

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
Internet www.phywe.de

Operating instructions


 The unit complies with the corresponding EC guidelines.



Fig. 1: Diffusion Cloud Chamber PJ80, 09043.93.

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1 SAFETY PRECAUTIONS



- Carefully read these operating instructions completely before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- Only use the instrument for the purpose for which it was designed.
- Check that your mains supply voltage corresponds to that given on the type plate fixed to the instrument.
- Only use the instrument in dry rooms in which there is no risk of explosion.
- Do not start up the instrument when there is visible damage to it or when it leaks.
- Do not cover or block the chamber base as there would then be an insufficient passage of fresh air into it.
- Only use an extension cable or a multiple socket when absolutely necessary.
- Wait at least 2 hours before putting the cloud chamber into operation to check that no faults have occurred to the refrigeration system during transport.
- Always unplug the mains plug before carrying out cleaning or maintenance work.

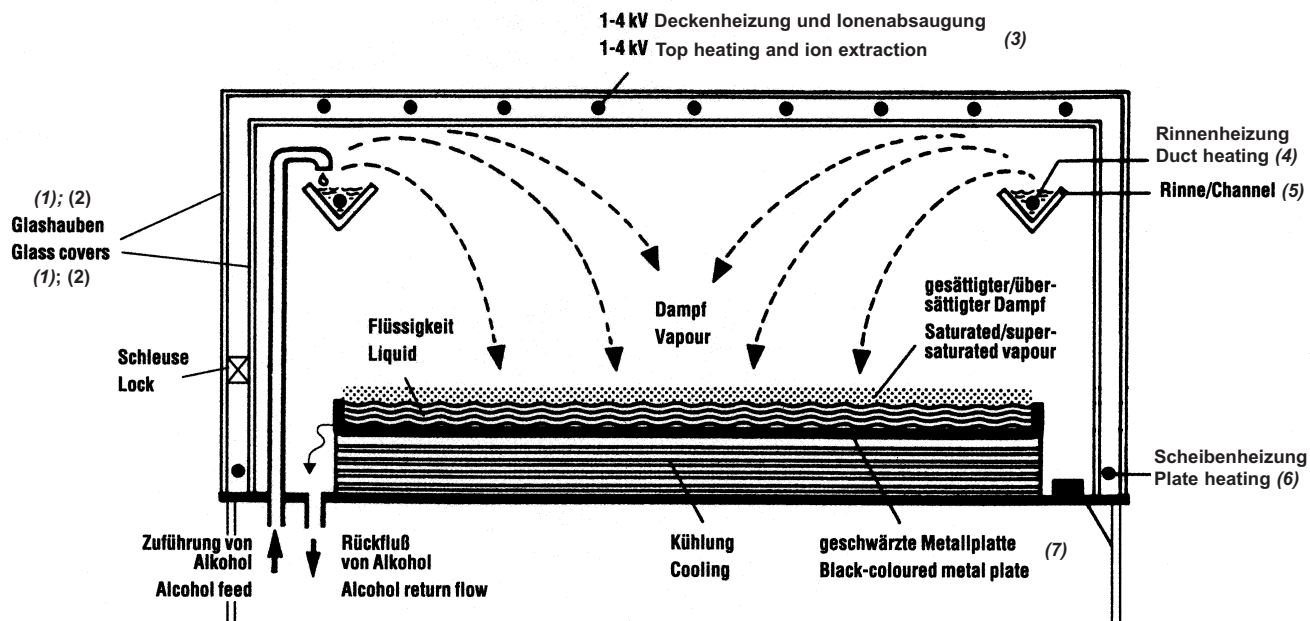


Fig 2: Section through diffusions cloud chamber.

2 DESCRIPTION OF THE DIFFUSION CLOUD CHAMBER

The body of the instrument is encased by lacquered metal sheets. The observation chamber that is positioned on top of it consists of two glass covers (1) and (2) placed one over the other. A heating grid at the top of the inner glass cover serves both as top heating (3) and as a high-voltage grid (ion extraction). With this construction, the high-voltage is outside of the chamber that is filled with alcohol vapour, so that the possibility of deflagration is eliminated.

The alcohol channel (5) can also be clearly seen under the glass covers. The alcohol that is evaporated here by an electric heater (duct heating) (4) is continually replaced by a small pump. A quadratic, black-coloured anodized metal plate (7) is the actual observation plate. Beneath this aluminium plate there is a thick-walled brass plate with a copper tube spiral that is cast-in in tin, which serves as evaporator for the refrigeration unit installed in the lower part of the body.

To open any one of the 4 body covers, first unlock the lock of it then unhook the safety chain and lift the cover up and outwards. Do this to take off the front body cover (Fig. 3). The instrument panel (10) with the operating elements can now be seen. The electrical equipment is situated behind this instrument panel. The alcohol reservoir (12) stands on the bottom of the compartment, the membrane pump for the pumping of alcohol (13) is higher up to the left of it and a housing that holds three automatic fuses (11) is higher up to the right of it.

