SIEMENS

MAGNETOM

MR

Planning Guide

MAGNETOM Trio *syngo* MR

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Document revision level

The document corresponds to the version/revision level effective at the time of system delivery. Revisions to hardcopy documentation are not automatically distributed.

Please contact your local Siemens office to order current revision levels.

Disclaimer

The installation and service of equipment described herein is to be performed by qualified personnel who are employed by Siemens or one of its affiliates or who are otherwise authorized by Siemens or one of its affiliates to provide such services.

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Safety

The safety notes are supplemented by specific descriptions in the documents supplied by us, e.g. product documents, ARTD (general guidelines) as well as by written instructions in specific cases.

All safety instructions must be observed in the performance of work and tests; in addition, there must be compliance with prescribed country-specific requirements (e.g. occupational safety and accident prevention regulations).

NOTE	**It is mandatory to read the Safety informations at the following Link:** **Link in Intranet** **> SELECT Safety**

Overview of the system components

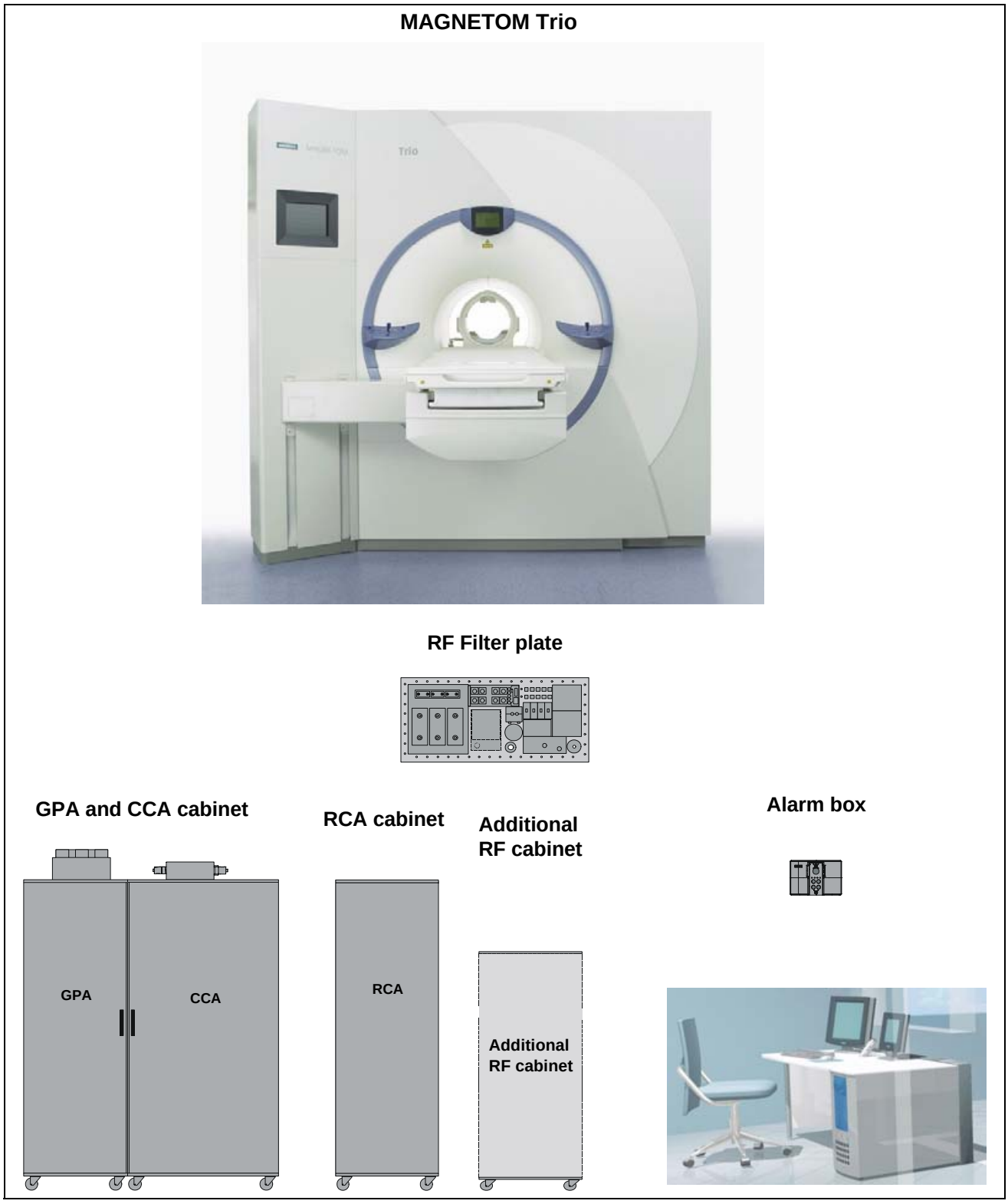

Fig. 1 System Overview

Project Manager Information

Trio a Tim system

The MAGNETOM Trio is already sold with the Tim functionality upgrade.

This means if you are planning a Trio system you have to consider the "Trio a Tim system" specifications. The differences to the "standard" Trio system are:

- "On-site electrical installations" on page 6 - 1
- "On-site water supply" on page 7 - 1

Service, installation and accessories

Service tools and auxiliary materials see also: "Installation and service tools" on page 13 - 1

The set of auxiliary service materials comprises the service and auxiliary materials for the product.

Installation information

NOTE	**The transportation, mechanical installation and cabling of the system has to be performed by trained personnel of our service providers (Hegele, RemeTronix) only!** **The system installation e.g tune-up, start-up will be performed by HSC Erlangen, US Installation or Factory.**

Project management

NOTE	**For each project the actual datas/informations and Planning Guides have to be used!** **Changes to the previous version of this document can be found under: "Changes to previous version" on page 15 - 1** **It is the responsibility of the Project Manager to check the Intranet for the latest version of the Planning Guide.** **In some cases PG Speed infos will be distributed.** **http://cs.med.siemens.de/For Service/Planning**

Service provider Installation

Subsidiaries and regional offices, external service providers, and the MR product group have to work together reliably and in partnership to ensure successful system assembly.

System assembly by Hegele or Uni-Data presupposes a designated project manager and support (during assembly) by the field office.
Tasks are assigned as follows:

Task	Responsibility
• Project planning and room preparation	Project manager from the subsidiary
• Project plan	
• Complete coordination	
• Transport	Hegele, Uni-Data (service provider)
• Delivery	
• Transfer	
• Assembly + Cabling	

The scope of service provided by Hegele and Uni-Data is as follows:

1. All work will be performed by trained personnel (current training certification will be created and stored by Siemens) in accordance with the documentation (installation instructions) delivered with the system.
   Work completed by the service provider will be confirmed in the "installation protocol" on pages 1 and 2. The current version of the "Service Provider Installation Protocol" can be found in the blue binder "Technical Documents Volume 1 of 2."
   The Key Account Manager of the service provider by Hegele, Unidata or other informs the on-site project manager as quickly as possible regarding deviations (time and reason) to the target specifications for the completion date.
2. The Key Account Manager of the service provider informs the project manager of the German subsidiary / RC or the Factory Installation Team (presently. Mr. Link / Mr. Geicke) regarding the telephone number of the installation team for the respective job.
3. Transport of MR systems to the following countries:
   Andorra, Benelux nations, Denmark, Germany, Finland, France, Greece, Great Britain, Ireland, Italy, Liechtenstein, Monaco, Norway, Austria, Portugal, Sweden, Switzerland, Spain, Vatican City.
   In the future, the following countries will also be served (for information purposes only; initially no lump-sum payments, but rather, invoices for expenses):
   Albania, Bosnia-Herzegovina, Bulgaria, Estonia, Serbia-Montenegro, Hungary, and Cyprus.
4. Unloading and transferring the MR systems

5. Standard transfer
   Trio: Flat transport route up to 25 m

	Dimensions for delivery (standard)	Minimum dimensions
height	2.55m	2.42m [1]
width	2.40m	2.17m [2]
diagonal	4.33m [3]	3.09m [4]

1. Dimensions excluding transport devices
2. Measurement applies after removing covers and electronic components
3. With patient table, excluding covers
4. These dimensions apply when the patient table, covers, and electronic components have been removed.

6. Installing and securing the MR system in accordance with documentation delivered with system (blue service binder)
7. Concluding activities after magnet has been positioned, e.g., disposal of packing materials, return of reusable pallets to Erlangen, such as the pallets for the filter plates
8. Installing and cabling the MR components in the RF room and the control room, initially without connecting to the on-site power supply.
9. Installation and cabling of hardware options
10. Completion of the "Service Provider Installation Protocol" (transfer to MRL employee responsible for start-up, or insert in binder "Technical Documents Volume 1 of 2").

The following services are not covered by the lump-sum payment for assembly and are charged by the service provider directly to the subsidiaries / regions:

1. Work and travel time for additional personnel (> 4 employees) required in conjunction with transfer and assembly.
2. Delays and wait times caused by project management (e.g., delays due to construction, workers in the room).
3. Crane costs.
4. Crane bridge / use of other trucks.
5. Site visits, including all travel costs (e.g., rental car, gasoline, flight, hotel).
6. Costs for an additional trip, after actual work performed for cabling / assembly (e.g., when there are delays due to construction .
7. Patient table disassembly.
8. Project-related hotel costs in conjunction with transfer and assembly (e.g., during RF room construction)
9. Disassembly, correct packing, loading, and transport of old systems.
10. Additional expenditures for deviations to standard transfers; additional expenditures for special work and materials when transport route is not flat; modifications required for the RF room
11. Additional expenditures during cabling for missing or insufficient cable ducts; when the technical room is not on the same floor as the MR room, or there is a room between them; routing required for cable sets that are too long or too short; cabling for uncommon options.
12. Return of "venting kits".

System Start-Up

If desired, employees of the MR production unit can perform the on-site start-up of the MR system.

Subsidiaries and regional offices, external service providers, and the MR product group working together reliably and in partnership remains the prerequisite.

Task	Responsibility
• Start-Up, Tune-Up including function and image quality testing.	Employees of the MR production unit

There are two contact persons within the MR product group for planned and current deployment of the MR start-up group:

Mr. Günther Link Tel. 09131 / 84-5587

Mr. Rainer Geicke Tel. 09131 / 84-8463

MR Product Group

Department MR LA 1

Allee am Röthelheimpark 2

91050 Erlangen Fax. 09131 / 84-8631

Handbook numbers:

07364750 - MAGNETOM Trio - Montage

Transport, delivery, transfer, assembly, and cabling of all system components, in rooms appropriately prepared, are performed by service provider Hegele or Uni-Data in accordance with the installation instructions delivered with the system. This includes the following activities:

- Positioning the components
- Assembling and securing the MR system
- Assembling and cabling of hardware options
- Assembling and cabling of MR components in the RF room and control room
- Installing the filter plate
- Concluding activities after magnet has been positioned, e.g., disposal of packing materials, return of reusable pallets to Erlangen (such as the pallets for the filter plates)
- Refer to the planning guide for the installation prerequisites.
- For service not covered by the lump-sum for assembly, refer to SI M 9-050, "ASSEMBLY AND INSTALLATION, Training, EVOLVE, Miscellaneous," Page 3.

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General

Information for using optical stimulation equipment

One of the major applications of the MAGNETOM Trio is fMRI (functional imaging). Due to the design the easiest way to position the optical stimulation equipment could be from the rear. This fact has to be considered during planning when the customer will use fMRI. Additional space is required for the stimulation equipment at the rear (service end) side of the magnet (e.g. beamer, panel etc.).

➪ Due to this fact we suggest 1.5m to 2.0m distance between the magnet and the rear RF wall.

Consult users manufacturer manual of the stimulation equipment for details regarding installation, required space and distance to the magnet (fringe field).

Planning

Major planning issues:

NOTE	**Power requirements have to fulfil Siemens specifications!** **The specifications are part of this Planning Guide. Refer to "On-site electrical installations" on page 6 - 1**

NOTE	**Chilled water requirements have to fulfil Siemens specifications!** **The specifications are part of this Planning Guide. Refer to "On-site water supply" on page 7 - 1**

When planning the MR-suite, the following influence the suitability of the site:

- Interference generated by the magnet
- Interference affecting the magnet
- Load capacity
- Minimum door height
- Minimum room height

Information for using digital cameras

The digital camera for *syngo* MR must be equipped with a DICOM interface.

The camera has to be equipped with a certain amount of memory; consult the "Cameras" collection on the Intranet for details.

NOTE	**Older digital camera models without DICOM interface will not work with *syngo* MR!** **A special interface has to be installed between the Host PC and the digital camera.**

Co-Siting

General

➪ Co-Siting describes the prerequisites ("Co-siting prerequisites" on page 2 - 4) for planning/ installing two MR systems with the same operating frequency (field strength) side by side.
One scenario could be:
A customer does have already a 3.0T system under operation and is getting a second 3.0T system in the close vicinity of the first one.

NOTE

**It is not possible to install electronics components (CCA/GPA/RCA/Optional RF-cabinet) of systems with the same operating frequency side by side! Additional prerequisites are mandatory!
("Co-siting prerequisites" on page 2 - 4)**

The CCA cabinets have to be sepatated by 6m (center to center Fig. 2; Fig. 3). The magnetic field of one system has to be ramped to the upper frequency limit of tolerance the other magnet to the lower frequency limit of tolerance!

Shim is only optimized with both magnets ramped up during the shimming procedure.

Magnet distances

Minimum distances between magnets							
	Harmony	**Symphony**	**Sonata**	**Avanto**	**Allegra**	**Trio**	**Concerto**
Harmony	**4.5m**	5.0m	5.0m	5.0m	7.0m	7.0m	5.0m[1]
Symphony	5.0m	**5.0m**	5.0m	5.0m	7.0m	7.0m	6.0m[1]
Sonata[2]	5.0m	5.0m	**5.0m**	5.0m	7.0m	7.0m	6.0m[1]
Avanto	5.0m	5.0m	5.0m	**5.0m**	7.0m	7.0m	6.0m
Allegra[3]	7.0m	7.0m	7.0m	7.0m	**10.0**	10.0	10.0m
Trio[3]	7.0m	7.0m	7.0m	7.0m	10.0	**10.0m**	10.0m
Concerto[3]	5.0m	6.0m	6.0m	6.0m	10.0m	10.0m	**10.0m**

1. With EFI unit, no ramping during measuring; Additional ironshielding can reduce distance.
2. Site survey measurement **recommended**!
3. Site survey measurement **required/mandatory**!

Measurement frequence and field strength

Operating frequency:

- Max. 123,265 MHz (= Typ + 65 kHz)
- Typ. 123,200 MHz
- Min. 123,100 MHz (= Typ - 100 kHz)

Field strength:

- Max. 2,895 T
- Typ. 2,894 T
- Min. 2,891 T

Co-siting prerequisites

NOTE **The following prerequisites for Co-Siting are mandatory for one of the two MR systems:**

If two systems with the same operating frequency have to be planned (or one is already installed) take the following into account:

- The attenuation of the **RF-cabin** must be **100dB** at the required operating frequency.
- For waveguides the following calculation applies:

$$L_{min} = 4.0 \times d_i$$

L_{min}= length; d_i = diameter (of waveguide)

- The two RF rooms must **not** be **electrical connected** at all.
- The openings of the RF-rooms (e.g. door, window, waveguide) have to be **turn away** from each other. Having the mentioned openings (e.g. door, window, waveguide) **facing** each other **must be avoided**.
- The **CCA cabinets** must be installed in a min. **distance** of **6.0m** ("CCA distance" on page 2 - 6) from each other.
- The cable ducts (CCA side) of the two systems have to be installed separated by **6m**.
- The short cable set (**1.5m**) is **not permitted** to use with two systems in Co-Siting even if the CCA cabinet is installed directly underneath the RF filter plate.
- There must be a **separate on-site power distribution panel as far away as possible from each other** installed for each system.
- The **RF filter plates** have to be positioned as far as possible **away from each other**.
- The connection of the RF filters (gradient and power) has to be performed as requested in the installation manual (e.g force).
- One of the MR systems has to be ramped to the **upper frequency limit** of **e.g. 123.265 MHz (3.0T)**, the other MR system has to be ramped to app. **100kHz less** than the first one.

NOTE **The special ramping procedure could require a different re-ramping time interval (to the operating frequency after the normal field decay) of the two systems!**

Decay

➪ The magnet marked "magnet 2" in the example in Fig. 1 has to be re-ramped first because due to the normal magnetic field decay the lower operating frequency tolerance limit will be reached earlier.

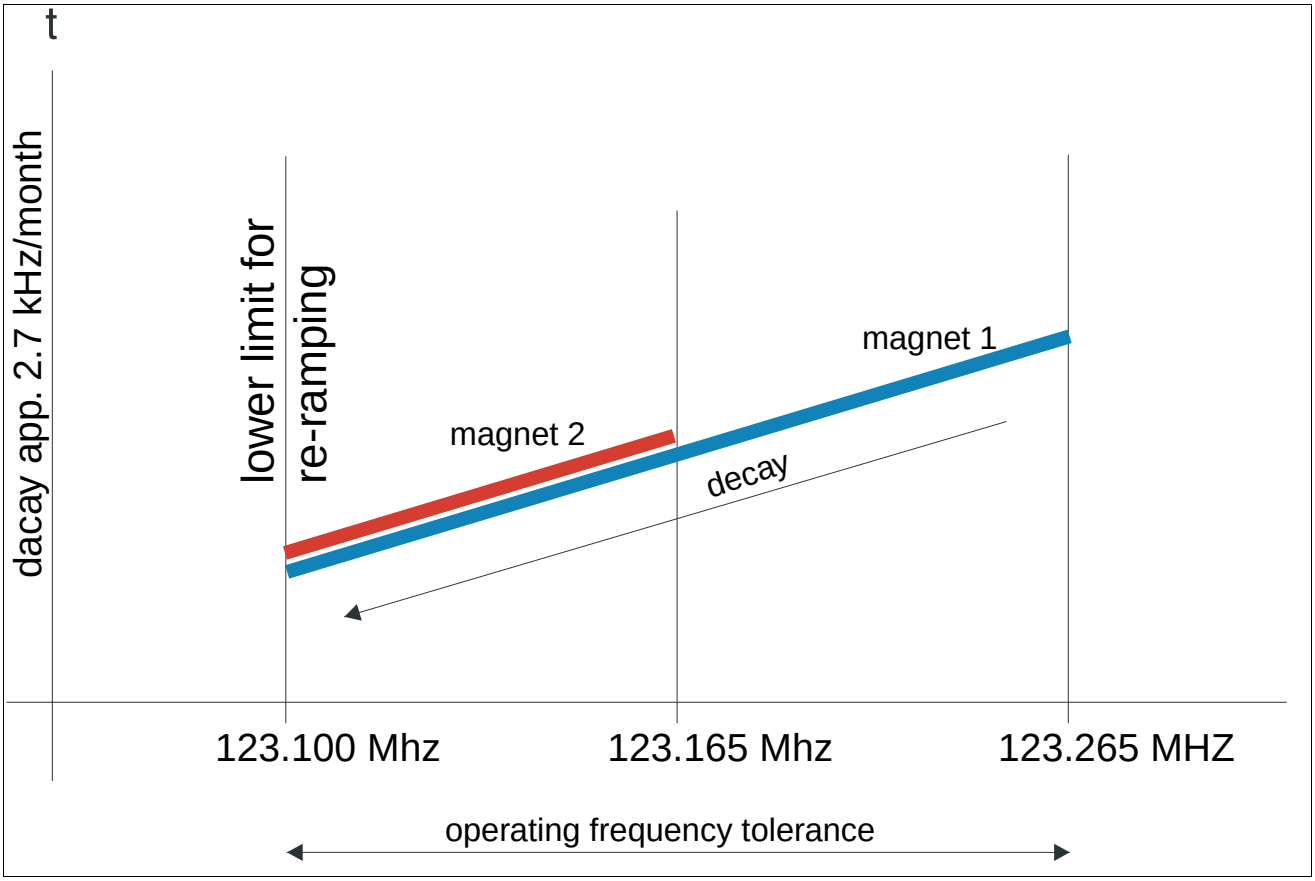


Fig. 1 decay

NOTE	**The special ramping procedure could require a different re-ramping time interval (to the operating frequency after the normal field decay) of the two systems!**

CCA distance

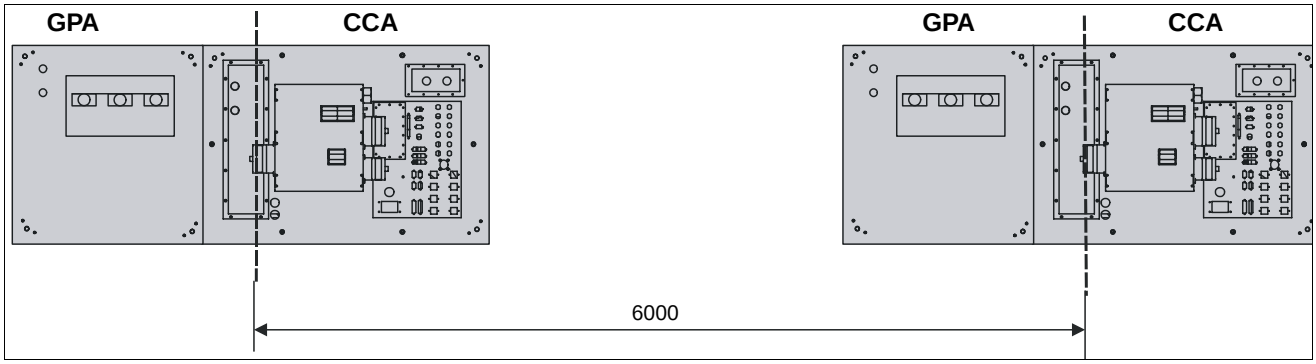


Fig. 2 CCA distance

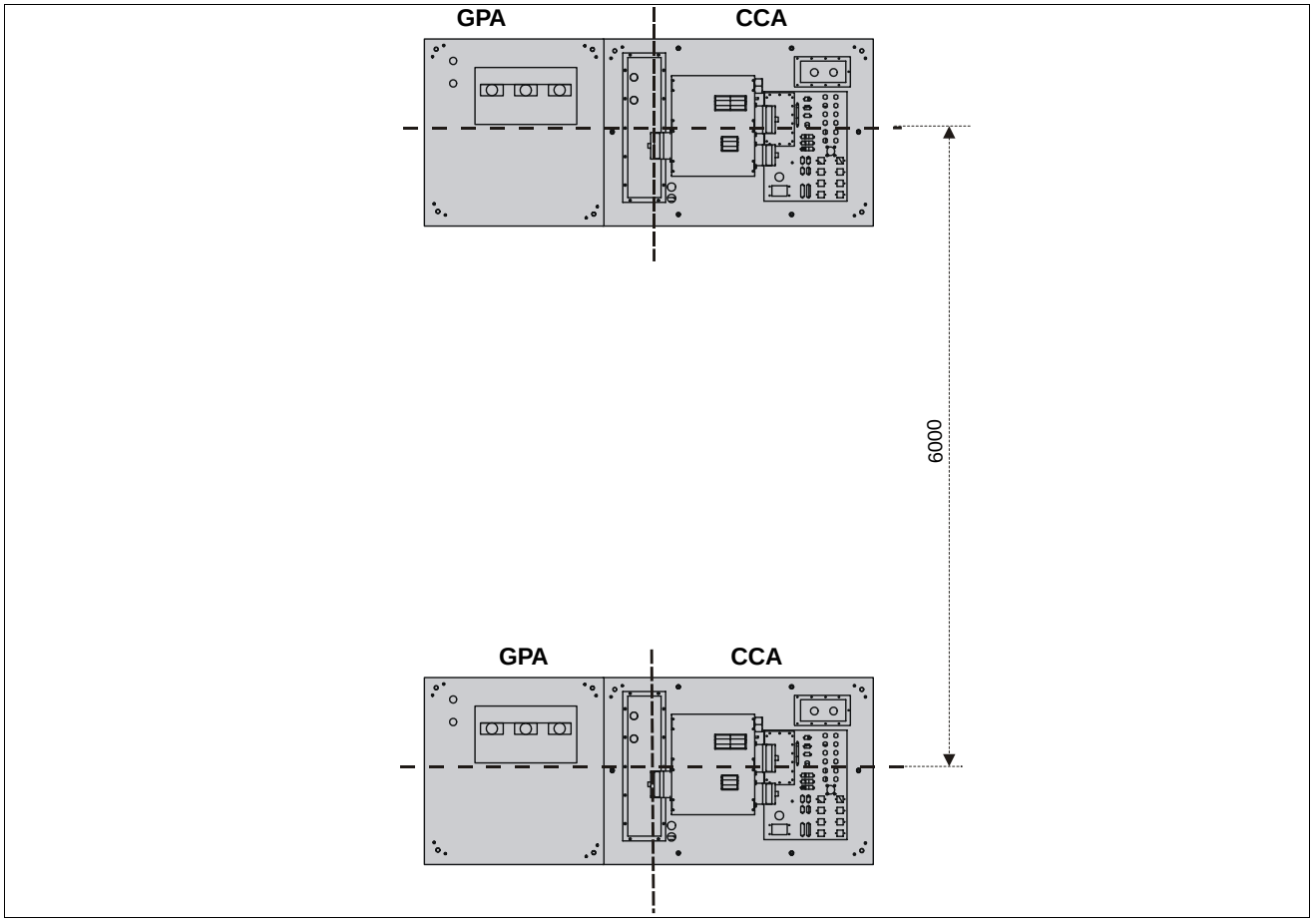


Fig. 3 CCA distance

Magnet orientation

NOTE

Two magnets with the same operating frequency positioned in "Z" direction should be avoided due to the required distances and increased RF coupling between the systems!

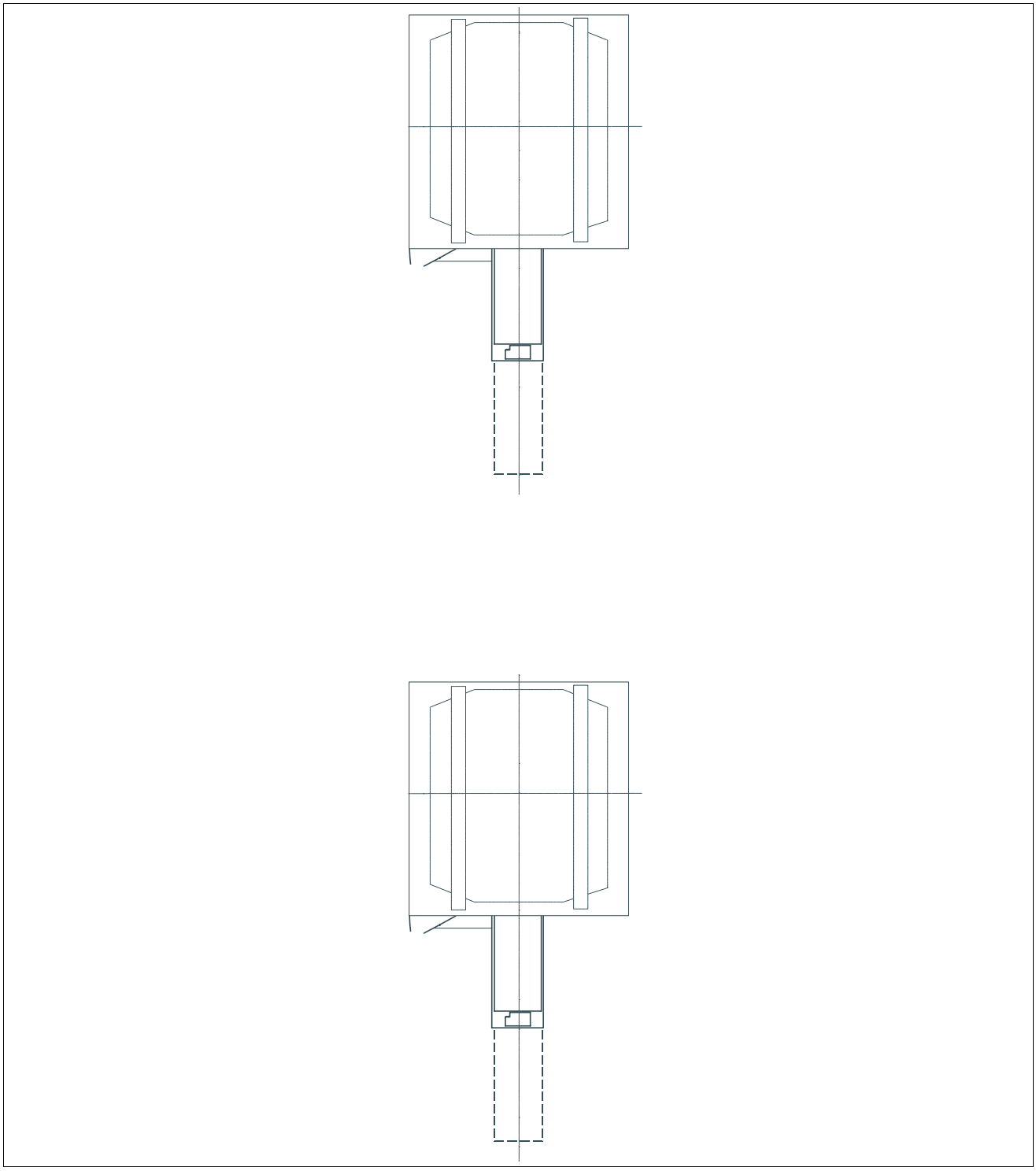


Fig. 4 Two magnets on the Z axis

NOTE	**Two magnets with the same operating frequency positioned in "X" direction is possible (10m distance center/center)!**

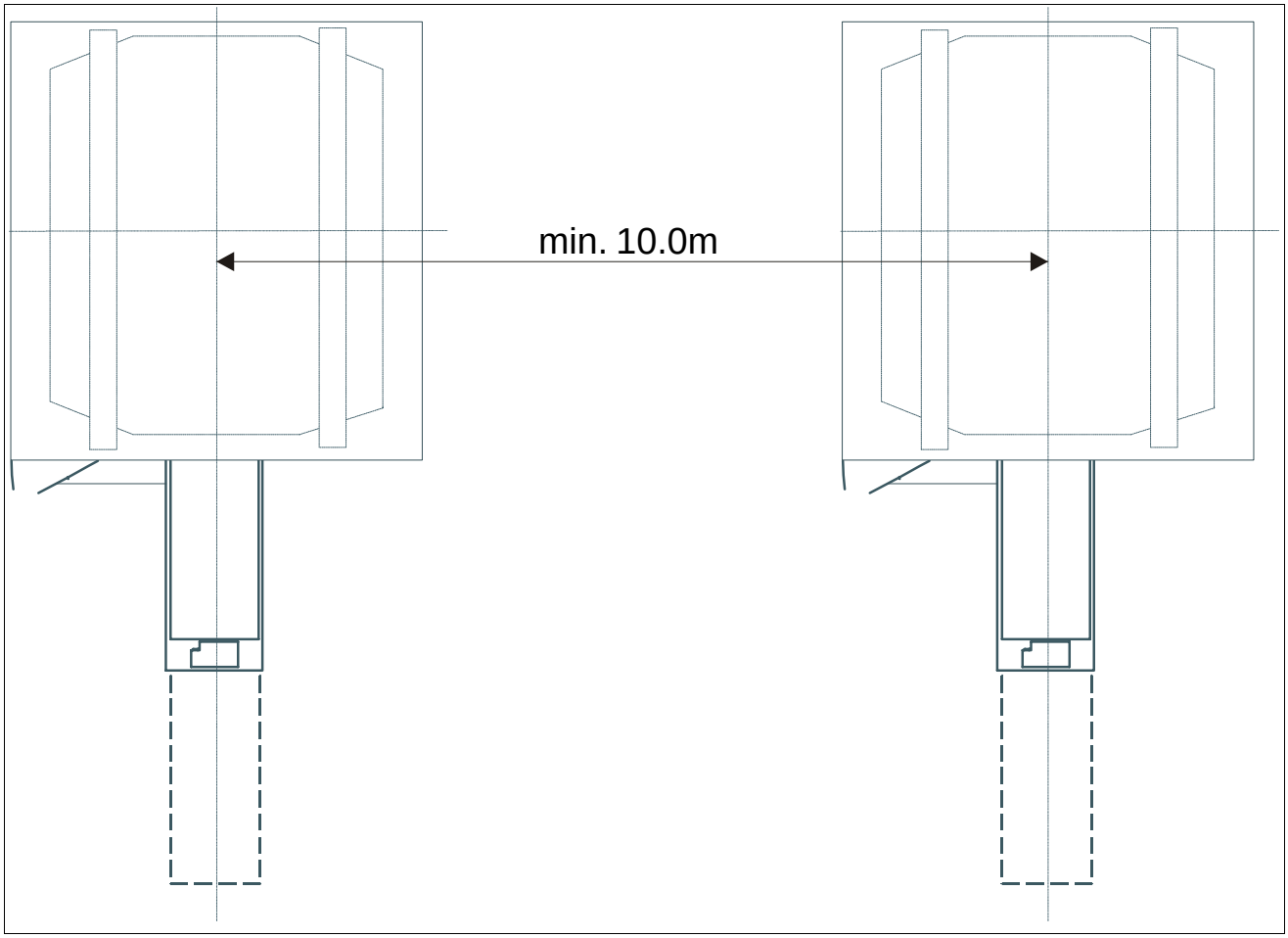


Fig. 5 Two magnets on the x axis

NOTE **Two magnets with the same operating frequency positioned in perpendicular to each other is possible!**

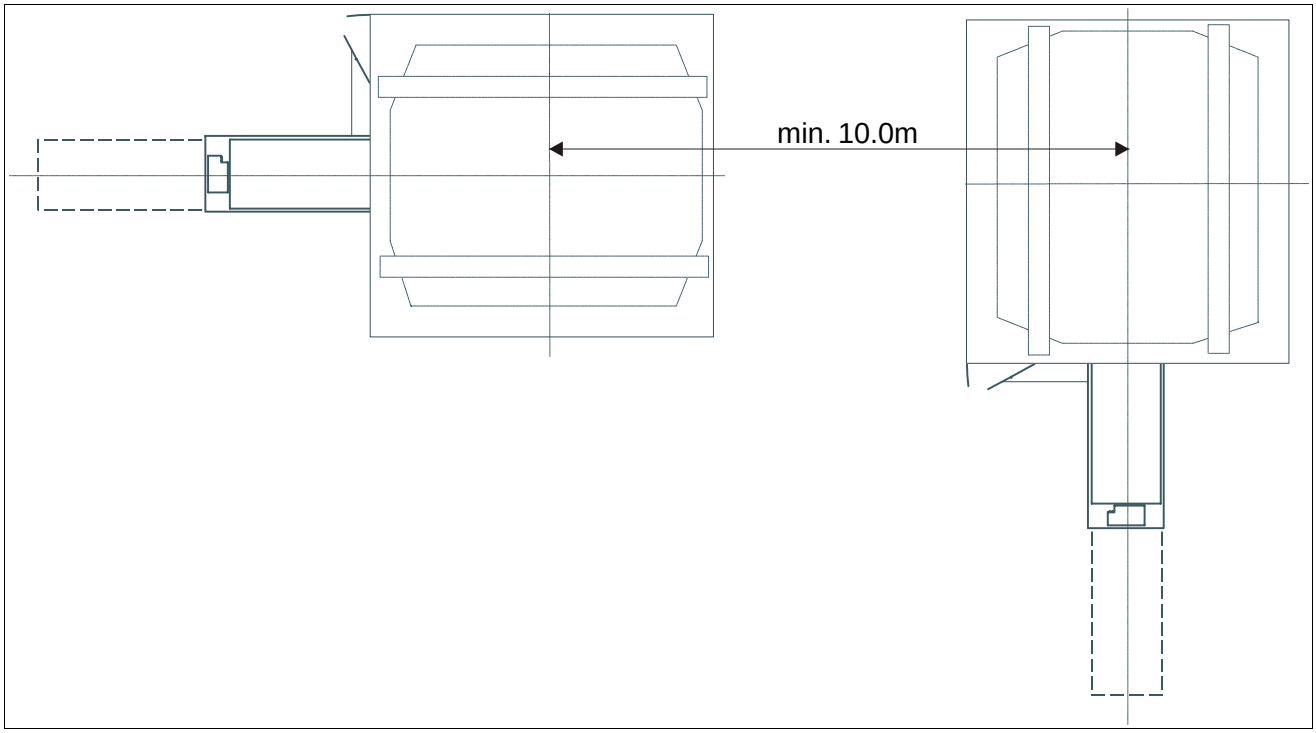


Fig. 6 Two magnets perpendicular to each other

Magnet siting requirements

Minimum distances between magnets (Siemens only)

NOTE

It is not possible to install electronics components (ECA/GPA/RCA/Optional RF-cabinet) of systems with the same operating frequency side by side!

Refer to: "Co-Siting" on page 2 - 2

The CCA cabinets have to be sepatated by 6m. The magnetic field of one system has to be ramped to the upper frequency limit of tolerance the other magnet to the lower frequency limit of tolerance!

Shim is only optimized with both magnets ramped up during the shimming procedure.

➪ The final location selected for the magnet has to ensure that the stability and homogeneity of the magnetic field are not adversely affected by extraneous fields. In addition, the magnetic fringe field should not impair the safety of personnel or the functions of other devices in the vicinity of the magnet.

The following minimum distances between magnets are valid if:

- Both magnets are on field
- No magnet is ramping during the other runs applications
- If one magnet is switched off the other magnet has to be reshimmed

➪ Get in contact with the VR P / CS department if you have non Siemens Medical Solutions products or older systems or if you have to plan e.g. two systems with the same operating frequency.

Minimum distances between magnets

	Harmony	Symphony	Sonata	Avanto	Allegra	Trio	Concerto
Harmony	**4.5m**	5.0m	5.0m	5.0m	7.0m	7.0m	5.0m[1]
Symphony	5.0m	**5.0m**	5.0m	5.0m	7.0m	7.0m	6.0m[1]
Sonata[2]	5.0m	5.0m	**5.0m**	5.0m	7.0m	7.0m	6.0m[1]
Avanto	5.0m	5.0m	5.0m	**5.0m**	7.0m	7.0m	6.0m
Allegra[3]	7.0m	7.0m	7.0m	7.0m	**10.0**	10.0	10.0m
Trio[3]	7.0m	7.0m	7.0m	7.0m	10.0	**10.0m**	10.0m
Concerto[3]	5.0m	6.0m	6.0m	6.0m	10.0m	10.0m	**10.0m**

1. With EFI unit, no ramping during measuring; Additional ironshielding can reduce distance.
2. Site survey measurement **recommended**!
3. Site survey measurement **required/mandatory**!

MAGNETOM Trio min. distance to system type:	**distance to the magnet iso center in m**
1.0T Harmony	7.0
1.5T Symphony	7.0
1.5T Sonata	7.0
1.5T Avanto	7.0
3.0T Allegra	10.0
3.0T Trio	10.0
0.2T Concerto	10.0
0.2T Jazz	10.0

NOTE

Shim is only optimized with both magnets ramped up!
No magnet is ramping during the other runs applications!
If one magnet is switched off (field is off) the other magnet has to be re-shimmed!

