

PHYWE Systeme GmbH & Co. KG  
Robert-Bosch-Breite 10  
D-37079 Göttingen

Phone +49 (0) 551 604-0  
Fax +49 (0) 551 604-107  
E-mail [info@phywe.de](mailto:info@phywe.de)

## Operating instructions



The unit complies with  
the corresponding EC  
guidelines.



Fig: 09057-51, 09057-61, 09057-71, 09057-81

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## 1 SAFETY PRECAUTIONS



- Carefully read these operating instructions completely before operating this instrument. This is necessary to avoid damage as well as for user-safety.
- Only use the instrument for the purpose for which it was designed.
- Only use the instrument in dry rooms in which there is no risk of explosion.
- Never cover up the vent slots of the experimental set-up.
- Do not open up the instrument.
- Do not connect other instruments to the unit than those intended for it.
- Take care that no liquid penetrates in through the housing openings.
- Switch the unit off after usage, as it is not designed for permanent operation. The maximum recommended daily operating time is 10 hours. Exceeding this does not represent a safety risk but can negatively influence the service life of X-ray tubes.



- Take care when drawing out a tube insert that has been in operation as internal parts of it could be very hot.
- **Handle with Care**

## 2 PURPOSE AND CHARACTERISTICS

Each plug-in consists of a pre-adjusted X-ray tube in a sheet steel housing with a handle. All plug-ins are supplied ready for use in the basic XR 4.0 X-ray expert unit.

- Pre-adjusted tubes with quick-change technology
- Hot parts contact protection
- Housing with ratchet and pawl mechanism and 2 safety contact pins which only unlock for tube operation when a plug-in has been correctly inserted.

## 3 FUNCTIONAL AND OPERATING ELEMENTS

The following ready for use plug-ins are available:

- Plug-in with Cu X-ray tube, article no. 09057-51
- Plug-in with Mo X-ray tube, article no. 09057-61
- Plug-in with Fe X-ray tube, article no. 09057-71
- Plug-in with W X-ray tube, article no. 09057-81

(For wavelengths and energies of the characteristic X-ray lines refer to the Technical specifications and the Appendix). Each plug-in consists of a factory-adjusted X-ray tube in a sheet steel housing. To prevent damage from overheating, each tube is enclosed in a Duran glass cylinder which has side tubes for forced air cooling via the fan in the basic device.

Each plug-in is equipped with an HV plug and a plug for tube cathode heating. Tube operating parameters can so be picked up via the corresponding sockets of the basic device. Two metal pins at the sides release a safety micro-switch which safeguards the tube plug-in chamber on correct insertion of an plug-in.

## 4 NOTES ON OPERATION

**Handle with care!**

**First start up:**



X-ray tubes are not to be operated under full power on their first start up. For the running-in of a tube we recommend that you first operate it for a period of 10 minutes with a maximum beam current but with an acceleration voltage which is not above 25 kV.

This procedure must be repeated when a tube has not been used for a period of some weeks.

- Minimum life time of the tube: 500 operating hours

## 5 HANDLING

**Handle with care!**

Inserting and changing X-ray tube inserts:

**Stop X-ray tube operation before carrying out a change of plug-ins.**

Plug-ins must be removed without tilting them. To insert an plug-in, fit the guide tabs in the guide rails without tilting the plug-in. Ensure that all plug connections have secure contact by pushing the plug-in in to the stop.



Fig. 2: Side view of a tube plug-in

## 6 TECHNICAL SPECIFICATIONS

- Target angle 19°
- Max. operating values 1 mA/35 kV-DC
- Test voltage 50 kV
- Dimensions (26.7x14.8x20.3) cm
- Weight 4.3 kg
- Minimum life time of the tube: 500 operating hours
- Characteristic X-ray lines for copper:
  - K-alpha: 8.03 keV; (154,2 pm)
  - K-beta: 8.90 keV; (139,2 pm)
- Characteristic X-ray lines for molybdenum:
  - K-alpha: 17.4 keV
  - K-beta: 19.6 keV
- Characteristic X-ray lines for iron:
  - K-alpha: 6.40 keV; (194 pm)
  - K-beta: 7.06 keV; (176 pm)
- Characteristic X-ray lines for tungsten:
  - See Appendix

## 7 PARTS SUPPLIED

- Complete with dust-protective hood

## 8 ACCESSORIES

09057-01 XR 4.0 X-ray diaphragm tube, d = 1 mm

09057-02 XR 4.0 X-ray diaphragm tube, d = 2 mm

09057-03 XR 4.0 X-ray diaphragm tube, d = 5 mm

## 9 NOTES ON THE GUARANTEE

We guarantee the instrument supplied by us for a period of 24 months within the EU, or for 12 months outside of the EU. Excepted from the guarantee are damages that result from disregarding the Operating Instructions, from improper handling of the instrument or from natural wear. The manufacturer can only be held responsible for the function and technical safety characteristics of the instrument, when maintenance, repairs and alterations to the instrument are only carried out by the manufacturer or by personnel who have been explicitly authorized by him to do so.

## 10 WASTE DISPOSAL

The packaging consists predominately of environmentally compatible materials that can be passed on for disposal by the local recycling service.



Should you no longer require this product, do not dispose of it with the household refuse.



Please return it to the address below for proper waste disposal.