Four large Allen screws (15) in the bottom plate of the body serve for lifting the diffusion cloud chamber up and levelling it.

Replace the front body cover, hook the safety chain back on and lock the cover.

Now open the back body cover (Fig. 4) to gain access to the

refrigeration unit. This is contained in a further closed housing made of wood for sound proofing. The main switch (19) of the instrument is on the left outer wall. The electrical socket (18) below it is directly connected to current, so that the hand-held lamp (230 V) that is supplied can be used even with the instrument switched off. The cover frame (8) can be removed by undoing the star knobs (14) when the fluorescent lamps (16) are to be replaced.

3 HOW THE CHAMBER FUNCTIONS

A logarithmic temperature gradient is built up between the only slightly heated cover and the strongly cooled bottom of the observation chamber, so that alcohol vapour falls in the top to bottom direction (settling velocity approx: 1...5 mm/s), whereby a horizontal supersaturated area is formed at an approximate height of from 1 to 20 mm above the bottom plate. In this supersaturated area, condensation nuclei that are created along their paths of alpha particles, protons, beta particles etc. by their ionizing effect result in their tracks being made visible by the appearance of condensed vapour trails. After their creation, these trails fall at about the same rate as the settling velocity of the alcohol vapour. The strength of each of these trails is a measure of the specific ionization of the particular particle or the radiation quantum that caused it. The light that is incident all around the cooled observation plate makes the trails clearly visible, so that they can also be photographed against the dark background of the bottom of the chamber. If the trails are very weak after switching on and correct adjustment of the voltage of the high-voltage system, this generally indicates an insufficient supply of vapour. Increase the supply by carefully increasing the duct heating. The average values of all settings are given on the plate adhered to the instrument panel.

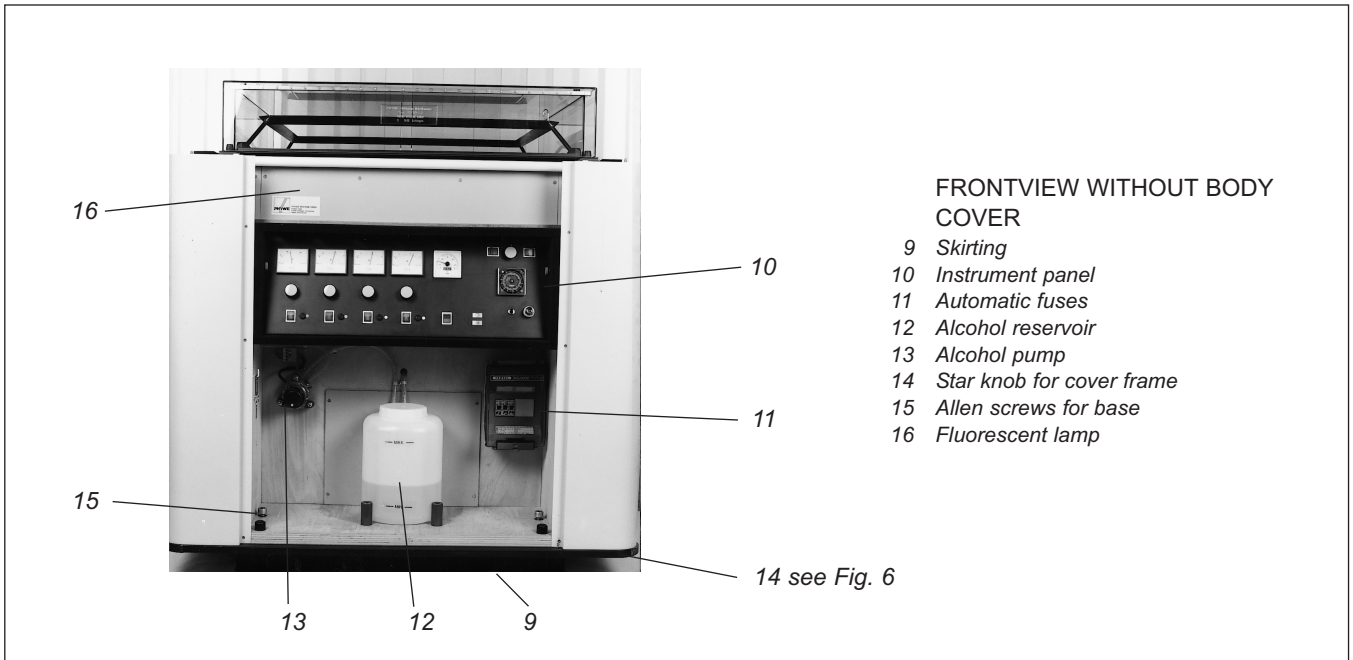


Fig. 3: Front view of the diffusions cloud chamber without body cover.