Effects of the magnetic field on peripheral devices

The fringe field may affect the functions of devices operated in the vicinity of the magnet. To prevent interference, the magnetic flux density at the location of these devices may not exceed certain values. The flux density acceptable for these devices depends on a number of different parameters. All pertinent information is available through the manufacturer.

NOTE **The fringe field of the MR system may make its location critical as specified in the planning documentation. Additional room shielding can be calculated and recommended by the planning department VR P in Erlangen.**

Reference values for acceptable magnetic flux densities B_{max}

B in mT[1]	distance in radial direction in m (X/Y)	distance in axial direction in m (Z)	Note
20	1.6	2.0	Servo ventilator by Siemens
10	1.7	2.3	RF-filter plate
5	1.9	2.6	MR electronics cabinet
3	2.0	2.8	Small motors, watches, cameras, magnetic data carriers
1	2.2	3.4	Processors, magnetic disk drives, oscilloscopes
0.5	**2.5**	**4.0**	**Pacemakers, B/W monitors, X-ray tubes, magnetic data carriers, insulin pumps**
1.0	2.6	4.4	Color LCD System monitor
0.2	2.7	4.8	CT systems by Siemens
0.3	2.8	5.1	Color monitor shielded
>0.15			Computer monitor (PC)
0.1	3.0	5.6	Linear accelerators by Siemens
0.05	3.7	6.6	X-ray image intensifiers, gamma cameras, linear accelerators from other manufacturers

1. **1mT = 10 Gauss**

Source of interference

NOTE	For each site a site survey measurement has to be performed.

- ➪ In critical cases, either Siemens or a third party authorized by Siemens checks the suitability of the site. The tests are designed to detect electro-magnetic and mechanical sources of interference.
- ➪ Siemens is not responsible for inspecting structural prerequisites, for example, the load capacity of floors or the heating and air conditioning system of the site. Similarly, Siemens is not responsible for executing or monitoring preliminary on-site installation steps. For these reasons, Siemens will not be held liable for the customer's failure to maintain specific operating conditions.

Effects on the magnetic field are divided into:

- **static interferences** caused by e.g. ferromagnetic objects, especially those located underneath the magnet
- **dynamic interferences** caused by e.g. moving ferromagnetic objects or low-frequency magnetic fields

NOTE	Static effects can be compensated for by shimming. Dynamic effects are compensated for by maintaining the maximum values indicated.

NOTE	A magnetic shielding is required e.g. if minimum distances to static / moving iron masses or AC/DC cables cannot be kept.

Dynamic

Source of interference (dynamic)	min. distance in radial direction (X/Y) to the magnet iso center in m	min. distance in axial direction (Z) from the magnet iso center in m	Note
Iron object < 50 kg	5.5	6.5	With additional iron shielding it is possible to reduce these distances by about 1m! For objects which appear under an angle of 45dg to 0dg from the Z-axis the axial values must be applied! The distances are measured from magnet center to the edge of the object!
Iron object < 200 kg	6.0	7.0	
Iron object < 900 kg	6.5	8.0	
Iron object < 4500 kg	7.0	9.5	
Wheelchair / Bed	5.5	6.5	
Car	6.5	8.0	
Truck	7.0	9.5	
Train	40.0	40.0	
Subway / Tram	40.0	40.0	
Axiom Artis (Miyabi)	30.0	30.0	

AC interferences

Source of interference (AC)	min. distance in radial direction (X/Y) to the magnet iso center in m	min. distance in axial direction (Z) from the magnet iso center in m	Notes
AC Transformer < 100 kVA	12.0	8.0	The distances are measured from magnet center to the edge of the object!
AC Transformer < 250 kVA	12.5	10.0	
AC Transformer < 650 kVA	13.0	12.0	
AC Transformer < 1.600 kVA	14.0	15.0	
AC Cables < 10 A	2.0	2.0	The distances are measured from magnet center to the edge of the object!
AC Cables < 25 A	2.0	2.0	
AC Cables < 50 A	2.0	2.0	
AC Cables < 100 A	3.0	2.0	
AC Cables < 250 A	7.0	3.0	
AC Cables < 1000 A	12.0	5.0	

Static interferences

Source of interference (static)	min. distance in radial direction (X/Y) to the magnet iso center in m	min. distance in axial direction (Z) from the magnet iso center in m	Notes
Water cooling unit	4.0	4.0	

For statical iron (reinforcements) hold the following limitations:

Iron mass	Iron mass 1.2m distance from magnet iso center
allowable reinforcement steel in the floor	</= 100 kg / m²
allowable iron beam mass in the floor	</= 100 kg / m

NOTE

Any type of iron underneath the magnet can generate problems e.g. shimming problems.

Consult VR P PS if the above mentioned iron masses are exceeded or the site survey measurement, which is mandatory for Trio systems, require VR P PS assistance.

NOTE

According to our recent experience the mass of the floor plate should be about 600 kg/m² (corresponding to a thickness of about min. 20 cm or 8") to achieve a good vibration and structure-borne sound isolation.

Additional iron shielding

➪ For additional iron shielding calculations (if required) contact the planning department of **VR P PS**, telephone:
++49 (0) 9131-84-7624
++49 (0) 9131-84-7616

See also: http://pascad.med.siemens.de/de/

Fringe field distribution

NOTE

The project manager has to inform the customer to protect the controlled access area (0.5mT) with the delivered warning signs. All doors leading into the 0.5mT area must be identified/protected with a warning sign. The project manager provides the customer the position of 0.5mT line as a e.g. table from the planning guide which is showing the diatances or the customer site drawings which are indicating the 0.5mT line. The warning sign “cardiac pacemaker” is e.g. for identifying the 0.5mT line. The warning signe “strong magnetic field” is e.g. for identifying the entrance doors into the examination room or the 0.5mT line.

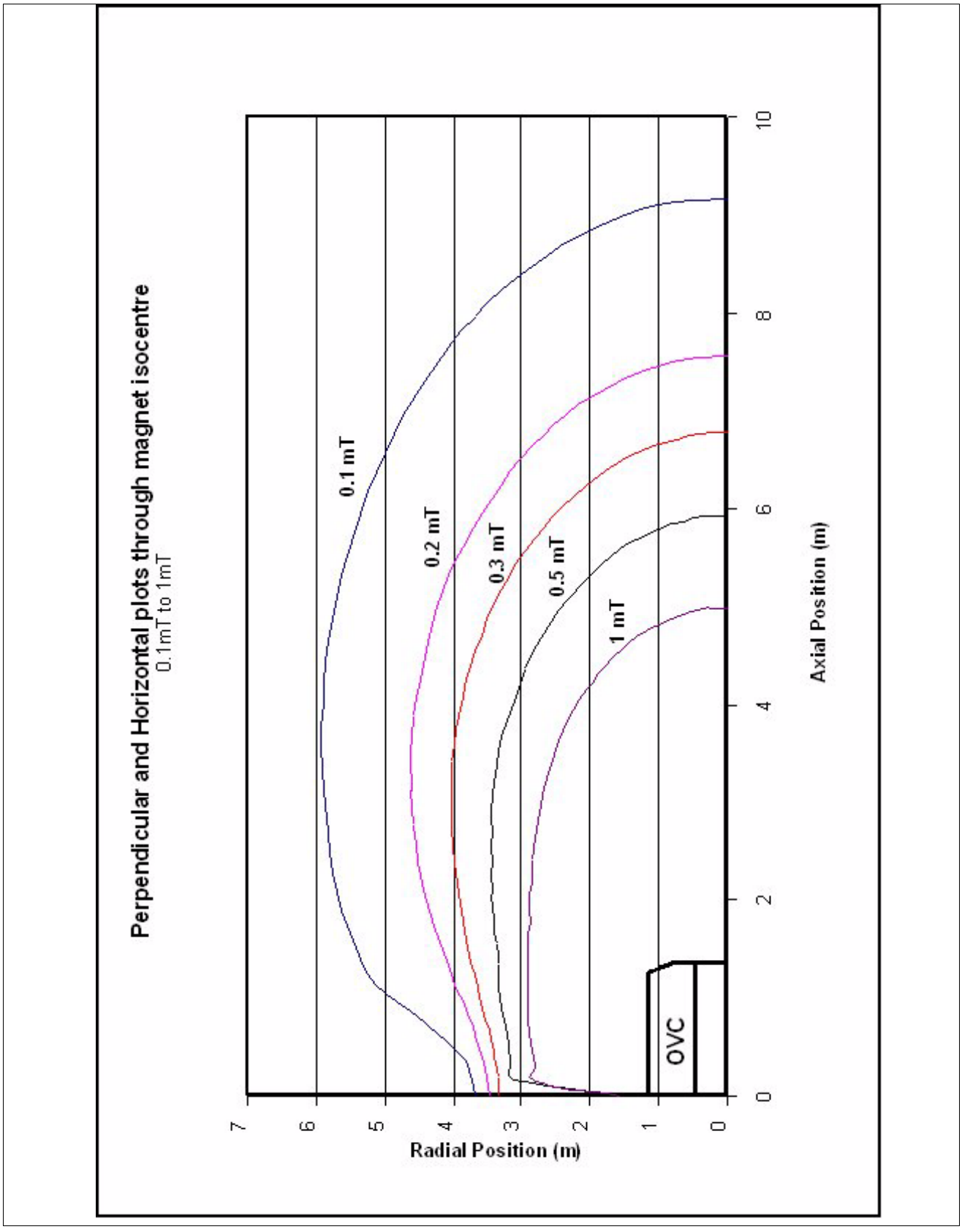


Fig. 7 Fringe field distribution axial/radial

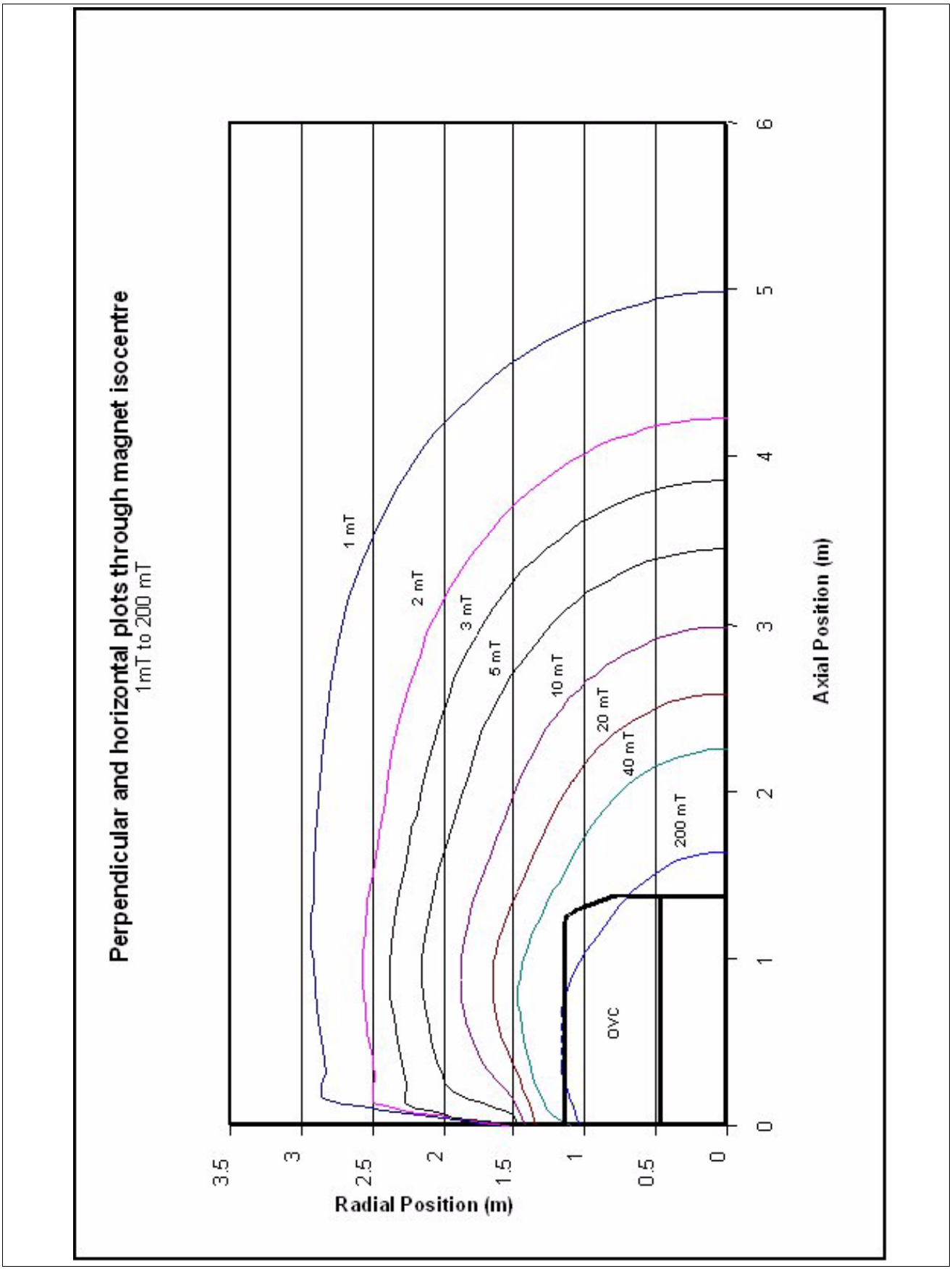


Fig. 8 Fringe field distribution axial/radial

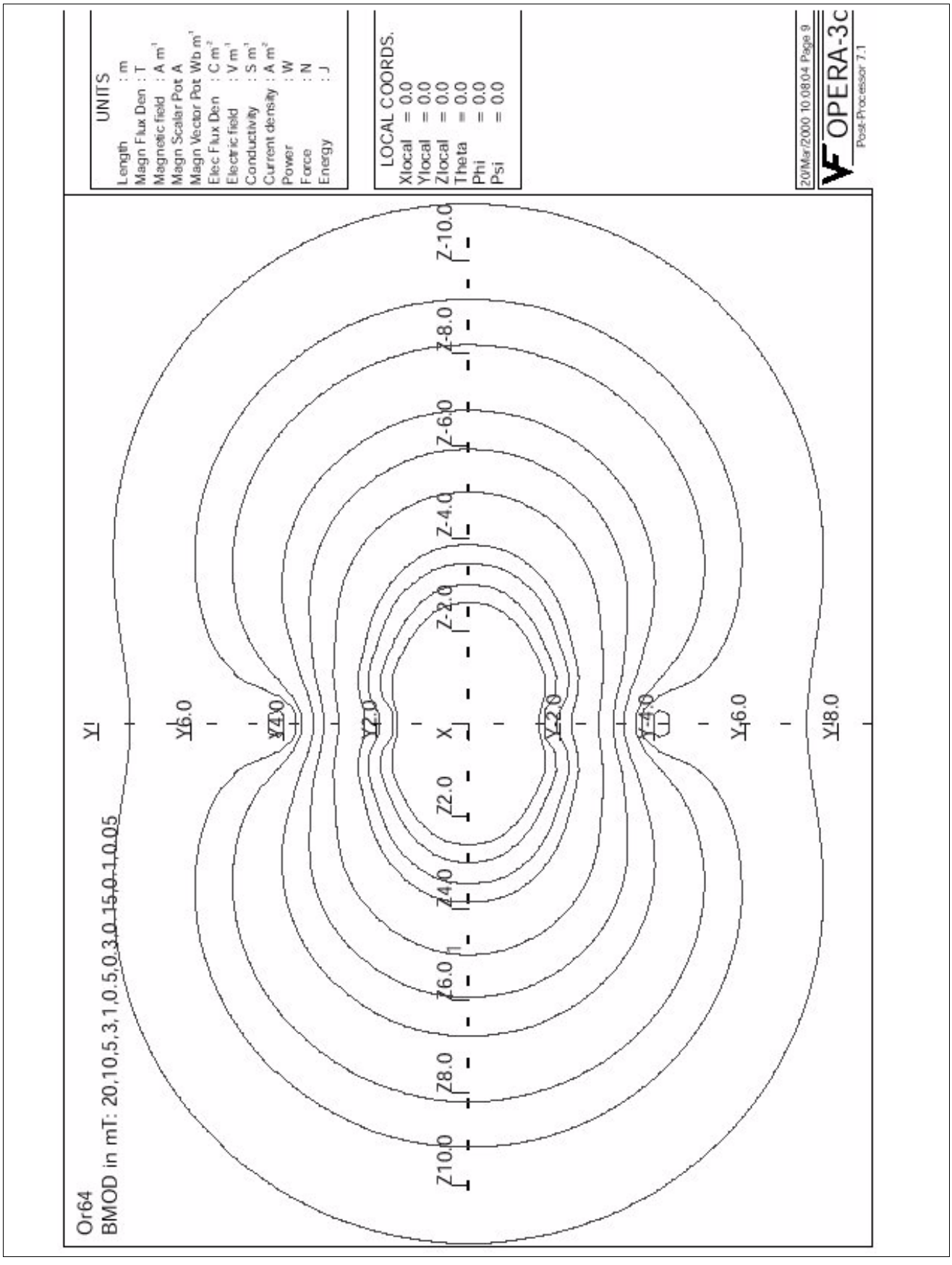


Fig. 9 Fringe field distribution Z and Y axis

Table 0.05mT to 100mT

Fringe field distribution MAGNETOM Trio			
Fringe field	**Distance from the magnetic center in direction of**		
	X-axis in m	**Y-axis in m**	**Z-axis in m**
100 mT	1.25	1.25	1.90
80 mT	1.30	1.30	1.95
50 mT	1.40	1.40	2.15
40 mT	1.45	1.45	2.25
30 mT	1.55	1.55	2.35
20 mT	1.65	1.65	2.60
15 mT	1.75	1.75	2.75
10 mT	1.90	1.90	3.00
5 mT	2.15	2.15	3.40
3 mT	2.35	2.35	3.80
1 mT	2.90	2.90	5.00
0,5 mT	**3.40**	**3.40**	**5.90**
0,3 mT	4.00	4.00	6.75
0,2 mT	4.60	4.60	7.50
0,15 mT	5.10	5.10	8.20
0,1 mT	5.90	5.90	9.20
0,05 mT	7.60	7.60	11.20

- Fringe field distribution in cuts parallel to the XY-plane should be represented by circles with the radius "XY".
- The fringe field extends three-dimensionally beyond the magnet and can be reduced by shielding. The typical lines represent the ideal flux density distribution in air which may be distorted by steel reinforcement in buildings.

Building vibration specification

NOTE	**The Sylomer/Sylodamp pad combination has to be used! This is mandatory.**

External vibrations or shocks affecting the magnet may degrade image quality. Vibrational acceleration $\mathbf{a_{max}}$ transferred through building vibrations to the magnet may not be exceeded in the three spatial orientations in the frequency range from **0 to 70 Hz**.

NOTE	**For all MAGNETOM Trio installations a site survey measurement is mandatory!** **The protocol/results have to be sent to ERLANGEN VR PS to be reviewed. Whether the site is suitable will be determined in ERLANGEN.** **The System will not be delivered if the site survey measurement including the vibration measurement fails!**

Building vibration specifications	
$\mathbf{a_{max}}$	**-83dB (g)**

The requirement for $\mathbf{a_{max}}$ is **-83 dB (g)** measured as max. rms value in the Fourier Transformation of the recorded signal (spectrum).

NOTE	**According to our recent experience the mass of the floor plate should be about 600 kg/m² (corresponding to a thickness of about min. 20 cm or 8") to achieve a good vibration and structure-borne sound isolation.**

Sound emission

The physical characteristics of the MR system generate a certain amount of noise, emitted as "air borne" or "structural borne" noise. The table below povides you with the information to install/prepare the noise attenuation as required by local laws. The attenuation usually incurs additional structural expenditures.

➪ The use of the delivered Sylomer/Sylodamp pads is mandatory.

NOTE

The MAGNETOM Trio system is equipped with sound damping pads. The Sylomer/Sylodamp pads will reduce the "structural borne" noise. The height of the Sylomer/Sylodamp pads is 25mm.

The position of the Sylomer pads is the same as the shim plates (see Fig. 11).

➪ The noise level for the MAGNETOM Trio system averaged across different sequences is shown in the table below.

Noise values

System	Examination room	Equipment room	Control room
MAGNETOM	**Acoustic noise**	**Acoustic noise**	**Acoustic noise**
Trio	< 100 dB(A)	65 dB(A) CCS Water	<55 db(A)

NOTE

For detailed information regarding noise reduction contact VR P PS or CS SD 23.

NOTE

The local german code of 55 dB (A) sound level at the operators console will be acchieved when installing a sound reduction RF room in direction to the operators room!

NOTE

If you expect noise problems consult the RF-Room manufacturer you are working with. He might be able to deliver noise reduction components with the RF-room (e.g. interior; RF-window; RF-door etc.).

Refer to "List of RF-room manufacturers" on page 10 - 17

Flowchart

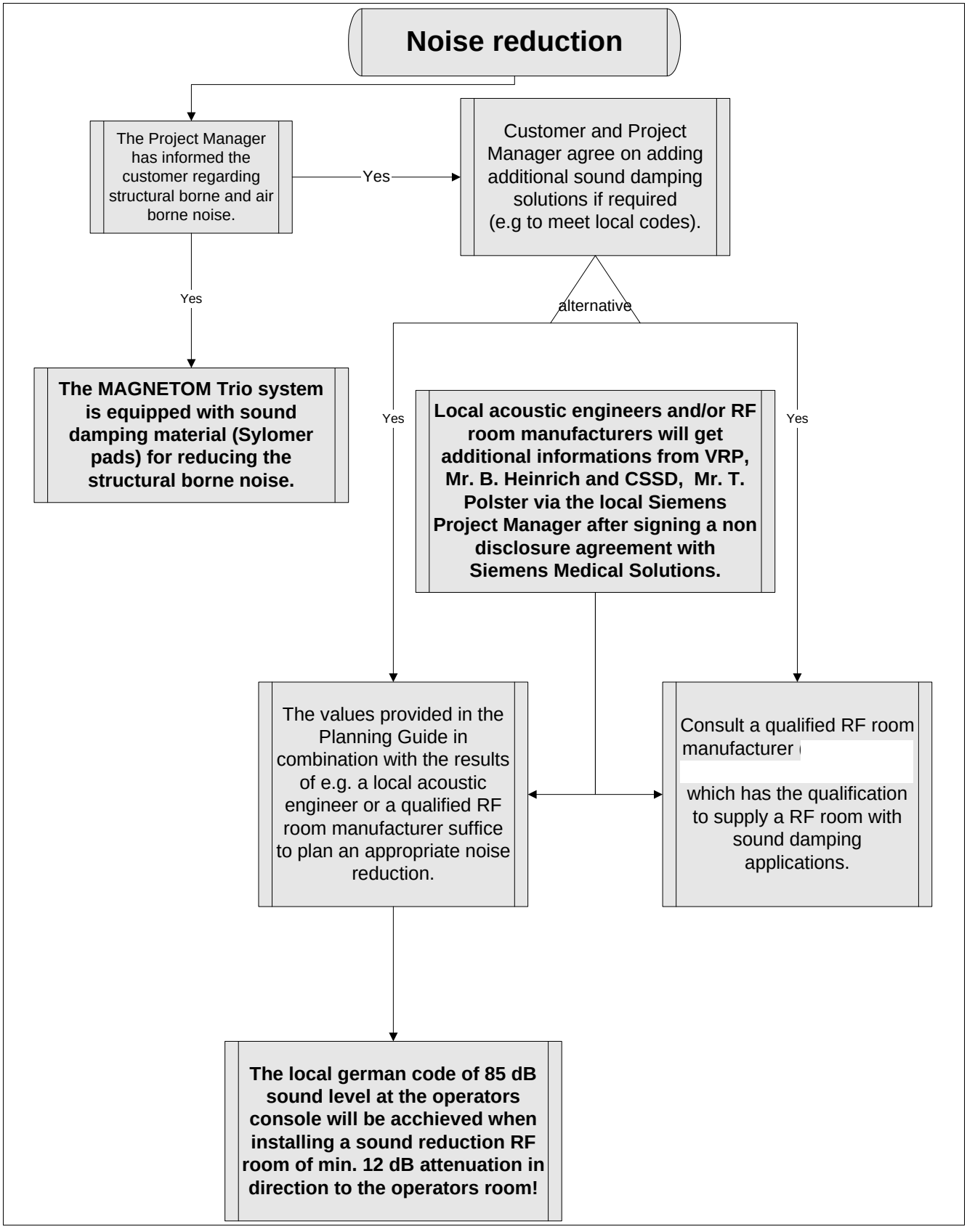


Fig. 10 Flowchart

Sylomer/Sylodamp pad position

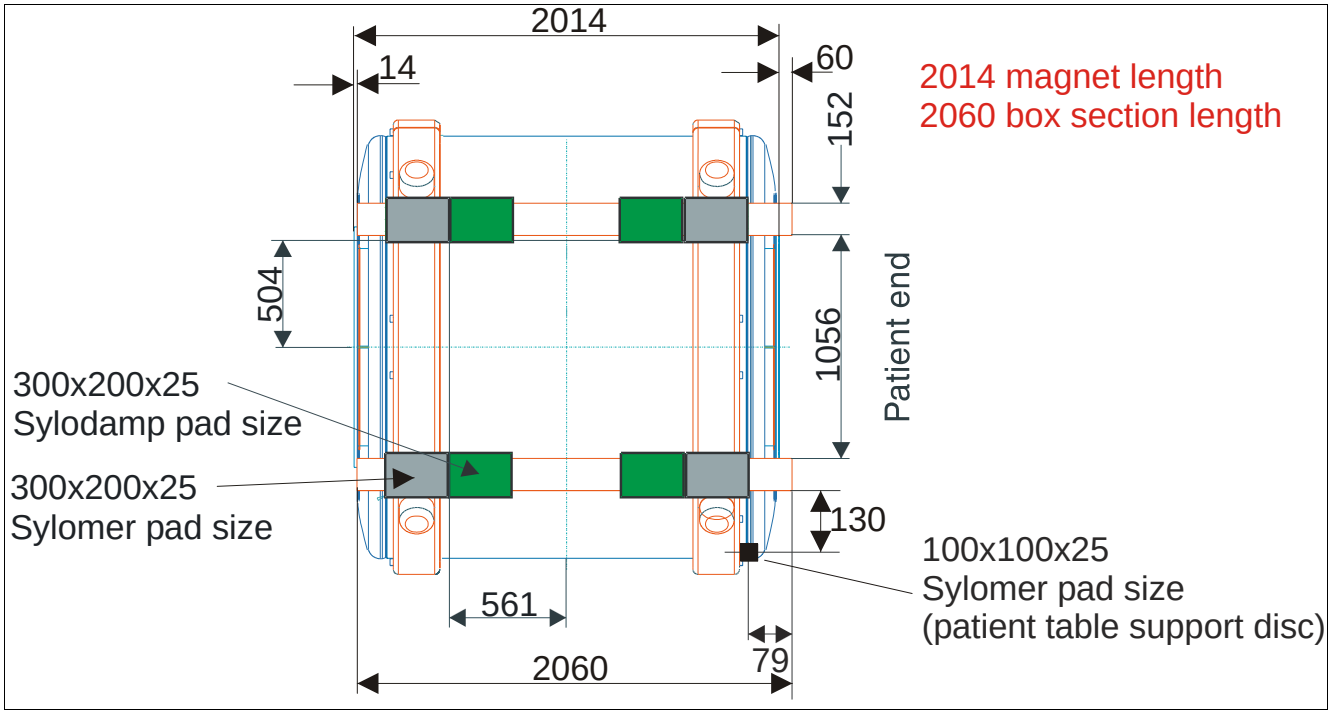


Fig. 11 Sylomer pad position

Sylomer/Sylodamp pads delivered with the system		
Sylomer S720 (black)	4 pieces 300x200x25mm	Box section
Sylodamp HD 300 (green)	4 pieces 300x200x25mm	Box section
Sylomer V25 (grey)	4 pieces 65x65x25mm	Cover frame
Sylomer V25 (grey)	1 piece 100x100.25mm	Support disc

NOTE **The magnet box sections are not installed symmetrical in reference to the magnet!**

Seismic anchoring

Cabinets

NOTE	**The seismic anchoring kit for the cabinets is not part of the delivery.** **If you need a seismic anchoring for your site you have to order the "Seismic Kit" with the part number 576 3367 seperately!**

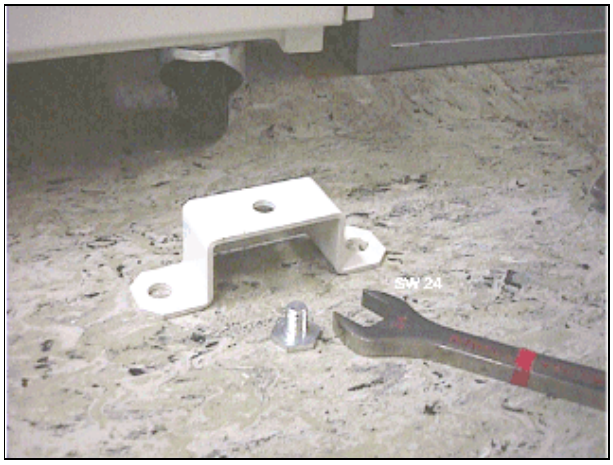


Fig. 12 Seismik Kit

The Seismic Kit (seismic anchoring) consists of the mounting brackets and the screws.

Magnet

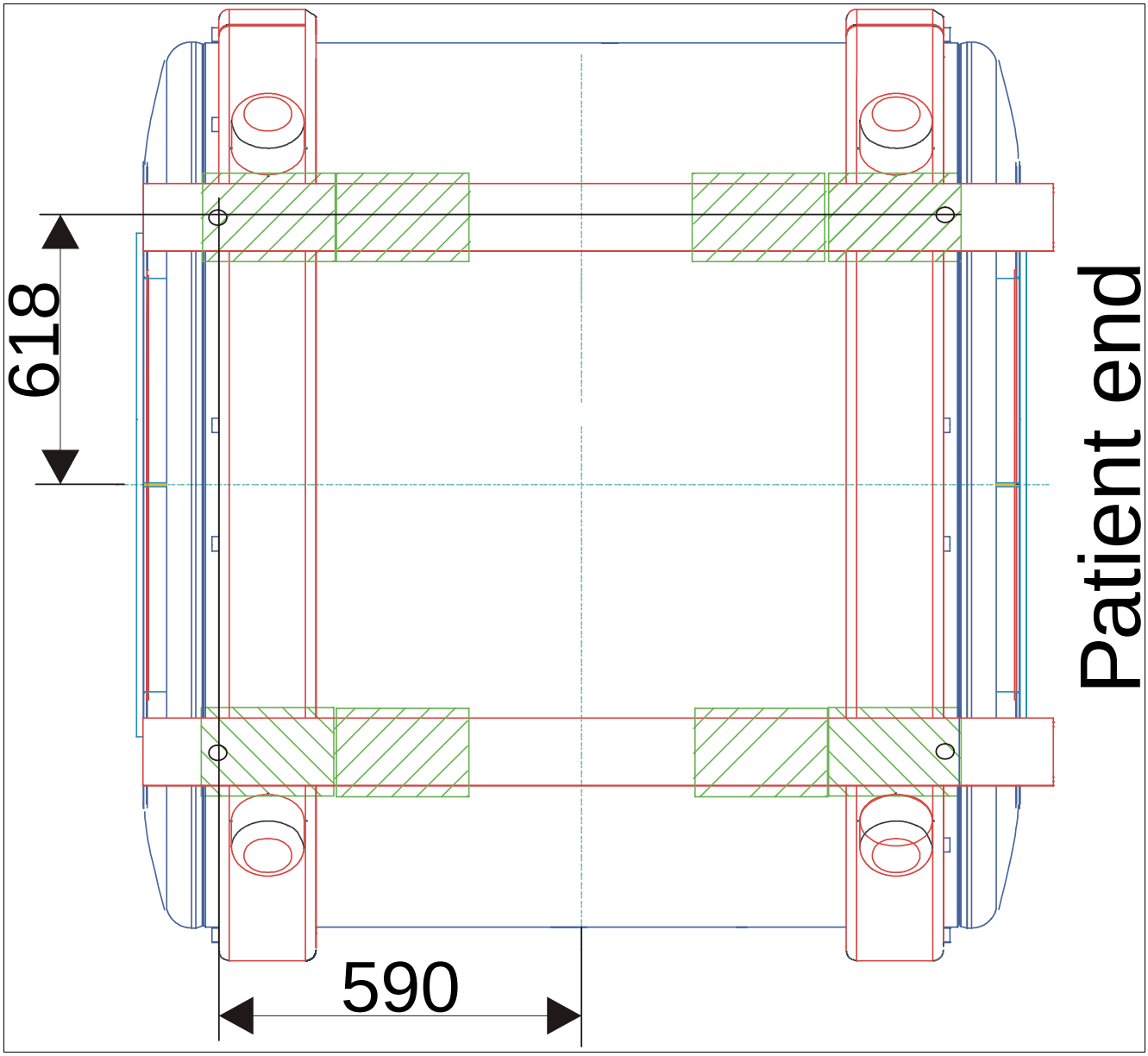


Fig. 13 Seismic anchoring of the magnet

Room requirements

General

Room planning for MR-systems must be based on the minimum distances specified for safety and installation related reasons. In the RF-room, the underflooring together with the floor cannot exceed the tolerance values specified.

To service the Magnet (e.g. cold head, current probe, etc.) the minimum finished room height has to be kept!

NOTE

The floor loading requirements do not include i.g. RF-room, sound damping or additional iron shielding. Contact the manufacturer of the mentioned components for getting detailed informations on e.g. weight!

NOTE

For the RF-shielding and/or an additional iron shielding (if necesarry) you have to add the corresponding weights !

If noise reduction material has to be used the corresponding weight has to be added as well.

NOTE

A communication system (intercom) between the operators console and the examination room is part of the system.

NOTE

If the patient cannot be observed (visually) through an RF window because of restrictions in the room layout, the patient video option must be included in the room planning.

⚠CAUTION

The opening direction of the RF-door has to be to the outside of the RF-room.

As an alternative other appropriate means have to be provided in a way that pressure built up during a quench, when the venting fails to work adequately, will not prevent the RF door of the examination room from being opened.

A flap with the dimension of 700mm X 700mm has to be built into the RF door if the door opening direction is to the inside of the RF room!

NOTE

The opening direction of the RF-door has to be to the outside of the RF-room.

As an alternative other appropriate means have to be provided in a way that pressure built up during a quench, when the venting fails to work adequately, will not prevent the RF door of the examination room from being opened.

NOTE

The floor in the vicinity of the magnet (2.2m x 5.5m) must be leveled within maximum +/- 2.0mm

fMRI (functional imaging)

One of the major applications of the MAGNETOM Trio is fMRI (functional imaging). Due to the magnet bore design the optical stimulation signals can only be fed to the patient from the rear. This fact has to be considered during planning when the customer will use fMRI. Additional space is required for the stimulation equipment at the rear (service end) side of the magnet (e.g. beamer, panel etc.).

Consult users manufacturer manual of the stimulation equipment for details regarding installation, required space and distance to the magnet (fringe field).

NOTE	**For using fMRI (functional imaging) applications a minimum distance from the magnet cover to the rear finished wall of 1500mm to 2000mm is required.**

Room configuration (example)

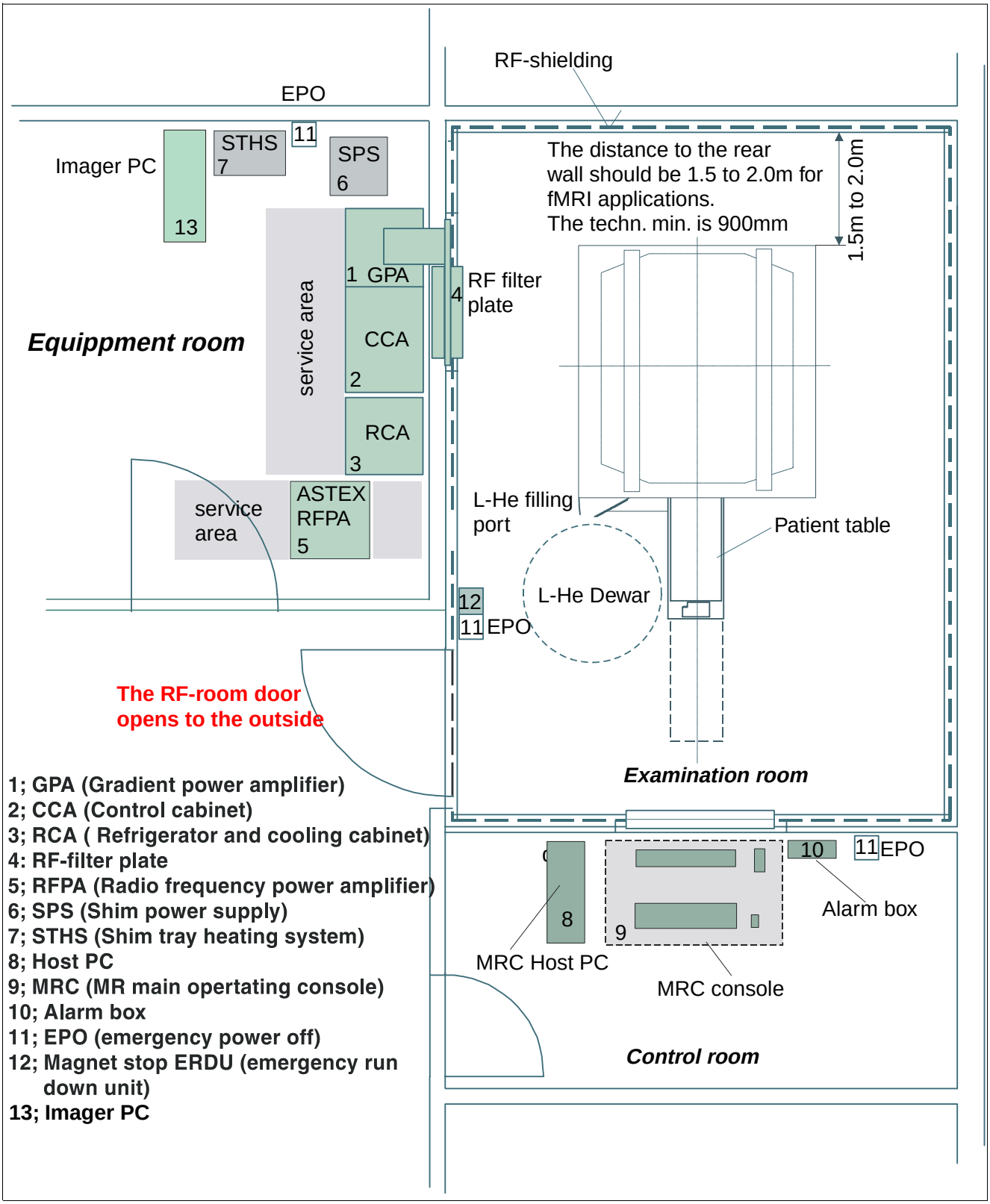


Fig. 14 Recommended room configurations for MAGNETOM Trio

NOTE

If the patient cannot be observed (visually) through an RF window because of restrictions in the room layout, the patient video option must be included in the room planning.

