considered for this results from the InitialBackgroundRead/Read Interval, both set in the Setting.</p>
Quality (Result Variance)		<p>Sum of squared deviations from the fitness line divided by the number of values</p>

## 7.6 Cleaning the machine



Do not clean the machine with a jet of water.

**Specialist**

If parts of the machine have to be dismantled for cleaning, the cleaning work may only be carried out by specialists.

After completion of the cleaning work, the specialist must restore and check the intended condition.

**Assistant  
Operator**

Cleaning work may be carried out by assistants and operators.

Clean the machine at regular intervals, depending on the degree of contamination.

The access routes to the machinery must not cause any hazards.

# 8 Maintenance

## 8.1 Safety instructions for maintenance



Maintenance work may only be carried out by suitable specialists.



### DANGER

#### Danger to life due to electrical voltage

If the electric current is not switched off or prevents the sustaining specialist from coming into contact with electricity, electric shocks can lead to death or serious injuries.

- ▶ Before working on the electrical equipment, turn off the electric current.
- ▶ Observe the five safety rules for working on electrical systems.



### DANGER

#### Risk of injury due to squeezing

Due to the movements of different actuators, there are risks of crushing between moving and fixed parts when distances are dangerously reduced.

- ▶ Maintenance work may only be carried out on a secured machine.
- ▶ On the basis of the activities to be carried out, the operator must determine with a risk assessment whether the machine must be secured by switching off the mains disconnecter and securing it against reactivation with lockout tagout devices or personal padlocks.

#### five safety rules

The five safety rules for work on electrical installations:

1. Unlock
2. against reconnection
3. Determine freedom from voltage
4. Earthing and short-circuiting
5. Cover adjacent, live parts

If protective devices are out of service, no persons shall be present in the hazardous area of the machinery during maintenance.

## 8.2 Preparation of maintenance work

Carry out maintenance work on the machine only in the secured state.

Turn off the main switch and secure it against re-activation (e.B. with a padlock).

If maintenance work is carried out with the control system switched on, you must define additional protective measures for safe personal protection.

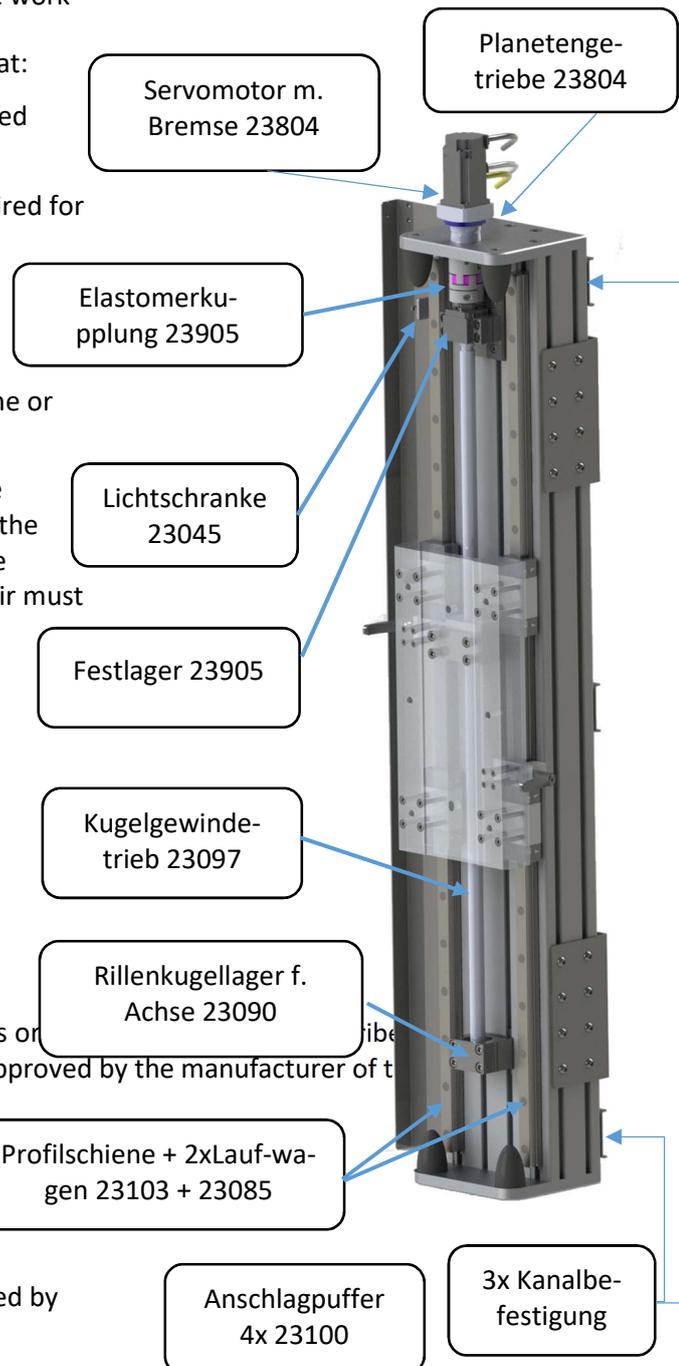
Disassemble protective devices only when the machine is safely switched off and this condition is assured.