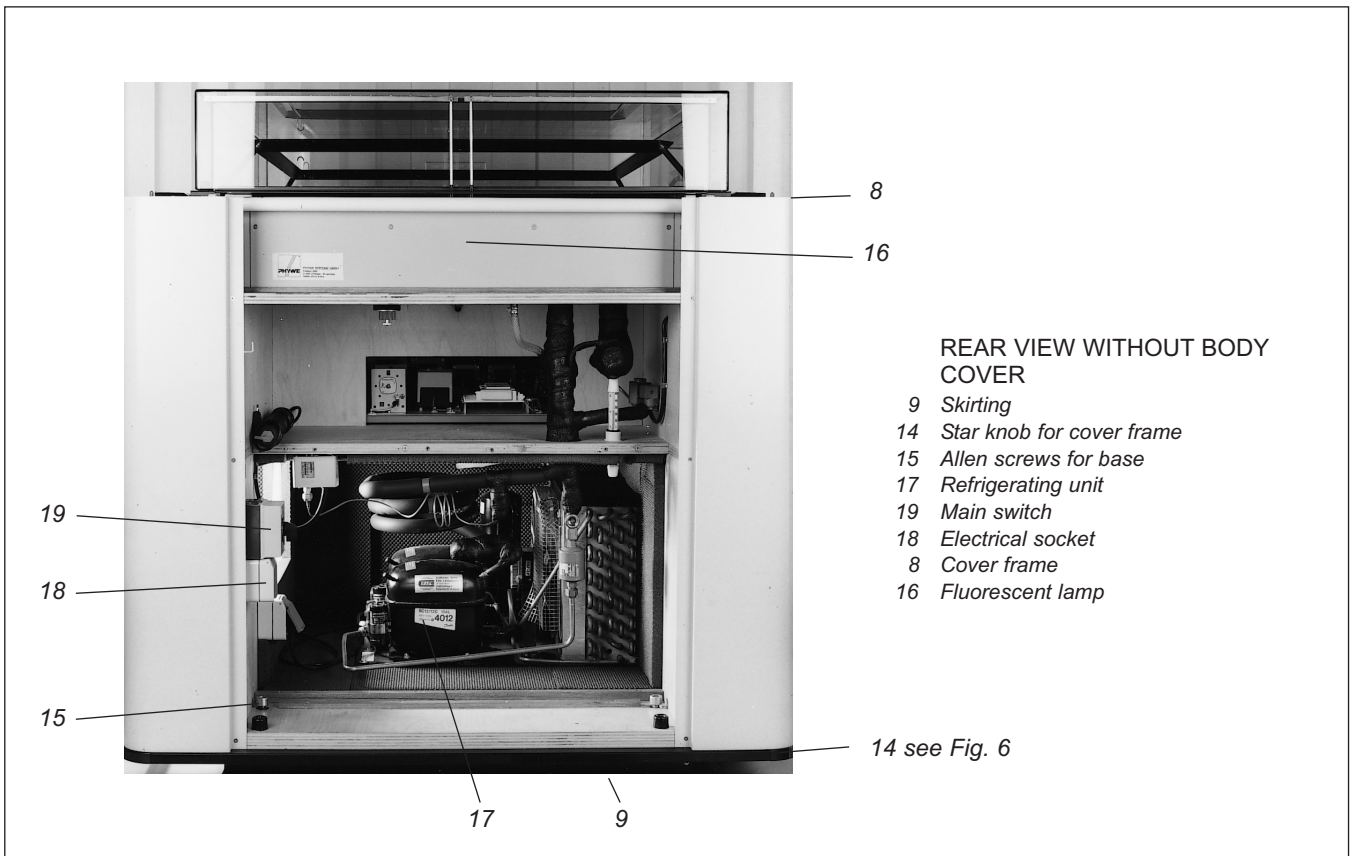


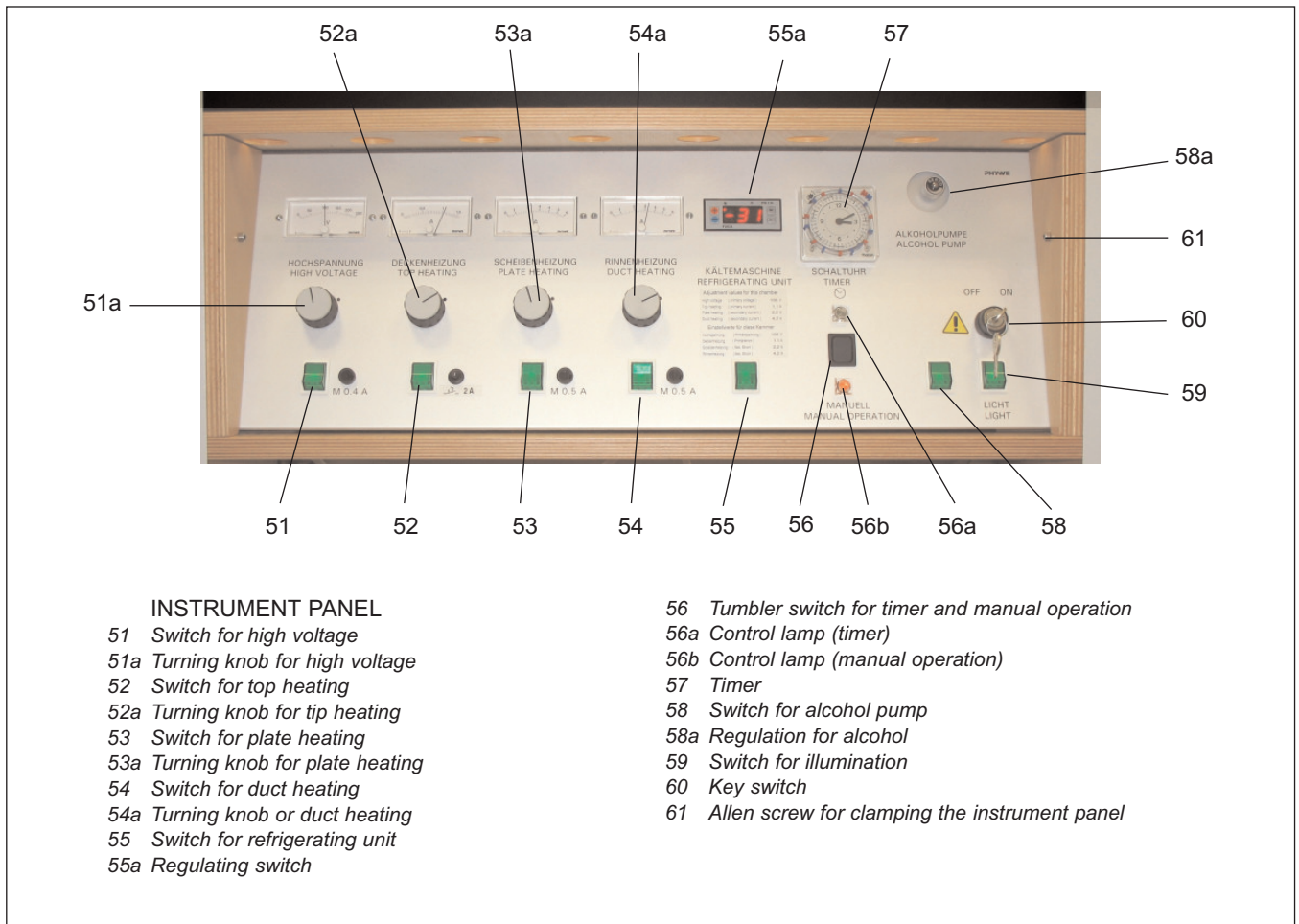
Fig. 4: Rear view of the diffusions cloud chamber without body cover.

4 TRANSPORT OF THE INSTRUMENT

It is vital to ensure the cloud chamber is not tilted during transport ($< 10^\circ$ from the vertical) as otherwise the refrigeration unit will be irreparably damaged.

5 SETTING THE INSTRUMENT UP

If possible, install the chamber in a room darkened to a great extent or one that can be darkened. The floor on which it is to stand must have an appropriate load-bearing capacity and must be so stable that the chamber is not subject to



INSTRUMENT PANEL

- 51 Switch for high voltage
- 51a Turning knob for high voltage
- 52 Switch for top heating
- 52a Turning knob for tip heating
- 53 Switch for plate heating
- 53a Turning knob for plate heating
- 54 Switch for duct heating
- 54a Turning knob or duct heating
- 55 Switch for refrigerating unit
- 55a Regulating switch
- 56 Tumbler switch for timer and manual operation