An accoustic intercom system is built into the system

Nr.	Component	max. fringe field	min. distance to	in m
1	GPA	5 mT		
2	CCA	5 mT		
3	RCA	5 mT		
4	RF filter plate	10 mT		
5	35kW RFPA	1 mT	6; SPS	3.0m
6	SPS	10 mT	5; 35kW RFPA	3.0m
7				
8	Host PC	1 mT		
9	MRC	1 mT		
10	Alarm box	5 mT		
11	EPO	-		
12	Magnet Stop	-		
13	Imager PC	1 mT		

NOTE

It is recommended to have a clearence of 500mm in front of each side cover of the RFPA!

NOTE

The required cable set (cable length) inside the equipment room is determind by the additional 35 kWA RFPA.

Minimum room size

Recommended finished room height	Minimum finished room height		Minimum finished room size in l x w
≥ 2800 mm	Examination room	2730 [1] mm	6670 [2] mm x 3500mm
≥ 2100 mm	Control room	2100 mm	3300 mm x 2000 mm
≥ 2570 mm	Equipment room	2200 mm *1	2900 mm x 1650 mm

1. The min. room height of 2730mm is to guaranty the serviceability of the magnet and its components.
2. The absolute techn. min. room length (finished wall to finished wall) is 6070mm. If the customer will use the system with fMRI functionality check for additional space which will be needed!

NOTE

To use the full Tim functionality 1500mm space from the rear magnet cover to the rear wall is required.

From the magnet iso center the distance to the wall has to be 2688mm.

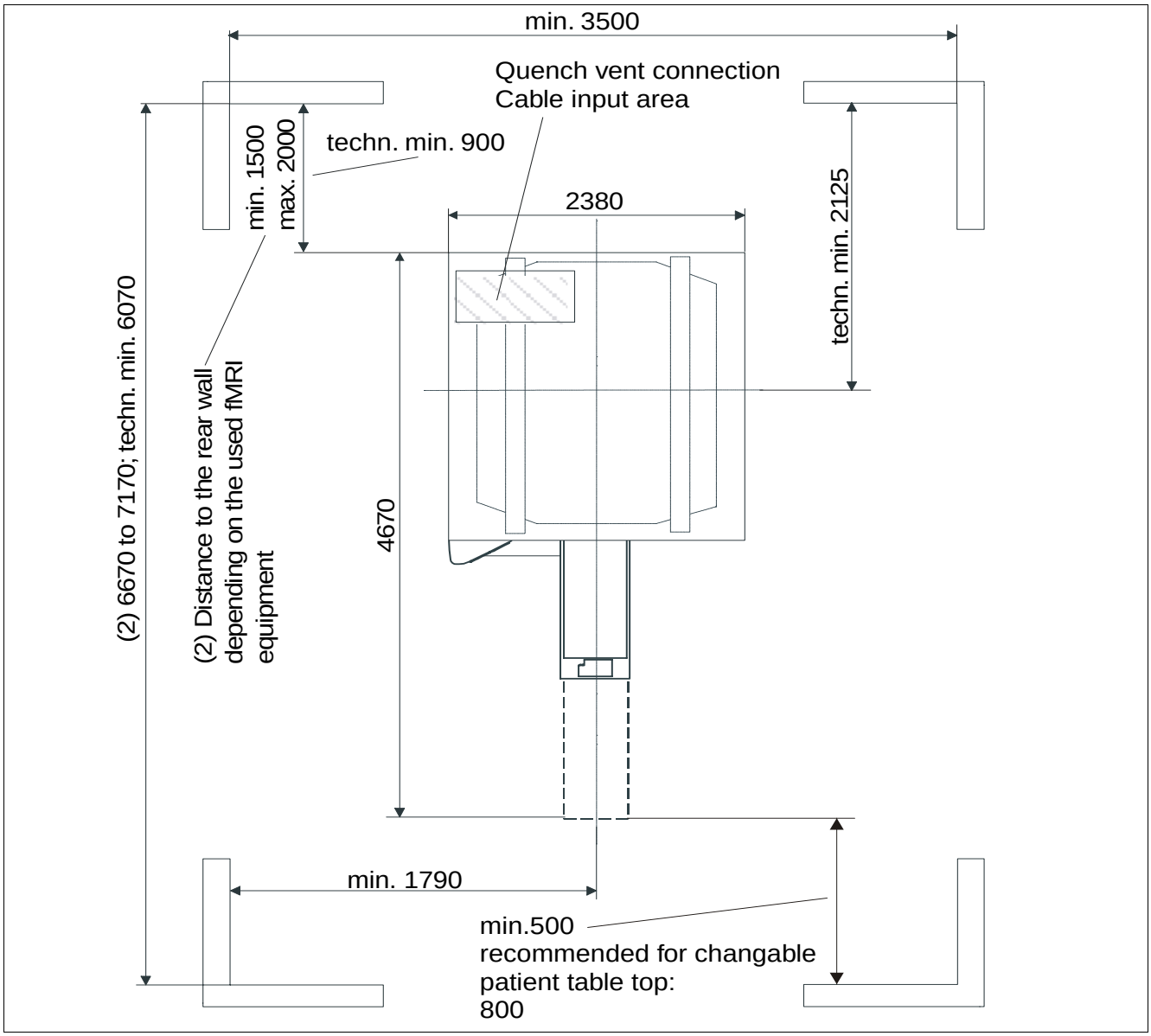


Fig. 15 MAGNETOM Trio Min. Room size

Floor loading requirements

NOTE

According to our recent experience the mass of the floor plate should be about 600 kg/m² (corresponding to a thickness of about min. 20 cm or 8") to achieve a good vibration and structure-borne sound isolation.

The floor must be leveled in the area of the magnet position plus patient table (2.2m x 4.5m). Acceptable tolerance: maximum ± 2 mm.

The use of the delivered Sylomer/Sylodamp pads is mandatory See als "Sylomer/Sylodamp pad position" on page 2 - 25.

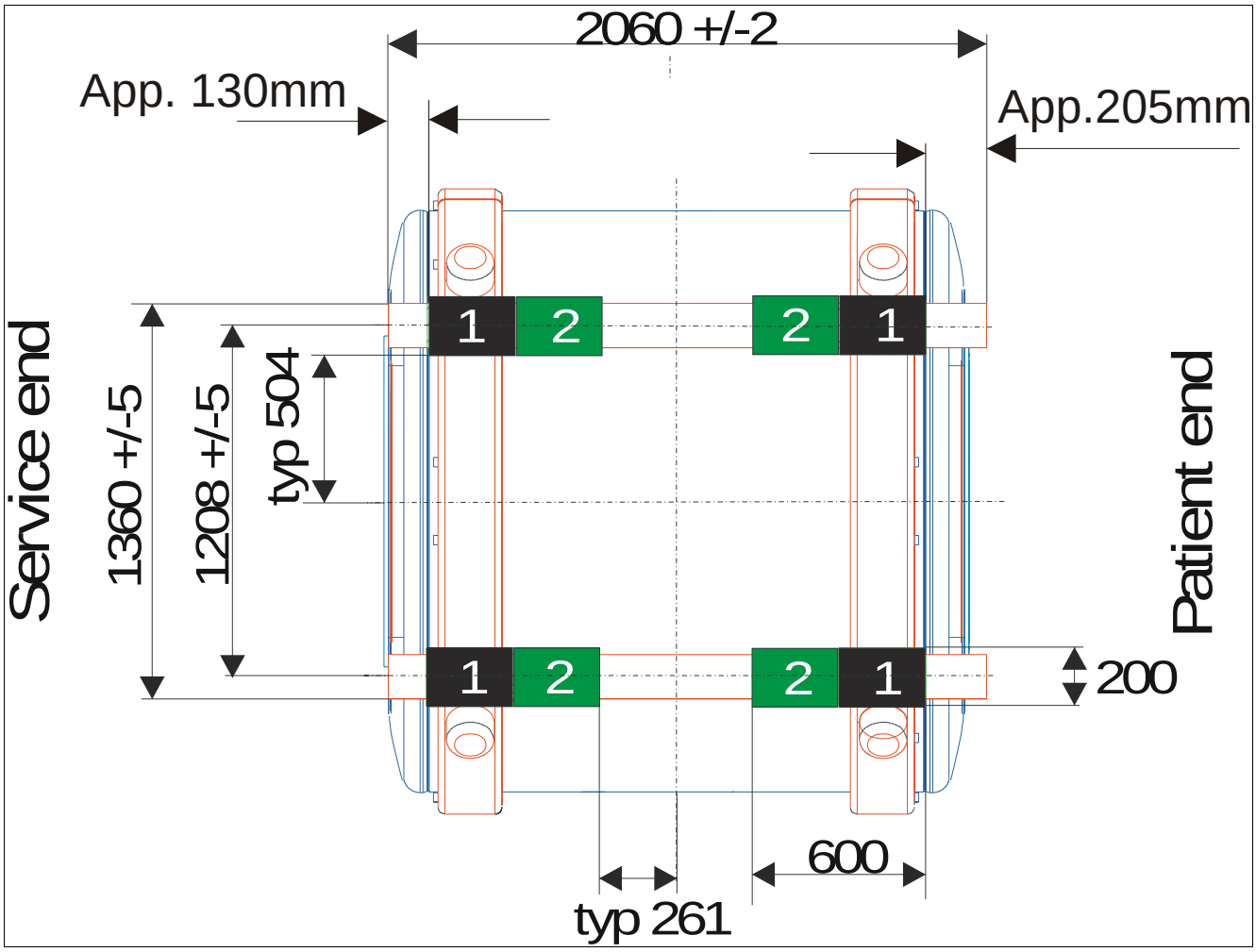


Fig. 16 MAGNETOM Trio Support surface

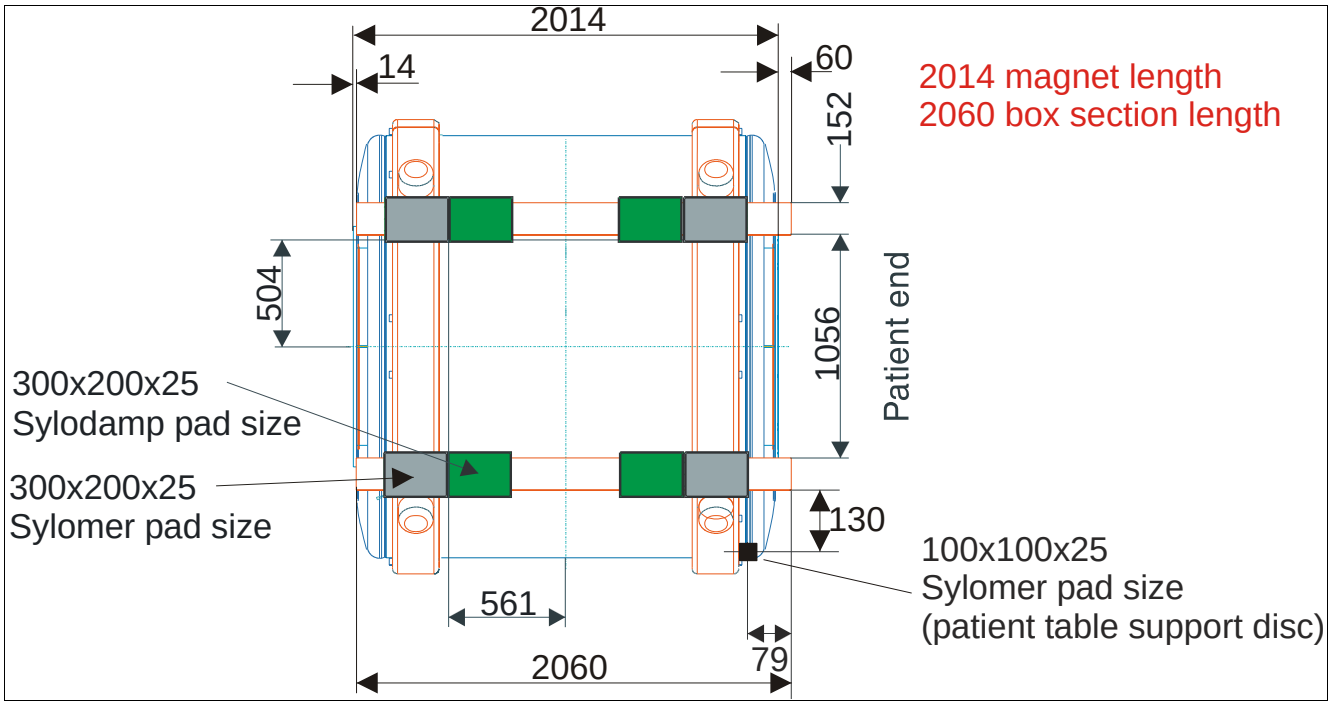


Fig. 17 MAGNETOM Trio Support surface

➪ 4 support surfaces (1+2) each 200mm X 600mm (**1200cm^2**)

Floor loading requirements	
tot. magnet weight: 13.000kg	**Floor loading per 1200cm^2:** **3125kg/1200cm^2** **30.66kN/1200cm^2**

RF-filter plate position examples

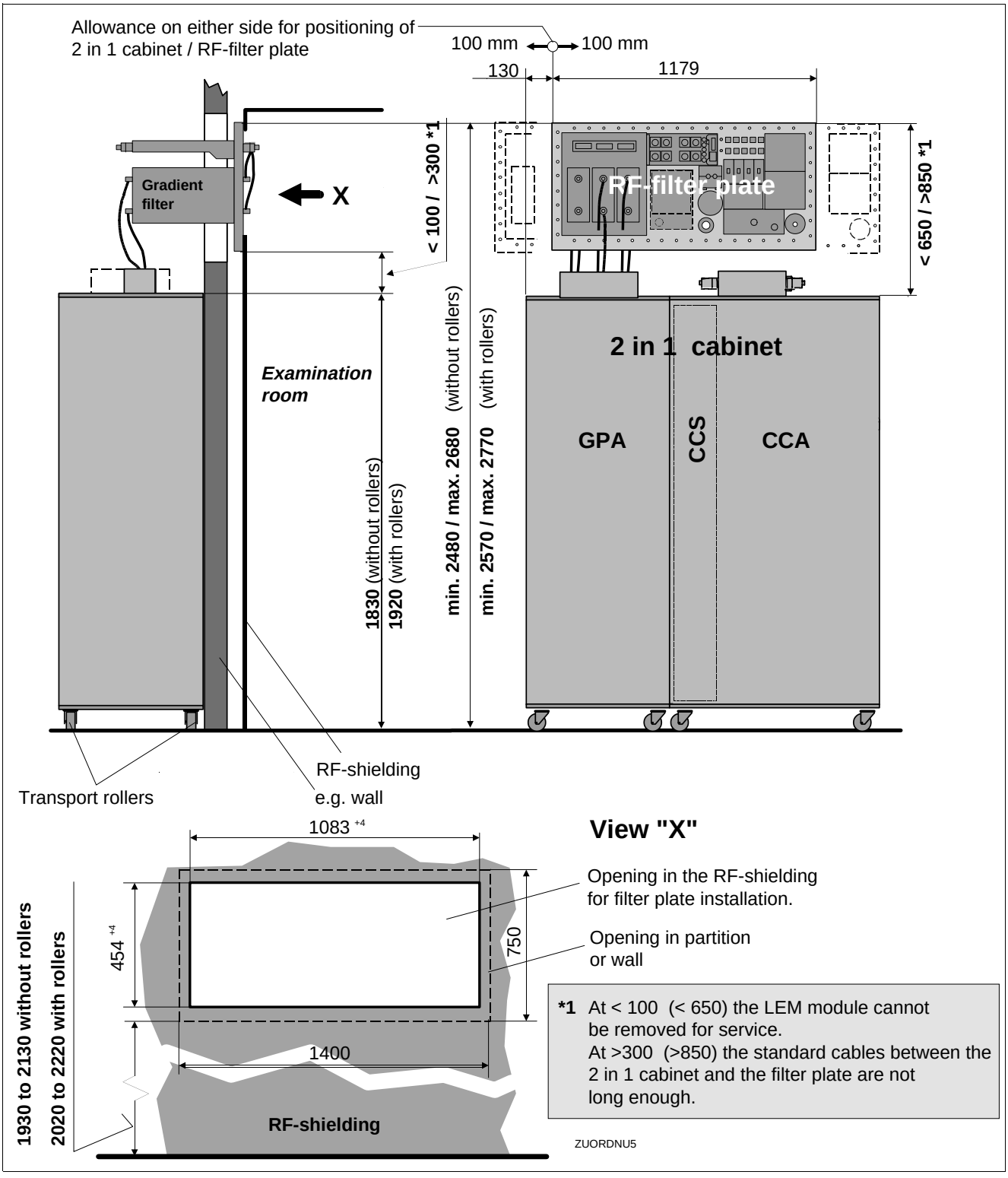


Fig. 18 Transport rollers installed (CCA cabinet)

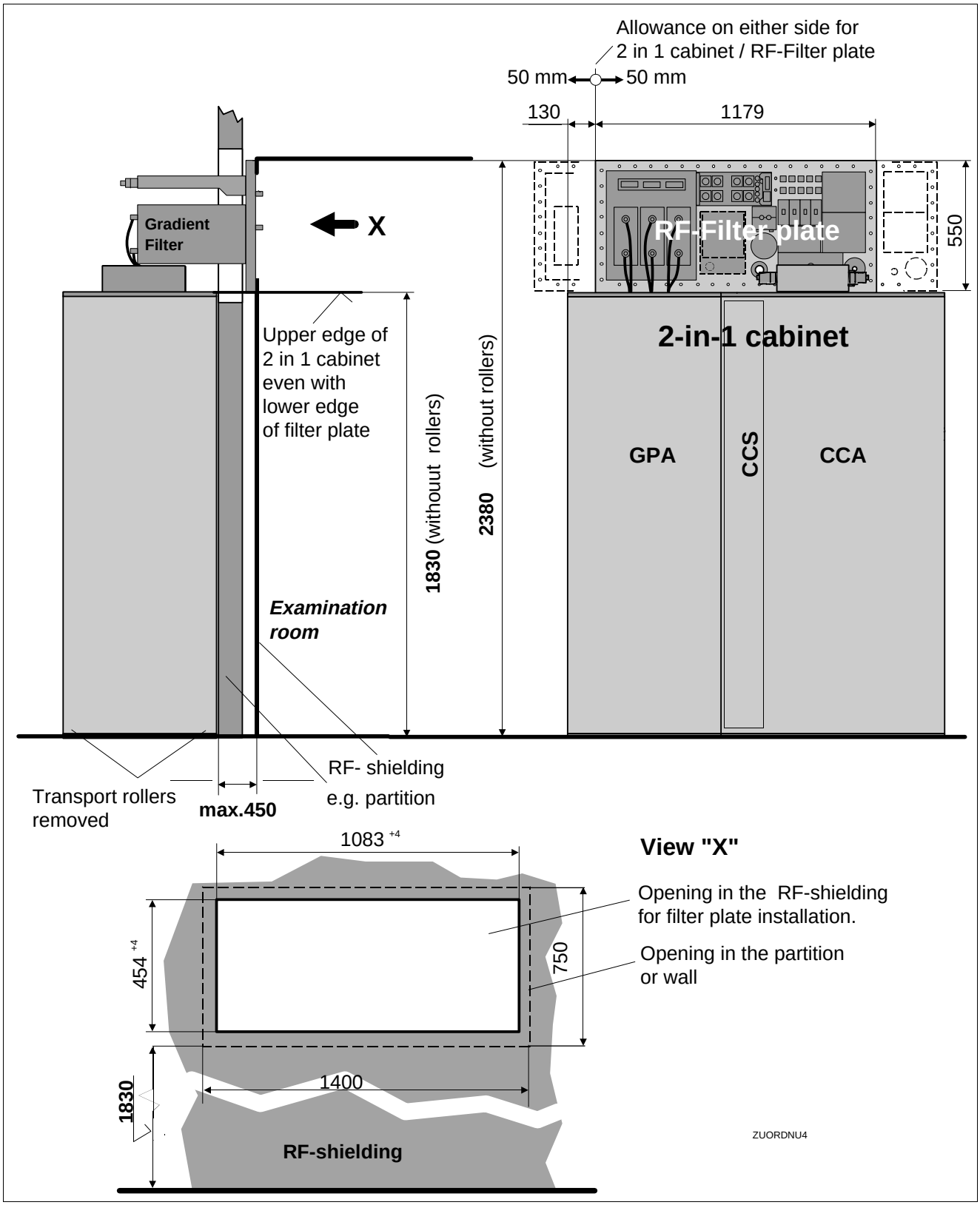


Fig. 19 Transport rollers not installed (CCA cabinet); RF filter panel low position

NOTE **The 2 in 1 cabinet could also be placed either on the left or right side of the filterplate inside the equipment room. A longer cable set has to be ordered for this configuration. Fig. 20; Fig. 21**

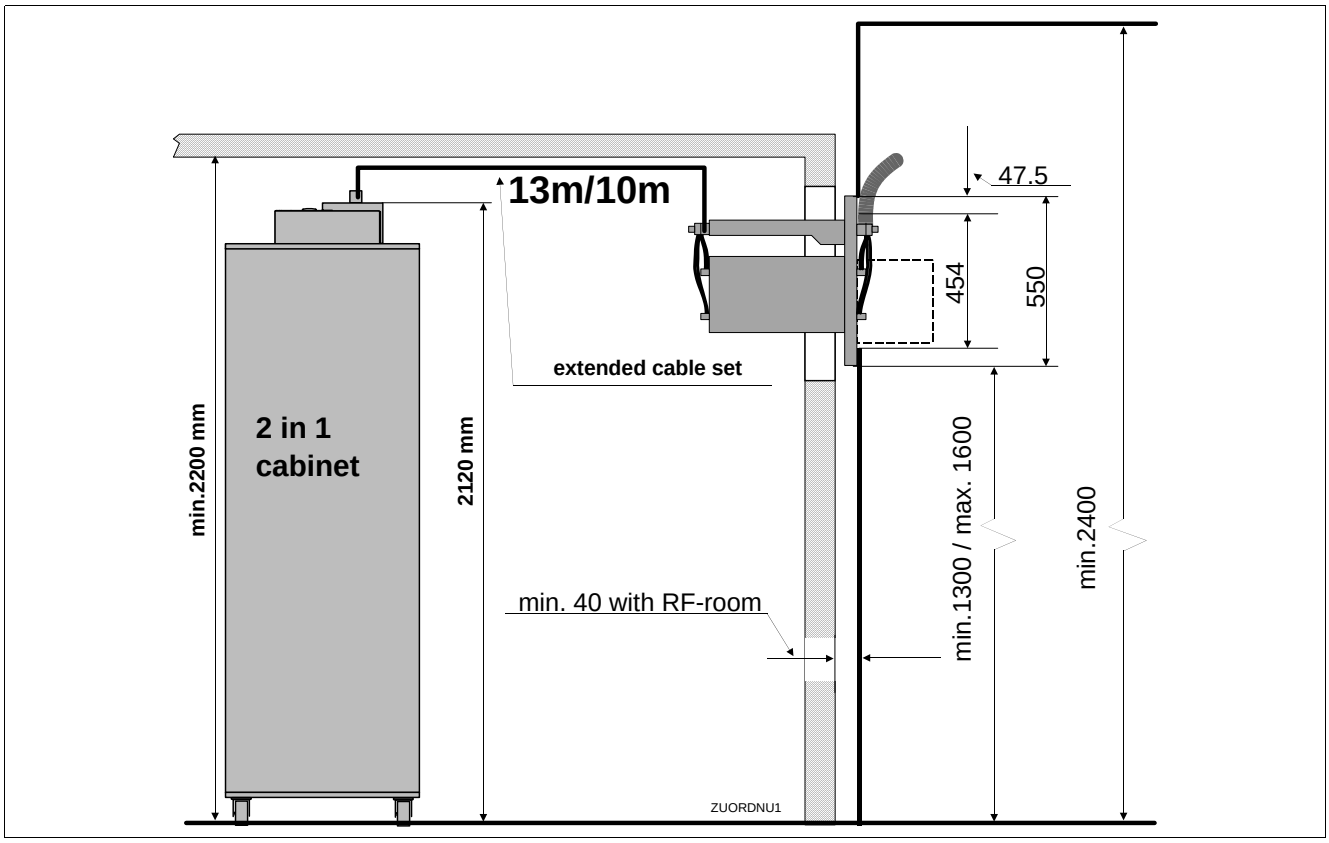


Fig. 20 Layout of 2 in 1 cabinet / RF filter plate

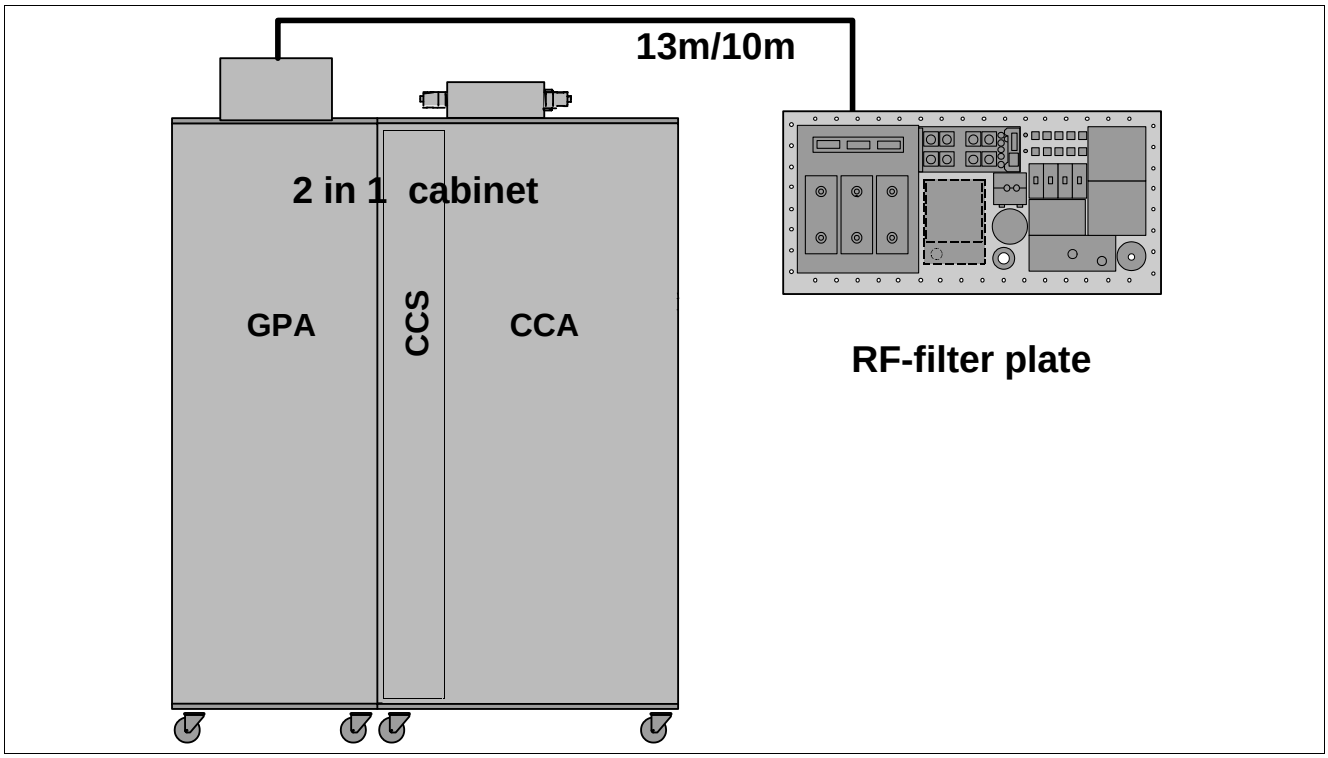


Fig. 21 Layout of 2 in 1 cabinet / RF filterplate

NOTE

If you have the minimum room height of 2200mm in the equipment room, the filterplate has to be mounted at a height of min. 1300mm to max. 1600mm.

In addition a longer cable set has to be ordered.

System dimensions

Magnet cover dimensions

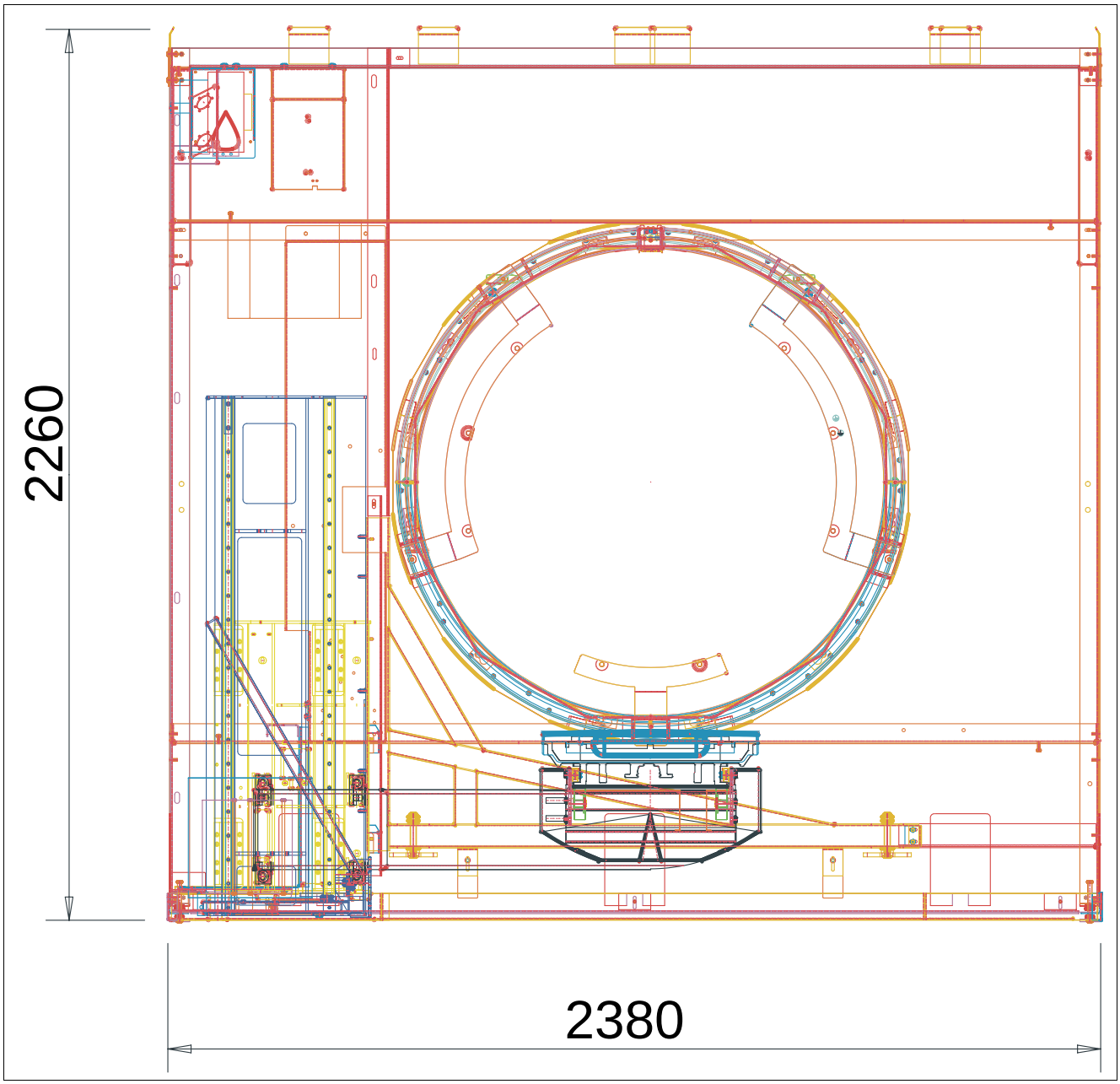


Fig. 1 Cover front view

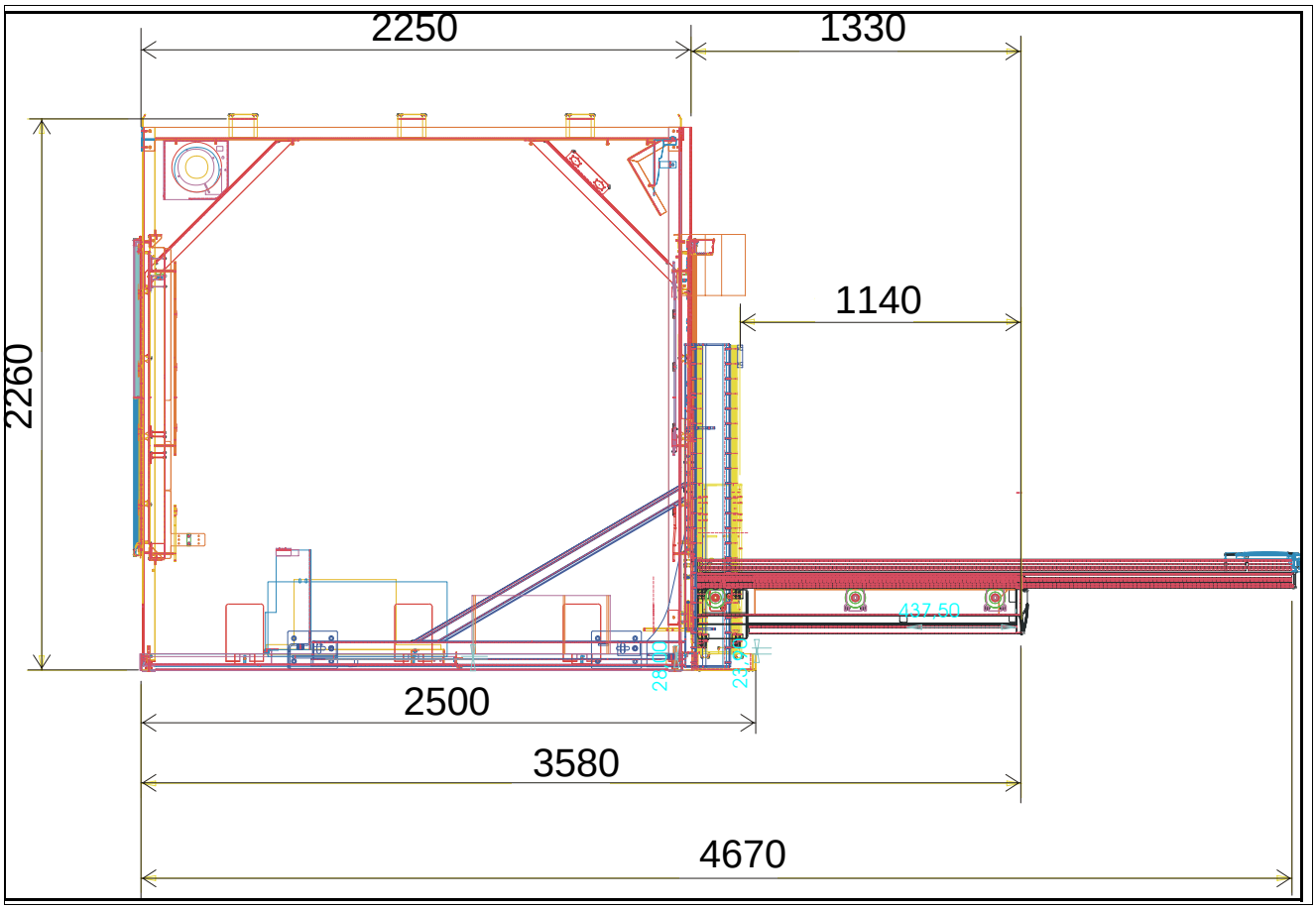


Fig. 2 Cover side view

Magnet weight

Approx. weight	
Magnet with cryogens	10.500
Gradient coil	950
RF-coil	100
Patient table	325
Covers	300
Total weight	~ 12.000kg