PHYWE Systeme GmbH & Co. KG  
Abteilung Kundendienst (Customer Service)  
Robert-Bosch-Breite 10  
D-37079 Göttingen

Phone +49 (0) 551 604-0  
Fax +49 (0) 551 604-107

## 11 APPENDIX

Symbols and safety designation

	CAUTION: General danger spot
	WARNING of hot surfaces

## 11 APPENDIX

Spectrum of the tungsten X-ray tube with Table

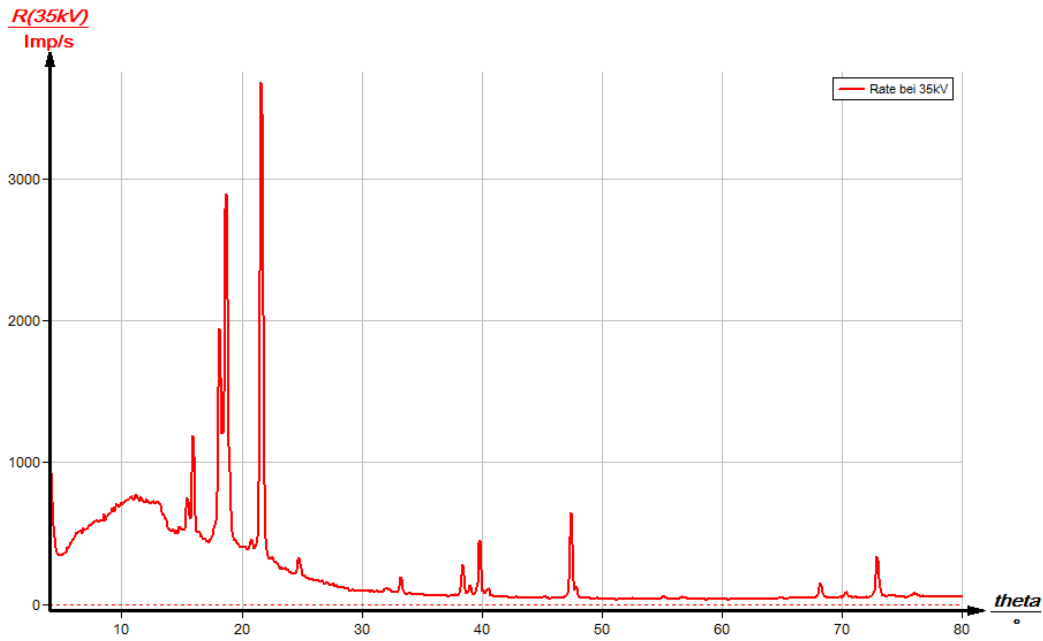


Fig. 3: The intensity of the W-X-ray radiation as function of the glancing angle  $\theta$  of the analyser crystal: LiF

Line	$\theta$ / °	$n$	$\lambda$ / pm	$E_{exp.}$ / eV	Lines	Transition	$E_{Lit.}$ / eV
1	14.69	1	102.15	12138	$\gamma_4$	$L_1O_3$	12063
2	15.23	1	105.81	11717	$\gamma_{3/2}$	$L_1N_3/L_1N_2$	
2	15.23	1	105.81	11717	$\gamma_{3/2}$	$L_1N_3/L_1N_2$	
3	15.74	1	109.27	11346	$\gamma_1$	$L_2N_4$	11286
4	16.28	1	112.92	10980	$\gamma_5$	$L_2N_1$	10949
5	17.92	1	123.94	10003	$\beta_2$	$L_3N_5$	9961
6	18.21	1	125.87	9849	$\beta_3$	$L_1M_3$	9818
7	18.47	1	127.61	9716	$\beta_1$	$L_2M_4$	9673
8	18.79	1	129.74	9556	$\beta_4$	$L_1M_2$	9525
9	20.60	1	141.72	8748	$\eta$	$L_2M_1$	8725
10	21.47	1	147.43	8409	$\alpha_{1/2}$	$L_3M_5/L_3M_4$	
11	22.51	1	154.21	8040	Cu- $K\alpha_{1/2}$		
12	24.57	1	167.49	7402	$l$	$L_3M_1$	7387
13	31.80	2	106.13	11682	$\gamma_3$	$L_1N_3$	11674
14	32.01	2	106.76	11613	$\gamma_2$	$L_1N_2$	11608
15	33.03	2	109.79	11294	$\gamma_1$	$L_2N_4$	11286
16	38.12	2	124.33	9972	$\beta_2$	$L_3N_5$	9961
17	38.80	2	126.20	9824	$\beta_3$	$L_1M_3$	9818
18	39.52	2	128.16	9674	$\beta_1$	$L_2M_4$	9673
19	40.24	2	130.10	9529	$\beta_4$	$L_1M_2$	9525
20	47.12	2	147.58	8401	$\alpha_1$	$L_3M_5$	8397
21	47.58	2	148.68	8339	$\alpha_2$	$L_3M_4$	8335
22	54.88	3	109.71	11300	$\gamma_1$	$L_2N_4$	11286
23	56.47	2	167.88	7385	$l$	$L_3M_1$	7387
24	67.90	3	124.28	9976	$\beta_2$	$L_3N_5$	9961
25	70.09	3	126.12	9831	$\beta_3$	$L_1M_3$	9818
26	72.66	3	128.04	9683	$\beta_1$	$L_2M_4$	9673
27	75.79	3	130.03	9535	$\beta_4$	$L_1M_2$	9525