- 56a Control lamp (timer)
- 56b Control lamp (manual operation)
- 57 Timer
- 58 Switch for alcohol pump
- 58a Regulation for alcohol
- 59 Switch for illumination
- 60 Key switch
- 61 Allen screw for clamping the instrument panel

Fig. 5: Instrument panel of the diffusions cloud chamber 09043.93.

vibrations (concrete and carpet). Take off the skirting (9) and push the instrument to the planned site on the free-standing swivel castors (20). Turn the adjustable levelling Allen screws (15) to lift the instrument and, using the spirit level supplied, bring it to the horizontal position.

To ensure a sufficient supply of fresh air, do not cover up the skirting.

As delivered, the **mains lead** of the cloud chamber is under its right hand side part.

To reach it, remove the body side cover, then lead the

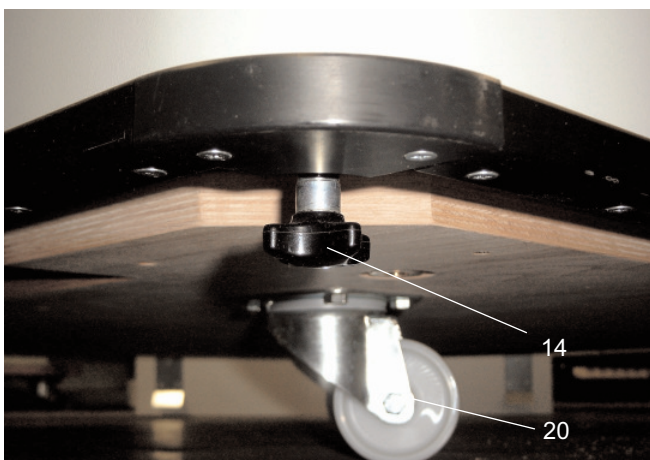


Fig. 6: View on the bottom side of the cloud chamber corner (without skirting).

connection cord that is now accessible through the lower vent slot and out.