Magnet dimensions without covers

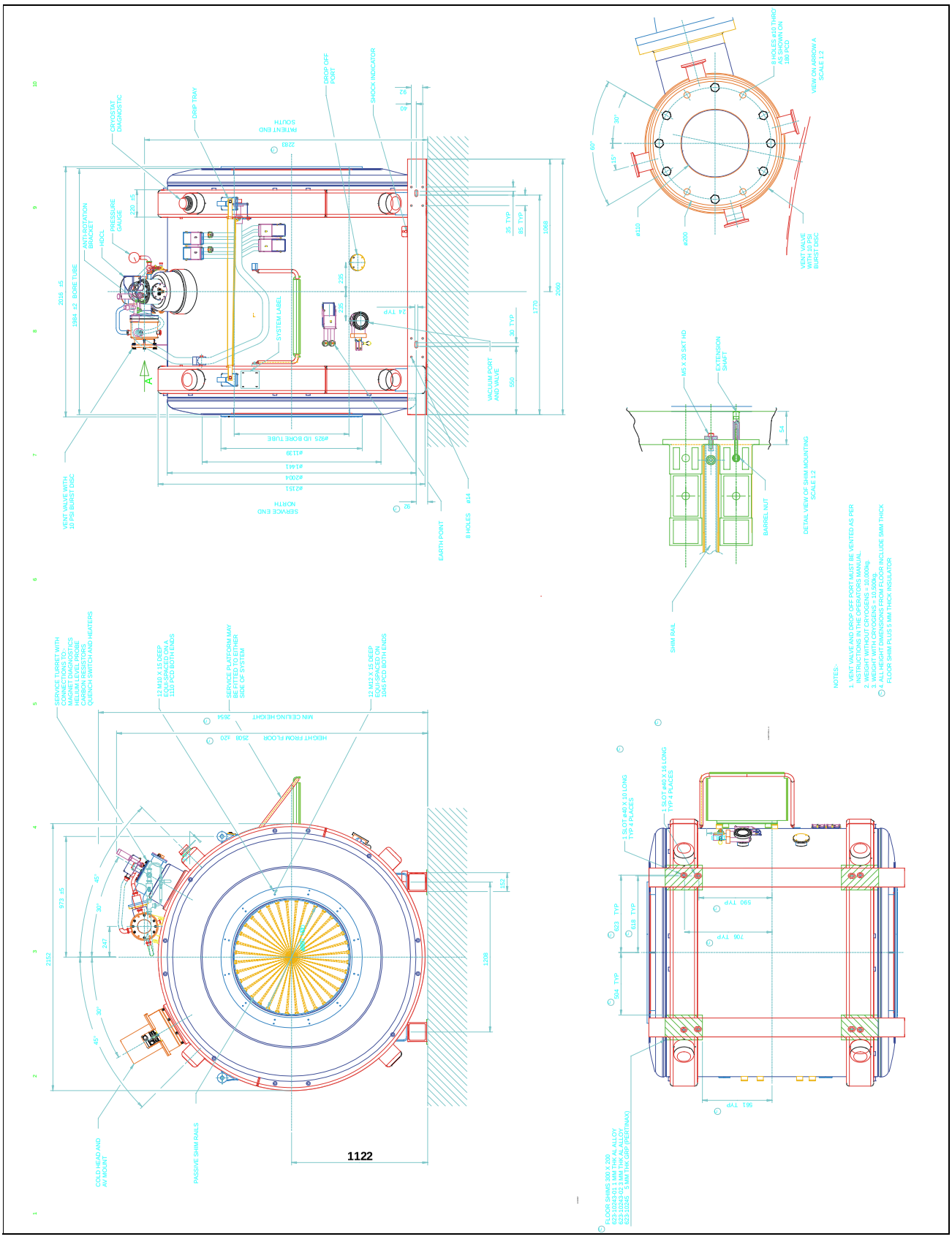


Fig. 3 Trio_Cl_OR64

Detail drawings of the magnet

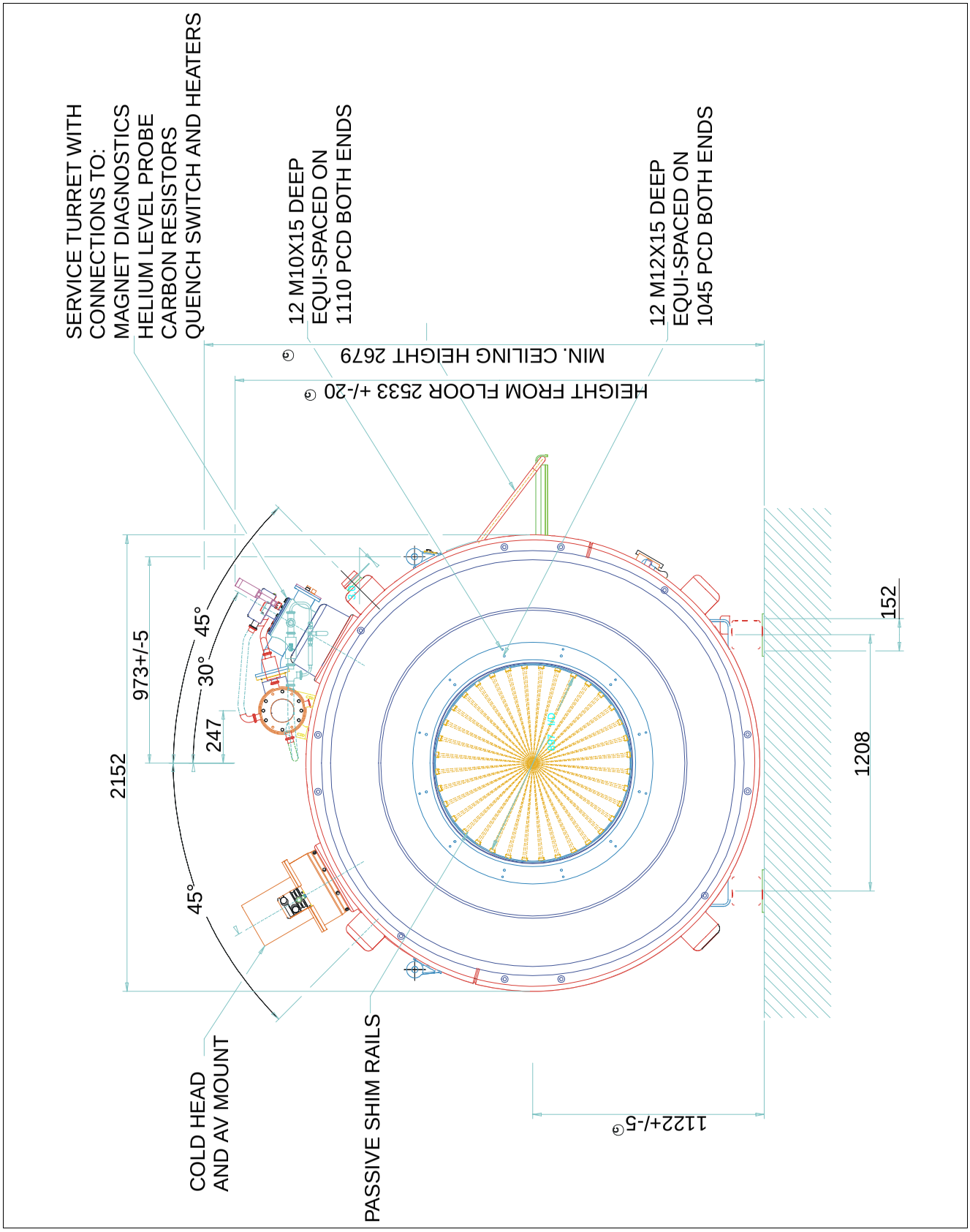


Fig. 4 Magnet service end view

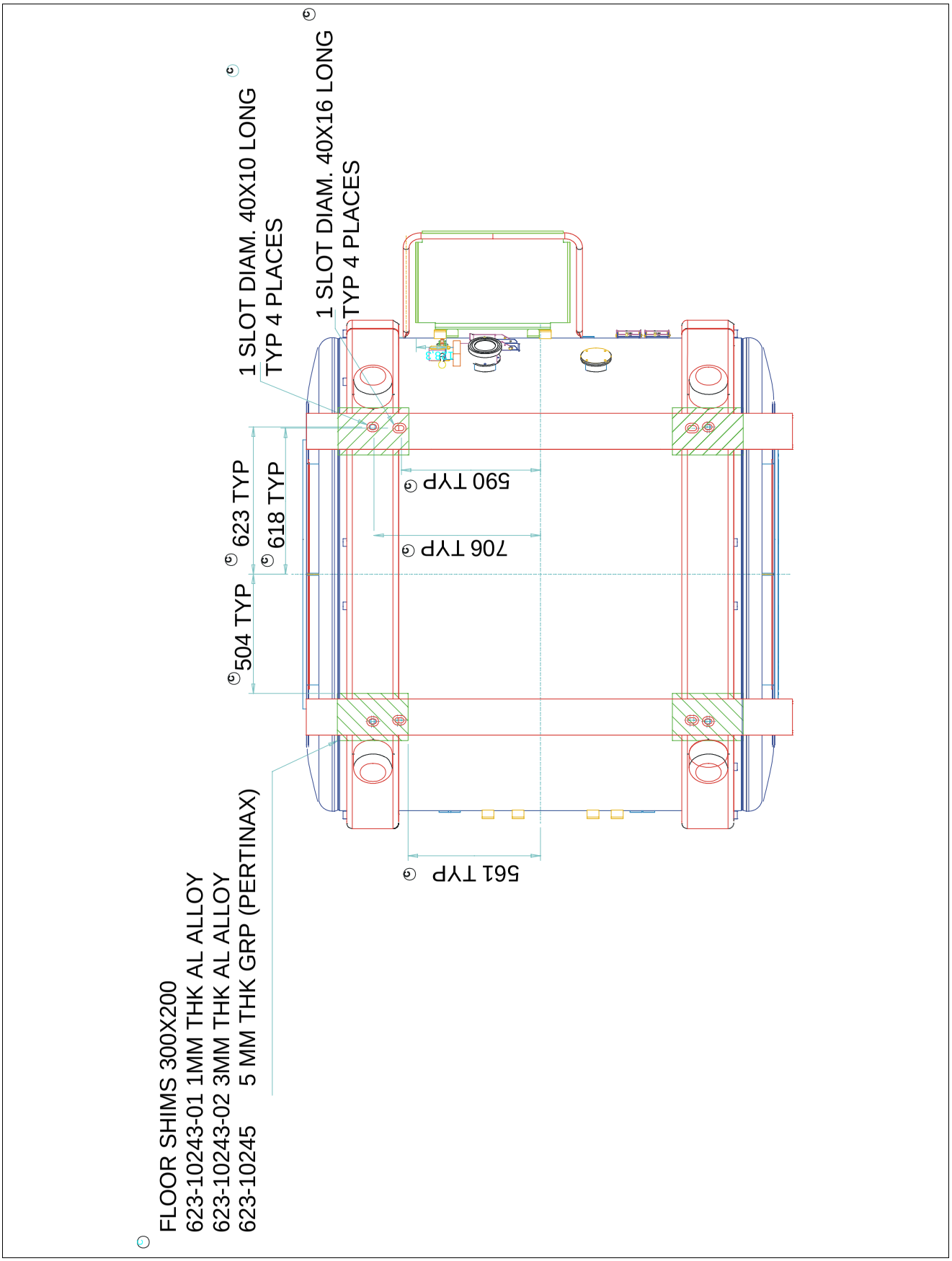


Fig. 5 Magnet BOTTOM view

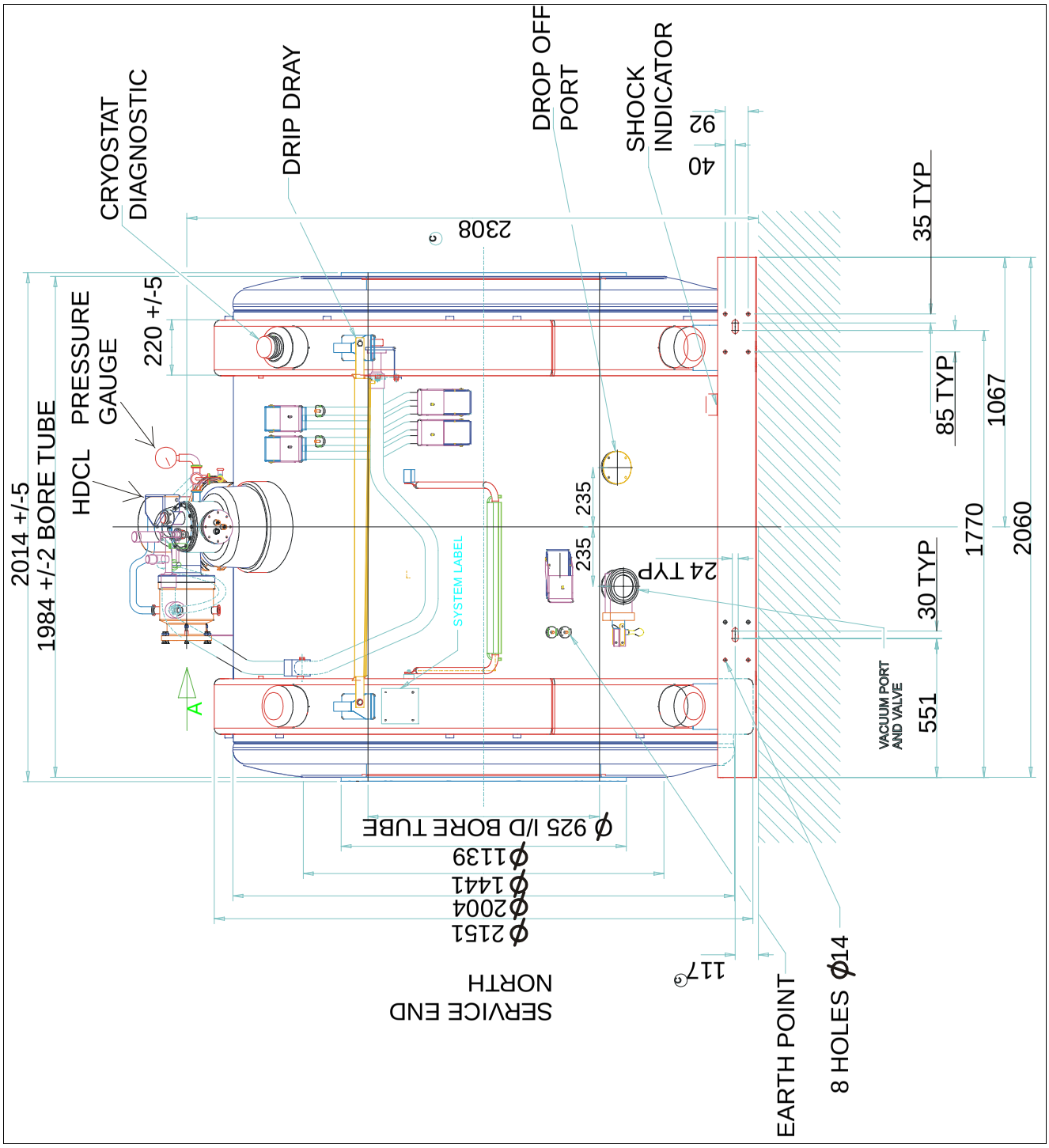


Fig. 6 Magnet SIDE VIEW

Quench pipe connection

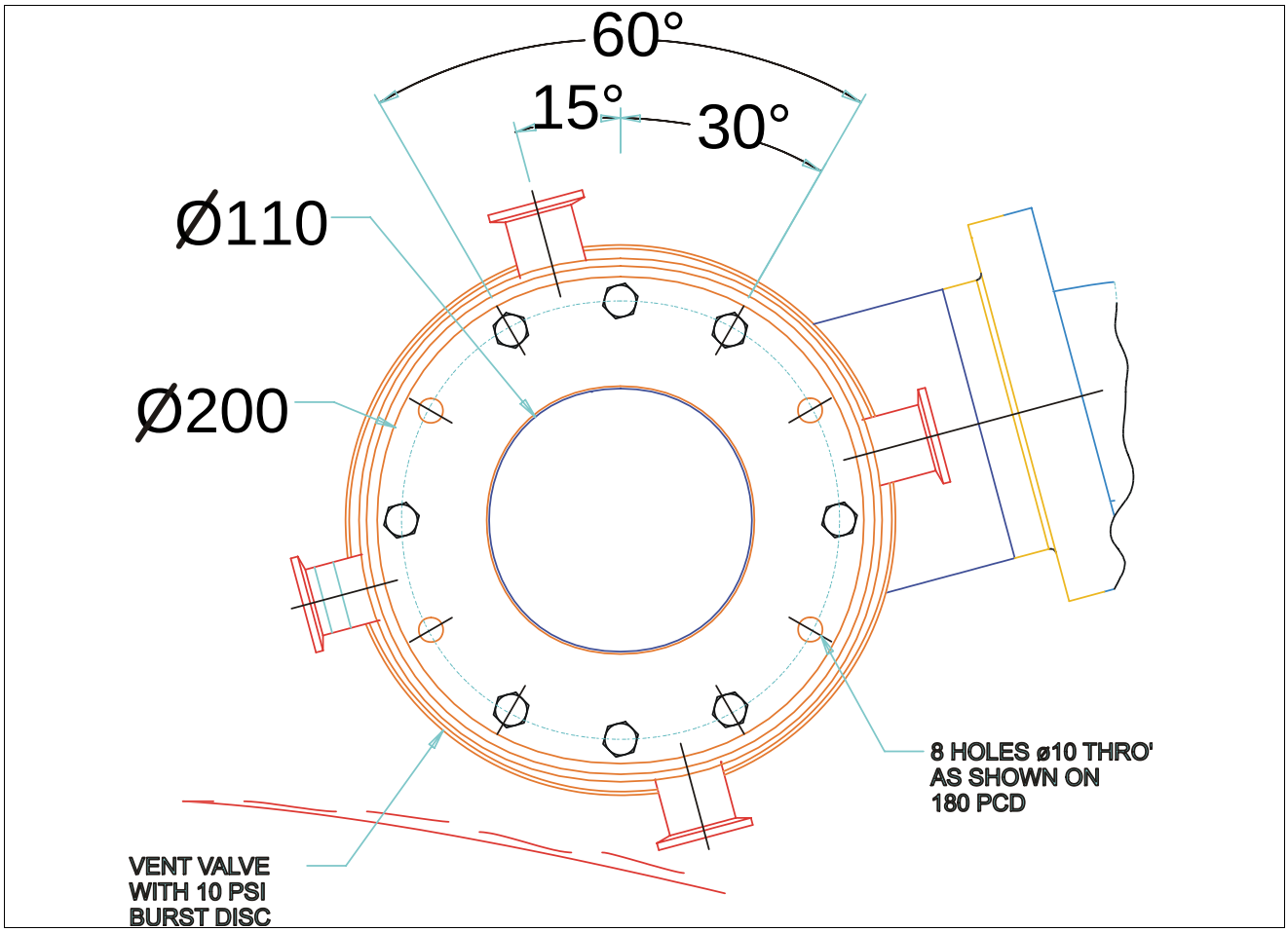


Fig. 7 Quench valve

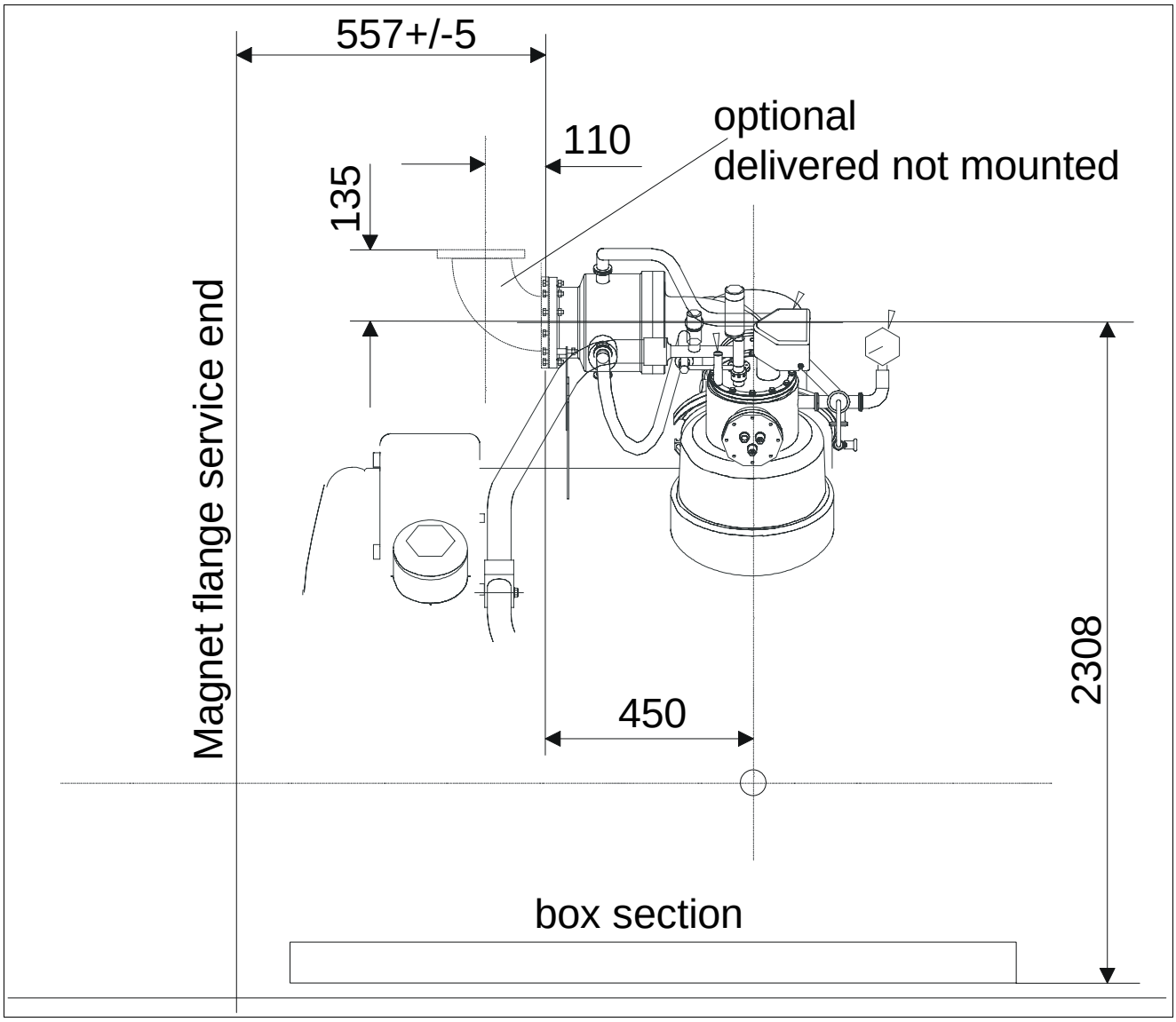


Fig. 8 Quenchtube connection 1

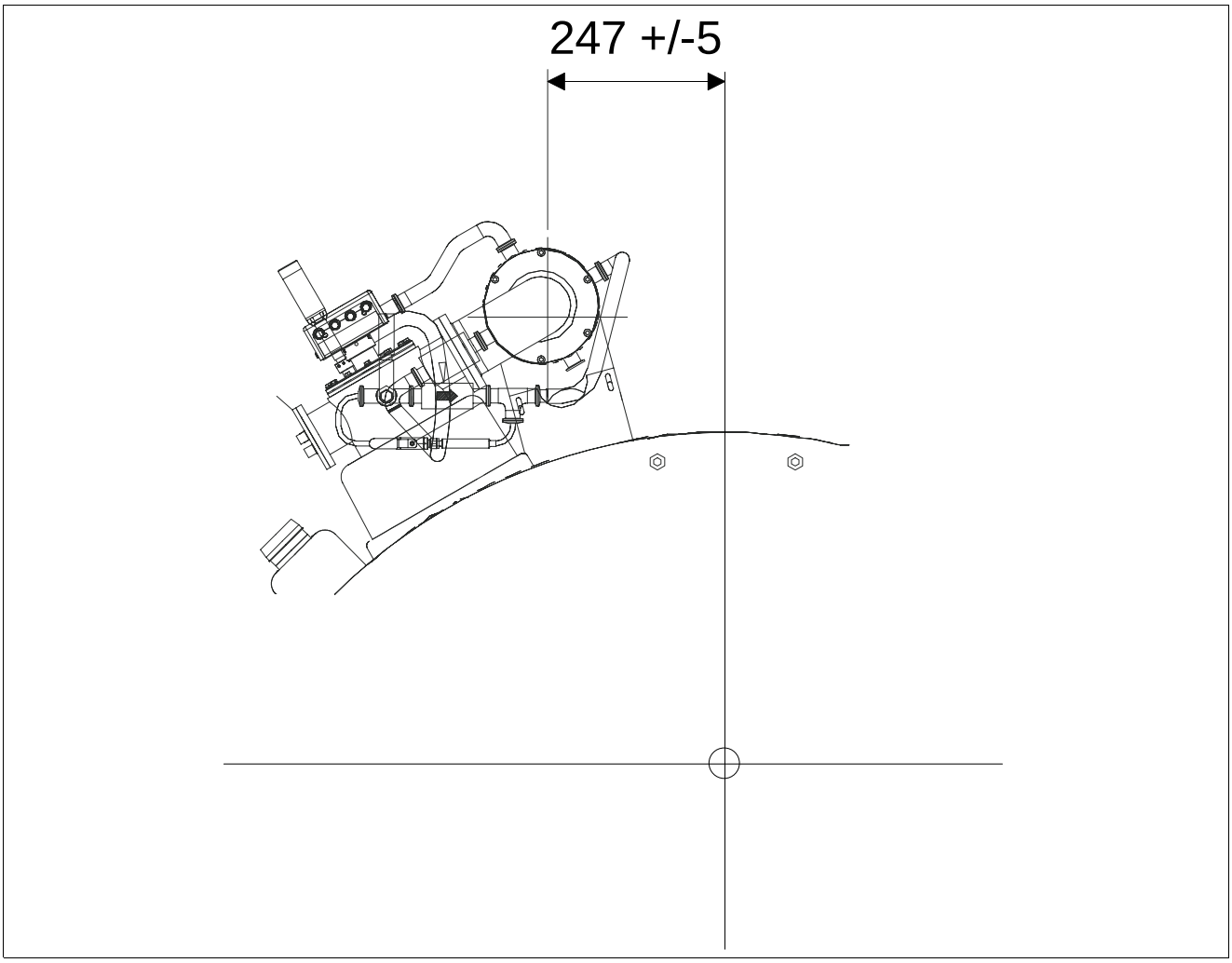


Fig. 9 Quenchtube connection

NOTE

The quench tube could be mounted vertical and horizontal.
The 90-degree ellbow for the vertical connection of the quench tube is part of the delivery volume.

90° elbow (delivered with the system)

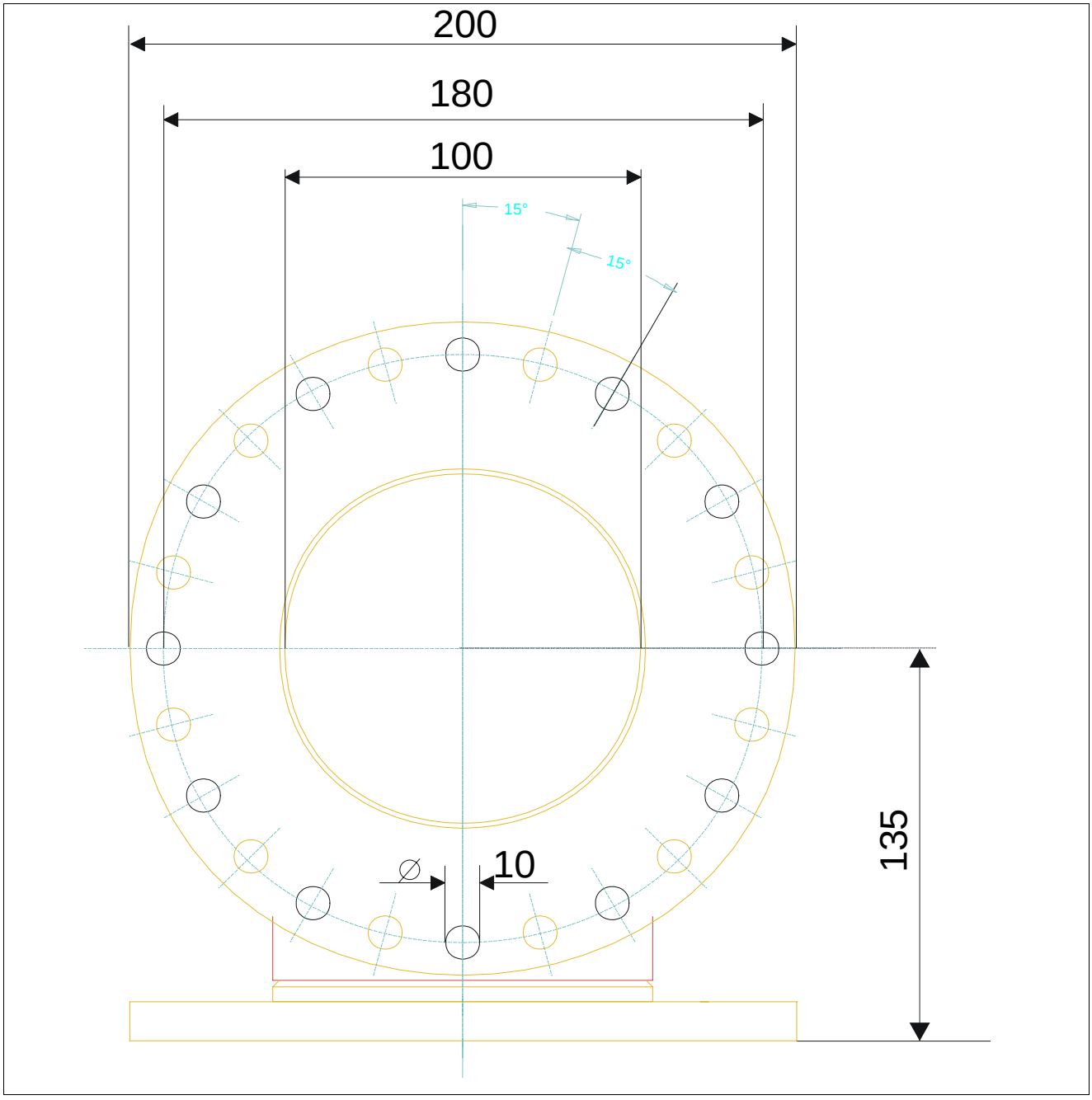


Fig. 10 Vent flange side view

- 12 holes with a diameter of 10.2mm
- The two flange sides are identical in dimension and holes (12 holes with a diameter of 10.2mm)

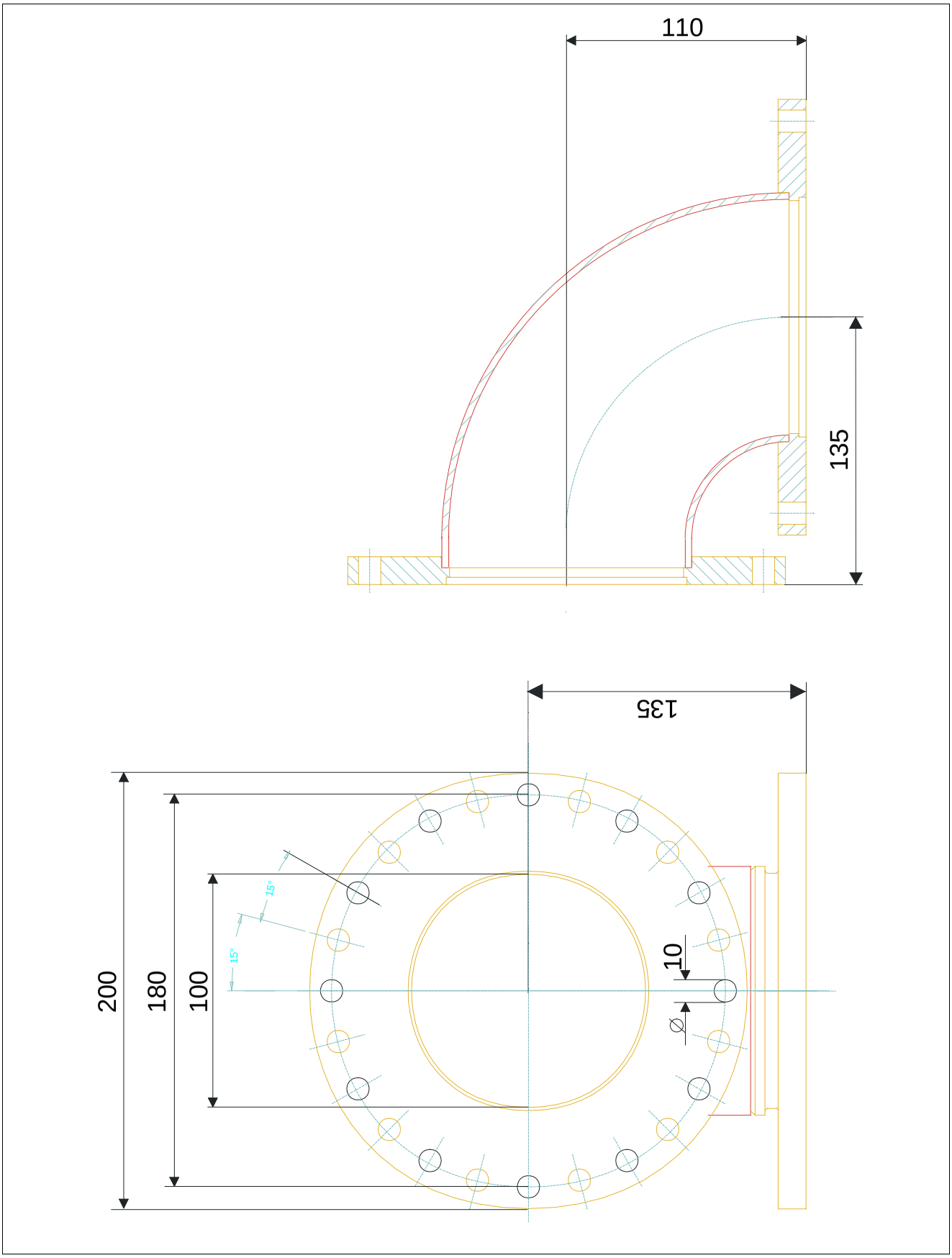


Fig. 11 Quench valve flange view

CCA and GPA cabinet

Technical Data		
Weight		≤ 1100 kg
Heat dissipation to air		≤ 5 kW
Limit value of magnetic flux density for operating safety	CCA cabinet	max. 5 mT
	GPA cabinet	max. 5 mT

NOTE

Standard delivery is CCS water cooled.
The transport wheels and the connection box on top of the cabinet can be removed to reduce the transport height.

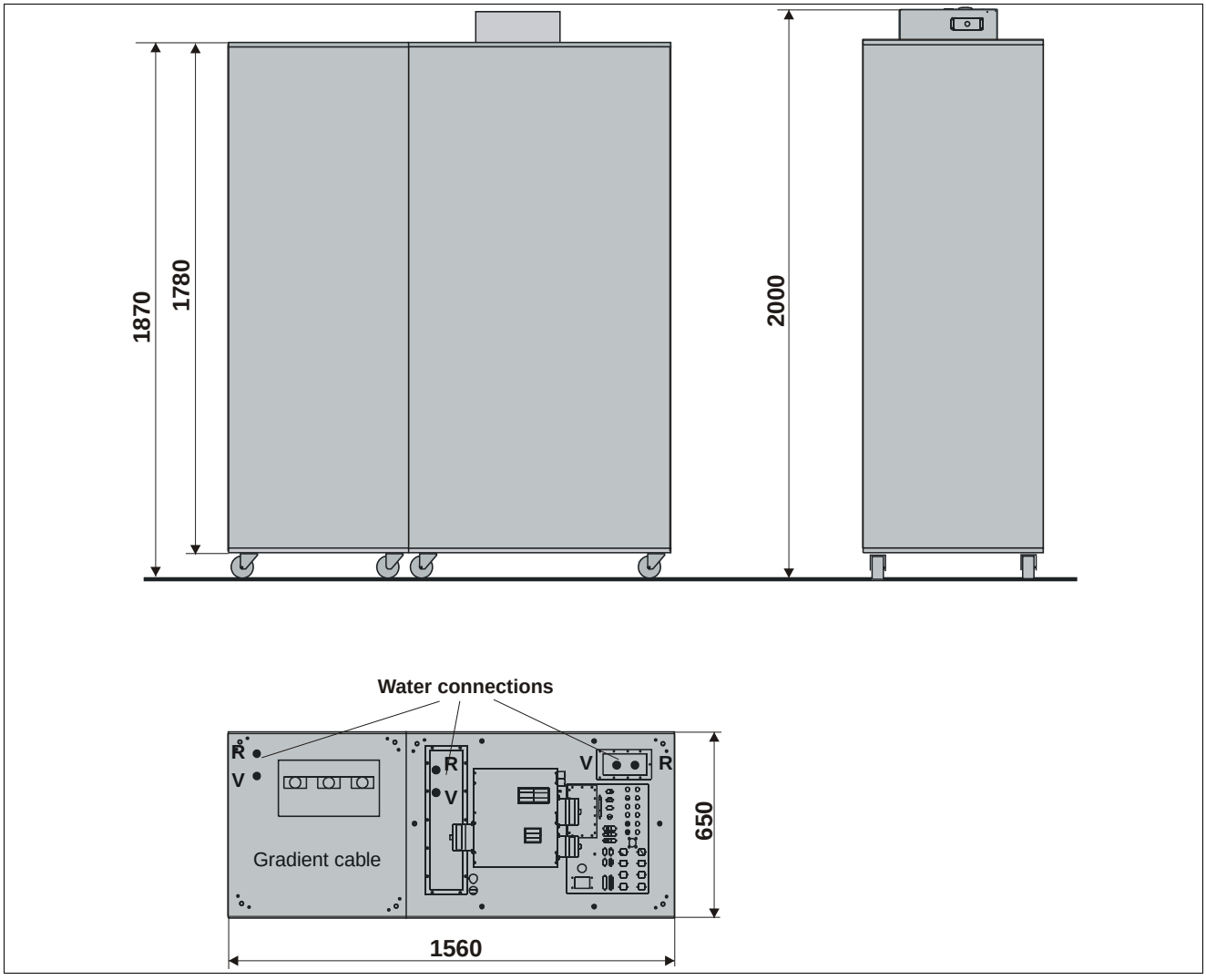


Fig. 12 Dimensions: 2 in 1 cabinet (GPA and CCA cabinet)

Service area for the electronic cabinet

To facilitate service, ensure that the following service area is provided.

Space required for all of the cabinets including service area is **3.8 m^2**.

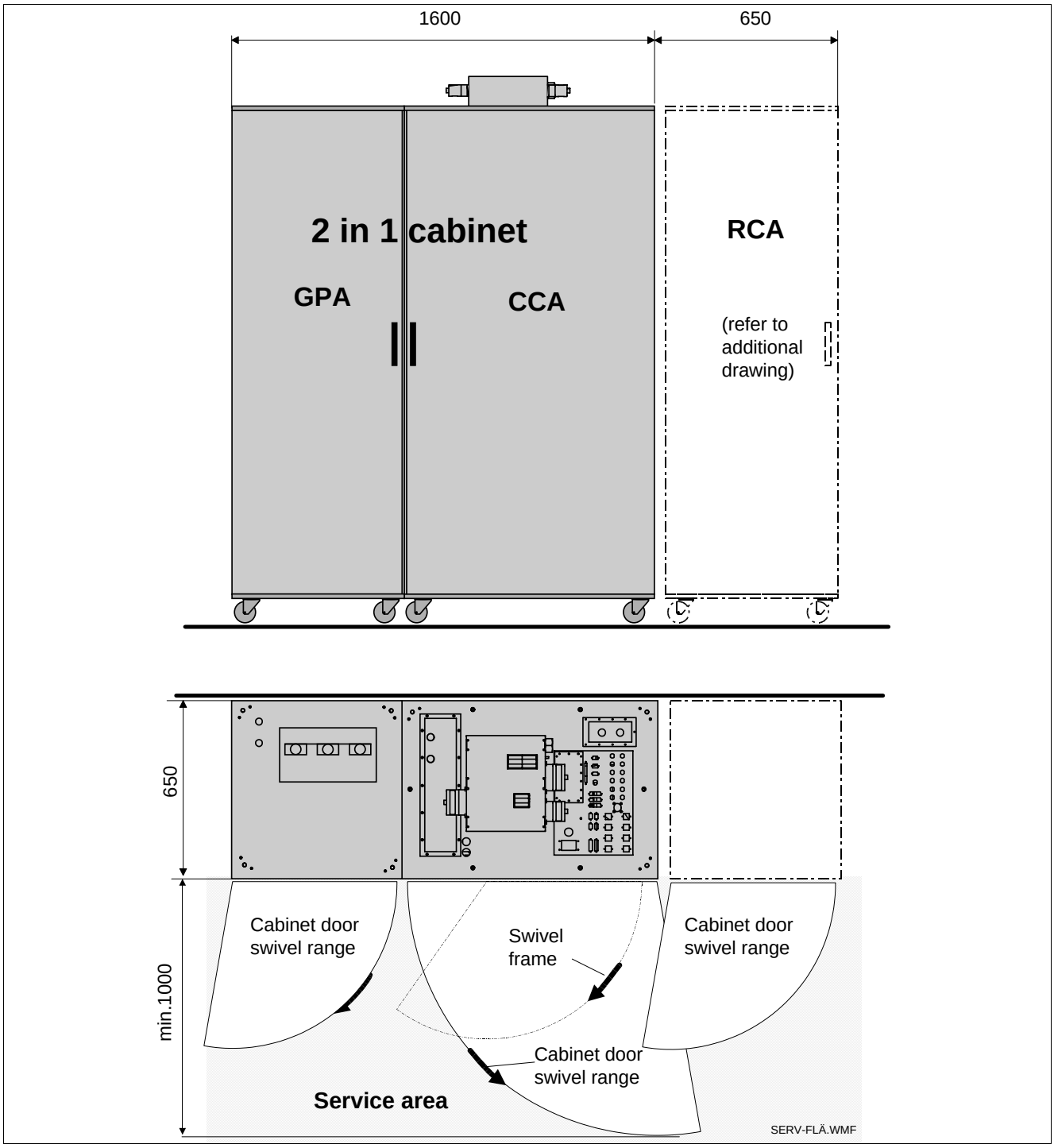


Fig. 13 2 in 1 layout with respect to RCA cabinet and minimum space requirement for service work.