8.3

8.3 Start-up after maintenance work

After maintenance, make sure that:

- removed guards are reattached and functional,
- all tools and equipment required for maintenance are removed from the working area of the machine,
- no one can be endangered by the energies of the machine or machine movements.
- ▶ all machine elements and the assemblies used are fixed. In the case of loose parts or damage detected, a professional repair must be carried out before recommissioning. The information on tightening torques of screw connections of the manufacturers of the individual assemblies must be adhered to (see relevant documents).



8.4 Spare and wear parts



Use only original parts as well as original spare parts from the manufacturer or the parts approved by the manufacturer of the machines.

If you use spare and wear parts not approved by the manufacturer, the manufacturer is not liable for any damage caused by this.

**Chapter 10.4** Remove the valid spare and wear parts from the relevant documents.



# 9 Dismantling, recycling and disposal

## 9.1 Dismantling



Only hire suitable specialists for the dismantling of the machine.

Provide the tools needed for disassembly. Tools for disassembly can be:

- Steighilfen
- Hebeeinrichtungen
- Tools

If these tools are not available to you, the operator must alternatively commission a suitable specialist company for the dismantling.

Before dismantling, make sure that you shut down the machine professionally.

## 9.2 Recycling



Check how certain materials can be properly recycled.

If the machine is intended for scrapping, pay attention to grade purity when disposing of the individual assemblies.

## 9.3 Disposal



Make sure that you dispose of the quantities of lubricating greases and oily cleaning waste generated during the operation of the machine in compliance with legal regulations.

When disposing of the auxiliary and operating materials, observe the specifications of the safety data sheets provided by the suppliers of the auxiliary and operating materials.

Do not cause environmental damage when disposing of it.