Subsequently replace the body side cover, hook the safety chain on and lock the cover

6 PUTTING INTO OPERATION

1. Ensure that the alcohol reservoir (12) is filled with sufficient (min. 3 litres) isopropyl alcohol, PHYWE article no.: 30092.70. Observe section 8 “Notes on handling isopropyl alcohol” when doing so. Fill isopropyl alcohol into the alcohol reservoir using the funnel plus tube that is supplied. Close the isopropyl alcohol reservoir.
2. Now switch the cloud chamber on at the main switch (19) (left outer wall), operate the key-operated switch (60) and switch the two-way switch (56) to “down”. Indicator lamp M lights up
3. Switch on all rocker-actuated switches (51), (52), (53), (54), (55), (58) and (59).
4. Open the alcohol dosing valve (58a) by about 2 turns. There is now a strong flow of alcohol through the filling tube into the alcohol channel (5). When this channel is filled to about half way up, close the regulating valve so far that the flow from the filling tube into the channel is about 3 - 4 drops per second. Excess alcohol automatically flows off, so that the channel cannot overflow.
5. Compare the values displayed by the instrument with the

factory setting values on the adhered plate and correct them with the corresponding adjusting knobs if appropriate.

6. The chamber should be fully functional after about 45 minutes.
7. When the chamber is to be turned off, it is sufficient to switch it off at the key-operated switch, so that the top heating (3) and the plate heating (6) remain switched on (max. 200 Watt). (Caution: When the chamber is turned off with the key-operated switch, the cover heating and the glass pane heating must remain switched on to avoid unwanted condensation of alcohol on the inner glass cover. Because of this, do not separate the chamber from the mains supply). Simply use the key-operated switch to put the system back into operation.
8. Operation using the timer:

Set the timer (57) to the wanted switching symbol (see the enclosed operating instructions from the manufacturer of the timer) and switch the rocker-actuated switch (56) to "up". The indicator lamp (timer) lights up. The key-operated switch must always remain switched on when the timer is in use (the key can be removed).

Should a power failure occur, the timer has reserve power for about 1 week (see the enclosed operating instructions).

7 MAINTENANCE AND CARE

Seen from the outside, the construction of the machine-cooled Diffusion Cloud Chamber is simple, clear and sturdy. Despite this, it is a highly sensitive thermodynamic system that has been finely tuned in long-time tests over many weeks prior to transfer to the customer and whose individual functional parts and their interaction are the result of many years of technological development and experience.

Because of this, interventions, changes and repairs to the instrument are only to be carried out by qualified skilled personnel.

In the case of any refrigeration unit fault that occurs in Germany, please contact the RAPO company at 37081 Goettingen, Koenigsstieg 104 (Tel.: +49 (0) 551-64442) to be informed on the particular service station responsible for your area (otherwise, see "Technical specifications").

A reduced cooling performance of the refrigerating unit could result when an insufficient amount of fresh air is supplied. In the case of such an insufficiency, check if this is because the skirting (9) of the chamber has been blocked. Also ensure that the cooling fins of the heat exchanger and the air filter are cleaned monthly using a vacuum cleaner or a brush. Replace the air filter if it is very dirty (Phywe article no.: 09043.53).

The cooling fins can be cleaned after removal of the left body cover.

The temperature inside the chamber should not exceed 40°C when there is a sufficient supply of fresh air.

The replacement of fluorescent lamps (16) can be easily carried out after removal of the cover frame (8). To do this, undo the 4 star knobs (14). After taking the cover frame off and undoing the knurled thumb screws, take out the black-lacquered covering sheet. The fluorescent lamps are now freely accessible. Only carry out this work when the chamber is without current (**unplug the mains plug**).

When cleaning is necessary, the cover frame must be taken



Fig. 7: Air filter for diffusions cloud chamber.

off before the glass covers (1) and (2) can be taken out. Unscrew the 2 connecting leads to the lower hood before taking this one out by hand. If the colour of the black-anodized observation plate should have unfavourably changed after many years, it can be simply removed and replaced by a new one after opening the glass chamber and screwing out the 9 small countersunk screws.

If there is a fault in the electrics, the instrument panel (10) can be drawn out by about 30 cm, but before doing this, interrupt the supply of power to the chamber (unplug the mains plug) and screw out the Allen screws (61) to take the side covers off.

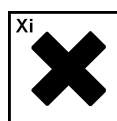
8 NOTES ON HANDLING ISO-PROPANOL

The handling of the alcohol iso-propanol (isopropanol, 2-propanol, propan-2-ol) is subject to the same rules for the avoidance of danger as is the handling of other chemicals, reagents and dye solutions. It is natural that such substances must be handled cautiously and carefully so that neither students and teachers nor others are exposed to unnecessary health hazards.