NOTICE	**The doors of the cabinets can be removed with less mechanical expenditure.**

RCA cabinet

Technical Data	
Weight	≤ 320 kg
Heat dissipation to air	≤ 1 kW
Limit value for magnetic flux density for operating safety	5 mT

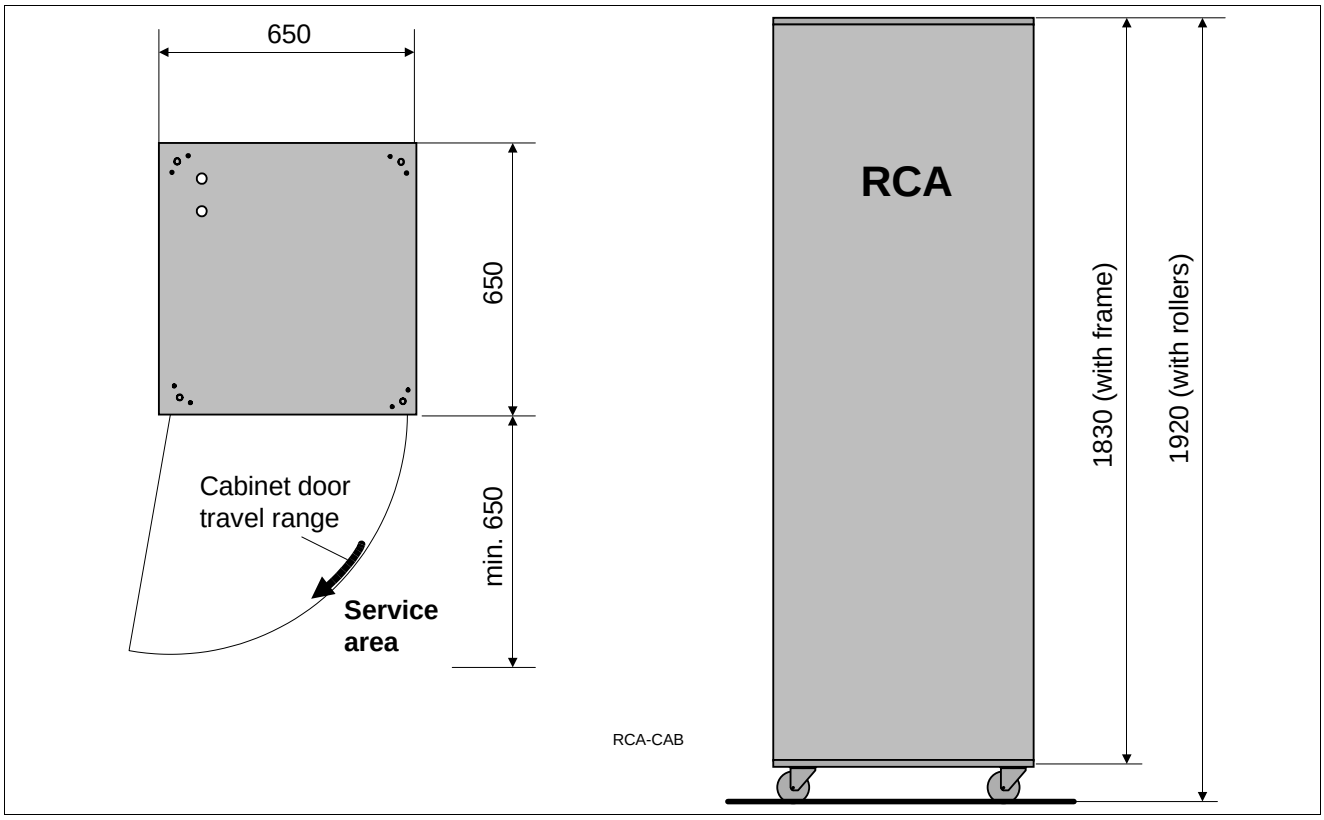


Fig. 14 Dimensions: RCA cabinet with minimum space requirement for service work.

NOTE **The RCA-cabinet should be installed next to the CCA cabinet, if possible. It may be installed at another location, if desired. However be sure to allow for the cable lengths between the RCA and CCA cabinets (cable length max.15m).**

Connections on the RCA cabinet

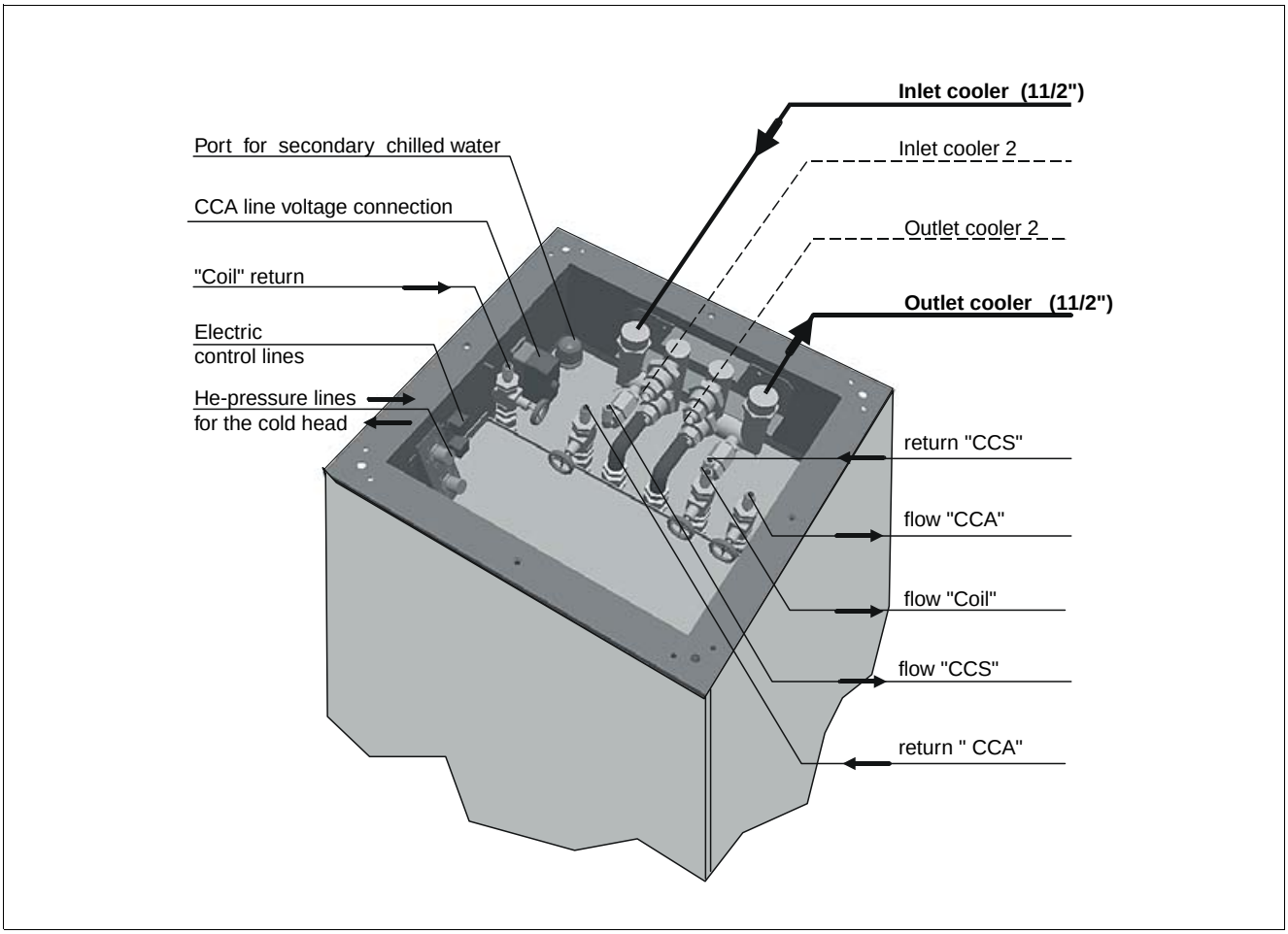


Fig. 15 Overview: RCA cabinet with the corresponding water and cable connections as well as the connections for the pressurized He lines.

Split floor operation kit for the RCA cabinet (Optional)

Function:

This Kit is fitted to prevent back flushing and spillage from the header tank within the RCA unit. This can occur if the solenoid operated valve and the check valve kit is not fitted when the magnet is installed above the RCA unit i.e. Magnet is located on the floor above RCA unit. The modification involves fittings a solenoid operated shut-off valves in the cooling return pipe from the gradient coil. The mechanical check valve is fitted into the cooling line fed to the gradient coil.

NOTE	**If the RCA cabinet is installed one floor above/below of the system components (CCA; Magnet) a option kit "split floor operation" with the part number: 71 20 954 is available to prevent a return flow of the secondary water into the water tank.**

APD Coldhead

SC-10/SC-10L Shield Cooler System

Function

The SC-10 or SC-10L Shield Cooler is a two-stage refrigeration system that conductively cools the warm (77 K) and cold (20 K) radiation shields of the MRI Cryostat, maintaining the shields at cryogenic temperatures and reducing the loss of liquid helium.

The SC-10 Shield Cooler mates with the cryostat interface flange and shields provided by the magnet manufacturer.

The system consists of a helium compressor (either HC-10 or HC-10L), interconnecting gas lines, cables and the shield cooler. The helium compressor uses high purity helium gas for its refrigerant. There is no co-mixing of the helium refrigerant with the helium in the crosscut. The equipment is designed for continuous operation. Electricity and cooling water for the compressor are the only required utilities.

Pressures are stated as gauge, not absolute. Pressure units are bar and pounds per square inch (psig). For reference:

1 bar = 14.5 psig

1 MPa = 10 bar

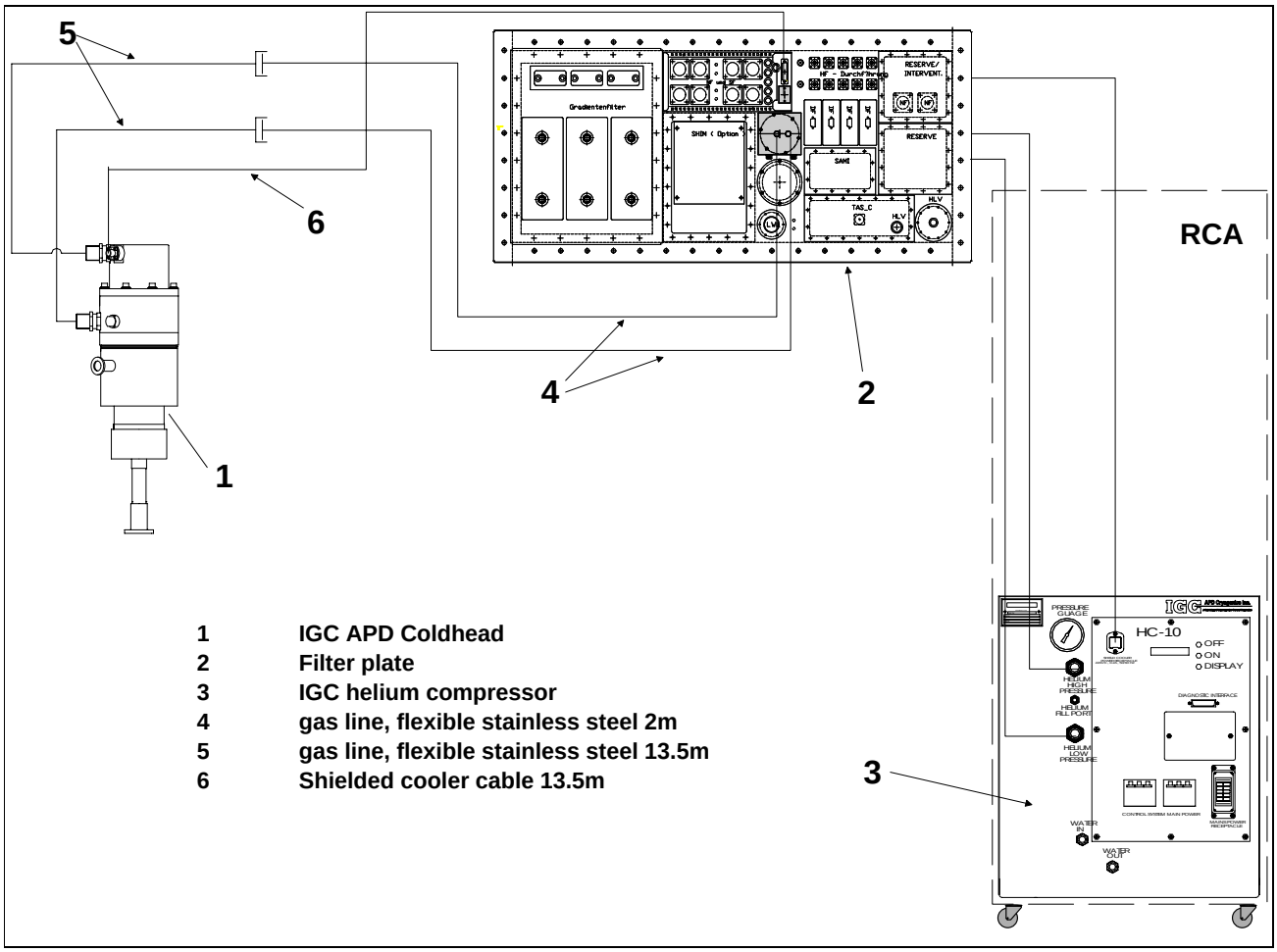


Fig. 16 Configuration

Additional RF-cabinet (Standard delivery)

NOTE **The position of the additional RFPA cabinet determinates the cable set length of the equipment room!**

Technical Data	
Weight	≤ 500 kg
Heat dissipation to air	7.5kW max.
Airflow temperature at exhaust	max. 120°C
Air throughput	530 m³/h
Limit value for magnetic flux density for operating safety	1 mT
Max. free cable length to CCA	5.0 m
Max. free cable length to filter plate	10.0 m

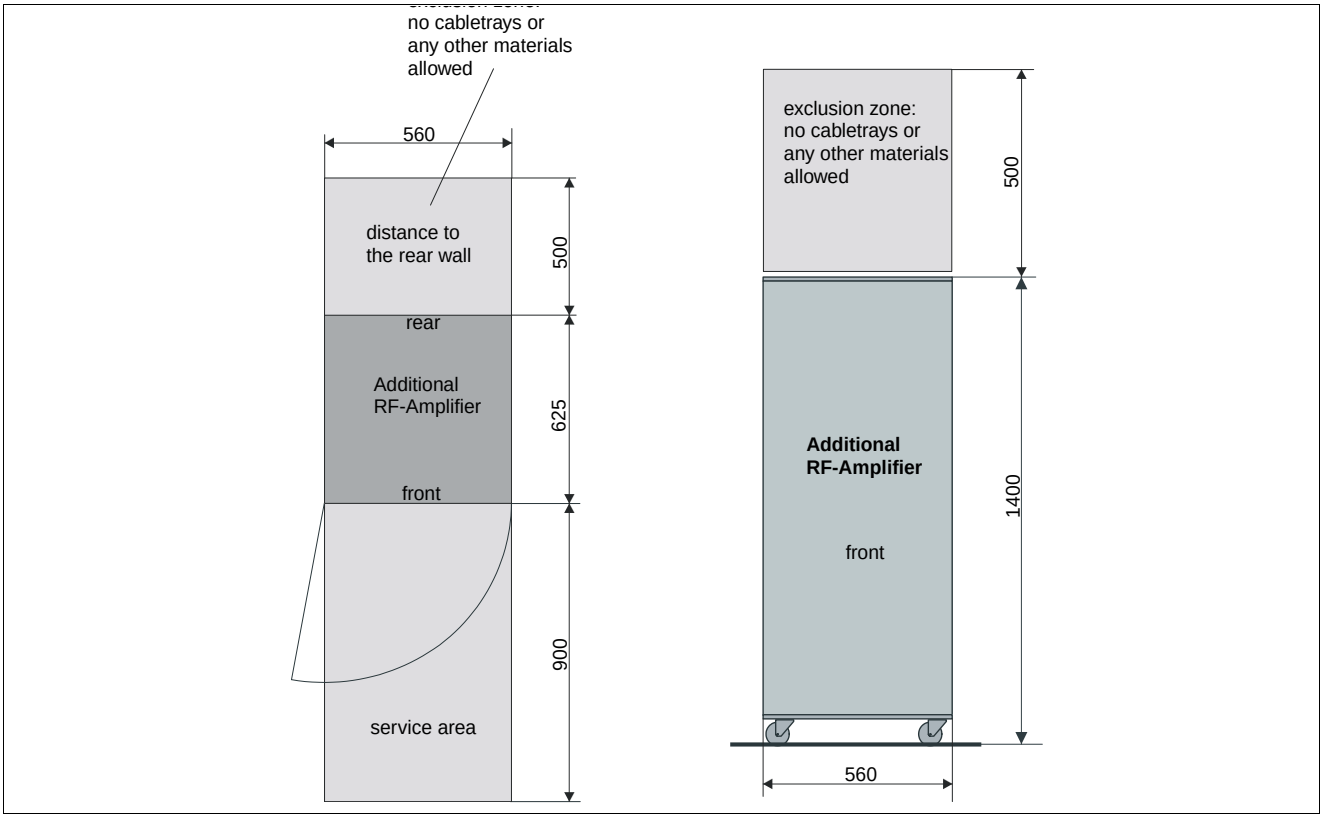


Fig. 17 Dimensions: Additional RF-cabinet with minimum space requirement for service work.

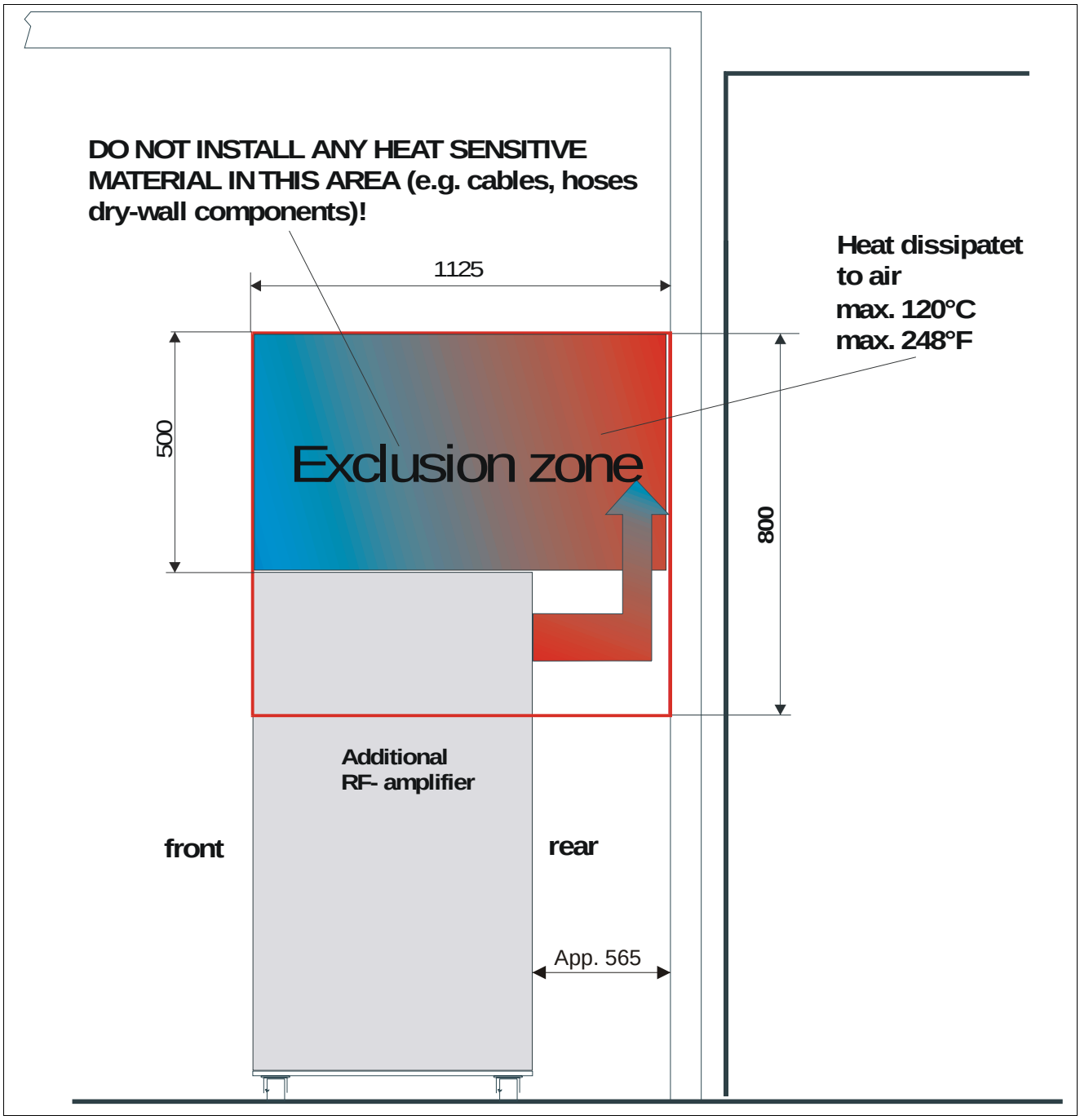


Fig. 18 Additional RF-cabinet

NOTE	The exclusion zone also comprises the width of the RFPA cabinet!

NOTE	It is recommended to have a clearence of 500mm for service access at one side of the RFPA!

Shim power supply

NOTE **The Shim power supply is a heat sensitive device! Do not position the Shim power supply in the close vicinity of heat sources.**

Technical Data	
Weight	≤ 100 kg
Heat dissipation to air	≤ **0.5 k**W
Limit value for magnetic flux density for operating safety	10 mT
Size	
tot. height	624 mm
length	659 mm
width	603 mm
Service area (front side)	603 mmx 573 mm
min. distance to ASTEX RFPA	3.0 m
Max. free cable length to CCA	10.0 m
Max. free cable length to filter plate	7.0 m

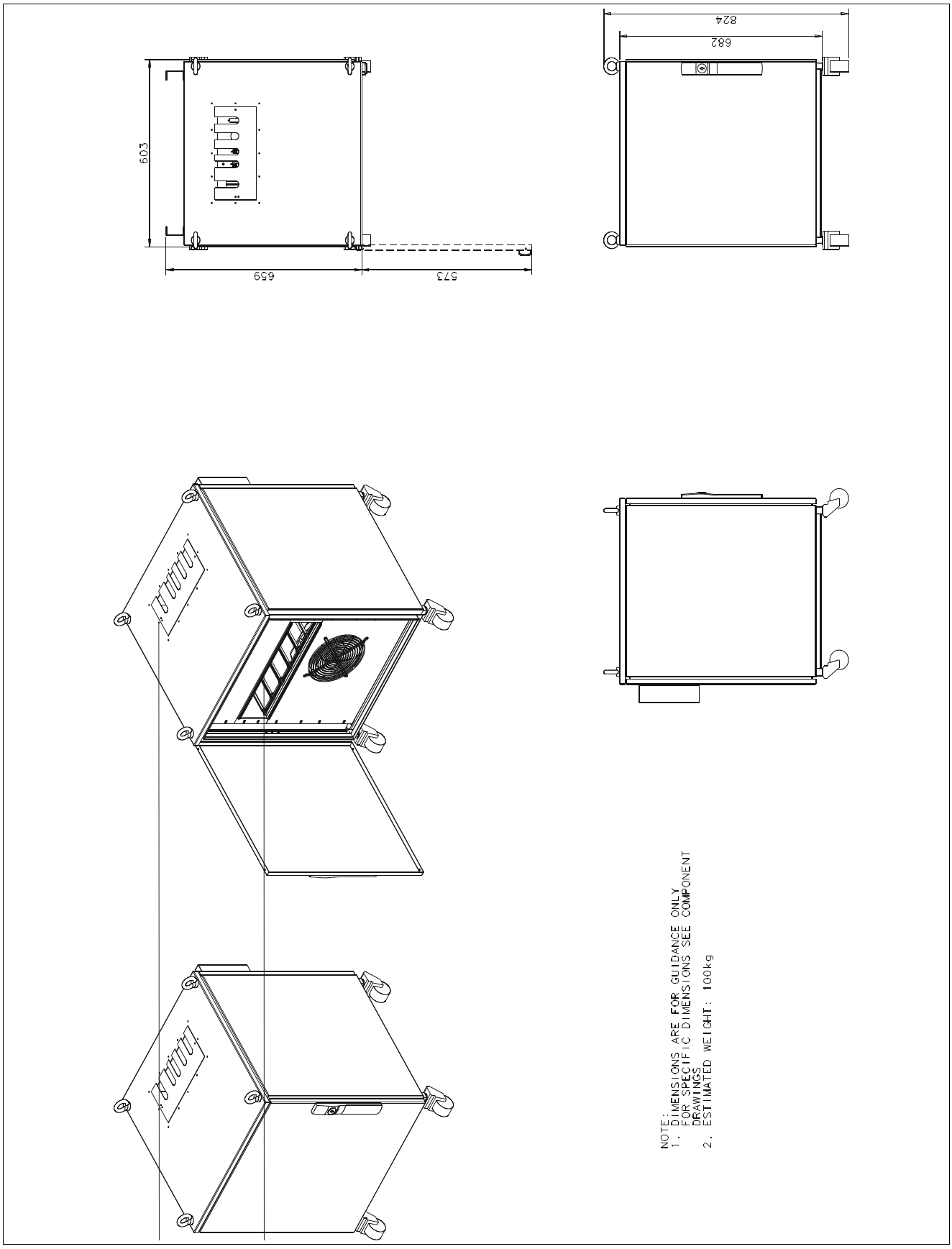


Fig. 19 Dimensions: shim power supply

Alarmbox

Technical Data	
Weight	≤ 1.3 kg
Limit value for magnetic flux density for operating safety	max. 5 mT

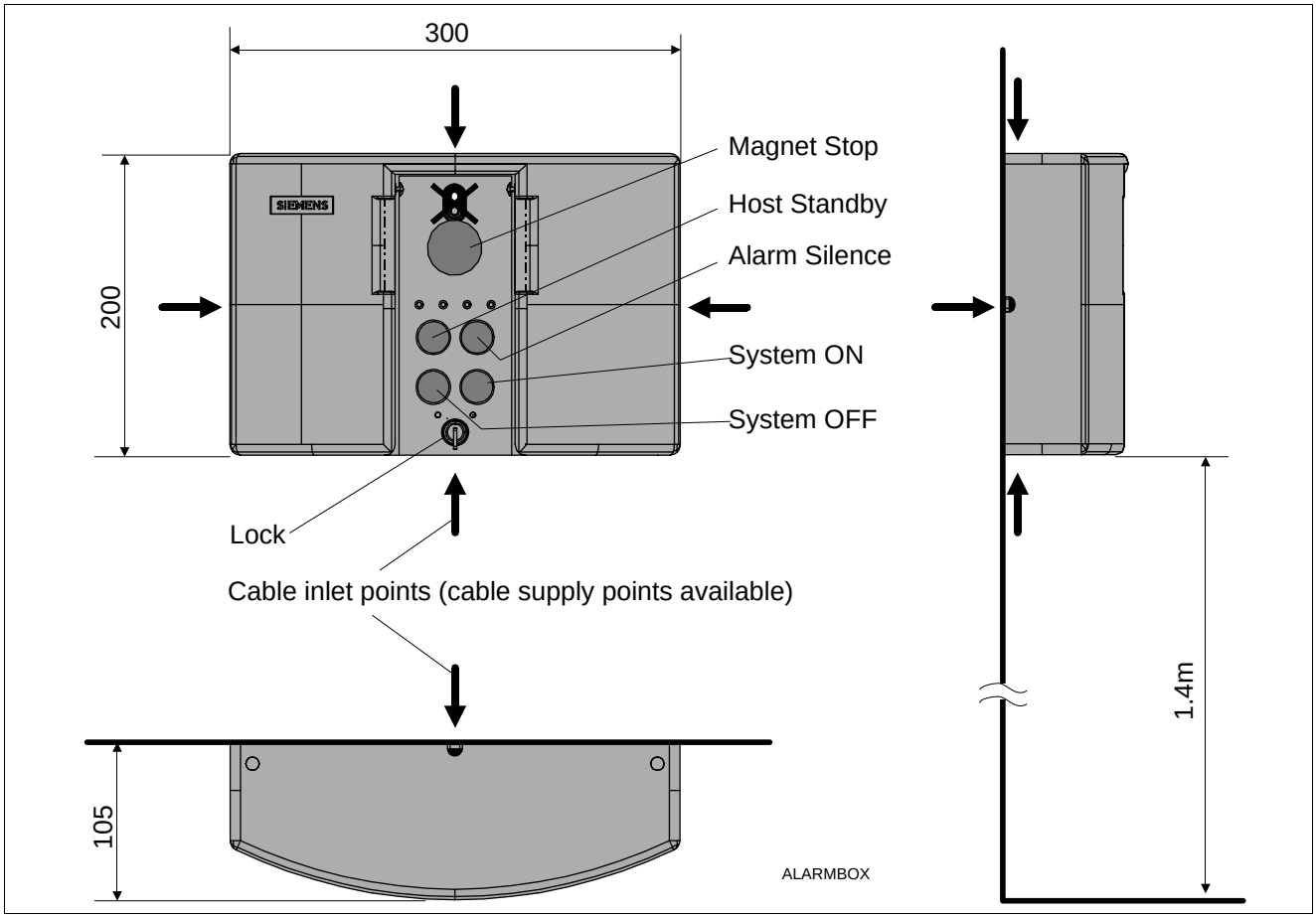


Fig. 20 Dimensions: Alarm box

Magnet Stop

For MAGNETOM systems containing superconductive magnets or resistive magnets, the technical descriptions provide decay characteristics for the magnet in case of a QUENCH or an emergency field shut-down to enable the USER to implement adequate life support and other safety procedures. These characteristics indicate the time from activating the EMERGENCY FIELD SHUT-DOWN UNIT to the moment when the field strength in the magnet center has dropped to 20 mT (typical value: 20s).

Technical Data	
Weight	≤ 0.3 kg

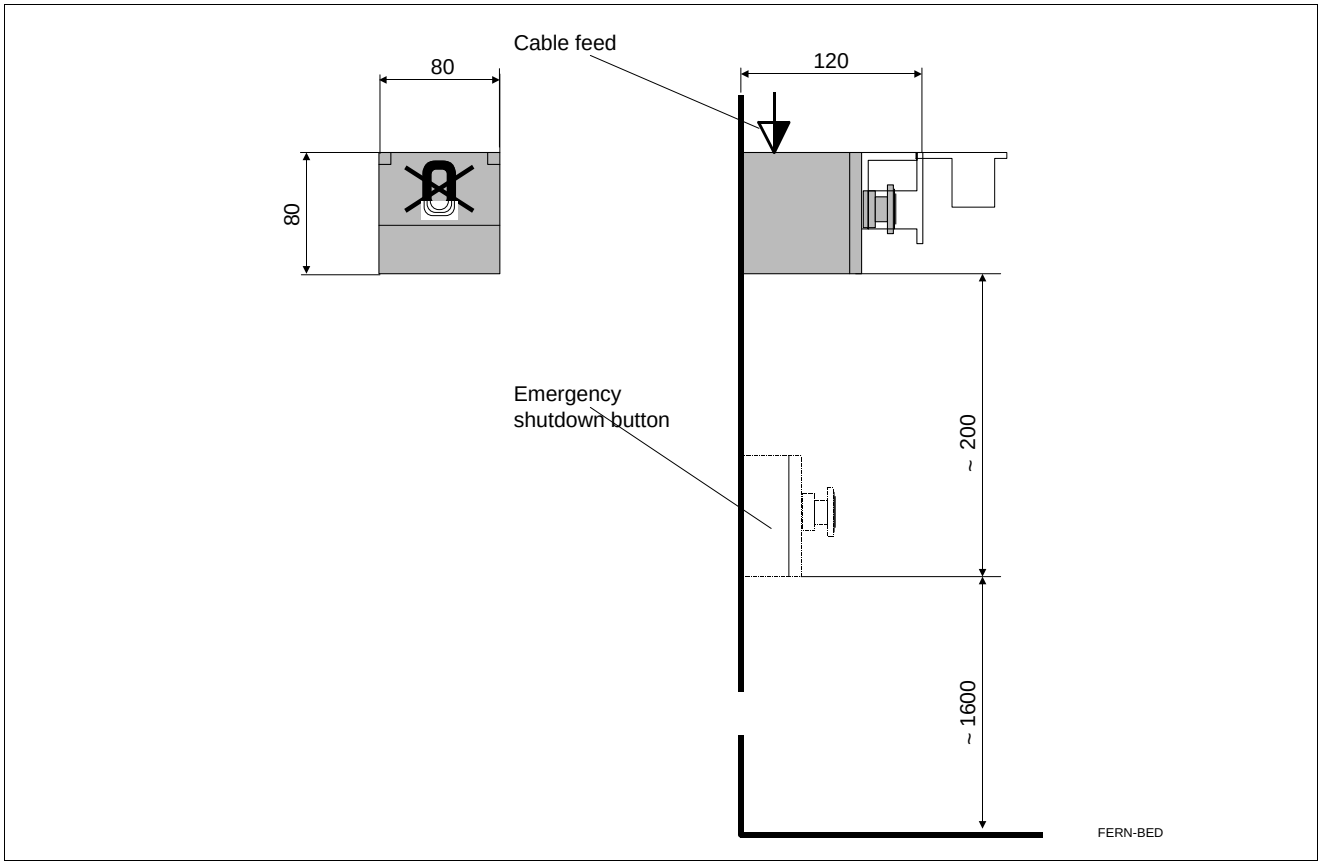


Fig. 21 Dimensions: Magnet stop

RF filter plate

Technical Data	
Weight	129.5 kg
+ shim filter weight	30.0 kg
+ vacuum pump weight (optional)	4.5 kg
+ pinbooster weight	5.0 kg
Heat dissipation to air (incl. pin booster)	400 W
Limit value for magnetic flux density for operating safety	10 mT

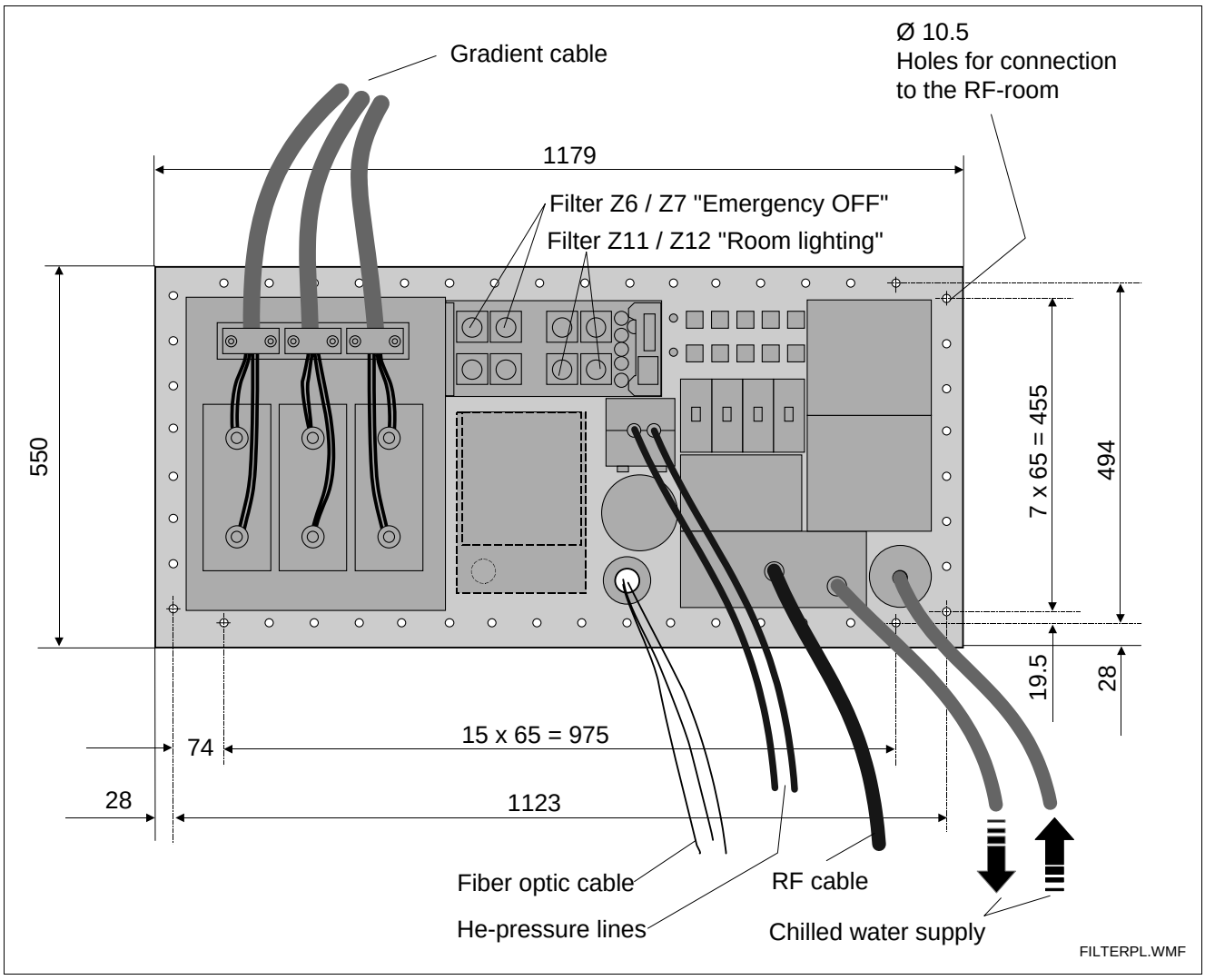


Fig. 22 Dimensions: RF filter plate with various inputs (front view). View from outside the RF-room.