# 10 Appendix

## 10.1 Nameplate

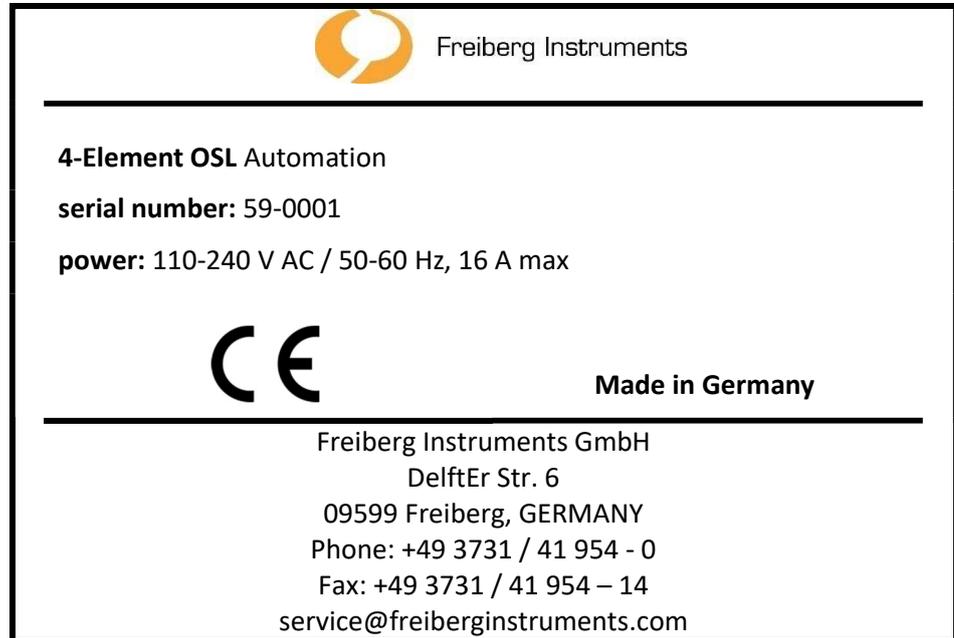


Figure 19: Nameplate

## 10.2 EC Declaration of Conformity

**within the meaning of the Machinery Directive 2006/42/EC, Annex II 1. A**

**The document reproduces the content of the EC declaration of conformity**

Name of the machine:	<b>Error! Reference source could not be found.</b>
Function:	Evaluation of dosimeters and extinguishing of radiant energy
Type:	4-elementautomation
Year of construction:	2020
Manufacturer:	Freiberg Instruments GmbH Delfter Straße 6 09599 Freiberg
Authorised representative for the compilation of the technical documentation:	Freiberg Instruments GmbH Address: see above

The manufacturer declares that the above-mentioned machinery in the version placed on the market complies with all the relevant provisions of the Machinery Directive. During production, the requirements of the following directive(s) and standards were observed.

**European Directive(s):**

2014/30/EU	EMC Directive
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**Harmonised standards applied:**

EN ISO 14118:2018	Safety of machines - Avoidance of unexpected start-up
EN ISO 13850:2015	Safety of machines - Emergency stop - Design principles
EN ISO 13849-1:2015	Safety of machinery - Safety-related parts of control systems - Part 1: General design principles
EN ISO 13849-2:2012	Safety of machinery - Safety-related parts of control systems - Part 2: Validation
EN ISO 12100:2010	Safety of machinery - General design principles - Risk assessment and risk reduction
EN ISO 20607:2019	Safety of machinery - Operating instructions - General design principles
IN 60204-1:2018	Safety of machinery - Electrical equipment of machinery - Part 1: General requirements

### 10.3 Safety-relevant tests

Tests must be carried out immediately if the machinery is affected by any of the following events:

- Changes subject to verification
- Exposure to damage-causing influences
- extraordinary events (e.B accident, prolonged non-use, natural event)

The following tests shall be carried out regularly:

Prüfgegenstand	Prüfumfang	Prüfintervall	Examiner
Protective devices	Completeness, intended condition, functionality	before each work shift	Operator
Screw connections	correct fit, correct position, tightening torques	before each work shift	Operator
ortsfeste Elektroanlage	Continuous equipotential bonding	after maintenance or replacement of parts	Electrician
	Residual current, residual current, residual voltage circuit breaker	half-yearly	
	Visual inspection, Functionality, Measurement of protective conductor and insulation resistance	recommended: annually	
Not-Halt-Befehlsgeräte	Completeness, intended condition, functionality	weekly	Operator
Security	proper functioning	recommended: semi-annual	Person qualified for examination
For safety-relevant components, a maximum service life of 20 years must be observed. If necessary, individual components must be replaced before the end of 20 years due to their requirement rate in accordance with the applicable SISTEMA calculation.			
Switchboard	Measure internal temperature, check for dust deposits, loose cable connections	recommended: semi-annually	Electrician

### 10.4 Applicable documents

- Drawings

- Elektroschaltplan
- Test protocols according to EN 60204-1, DIN VDE 0100-600/0105-100
- EC Declaration of Conformity
- Risk assessment
- Spare and wear part list
- Instandhaltungsanleitung
- Instructions for controls

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