When handling iso-propanol, therefore, the directions must be observed that are given in the current up-dated data sheet (acc. to EC Directive 91/155/EEC), the valid accident prevention regulations and the directions that apply to the particular workplace.

Some of the most important handling regulations and general rules of behaviour are named here without any claim to completeness:

2-Propanol is a clear, highly flammable and somewhat oily liquid with an odour that is reminiscent of a mixture of ethanol and acetone. It mixes in all proportions with water and most organic solvents. The vapour from iso-propanol can form explosive mixtures with air.



Risk phrases: R 11-36-67

Highly flammable. Irritating to eyes. Vapour can make

drowsy and dazy.

Safety phrases: S 7-16-24/25-26-39

Keep container tightly closed. Keep away from sources of ignition – No smoking. Avoid contact with eyes and skin. In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear eye/face protection.

First aid: Immediately rinse contacted skin or eyes, with eyelids open, with plenty of water. On eye injury, seek medical advice immediately. In case of accident or if you feel unwell, seek medical advice immediately. After inhalation: Fresh air, keep airways free. On respiratory distress: Transport to doctor in half-sitting position.

Waste disposal: Collect combustible halogen-free organic solvents and solutions in a container labelled for them and pass to appropriate waste disposal.

9 TECHNICAL SPECIFICATIONS

Phywe Diffusion Cloud Chamber PJ 80

The instrument corresponds to protection class I. It is only to be connected to a socket with an earth lead connection.

Connecting voltage see type plate
(+6%/-10%)

The series transformer that is supplied enables the cloud chamber to be operated by a line voltage of from 100 to 200 VAC.

For a description, see the set-up procedure for 09043.93

Mains connection 230 V plug with earthing contact
Special voltages with series transformer are supplied without connecting plug (matching to the local supply network under observation of the valid local regulations).

Mains frequency 50/60 Hz

Power consumption approx. 2.0 kVA
Caution: The power consumption may be exceeded by about 20% during the starting up phase (approx. 15 min. after switching on).

Protection Quick-break cut-outs and blow-out fuses in the primary circuit

Mains fusing at the installation site 230 V, 16 A
100 - 115 V, 20 A

Quick-break cut-outs K-characteristic

Dimensions Height 126 cm
Outer dimensions 128 × 128 cm
Skirting height approx. 10 cm
The skirting (9) is removable. When it is removed, the instrument can be moved on its swivel castors (20).
Chamber base (observation plate) 80 cm × 80 cm
Fully transparent chamber:
Upper hood
side area 17 cm × 100 cm
Glass thickness 6 mm

Weight approx. 450 kg



The installation site surface must have sufficient load-bearing capacity (check prior to installation).

Refrigerant R 404 A, CFC-free
Alcohol circulation Membrane pump (13) 12 volts
Alcohol reservoir (12) 10 litres

Alcohol filling Isopropyl alcohol, high purity, 1000 ml
Art.-no.: 30092.70

Heating Duct heating (4)
max. 6 amps at 17 volts
Top heating (3)
max. 20 amps at 17 volts
Plate heating (6)
max. 5 amps at 17 volts

High voltage supply (51) 0 - 230 VAC at the monitoring device
= 0 - 7 kV at the grid (pos.)

The cover heater is simultaneously used as a high-voltage grid (ion extraction)!

Fluorescent lamps TLD 30/84 "white"
(16)

The instrument is fully functional after 45 minutes.

The values for optimal setting of the chamber are given on this adhered plate. It takes about 25 minutes before changes to them come into effect.

Adhered plate

Replacement part:

Air filter for the diffusion cloud chamber PJ 80

09043.53

10 POSSIBLE FAULTS

Fault message	Possible cause	Remedy
Cloud chamber does not start	No current Main switch off Time switch off Key-operated switch off Defective fuse	Switch current on Switch main switch on Set the time switch or switch to "Manual" Switch key-operated switch on Switch fuse on / replace it On renewed switch-off, call skilled personnel or Service.
No tracks or no cloud can be seen	No isopropyl alcohol in the alcohol channel There is isopropyl alcohol in the alcohol chamber	Open alcohol valve, fill channel, throttle flow to regular drops.- Check duct heating Check cooling (approx. -32°C)
Blurred traces	No high-voltage	Check high-voltage, switch on set regulator to 100 V, check fuse. On renewed switch-off, call skilled personnel or Service.
Loud noises from the membrane pump (rapid clacking)	No isopropyl alcohol in the alcohol reservoir	Fill isopropyl alcohol in alcohol using funnel plus tube, min. 3 L to max. 10 L. See "Handling hazardous substances".
Cooling stays on for a very long time or constantly	Room temperature too high Air inlet blocked	Let fresh air in Clean vents. See instructions. If these measures do not lead to normal running of the chamber, call refrigerating engineer / air conditioning engineer. See - instructions.
Excessive consumption of isopropyl alcohol	Chamber leakage	Check gasket under the lower hood. The stopper must be in the lock passage. Check chamber for outflow of isopropyl alcohol. If isopropyl alcohol soaks the wooden parts, hoses leak or drops are to be seen, put the cloud chamber out of operation. Emerging isopropyl alcohol is a fire hazard. See "Handling hazardous substances". If sealing problems cannot be eliminated, do not further operate the cloud chamber. The wooden body will be destroyed and there is an increased risk of fire. The cloud chamber must be repaired by skilled personnel or by Service.