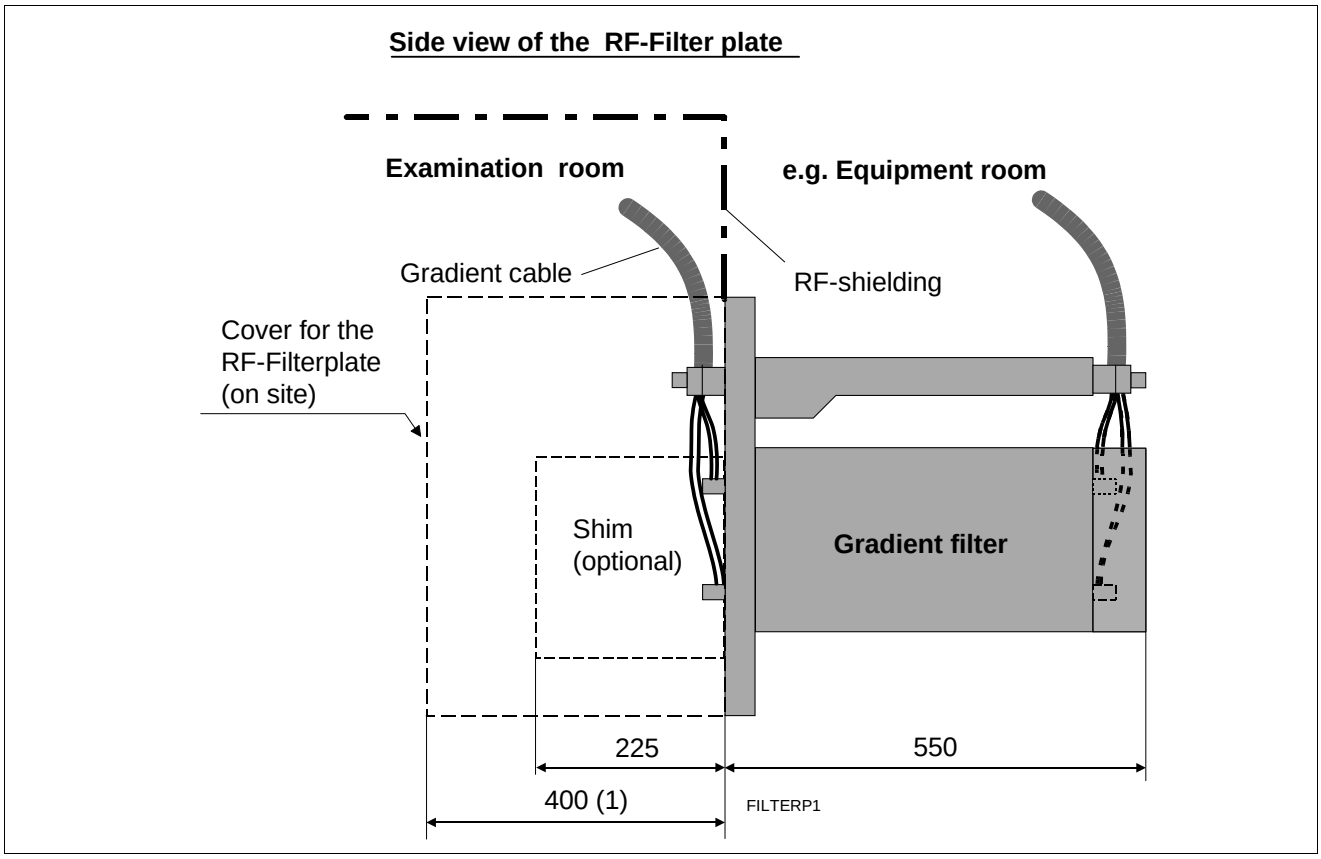


Fig. 23 Dimensions of the RF filter plate (side view)

NOTE	**(1) If you want to install a cover around the RF-Filterplate inside the examination room (not part of the delivery) it is necessary to keep a distance of 400 mm (Fig. 23) to allow a propper cabeling.**

NOTE	**Materials (e.g. screws, nuts and bolts) for mounting the RF filter plate to the RF- room must be purchased locally.**

NOTE	**Additional RF-filters must be provided for e.g. smoke detectors inside the examination room if required.**

Operating console components (MRC)

Overview

Fig. 24 Console top

Siemens Color Display

Technical datas			
Weight	10 kg	**Line voltage**	100V...230V AC +/-10V
Size	465 X 430 X 120 (l X H X W) in mm	**Monitor foot**	240mm
Heat dissipation		**Frequency**	47Hz...65Hz
Audible noise	< 35 dB(A)	**Power consumption**	75 W

NOTE **There is no measurable influence of the magnetic field to the monitor outside the RF-cabin.**

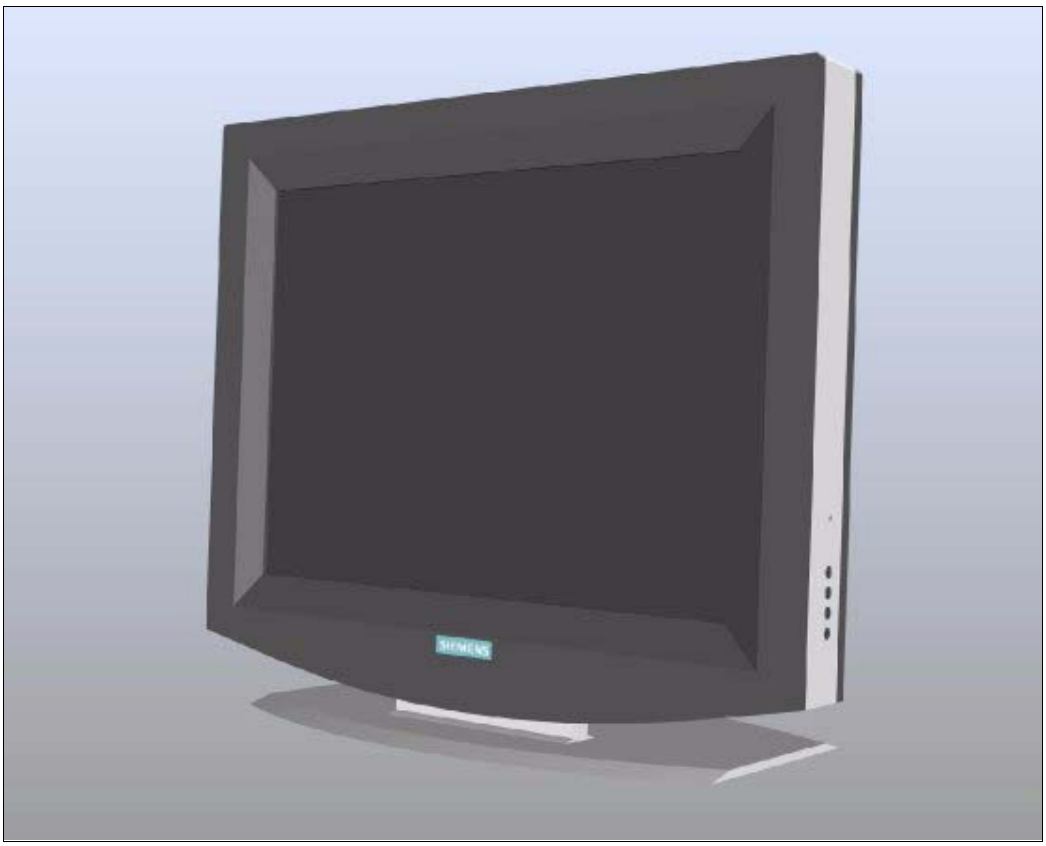


Fig. 25 SCD 1880 Color Display

Host PC MRC

Technical Data	
Weight	≤ 22 kg
Heat dissipation to air	≤ 700 W
Power consumption	654 VA
Limit value for magnetic flux density for operating safety	max. 1 mT
Size (height X width X depth) in mm	460 X 280 X 685
Audible noise	< 45 db

Fig. 26 Host PC front

Fig. 27 Host PC rear

NOTE

The Host computer has to be positioned in the close vicinity of the MRC console. The free cable length between Host PC and CCA cabinet is 23.0m.

The connection for the modem is located at the rear side of the Host PC. The network connection as well.

Console components

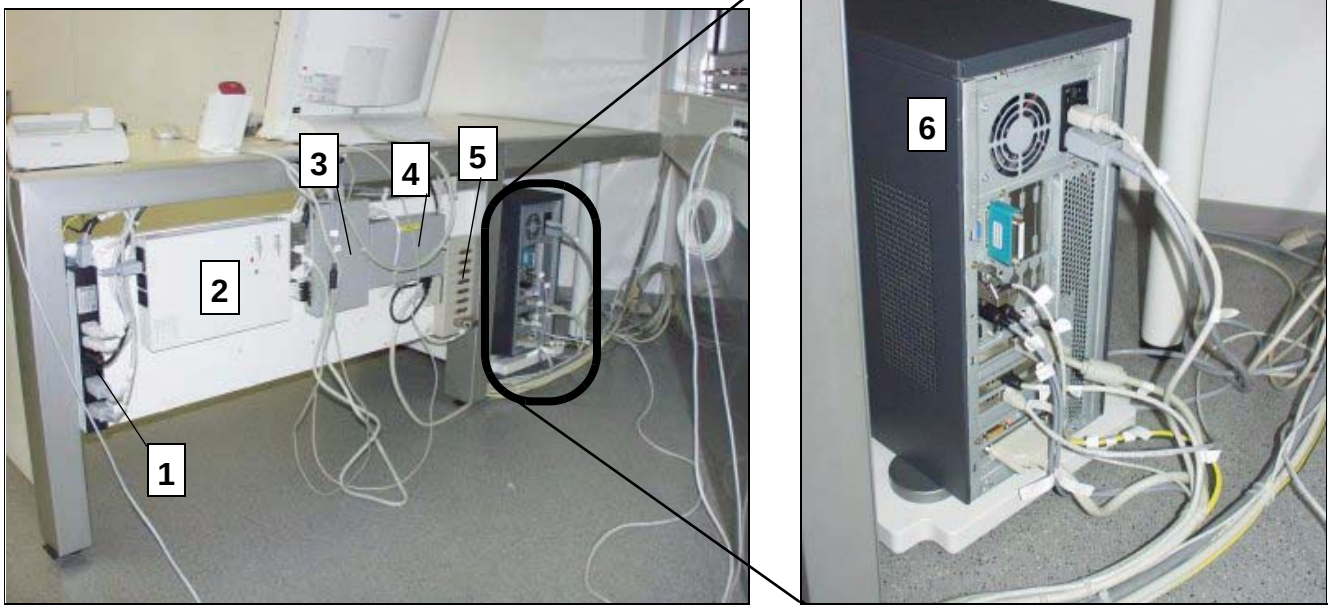


Fig. 28 Console rear side

Fig. 29 Host PC rear side

Item Nr.	Component name	Size (L x W x H) in mm
1	Power distribution	330 x 45 x 50
2	Intercom	320 x 210 x 55
3	Switch (1) Network switch	210 x 120 x 40
4	Switch (2; only if option MRSC is available) Network switch	210 x 120 x 40
5	Serial distribution	250 x 160 x 40
6	Host PC	280 x 685 x 460

NOTE **If the console table is not part of the delivery volume the components (item 1 to 5) have to be installed e.g to the wall in the close vicinity of the Host PC (item 6).**

NOTE **If the console table is not part of the delivery volume the components (item 1 to 5) have to be installed e.g to the wall in the close vicinity of the Host PC (item 6).**

Imager PC

Technical Data Celsius 670	
tot. weight (depending on hardware options)	app. 25 kg
tot. heat dissipation to air	max. 400 W
tot. power consumption (typical)	200 W
Limit value for magnetic flux density for operating safety	max. 1 mT
tot. audible noise	< 45 db
Size (height X width X depth) in mm	470 X 220 X 460

Fig. 30 Celsius 670 front

Fig. 31 Celsius 670 rear

NOTE

The Imager PC has to be positioned inside the equipment room.
The free cable length between Imager PC and CCA cabinet is 23.0m.

It could be positioned on a site prepared shelf for wall mounting or on a on site prepared table. Do not position the Imager PC on the floor.

Fig. 32 Imager

Installation example of the Imager PC on a shelf inside the equipment room beside the CCA cabinet

Host PC MRSC

NOTE

For the option MRSC a on site power outlet has to be installed in the close vicinity of the MRC (see "on-site electrical installation for details").

NOTE

If the control room is used as a patient preparation room and the MRSC is located inside this room a patient or other persons which are not members of the operators team must not be able to reach the MRSC console within 1.5m for safety reasons.

Technical Data	
Weight	≤ 22 kg
Heat dissipation to air	≤ 700 W
Power consumption	654 VA
Limit value for magnetic flux density for operating safety	max. 1 mT
Size (height X width X depth) in mm	460 X 280 X 685

Fig. 1 Host PC front

Fig. 2 Host PC rear

NOTE

The Host computer has to be positioned at the MRSC console.The free cable length between Host PC and Imager is 23.0m.The connection for the modem is located at the rear side of the Host PC. The network connection as well.

MRSC Host PC power connection

NOTE **For the option MRSC a power outlet has to be provided in the close vicinity of the MRSC console!**

MRSC power outlet specifications		
	Nominal value	**Tolerance**
Voltage	115/230 V	+10% / -10% (for all line and load conditions)
Line to line unbalanced	--	max.2%
Frequency	50/60 Hz	±1 Hz
Power consumption	1.8 kVA	

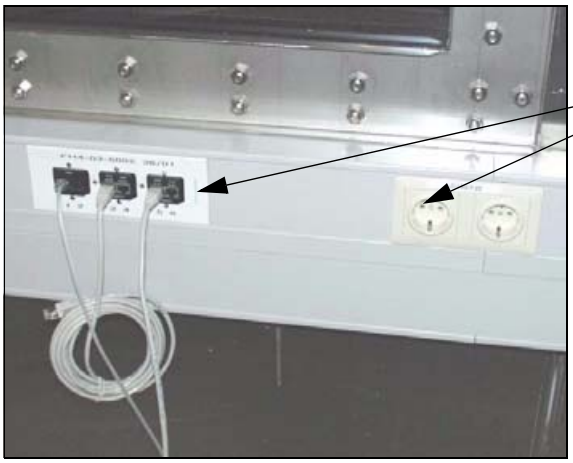


Fig. 3 Power outlet

➪ For the MRSC Host PC you need to prepare additonal power outlets and network outlets in the close vicinity of the MRSC Host PC.

NOTE **This power outlet is not connected to the CCA cabinet.**

NOTE **If the control room is used as a patient preparation room and the MRSC is located inside this room a patient or other persons which are not members of the operators team must not be able to reach the MRSC console within 1.5m for safety reasons.**

Host / Imager container

Item	Size (L X W X H) in mm
450 mm Host container	450 X 800 X 700
600 mm Host plus Imager container	600 X 850 X 700

Fig. 4 Host PC container

Fig. 5 Host PC container

NOTE **The picture Fig. 4 shows the 450 mm Host container.**
Refer to the actual price book for details.

NOTE **The 600 mm container is for one PC only, ether the Host or the Imager PC!**

Table top transport trolley

Technical Data	
Weight	≤ 132 kg / 290.4 lb
Size (height X width X length) in mm	1000 X 670 X 1810
Overall length including removable table top in mm	2445

Fig. 6 Dimensions: Patient transport trolley.

NOTE **The floor in the vicinity of the magnet (2.2m x 4.5m) must be leveled within maximum +/- 2.0mm to use the option.**

In-room MRC

Technical Data	
Weight	≤ 63 kg

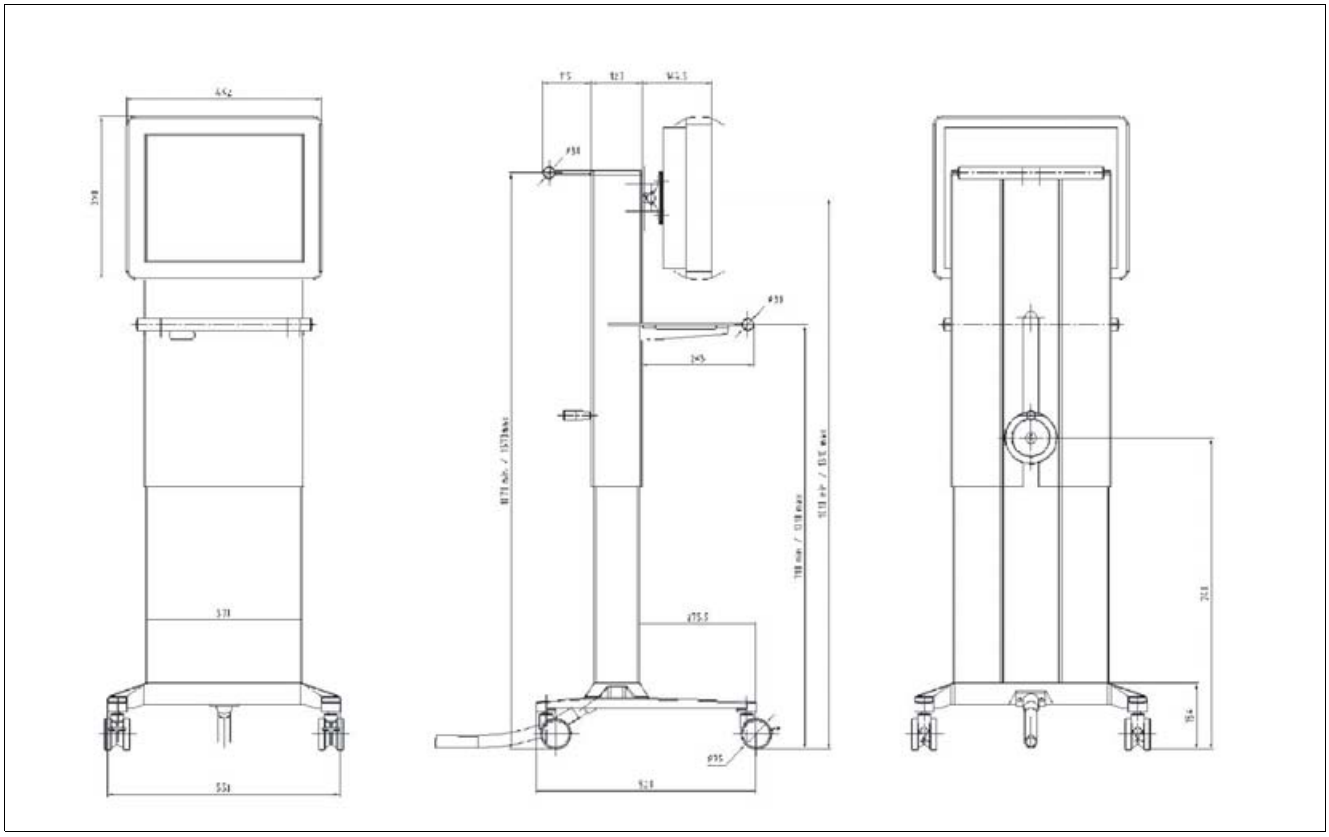


Fig. 7 Dimensions for the in-room MRC

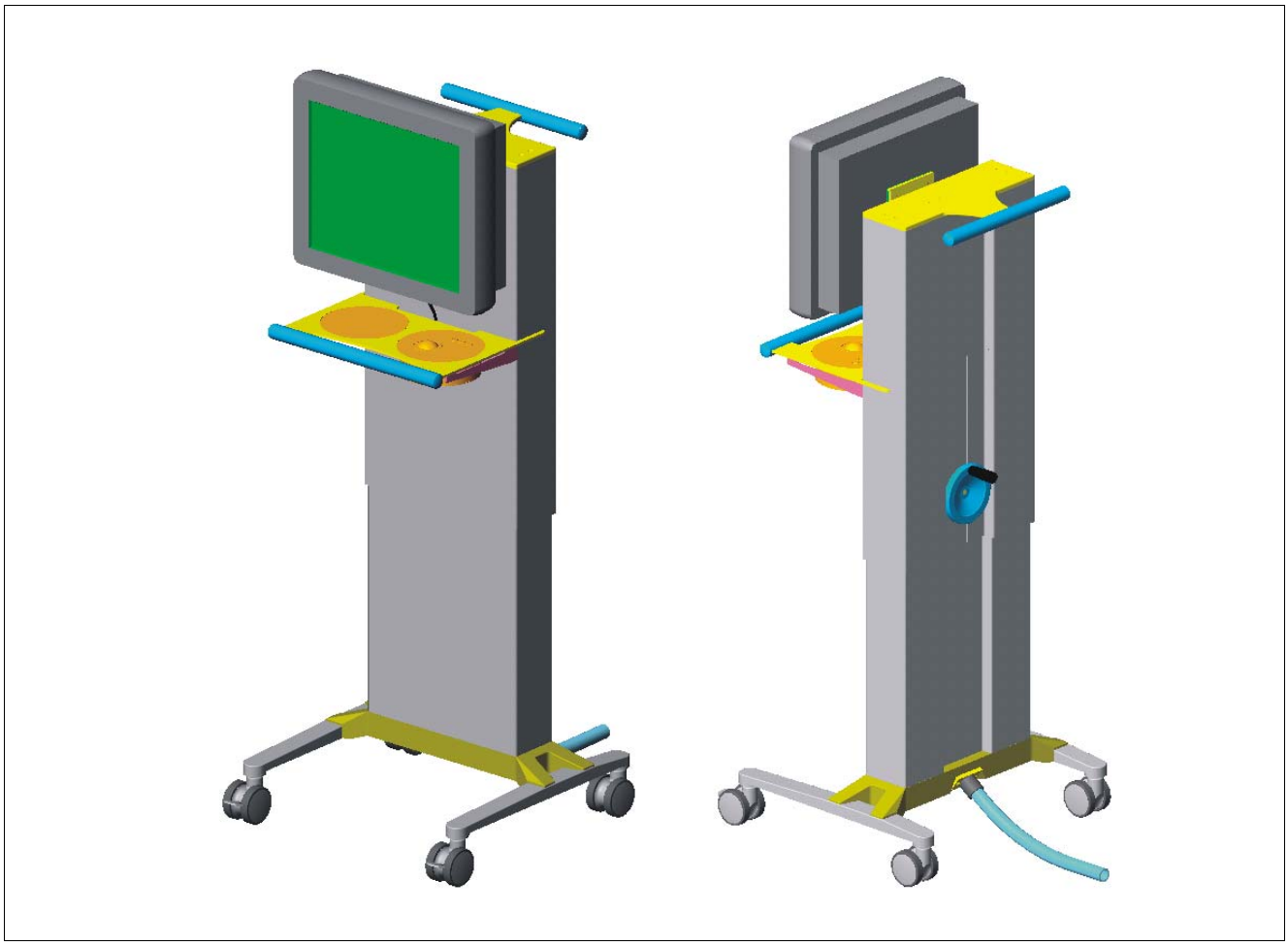


Fig. 8 Dimensions for the in-room MRC

For planning purpose it is important to know the following:

When the In-room MRC is installed a transformator has to be installed inside the examination room at the filter plate. A special position with already prepared bolts on the filter plate is prepared.

If due to any reason (e.g. sound reduction; thick wall) the cutout in the wall/sound reduction construction for the filterplate is exactly the same dimensions as the outer dimension of the filter plate the transformer can not be mounted to the filter plate!

The transformer has to be mounted in this case in the close vicinity of the RF filter of the filter plate. The cable length is 700mm.

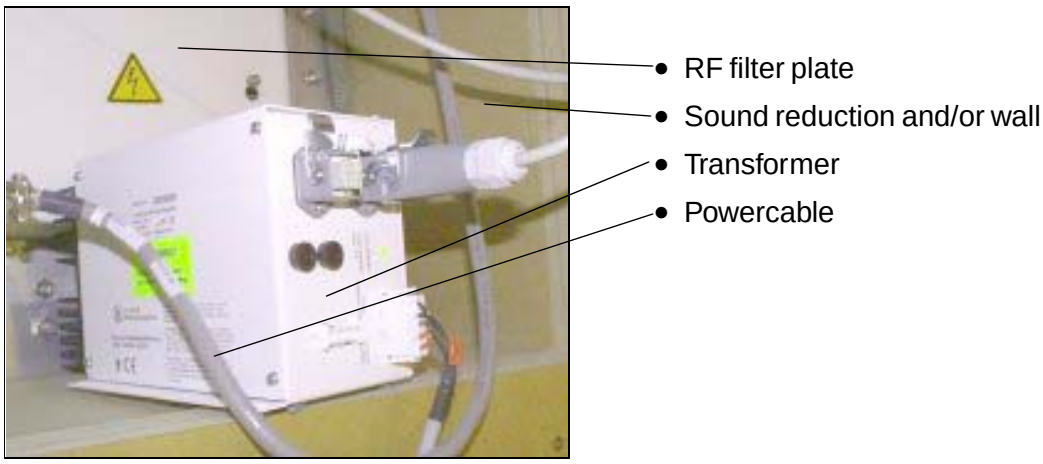


Fig. 9 Transformer

Footswitch

Functionality

The footswitch / kneeling chair allows starting and stopping selected sequences at the MR system. The pushbutton contains no electronics and transmits signals to a converter via air pressure.

Components

The footswitch consists of two components:

- **Footswitch** (kneeling chair optional)

The footswitch is located in the RF cabin. It has two buttons "Start" and "Stop". The signals are transmitted pneumatically to the converter via two air hoses.

- **Signal converter**

The converter is located at the back side of the MR operating console. It converts the pneumatic signals of the footswitch or kneeling chair into electrical signals that are transmitted to the host computer via a RS232 interface and the adapter card.

Contents of the kit

- footswitch (kneeling chair optional)
- signal converter
- hose assembly, 35m
- RS232 interface cable
- accessories (mounting material, power cable, connector, feed-through plate)

Fig. 10 Footswitch

The footswitch is located inside the examination room.

The connections of the footswitch are fed through the filter plate. The required adapter is part of the delivery volume.

Fig. 11 Converter

The signal convertor has to be mounted in the close vicinity of the console electronics components.

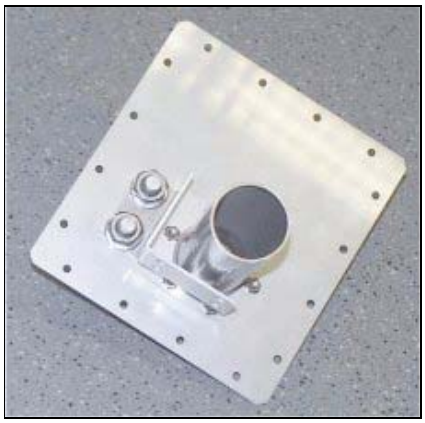


Fig. 12 Feedthrough

The feedthrough has to be mounted to the filterplate. Therefore a blind plate has to be removed

Additional Monitor

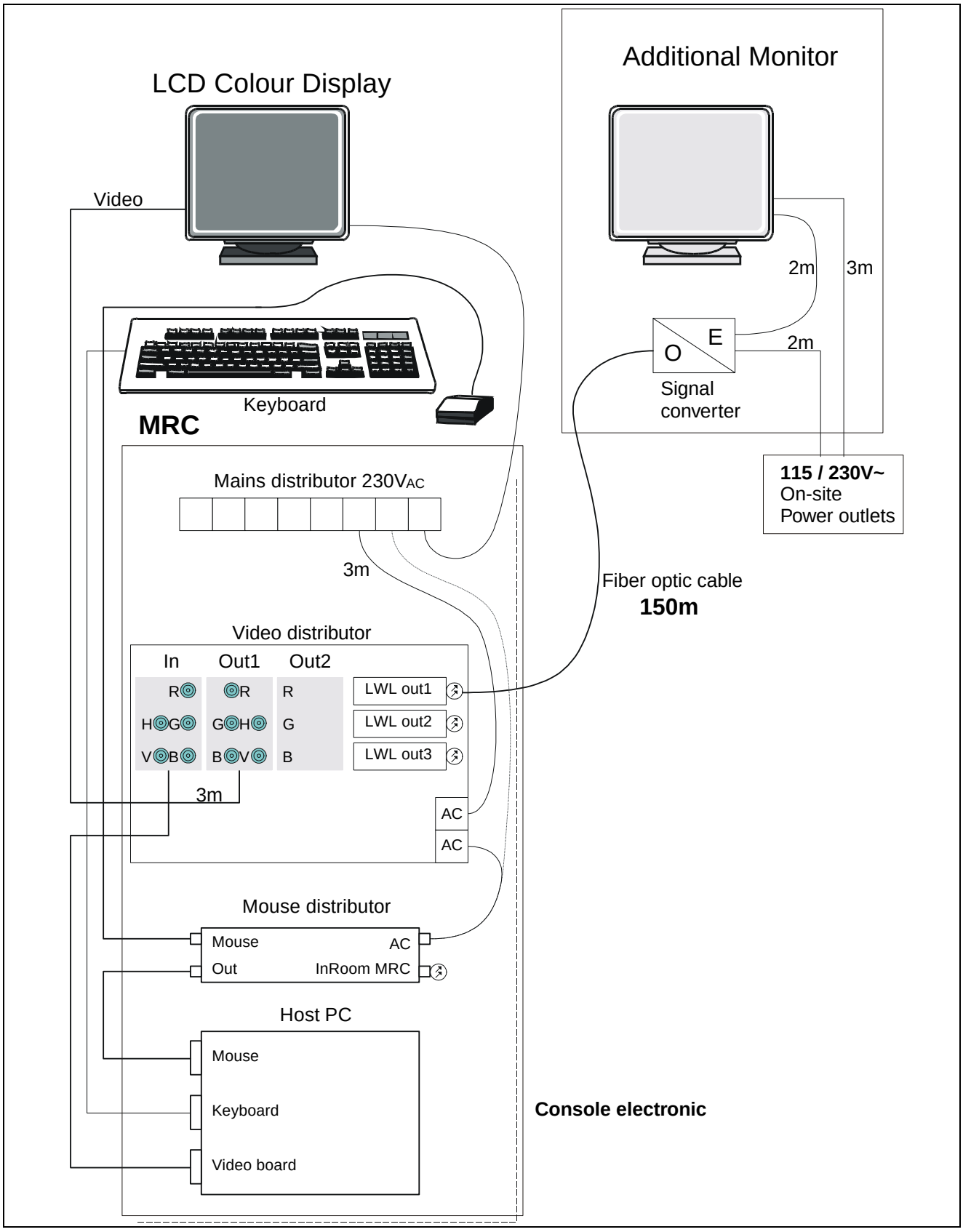


Fig. 13 Cabling for the additional monitor

Patient supervision unit

➪ Special video camera integrated in the back magnet cover ring for observing the patient. Color LCD monitor maybepositionedat the operator's console or at a convenient wall location

Technical Data	
Weight	≤ 4.5 kg
Cooling	convection
Power consumption	20 W max.
Operating temp.	+15°C - +30°C
Humidity (non condensing)	40% - 80%
Power supply	115/230VAC +/- 10% automatic selection
Limit value for magnetic flux density for operating safety	max. mT
Size (height X width X depth) in mm	314 x 312 x 94.6 / 180 at pedestal

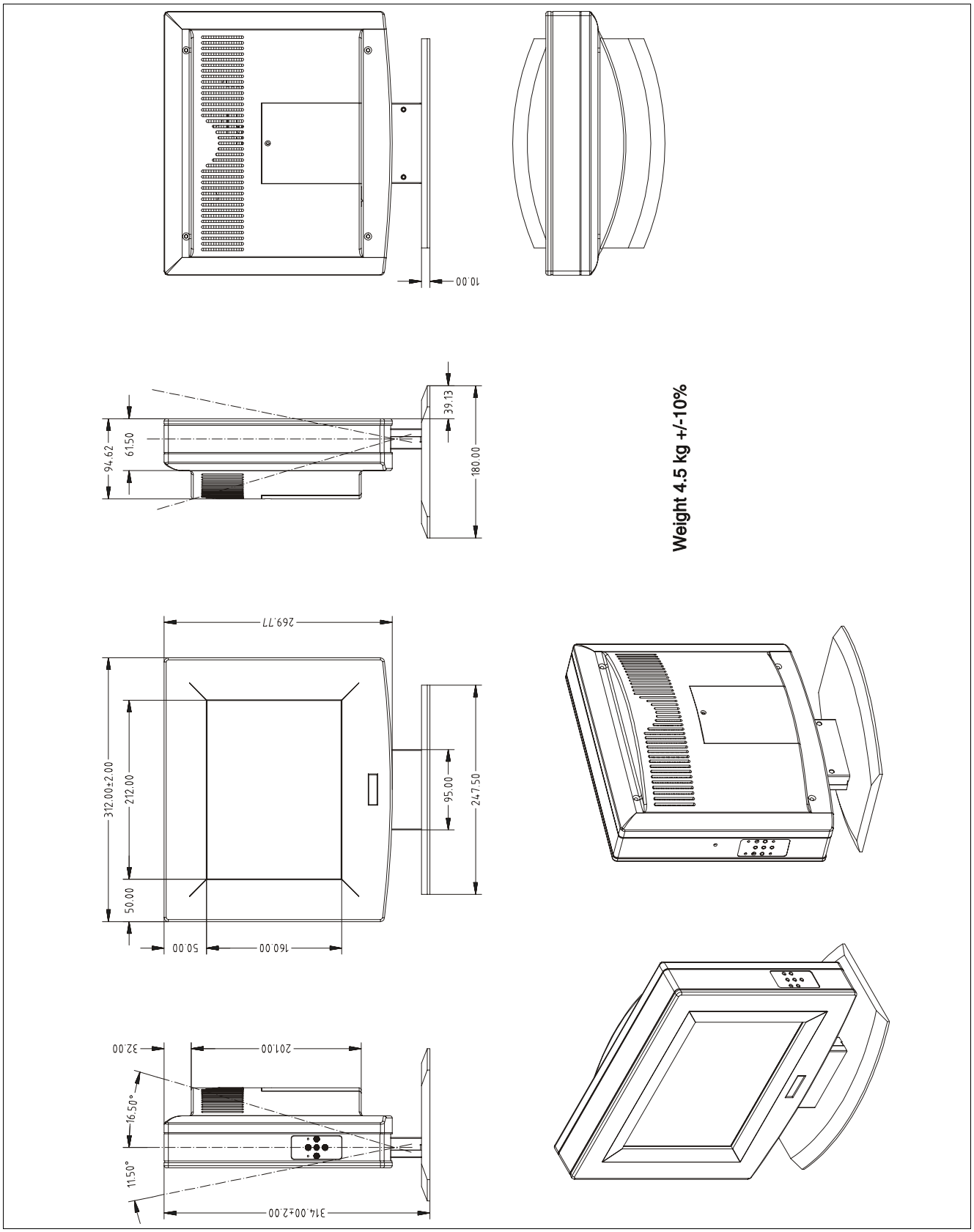


Fig. 14 Patient monitor

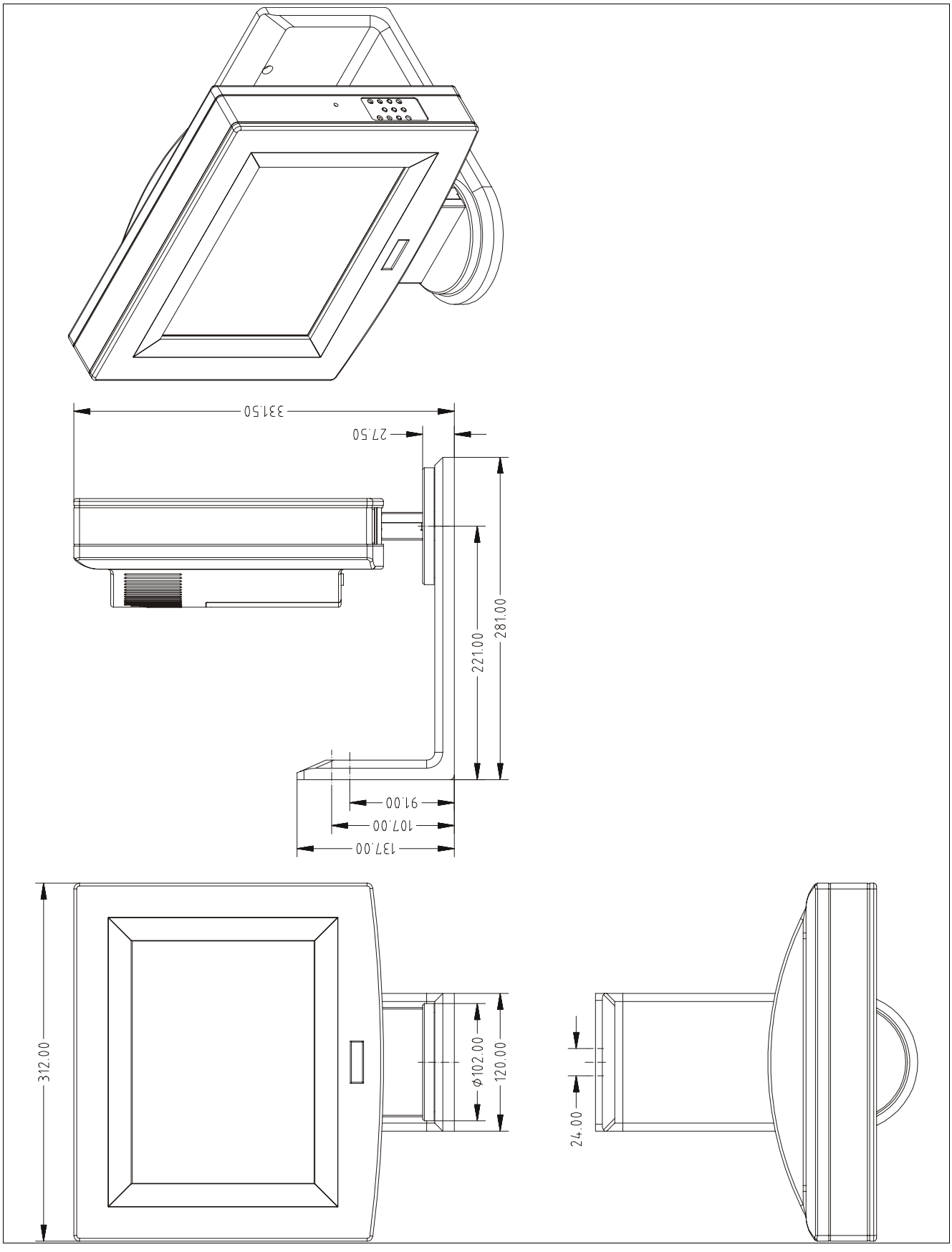
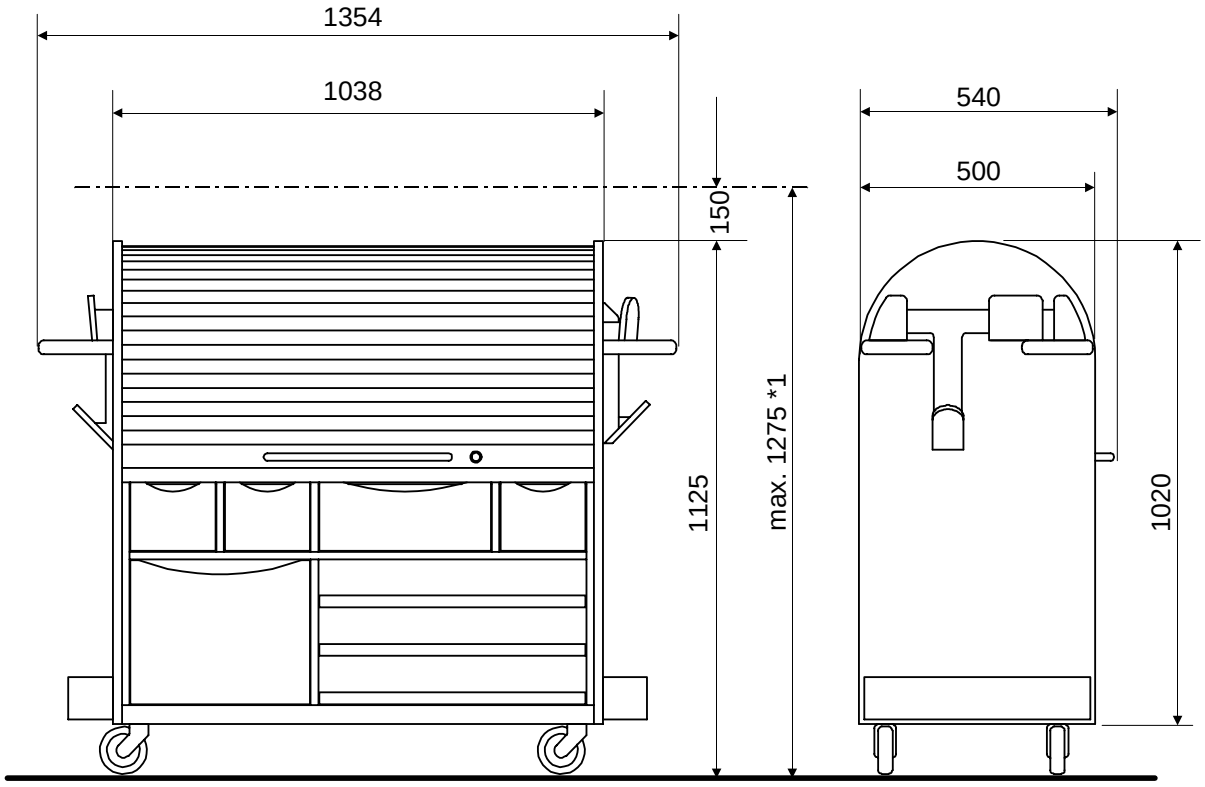


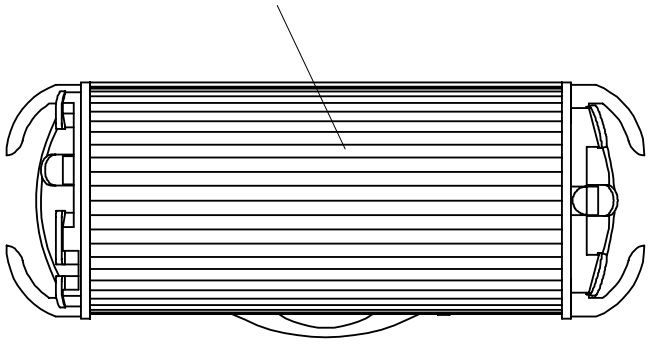
Fig. 15 Patient Monitor

Coil storage cart

Technical Data	
Weight without coils	≤ 50 kg / 110 lb



Coil storage cart with louver closed



***1** with respect to the CP Body Array- or CP Neck Array coil

Source reference:
Schreinerei Popp
Erlanger Str. 17
91083 Baiersdorf
Tel.: 09133/896

Coil storage cart
Item no.: 47 61 651 K 2200

SPUWA003

Fig. 16 Dimensions for coil storage cart.