11 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.

12 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
Robert-Bosch-Breite 10
D-37079 Göttingen

Phone +49 (0) 551 604-274
Fax +49 (0) 551 604-246

GENERIC

PHYWE

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PJ 80/3 09043.93**

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Approved (Sonderbau)	Hardieck		Date:	

PHYWE System GmbH & Co. KG

Robert-Bosch-Breite 10, 37079 Göttingen, Telefon +49 (0) 551 604- 0, FAX: +49 (0) 551 604
107,

www.phywe.de

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List of Abbreviations

Abbreviation	Meaning
AC	Alternating current
A	Ampere
V	Volt

1. INTRODUCTION

1.1. GENERAL

The PHYWE large diffusion cloud chamber 09043.93 is designed for power grids with 230 V AC supply voltage.

In the case the PHYWE cloud chamber 09043.93 is used with a 115 V AC supply voltage a modification of the cloud chamber 09043.93 is needed.

1.2. SCOPE

This document defines the modifications which have to be done to adapt the PHYWE large diffusion cloud chamber 09043.93 to a 115 V AC electrical power grid.

This documentation consists almost of images to make the procedure as easy as possible for the user.

2. SET-UP OF A 115 V AC / 230 V AC TRANSFORMER

In the following all necessary steps for the set-up are listed and afterwards any single step is documented with a photograph.

2.1. SET-UP STEPS LIST

Step/ Picture	Object	Part Number
01	Front side view of the transformer 100...200 V AC/230 V AC, 2 kVA1	XX330461
02	Rear side view of the transformer 100...200 V AC/230 V AC, 2 kVA1	XX330461
03	4 screws to be removed from the cloud chamber bottom for removal/fixation of the black frame which holds the glass cover	
04	Remove side walls / Chamber with removed side walls	
05	Position of the feed through and the corresponding dummy insert	
06	Feed through with removed dummy insert	
07	Storage position of the feed through dummy	
08	Position of the transformer XX330461 inside the cloud chamber	
09	Wiring of the power supply cable	
10	Installation of feed through dummy after positioning of the	

Step/ Picture	Object	Part Number
	transformer XX330461	
11	Positioned transformer with plugged in 230 V AC cable (black)	
12	Large Diffusion Cloud Chamber with installed black frame, 4 screws are fixed in each corner from the bottom	
13	Plug in the white cable in the local power grid (USA: 115 V AC)	

2.2. SET-UP PHOTOGRAPHIES

The set-up process of the 115 V AC version of the PHYWE large diffusion cloud chamber PJ 80/3 09043.93 is documented in the following photos.



Figure 2.1: Front side view of the PHYWE 100...200 V AC/230 V AC transformer XX330461. This transformer has an input voltage of 100...200 V AC and an output voltage of 230 V AC. The total power provided by this transformer is 2 kVA. The two analogue displays show the current (A) and voltage (V) of the output. On the left hand front side of the front panel a 25 A safety overload switch. On the right hand front side a 230 V AC socket with ground contacts (shock proof plug/socket) is installed. In this socket the plug of the diffusion cloud chamber (black cable) has to be installed.



Figure 2.2: Rear side view of the PHYWE 100...200 V AC/230 V AC transformer XX330461. On the right hand rear side the typ plate is mounted. The housing has many cooling slots. Attention! Do not cover these slots!