Coil shelf design example

In addition to the coil storage cart there is the possibility to supply a coil shelf locally.
The coil shelf shown in the picture below is just a proposal and might not meet the customer needs.

The width of the coil shelf should be **600 mm**.

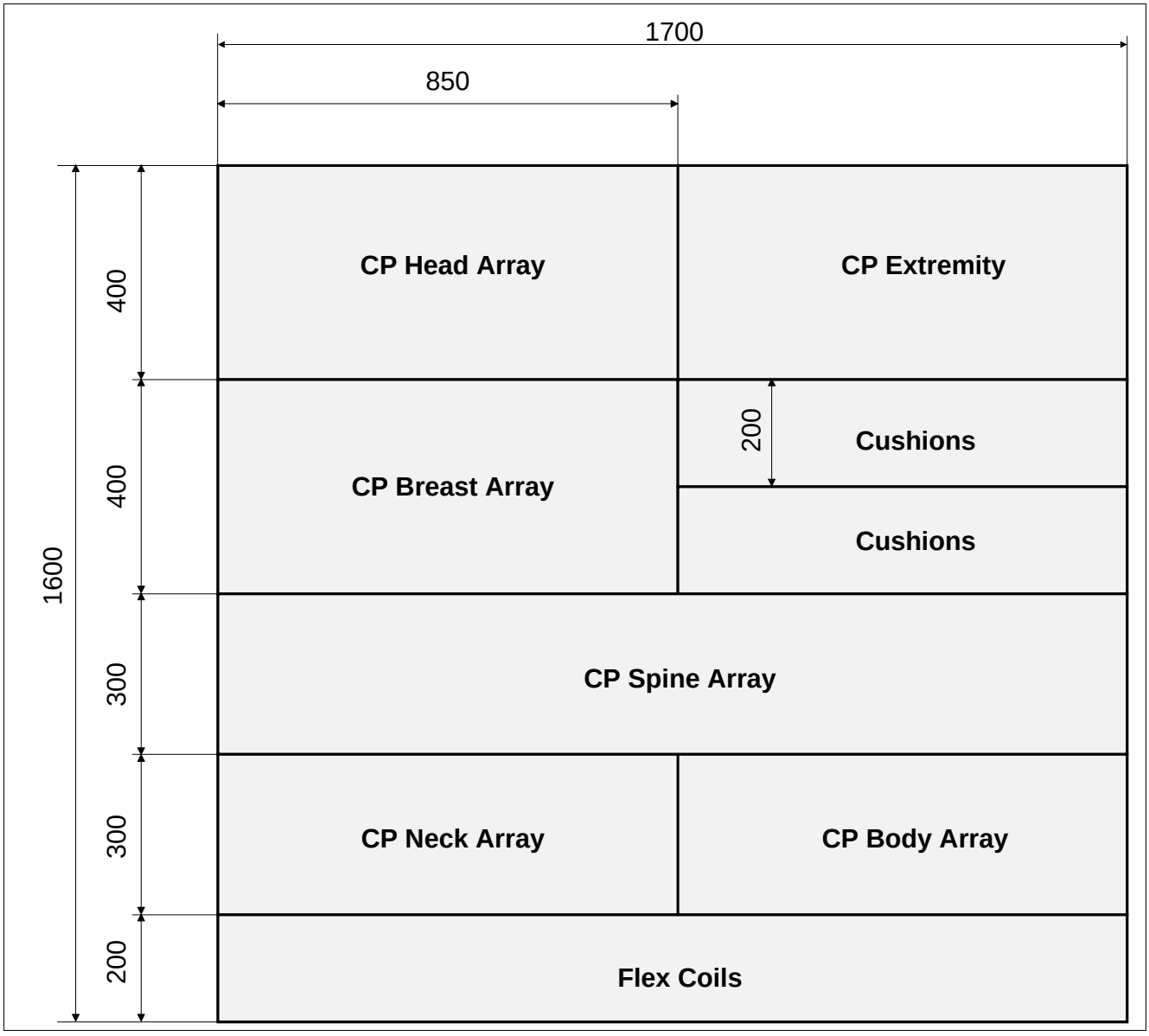


Fig. 17 Coil shelf

Patient transport trolley 3

Technical Data	
Weight	≤ 130 kg / 286 lb
Max. patient weight	≤ 160 kg / 352 lb
Max. load at head-end	≤ 60 kg / 132 lb

Application

Height-adjustable patient transport trolley specially designed for use in examination rooms containing MAGNETOM systems. It permits the transport of non-ambulatory patients into the examination room.

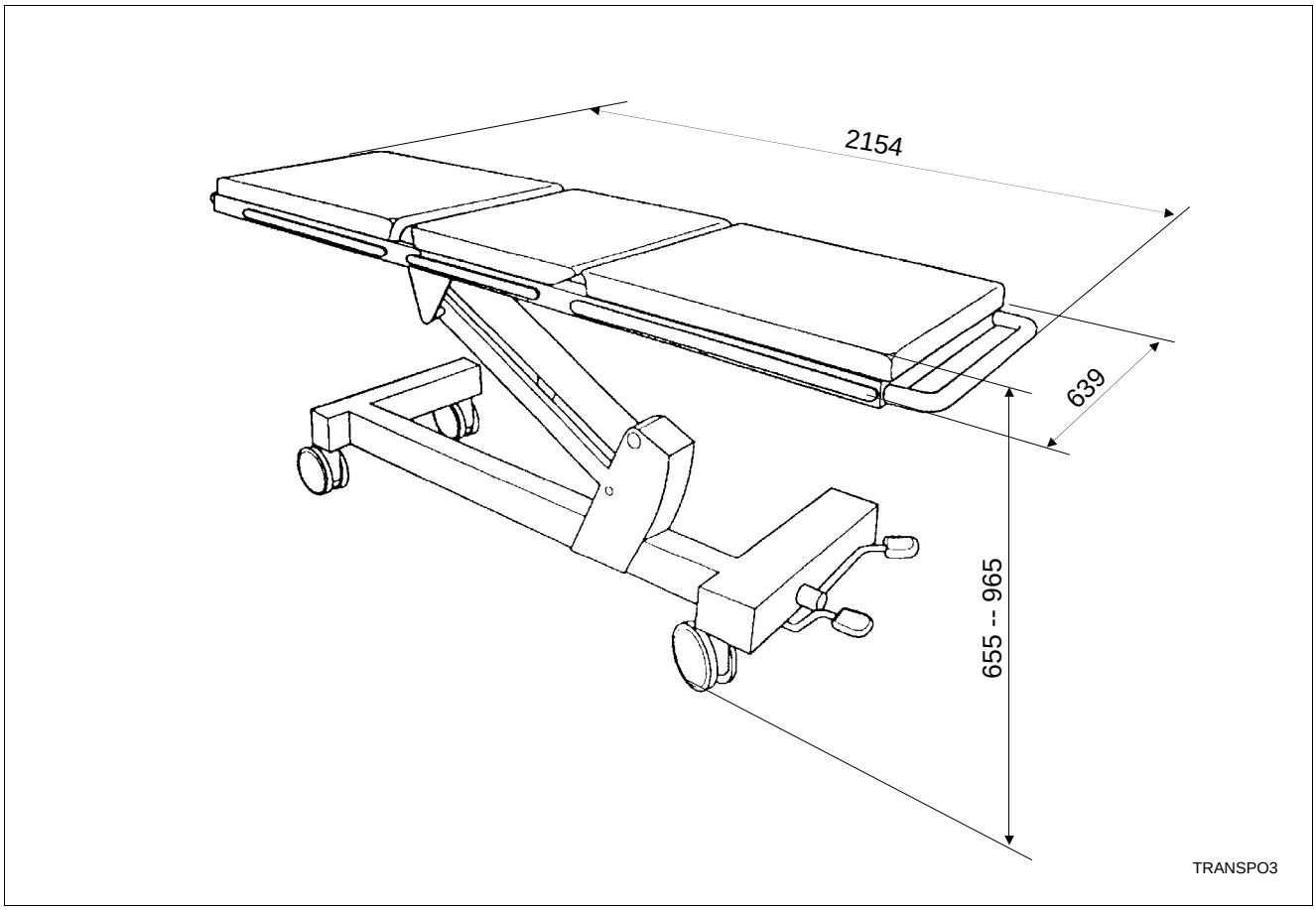


Fig. 18 Dimensions of patient transport trolley 3.

The head-end may be tilted up to approximately 75°.

Adaption transformer for the RCA cabinet

Application

The Adaption transformer has to be used in countries where the line power can **not** be adapted to the Voltage / Frequency combination 400V/50Hz and 480V/60Hz which are necessary for the RCA-cabinet (e.q.Brazil, South Korea..)

Ordering information

Ordering information		Ordering address
Type	Article number	Siemens AG Bereich Med Technik Department MRL A1 Tel.:.....++49-9131/84-4044 Fax:.....++49-9131/84-8648
Adaption transformer (incl. connection cable)	**56 72 378**	

Dimensions

Item	Size L x W x H in mm	Weight in kg / lb
Adption transformer	360 x 330 x 570	55 / 121

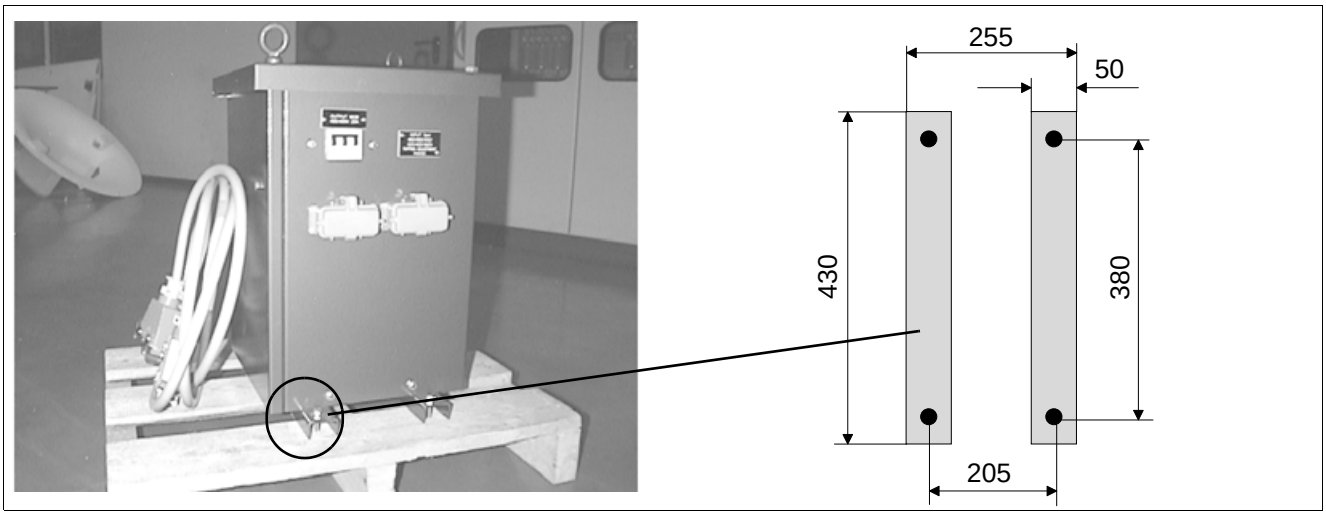


Fig. 19 Adaption transformer

Condensation Pump

General

Increased condensation due to high humidity can be eliminated by installing a condensation pump into the CCS water cabinet.

Safety

NOTE	**Voltage continues to be present at the line voltage transformer even after the MR system has been switched off.** **If not observed, death or serious physical injury can occur** **The line power distributor has to be switched off for service work and the on-site circuit breakers have to be set to OFF.**

Ordering information

Ordering information		Ordering address
Type	Article number	Siemens AG Bereich Med Technik Department MRL A1 Tel.:.....++49-9131/84-4044 Fax:.....++49-9131/84-8648
Condensation pump	**57 62 153**	

Contents of the kit

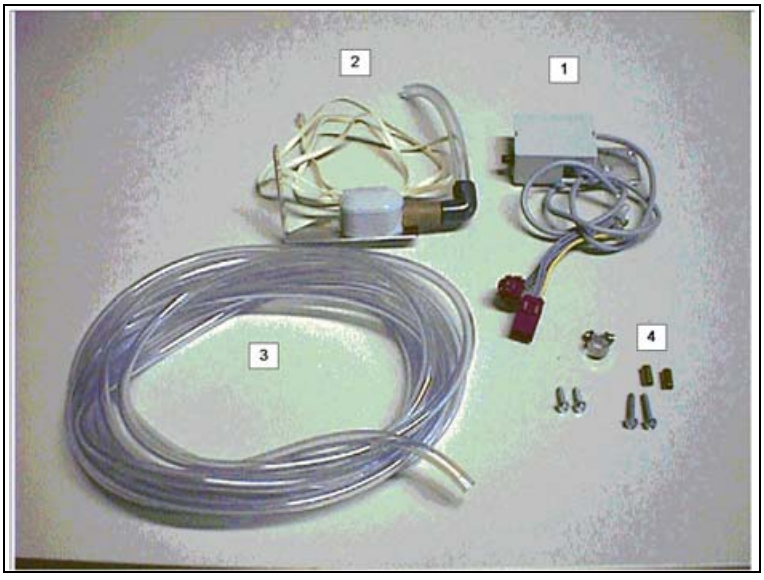


Fig. 20 Contents of the kit

1 Pump
2 Floater module
3 Hose
4 Screws and spacer bolts

UPS-System for the Host PC

NOTE: If there is a MRSC console installed, the Powerware PW 9125 2000® UPS will ***not*** supply the MRSC PC! A standard PC UPS can be installed to supply the MRSC PC.

Powerware PW 9125-2000® UPS for the MRC-Host computer

Application

With a static UPS (Uninterruptible Power Supply) the system computer can be protected against all types of line disturbances.

In most cases, the local power supply is sufficiently reliable for satisfactory operation. Modern processor-controlled devices, however, require highly reliable sources of power.
The Powerware 2000® satisfies this requirement.
The Powerware 2000® is the standard UPS for backing up only the MRC Host PC and Imager PC.

Technical data

Technical Data Powerware 2000		
Weight in kg / lb	UPS PW 9125 2000®	app. 23 / 50
	EBM* PW 9125 48® (Battery Module)	29.5 / 65
Dimensions of the cabinets H x W x D in mm	UPS PW 9125 2000®	89 X 432 X 494
	EBM PW 9125 48® (Battery Module)	89 X 432 X 494
Output in kVA		2,0
Backup time in min	at max. Load 5min with built in batteries	with one EBM* at max. Load 26 min
Heat dissipation		280 W
Temperature		$+0^0$C...$+40^0$C
Relative humidity		5%...90% (before dew point)
Audible noise		<50dBA

NOTE: *) EBM = **E**xtendted **B**attery **M**odule

Ordering information

NOTE	The article numbers and decribtions of the PM are valid!

Ordering information		Ordering address
Type	Article number	Siemens AG Bereich Med Technik Department MRL A1 Tel.:.....++49-9131/84-5108 Fax:.....++49-9131/84-8648
Powerware 2000®	**73 64 354**	
Siemens cable set	**58 02 918**	

NOTE	**The distribution box for the Powerware 2000® must be supplied on-site. The distribution box must be installed in the vicinity of the UPS. For technical details refer to Installation Volume 1.**

Scheme

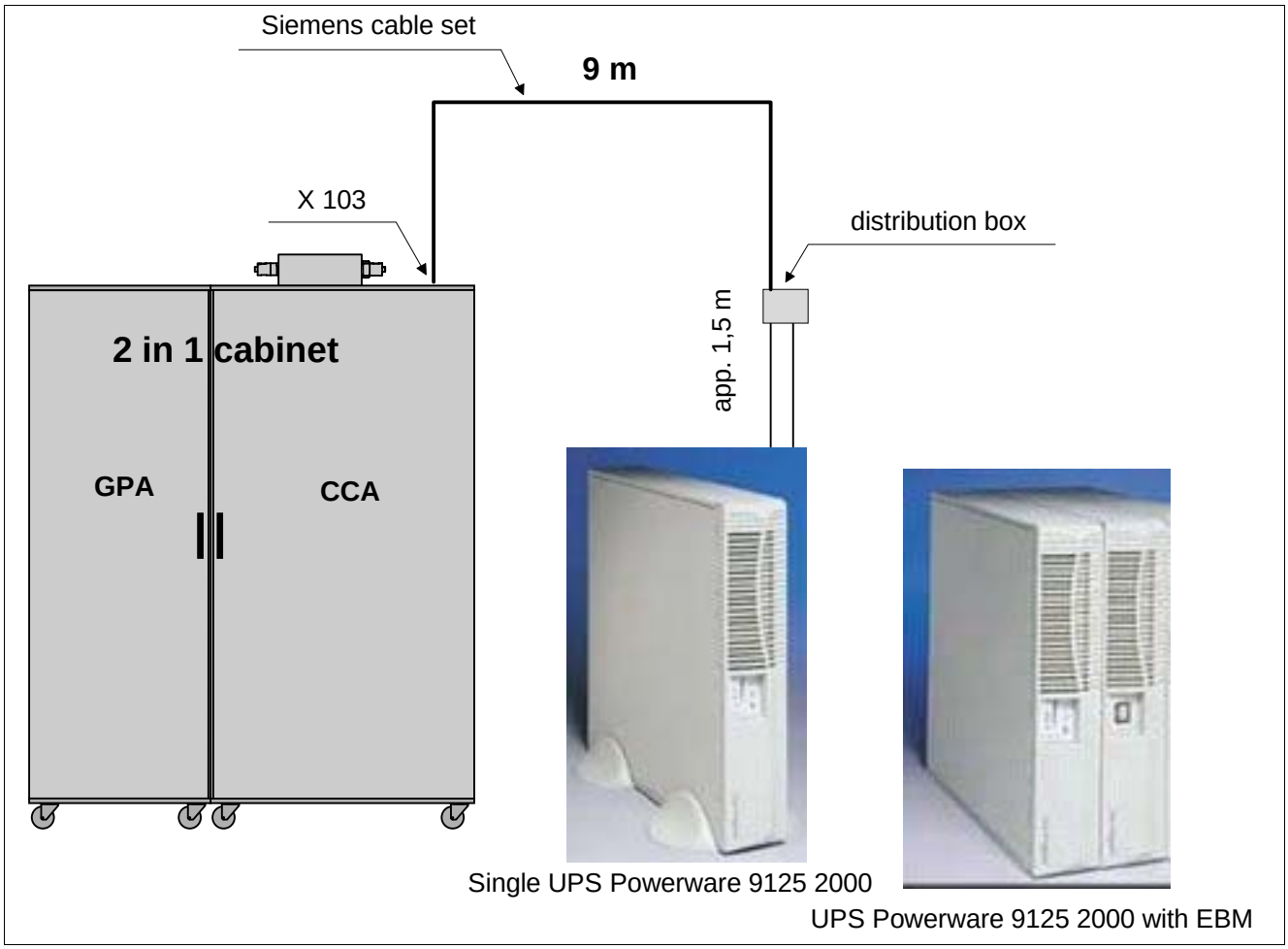


Fig. 21 UPS Scheme

Distribution box (example)

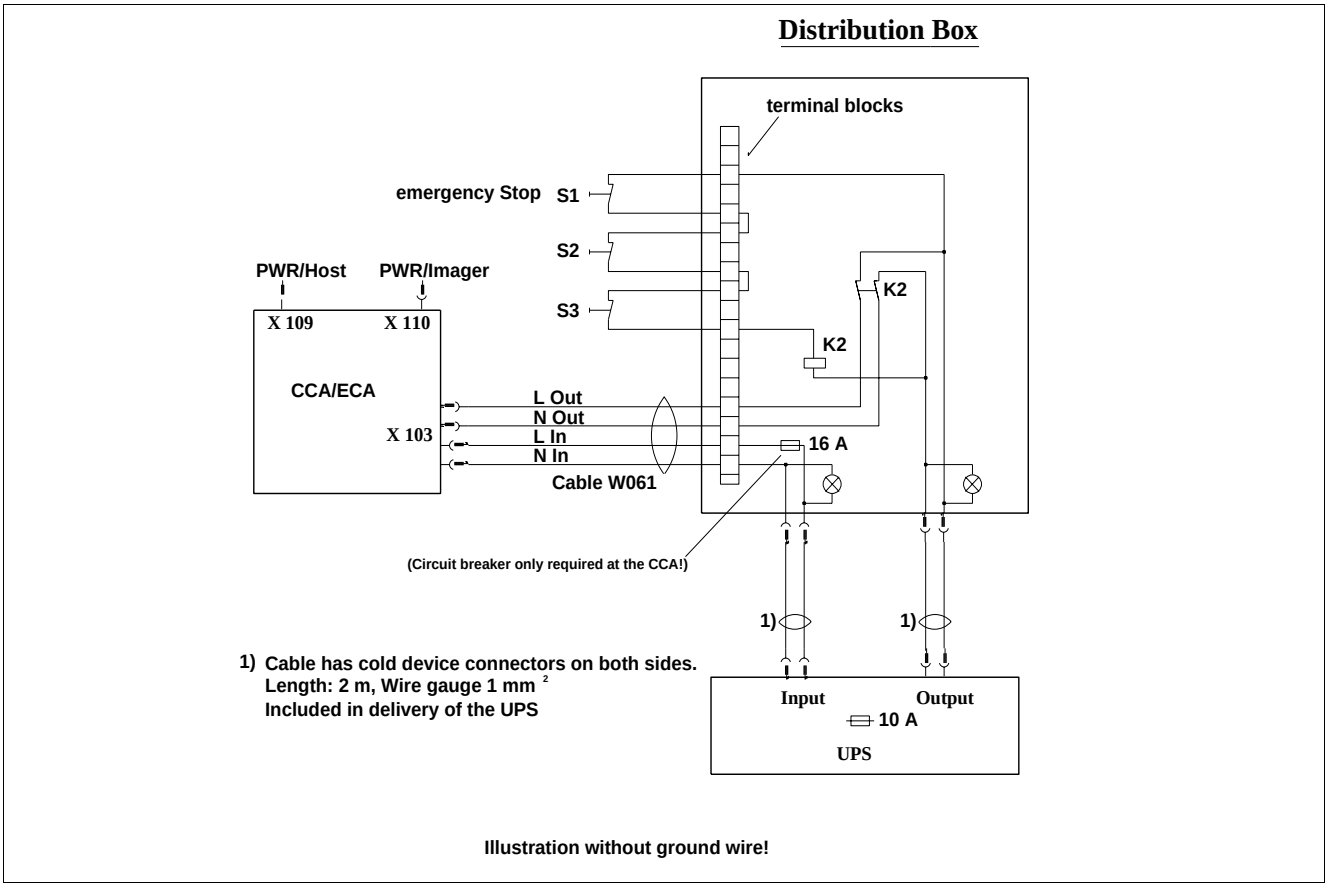


Fig. 22 Distribution box example

UPS-systems for the complete system

NOTE

POWER CONDITIONING DEVICES NOT APPROVED BY Siemens Medical Solutions MAY NOT BE COMPATIBLE WITH THE MAGNETOM SYSTEM. SUCH DEVICES ARE INSTALLED AND APPLIED AT CUSTOMER'S RISK.

➪ In countries where the power supply is not reliable, UPS systems are used to supply the required power to the MR system, and in special cases to the chiller, when there are power interruptions or power failures. When there is a power failure, the UPS backup allows the MR system to be shut down normally or supplies power to the MR system during the time required to transfer to an emergency power supply. This allows you to complete measurements that have already been started. The UPS offers the additional advantage of reducing system down-time due to hardware and software errors.

Special power requirements if the on-site power is provided through a UPS system

➪ The following table gives values, which should be used to select a suitable UPS system under the condition, that the water chiller is not connected to the UPS. If the water chiller should be connected to the same UPS, the required values power/current (the maximum possible value, e.g. switch-on current) for the chiller should be added to the values given below. In this case the chiller must be equipped with soft start compressors.

MAGNETOM	Switch on current pulse [1)]	Momentary power [2)]	Recommended minimum power of UPS [3)]	Recommended UPS system
Trio	250 A	100 kVA	120% of momentary power [3]	Type 2; 4
Trio a Tim system		140 kVA		

Dis-claimer	Content
1)	Typical current pulse amplitude during Switch-on procedure. During this pulse the UPS may switch to by-pass mode. The UPS internal fuse/circuit breaker should be able to withstand the max. switch-on current of the system (Caution: magnetizing inrush current might exceed the measured value above). The switch-time between battery mode and by-pass mode should be less than 1 ms. The UPS should fulfill local regulations additional to the above listed requirements.
2)	Momentary Power during measurement sequences (< 5 sec.).
3)	The factor in this column is defined according experiments with specific UPS model series. The factor may vary according to manufacturer and model series, the minimum factor applied should be 1.20. If the UPS model series is not released by the factory (see list below) a qualification procedure is recommended.

Ordering information

NOTE	**If the connection of the chiller to the UPS system is planned, the output of the UPS must be correspondingly larger.** **In this case the chiller must be equipped with a soft start compressor.**

NOTE	**The article numbers and decribtions of the PM are valid!**

Ordering information:			Ordering address
Type	**Model**	**Article number**	Siemens AG Medical Solutions Department MRL A1 Tel.:.....++49-9131/84-5108 Fax:.....++49-9131/84-8648
2	**JOVYATLAS JSTD 160-7**	**07 089 787**	
4	**Masterguard S52150**	**07 089 811**	

Connection of the UPS systems (Examples)

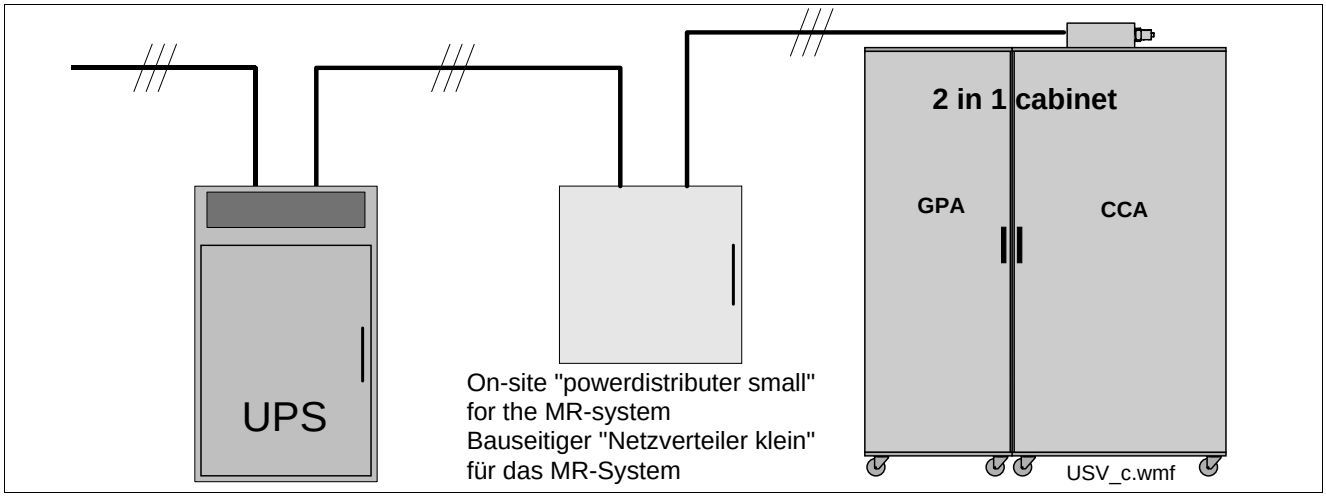


Fig. 23 UPS / Distributor / CCA

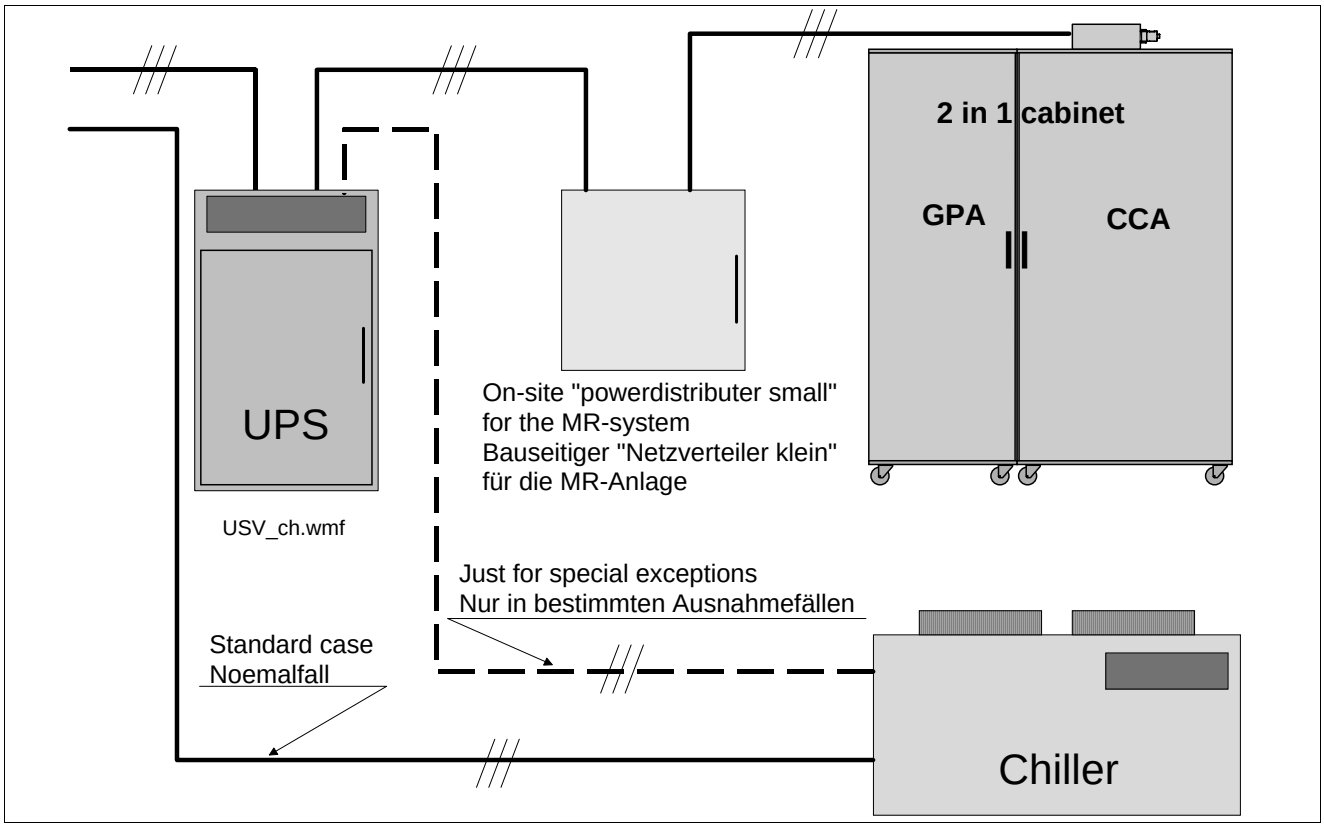


Fig. 24 UPS / Distributor / CCA / Chiller

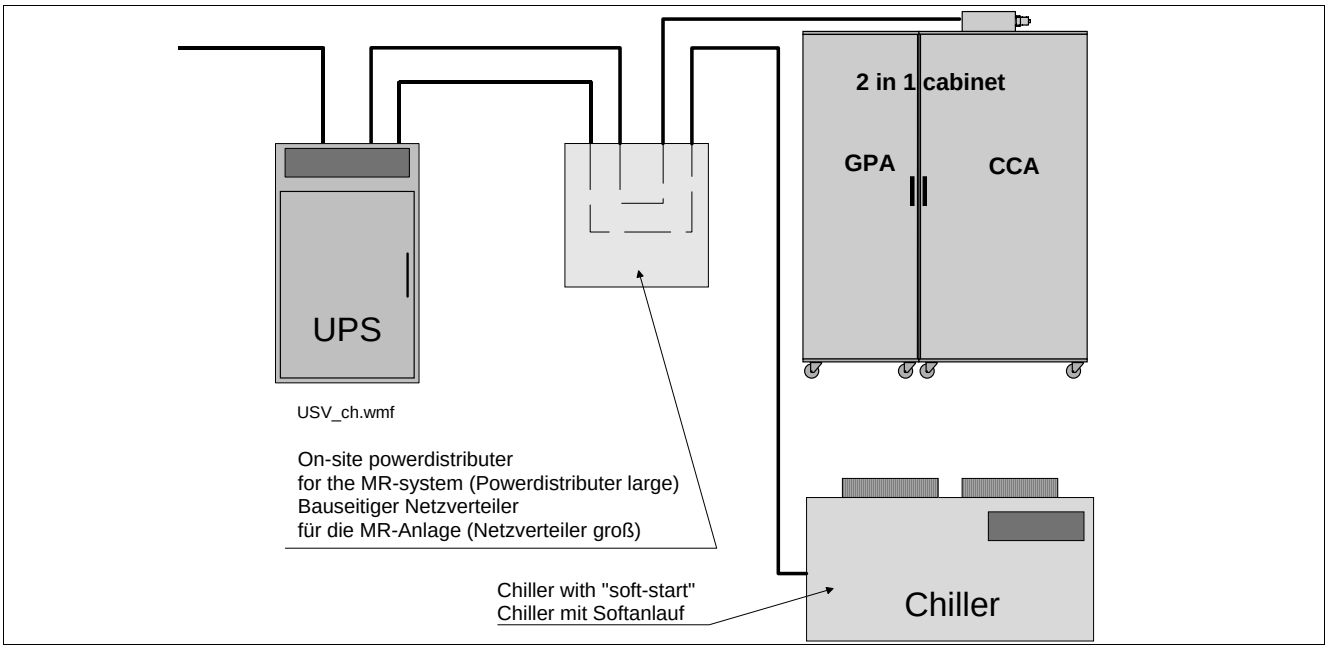


Fig. 25 UPS / Distributor / CCA+Chiller

RF filters

RF filters have to be installed, for example if a fire alarm or other devices will be installed in the examination room.

The following RF filters can be purchased:

Item number	Max. voltage / V	Max. current / A
46 84 866 B1205	250	6
31 62 567 B1205	250	25

Water transfer station

Application

The Water transfer station can be used as an interface between a water chiller and the MAGNETOM Harmony/Symphony RCA cabinet primary water inlet connections. All required measurement devices (e.g. temperature, differential pressure etc.) are included in the water transfer station.

Ordering information

Ordering information		Ordering address
Type	Article number	Siemens AG Bereich Med Technik Department MRL A1 Tel.:.....++49-9131/84-4044 Fax:.....++49-9131/84-8648
Water transfer station 1 1/2"	**05 672 402**	

Dimensions

Type	Size L x W x H in mm	Weight in kg / lb
Water transfer station	570 x 835 x 60	29 / 63.8

Flowmeter for primary chilled water

NOTE

To be able to determine the waterflow between the water chiller and the RCA cabinet you should install a flowmeter in the close vicinity of the RCA cabinet. The flowmeter is not part of the delivery volume and has to be purchased locally.

For the waterflow you have to take in concideration the distance between the water chiller and the RCA cabinet.