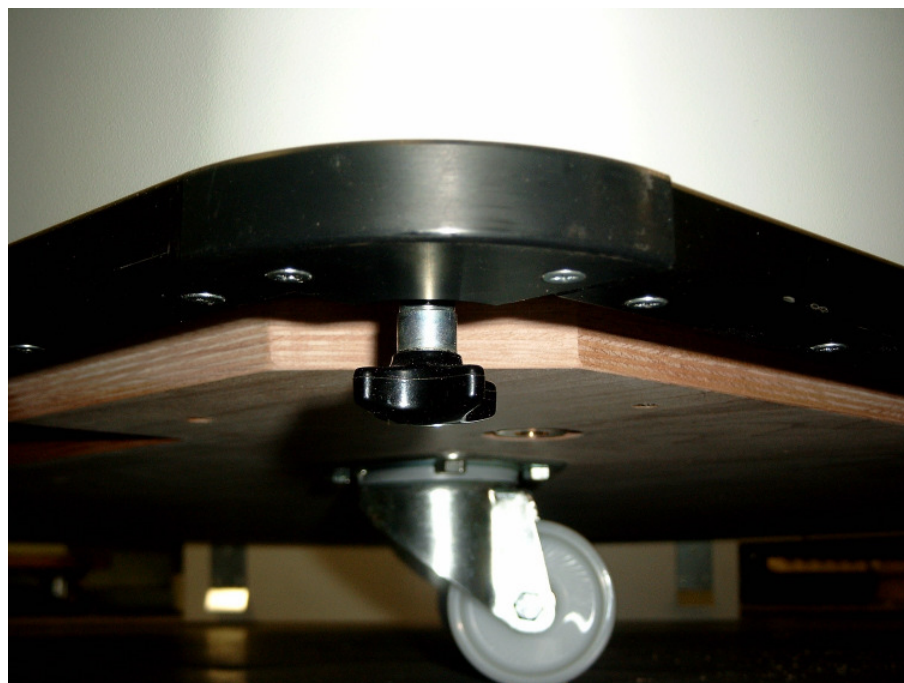


Figure 2.3: View on the bottom side of the cloud chamber corner. Each corner holds a screw with a hand wheel. With these screws the black frame on top of the chamber is fixed (for the black frame see also Figure 2.11). This frame has to be removed for removal/cleaning of the glass covers.



Figure 2.4: Side view of the cloud chamber with removed side walls. On the right hand side the feed through hole for the power cables can be seen. On the left hand side the operation panel (top) and the 2-Propanol storage vessel (bottom) are shown.



Figure 2.5: Inside view of the cloud chamber showing the feed through for radioactive sources – a dummy insert is installed.



Figure 2.6: Feed through for radioactive sources with removed dummy insert. The insert has to be removed for the installation of the PHYWE transformer XX330461 inside the base of the cloud chamber.



Figure 2.7: Inside view of the PHYWE cloud chamber PJ 80/3 with installed PHYWE transformer XX330461. The feed through dummy insert is stored into the wooden holder below the place of the transformer.



Figure 2.8: Feed through hole for the power cables. The black cable is the 230 V AC cable of the cloud chamber and the white cable is the supply cable from the grid – for the USA this means 115 V AC.



Figure 2.9: Inside view of the cloud chamber with installed PHYWE transformer XX330461 and feed through dummy insert.



Figure 2.10: Inside view of the PHYWE cloud chamber PJ 80/3 09043.93 with installed PHYWE transformer XX330461, installed feed through dummy insert and plugged in 230 V AC plug in the socket of the PHYWE transformer XX330461.

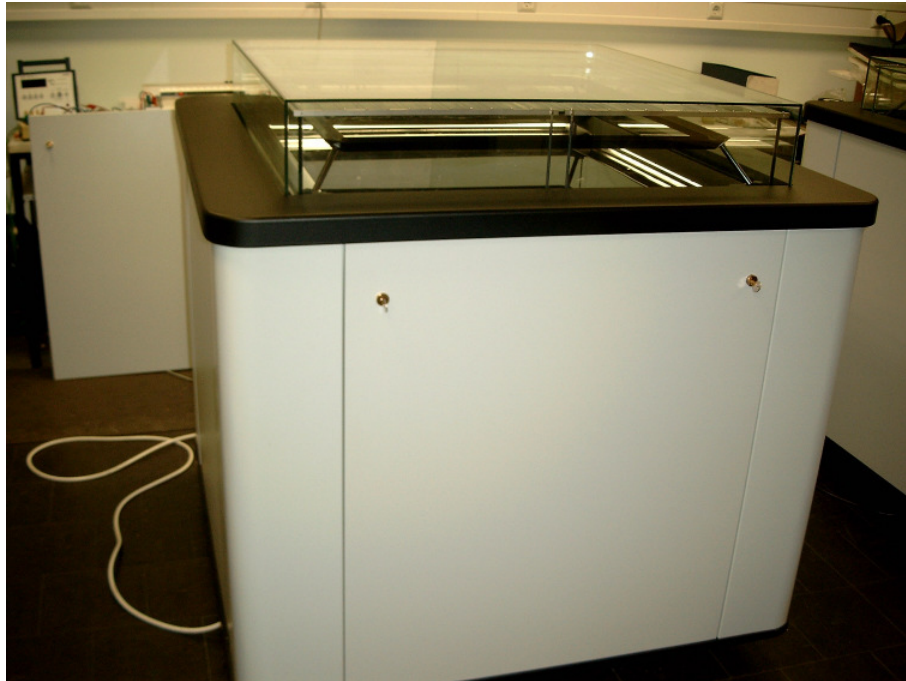


Figure 2.11: Completely installed PHYWE large diffusion cloud chamber PJ 80/3 09043.93 with closed side walls and ready for operation.

3. ADDITIONAL REQUIRED DOCUMENTS

For the installation and set-up of the PHYWE large diffusion cloud chamber PJ 80/3 09043.93 further documents are required.

Document Title	Document Number
Diffusion Cloud Chamber PJ 80/3	09043.93 09043.90 09043.98
Diffusion-Nebelkammer PJ 80/3	09043.93 09043.90 09043.98