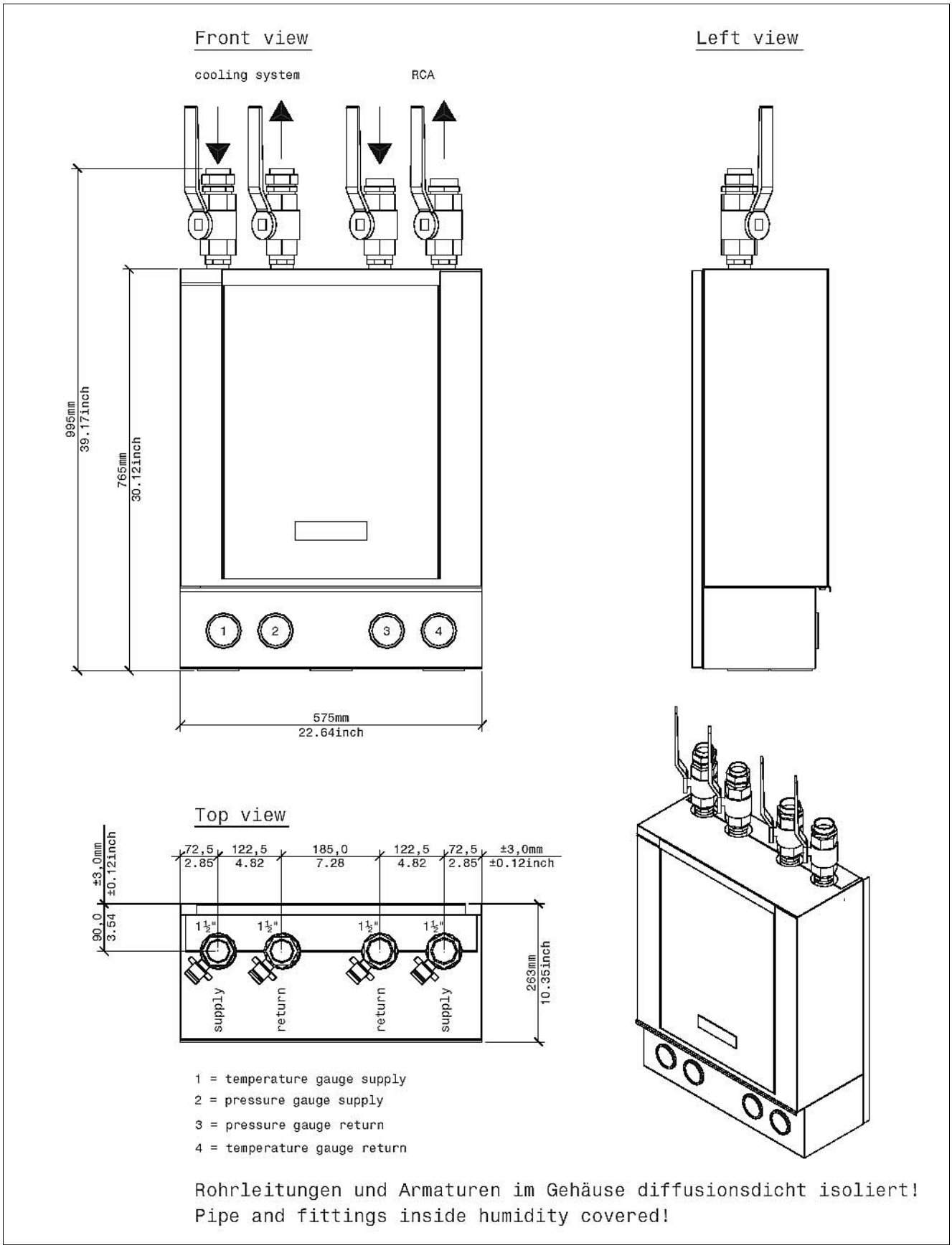


Fig. 26 Transferstation 1

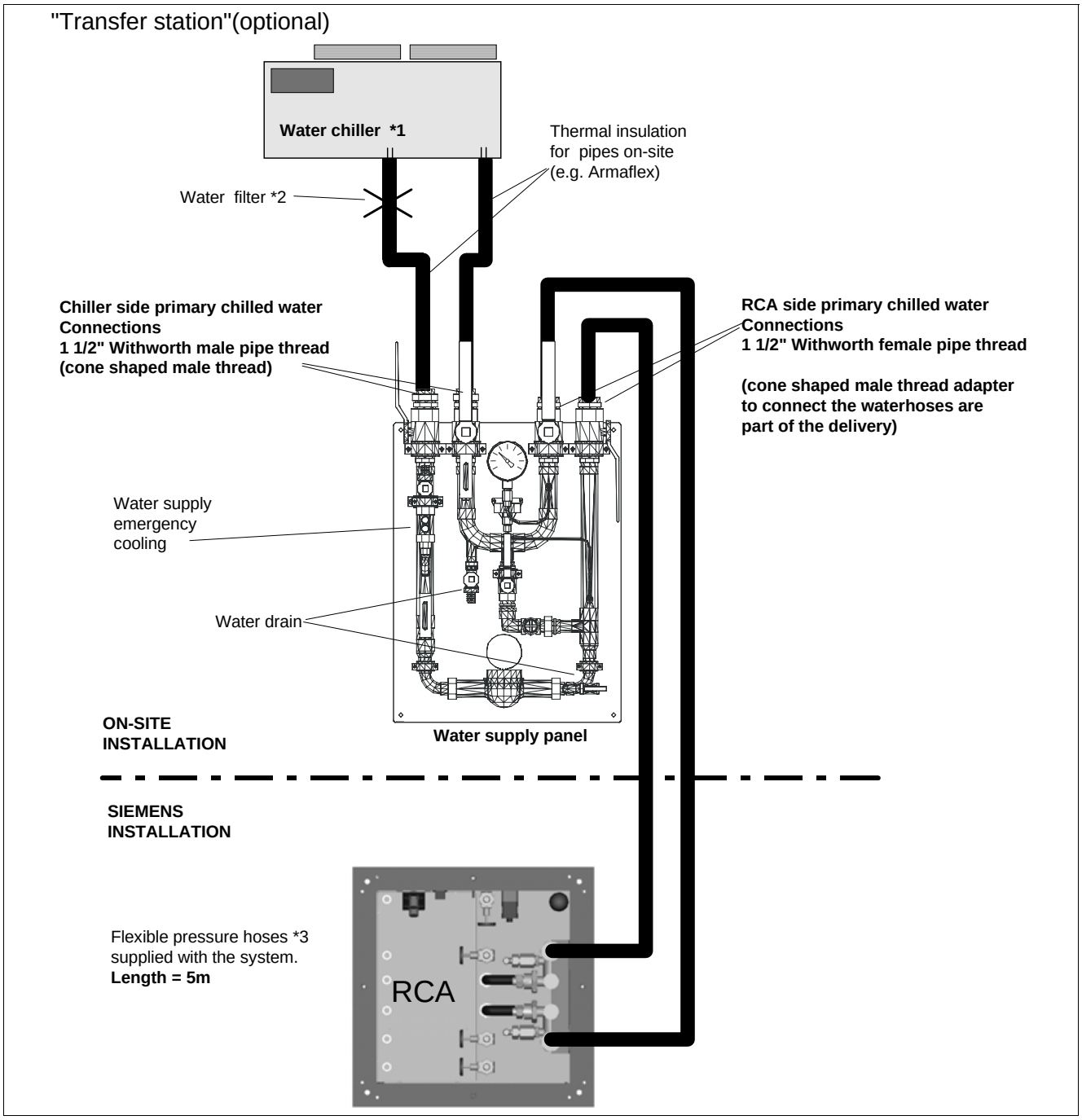


Fig. 27 optional water transfer station

***1** Internal/external capacitor can be isolated from the chiller. Chiller vibrations must not affect the building (vibration absorption).

***2** An on-site water filter should be installed, if needed, to remove sediment, particularly for older water installations.

***3** When routing pressure hoses, ensure that there are no loops. The ideal configuration consists of a permanent tube starting from the RCA, positioned perpendicular to the top of the cabinet and pointing upward.

Primary water filter system

NOTE	**To prevent pollution iside the primary water circuit a external water filter is required if the local waterquality does not meet Siemens specifications.**

A special made set with water filter and water hoses can be ordered at:

company name	**RK Kutting GmbH**
post office box	**Postfach 2**
zip code	**D-74386**
city	**Talheim**
country	**Germany**
URL	**http://www.kutting.de/**

Fig. 28 filter

Item	Kutting part number
filter system (complete) **filtration: 5µm**	**HS 7121366**
consisting of:	
housing with three filter elements **1 adapter (Kutting connection)** **2 hose 5m with insulation** **2 shut off valves**	

The set is consisting of:

Filter elements can be ordered as consumable supplies:

Item	Kutting part number
consumable supplies	**HS 7121374**
consisting of:	
three filter elements	

Split floor operation kit for the RCA cabinet (Optional)

Function:

This Kit is fitted to prevent back flushing and spillage from the header tank within the RCA unit. This can occur if the solenoid operated valve and the check valve kit is not fitted when the magnet is installed above the RCA unit i.e. Magnet is located on the floor above RCA unit. The modification involves fittings a solenoid operated shut-off valves in the cooling return pipe from the gradient coil. The mechanical check valve is fitted into the cooling line fed to the gradient coil.

NOTE **If the RCA cabinet is installed one floor above/below of the system components (CCA; Magnet) a option kit "split floor operation" with the part number: 71 20 954 is available to prevent a return flow of the secondary water into the water tank.**

Chiller-Systems recommended by Siemens Medical Solutions

NOTE **The technical descriptions and article numbers published in the actual PM are valid!**

Ordering information

Ordering information			Ordering address
kW	**Model**	**Article number**	
50	**KKT KPC 215-L-U/S** (only for U.S.A.) 480V / 3Ph / 60Hz	**70 89 720**	Siemens AG Medical Solutions Department MRL A1
	KKT KPC 215-L-S/FU 380...480V / 3Ph / 50/60Hz	**70 89 936**	

NOTE **For MAGNETOM Trio a Tim system the above mentioned KKT chillers will only apply up to ambient temperatures < 40°Celsius! In general a 60kW chiller is required.**

NOTE **For MAGNETOM Trio the heat dissipation of the system to the cooling water is specified in "On-site water supply" on page 7 - 1.**

General

NOTE **The magnet is delivered with an air- or sea freight kit. This kit has to be removed prior connecting the magnet to the quench vent.**

The removing of the kit has to be performed by trained personnel only!

For satisfactory operation of the MR system, liquid as well as gaseous helium is required.

Because of the physical characteristics and the price of liquid helium, the cryogen has to be handled according to the special instructions given in the subsequent pages.

As early as in the planning phase, the structural and logistic aspects of gas supply for the MR system have to be established.

The liquid helium is transported in containers especially designed for this purpose (dewars).

CAUTION **Every reputable supplier provides liquid helium dewars of non-magnetizable material. However, cylinders for gaseous helium are usually made from magnetic material. These cylinders must remain outside the vicinity of the magnet when it is energized.**

Structural requirements

Since the vessel dimensions for liquid and gaseous helium must meet certain specifications, the following issues have to be clarified with the supplier prior to delivery:

1. Access routes
2. Width of doors
3. Size of elevators and capacity
4. Height of rooms and hallways
5. Temporary and permanent storage area for gas cylinders
6. Load capacity and condition of transport routes

CAUTION **To move the Helium dewars into the MR-suite, evaluate the height and width of all access routes and doorways during the planning phase.**

Transport methods for helium

Liquid helium is transported from the supplier to the magnet in dewars holding between 100 to 450 liters of liquid helium. The dewars are transported in special trucks equipped with an elevator platform. Special containers are available for air-freighting liquid helium.

Dimensions of the dewars

After the transport routes have been determined, the dewars and the refill equipment required have to be established.

The following items require clarification:

1. Dimension and fill capacity of dewars?
2. Pressurized or non-pressurized dewar?
3. Supplier provides a full set of refill equipment?
4. The syphon attaches to the magnet?

The following suppliers provide a full set of refill equipment:

- Linde AG
- Messergriesheim GmbH
- Air Products GmbH

The magnet is shipped cold (standard case).

NOTE

Magnets that are shipped cold leave the factory with a fill level of approx. 70%.

This allow a total transport time starting ex-factory of 20 days only!

To keep helium boil-off to a minimum, the refrigerator (cold head) should be put in operation as soon as the magnet arrives on-site.

For magnet start-up 100% He level is required! Refer to the table "Helium content" on page 5 - 3 for the required amount of helium, e.g. appr. 800 L/He.

During magnet start-up (shimming) 500l L/He have to be on site!

For safety reasons (e.g.in case of a quench) app. 2500l L/He should stand by at the liquid helium supplier.

The magnet is shipped warm (exception).

The magnet is cooled on-site with

- approx. 2500 l liquid nitrogen
- approx. 2500 l liquid helium
- approx. 1 cylinder (50l) 99.999% dry nitrogen
- approx. 8 He cylinders (200 bar / 50 l / 99.9999 % grade 5 purity)

The liquid cryogens should be available on-site at the time planned for start-up of the magnet.

CAUTION

Special equipment is required for filling the magnet.

Technical support as well as equipment (pumps, leak tester, flange, etc.) are available from OMT.

To avoid start-up delays, clarify the logistics and technical details pertaining to deliveries of warm magnets in advance.

Helium level and boil off

Before the magnet is installed or energized, the helium level can be measured with a helium service level meter.

Helium content

Helium content Magnet Trio type OR 64	
Volume in %	Volume in liters
10	180
20	325
30 [1]	435
35	490
40	530
45	580
50	630
55	689
60	749
65	809
70	865
75	920
80	975
85	1032
90	1088
95	1143
100	1200

1. Minimum level for LHe refilling.

- Boil off rate in "stand-by": 0.12l/h
- Boil off with cold head compressor (refrigerator) switched off: app. 3%/24h (= app. ***1.7l/h)***

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General

To minimize interference on the line voltage cables for the MAGNETOM, non-MAGNETOM components (e.g. heating and air conditioning unit, pumps, light sources) must not be connected to the same breaker. As a rule, heating and air conditioning units have to be equipped with line filters.

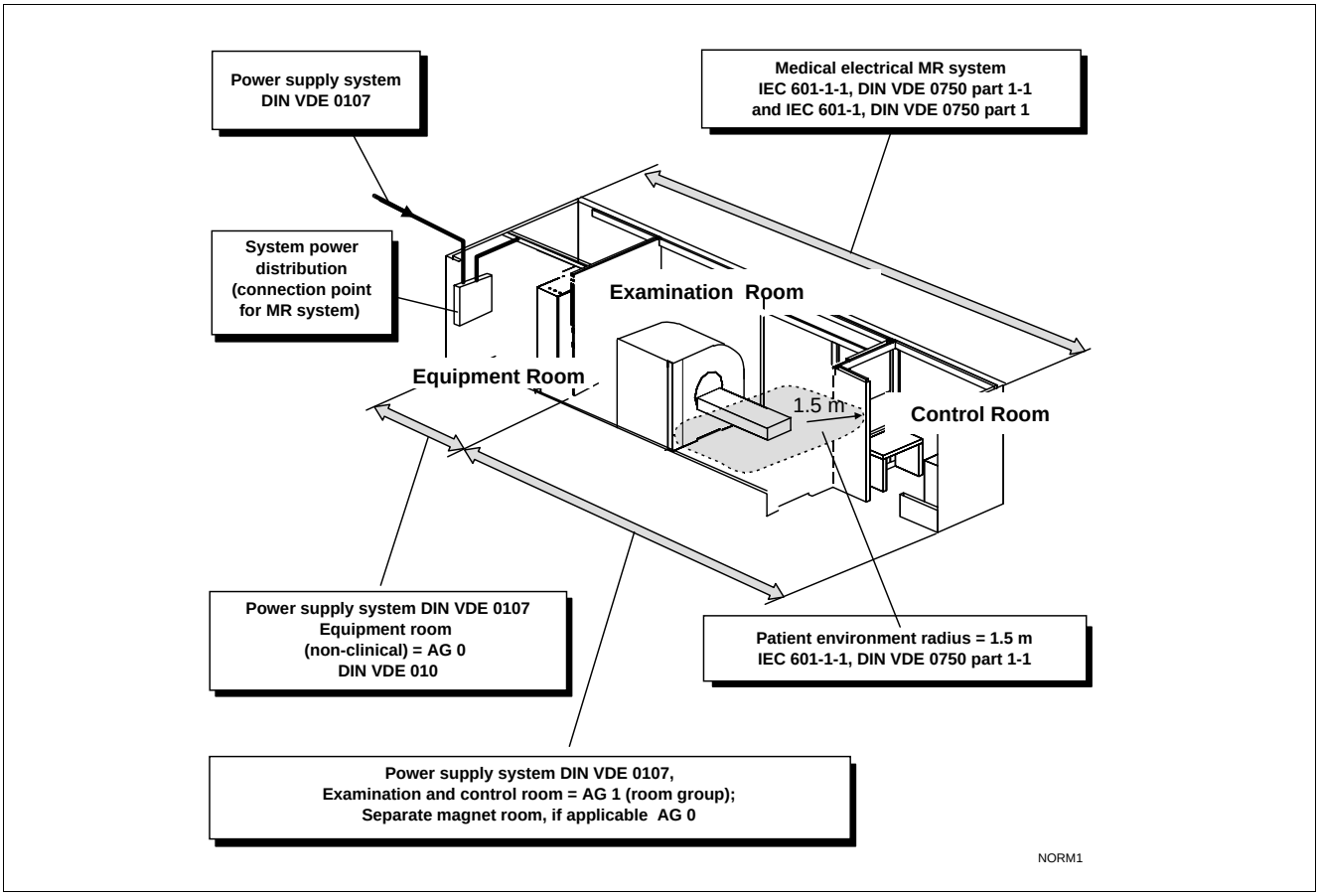


Fig. 1 Applicable standards for MR site installations.

The examination room installation must be completed according to DIN VDE 0107, and if necessary, connected to an emergency power supply.

Room lighting should not be affected when the MR system is switched off or shut down with the Emergency SHUTDOWN button.

To avoid extraneous electrical fields in the examination room, the following should not be installed or used:

- Telephone connections
- Extensions for in-house intercom systems
- Fluorescent lights
- Energy-saving light bulbs

Equipotential bonding

Equipotential bonding of main and additional voltage must conform to DIN VDE 57100 (Parts 410 and 540) and DIN VDE 0107, so that allowable leakage current values as outlined DIN VDE 0750 part 1 and part 1-1 are not exceeded.

The above standards are identical to IEC 601-1 and IEC 601-1-1 (international) and EN 60 601 as well as EN 60601-1-1 for Europe.

On-site power supply

Electromagnetic Compatibility (EMV)

All information regarding electromagnetic compatibility is based on IEC 60601-1-2:1993 and EN 60601-1-2:1994 standards.

Emitted interference	
Radiated interference	Class B
Conducted interference	Class B

Interference immunity	
Electrostatic discharge (ESD)	
Contact discharge	+/- 6kV
Airborne discharge	+/- 8kV
RF radiation	
ISM bands	3 V/m
Quick, transient disturbances (bursts)	
AC supply lines	+/- 2kV
Other connecting lines	+/- 1kV
Surges	
AC supply lines	+/- 2kV

Power quality requirements

	Nominal value	**Tolerance**
Voltage Range	380, 400, 420, 440, 480V 3~ **1)**	+10% / -10% **2)**
Line to line unbalanced	--	max.2%
Frequency	50/60 Hz	±1 Hz

Disclaimer	**Content**
1)	Currently the RCA cabinet supports only the voltage/frequency combinations 400V/50Hz and 480V/60Hz. A supplemental transformer is required for other voltages.
2)	For all line conditions (e.g. power supply undervoltage from the power plant) including maximum voltage drop according to the connection value.

Notes

IT IS THE CUSTOMER‘S RESPOSIBILITY TO COMPLY WITH THE POWER QUALITY REQUIREMENTS FOR SIEMENS MEDICAL SOLUTIONS EQUIPMENT.

The electrical feeder to the Siemens Medical Solutions equipment must feed only the imaging system and be kept separate from electrical feeders to HV-AC, motors, pumps, compressors, elevators and other potential sources of electrical interference.

The electrical feeder to the imaging system must be run directly to a main facility distribution panel or to the facility service enterence, with no other loads powered from this feeder.

Power consumption of the MAGNETOM Trio

Power consumption state	Value
System off	6.5 kW
Stand by	8.0 kW
Ready for measurement	20.0 kW
Typical measurement	33.0 kW
Highest average power	50.0 kVA

NOTICE **The power consumption of the systems differ because of the type of sequences and applications are used.**

General requirements to the on-site power

MAGNETOM	Recommended fuse rate [3]	Connection value [4]	Momentary power [5]	Internal line resitance
Trio	125 A (NH)	100 kVA	120 kVA	
Trio a Tim system [1]	160 A (NH)	110 kVA [2]	140 kVA	< 95mOhm

1. For Trio installations which will be already sold as a Tim system the above mentioned specifications will apply.
2. 120 kVA for maximum total power consumption.

Dis-claimer	Content
3)	The conductor size of the main connection line should be selected to ensure that the maximum voltage drop is less than **4%**, including the source impedance, feeders, and any transformers. Fuse rating to be selected in order to protect the mains connection line conductors and to supply the momentary current. This is valid for the on-site power installation (e.g. Hospital).
4)	Connection value during measurement sequences (< 5 min.) at nominal voltage.
5)	Momentary power during measurement sequences (< 5 sec.), relevant for maximum voltage drop calculation over the mains connection line and UPS size selection.

On-site power supply switch board (Example)

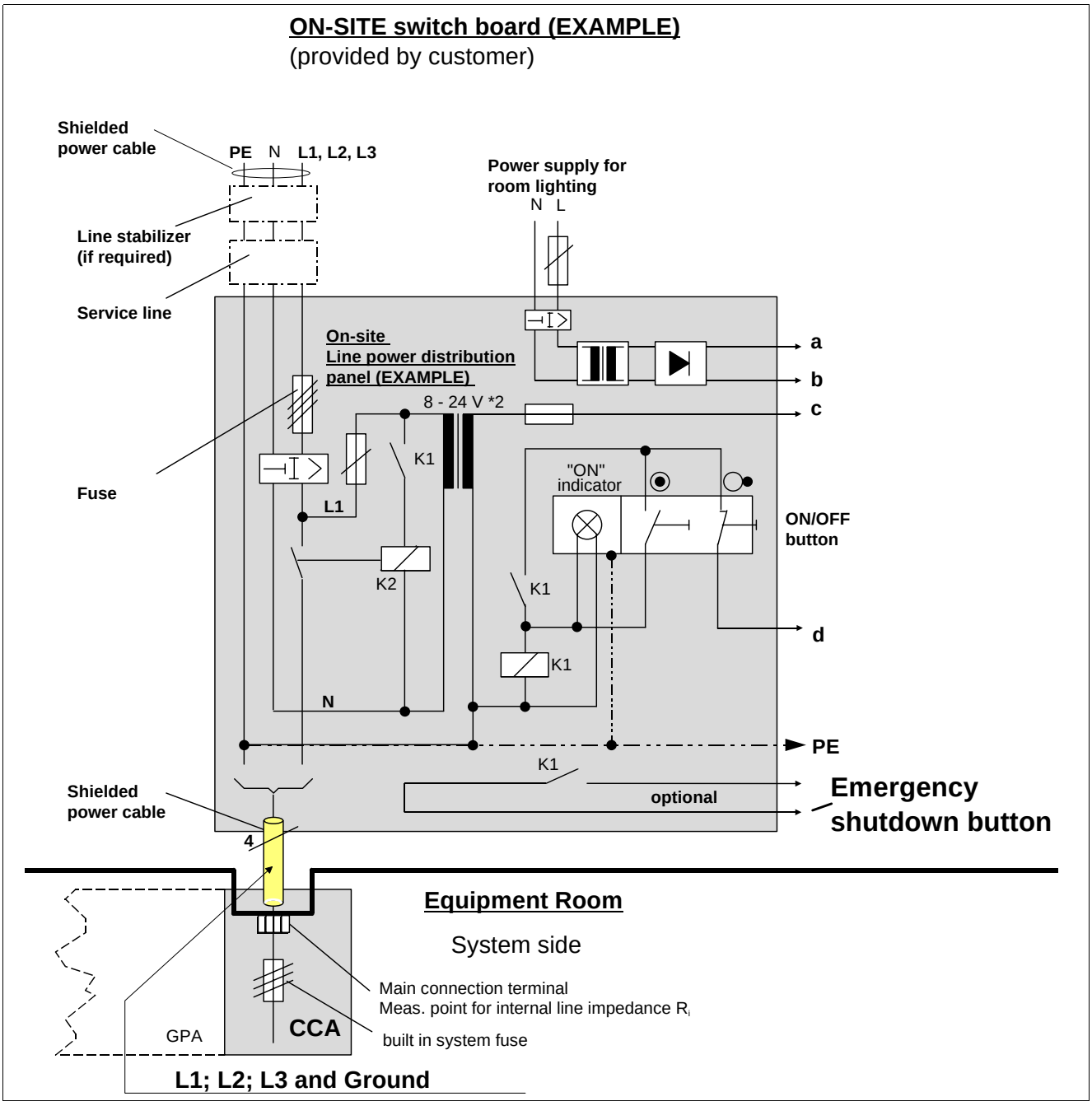


Fig. 2 On-site power supply for MAGNETOM Allegra for european installations.

NOTE

The MR-system uses only a supply line (L1, L2, L3) and ground (PE). Neutral is not required. In some countries neutral is used due to country specific regulations in the on-site power distribution panel (e.g. for FI installation). The neutral will not be connected to our system (Mains-box)!
If a 5-conductor cable is used, neutral (N) is not connected at the MR System.
The above shown example in Fig. 2 is for european country specific regulations only.

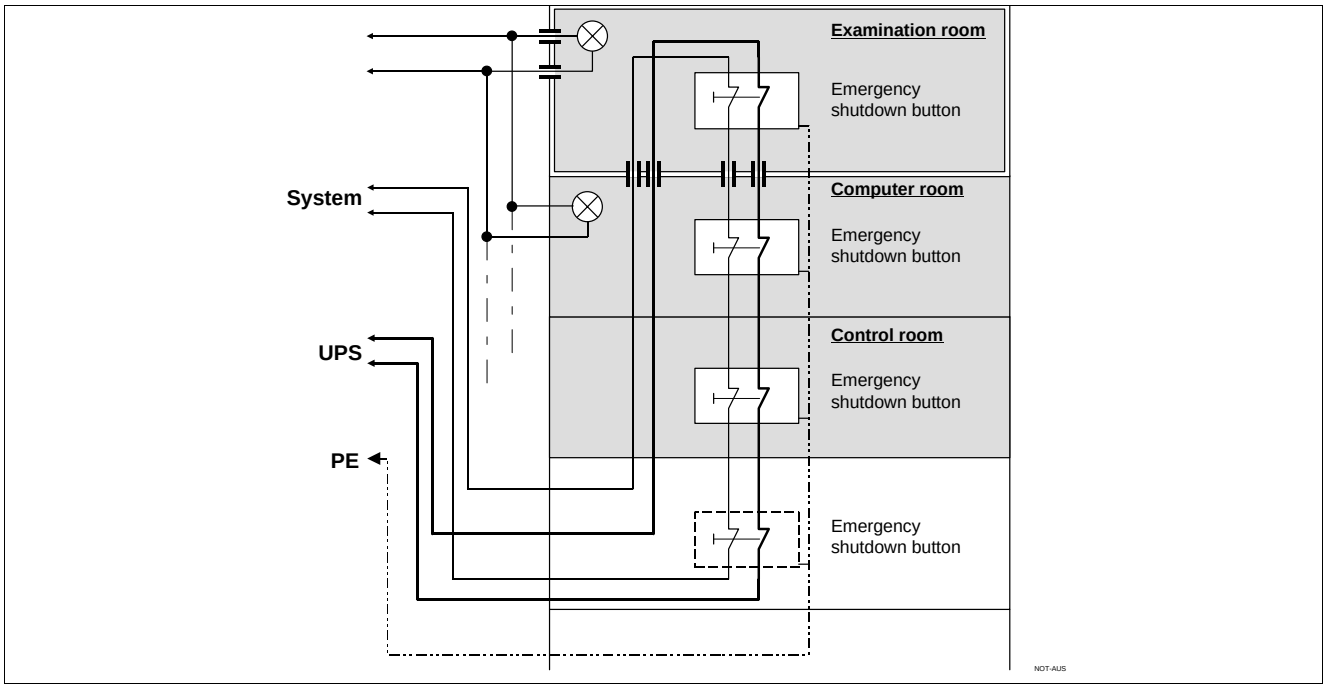


Fig. 3 On-site emergency shutdown circuit

NOTE	**If a UPS system will be installed prepare the connection of the UPS system to the system emergency shutdown buttons. If a UPS system is installed the system emergency shutdown buttons must switch off the UPS system.**

Line power distribution panel

The on-site power supply has to be switched on or off with the ON/OFF button which should be located on the line power distribution panel.

NOTE	**The MR system is switched on or off via the button on the alarm box supplied with the system.**

Install the **EMERGENCY SHUTDOWN buttons** in the MR suite in accordance with the project plans.

The MR system should be shut down via the shutdown circuitry (Emergency SHUTDOWN button) in emergencies only. The refrigerator is switched off in emergency cases, which means that the helium boil-off rate increases considerably.

CAUTION	**If a UPS is connected to the system it has to be shut-off with the emergency shutdown buttons as well.**

NOTE	**Ensure that the MR system cannot be switched on accidentally after e.g. the Emergency SHUTDOWN button has been unlocked.**

Grounding

Siemens Medical Solutions products are sophisticated electronic systems that require attention to grounding to ensure optimal equipment performance and reliability.

Equipment grounds to the Siemens equipment are specified to be "isolated" type as permitted in NEC 250-96(b) for the reduction of electrical noise.

In order to maintain the integrity of the RF-shielded examination room, the ground must originate at the Siemens electronics cabinet ground bus (CCA cabinet), and should be connected at both ends under Siemens supervision.

Non-current carrying conductive surfaces shall be grounded by a #6 a.w.g. insulated green copper conductor installed in the metal raceway that contains the branch-circuit conductors supplying the equipment.

A neutral conductor if present is not used for the line voltage connection to the Siemens equipment. if the neutral conductor is provided it should not be electrically connected at any point in the power distribution to the siemens equipment unless specifically required. Unintentional neutral to ground bonds may violate local and national electrical codes as well as create grounding problems.

The grounding of the system, esp. the provided facility ground should be prepared obeying local regulations.

The internal grounding of the MR system must be setup with minimum ground loops in order to prevent noise currents and general disturbances flowing through the grounding path.

Grounding points

To achieve such a grounding three major grounding points should be used:

1. The provided facility ground in the distribution panel.
2. The main grounding point at the CCA cabinet (should be directly connected to (1)).
3. The RF-room common grounding point at the RF filter panel (should be directly connected to (1)).
4. An optional UPS System should be connected as well to (1).

To check for possible ground loops the ground resistance between the RF cabin (3) and the facility ground (1) should be checked prior switching on the system. The minimum resistance between (1) and (3) without connected ground wire should be at least 100 Ohm. After having measured that all ground wires should be connected and then the maximum resistance between any two points on the ground system should not exceed 200 mOhm.

Additional electrical equipment installed inside the RF cabin should use RF filters mounted on the filter panel. These additional filters should be grounded as well to the RF cabin common ground.

Any modifications or non-MR equipment grounds added to the MR ground system must be approved by Siemens representative to guarantee safety and performance of the system.

Scheme

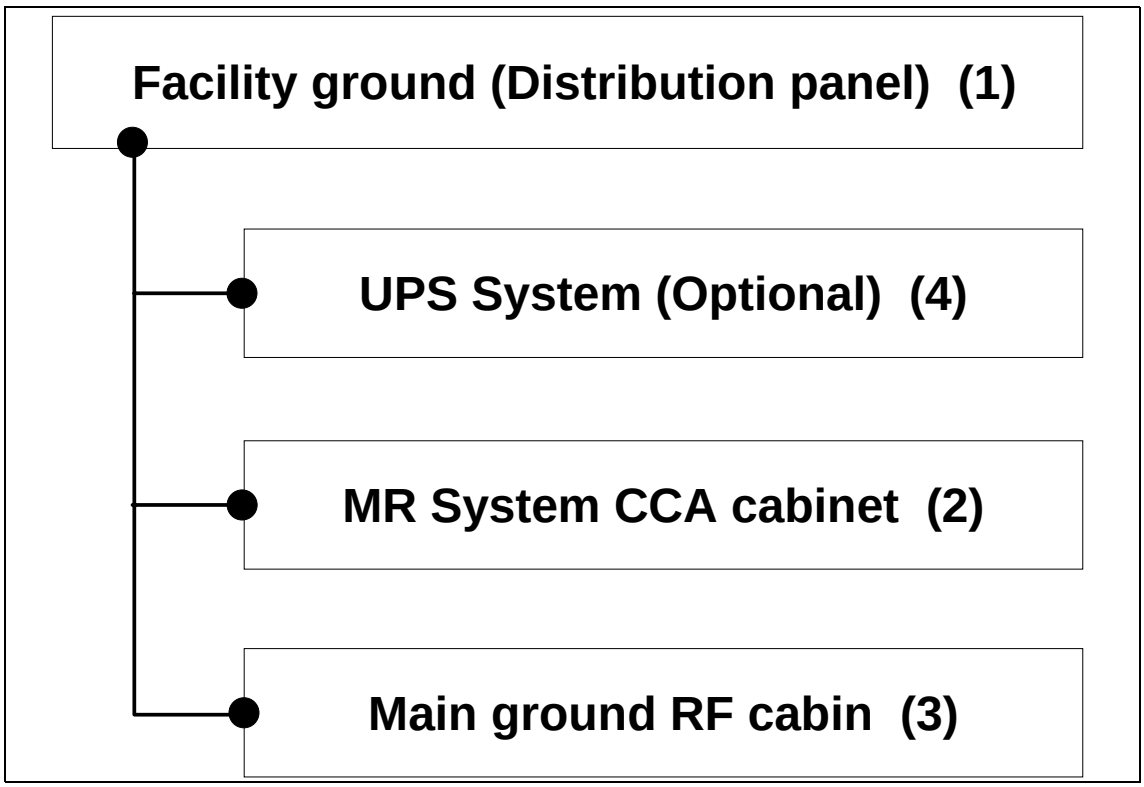


Fig. 4 grounding

On-site filter connection at the RF-filter plate

Filter	Use for
Z6 / Z7	Emergency Stop
Z11 / Z12	Room Light
Z13 / Z14	Mains voltage

AG wiring diagrams (Example)

AG1 wiring diagram (Example)

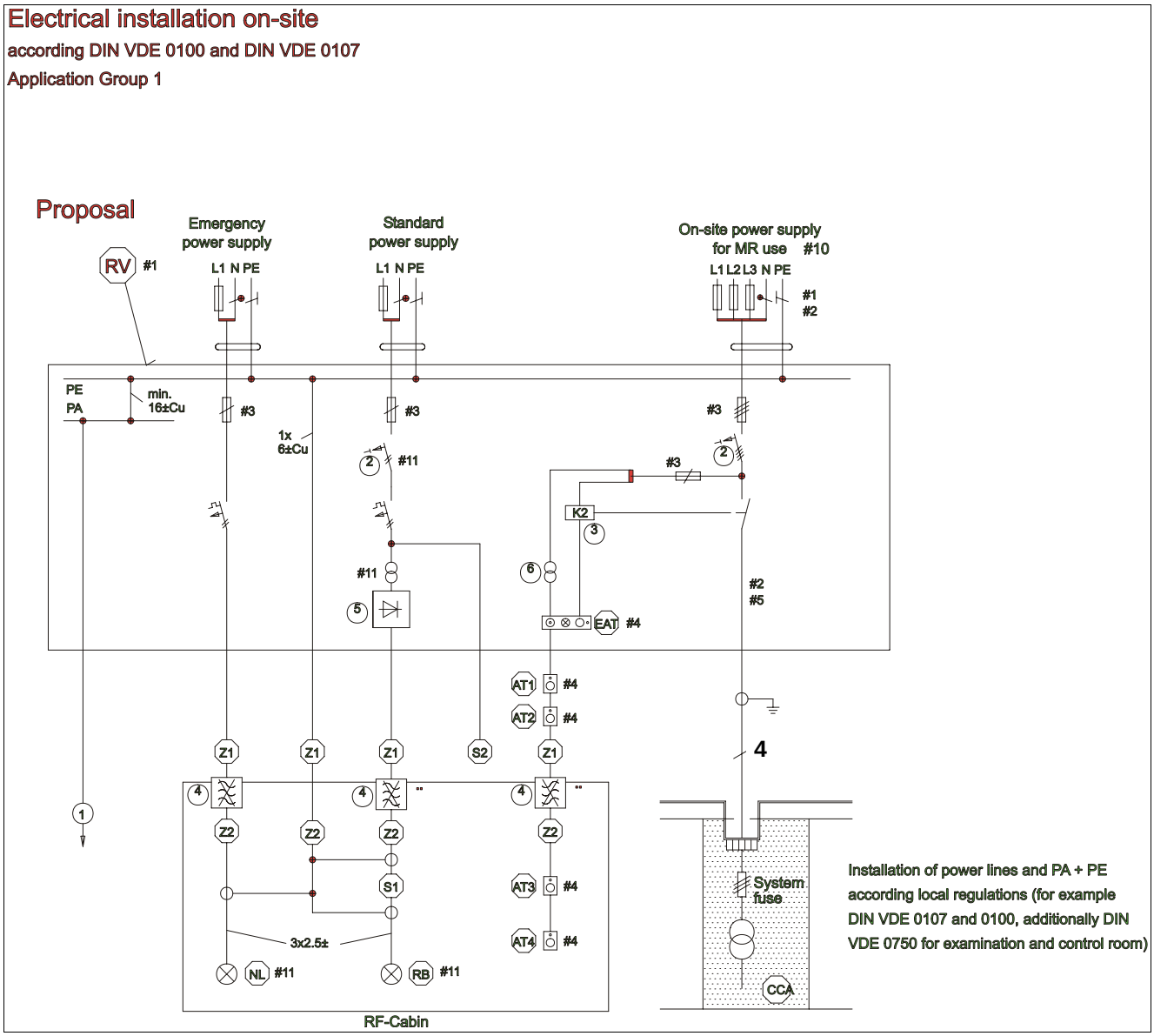


Fig. 5 On-site power supply for MAGNETOM Harmony/Symphony/Sonata AG1.

AG1 / AG 2 Legend

Legend **AG 1**

(with märked positions are included
in the delivery volume of SIEMENS)

1 To extraneous conductive parts

2 Recommended GFI × 30mA
63A Type 468 KVP Manufacturer: Doepke
or 125A Type 580 KVP Manufacturer: Doepke

3 Unit breaker

4 Radio interference filter Art.No.3162567
2 filter sets included in delivery

5 Rectifier

6 Insulating transformer 8V to 24V

** AB Alarmbox

AT Emergency OFF button with interlocking (unit)

** B Magnet

B2 Door contact (RF-blocking)

** CCA Power cabinet / Electronics cabinet

EAT ON/OFF button

** F Filter plate

** GPA Gradient cabinet

** J Control console MRC

** J1 Imager

** J2 Host PC MRC

J3 Documentations camera

J4 Control console MRSC

J5 Host PC MRSC

M External telephone line

** MS Magnet Stop

NL Emergency room lighting in
protective isolation/protection class II

** RCA Cooling system

RB Room lighting

RV Power distributor panel
Can be ordered over MRL 1, Fax: 09131 84 8648
Partnr.: 5802827 Power distributor small
5802834 Power distributor large (with

S1 Lighting switch inside examination room

S2 Lighting switch outside examination room

** Z1 Filter plate outside RF cabin
Connection on radio interference filter

** Z2 Filter plate inside RF cabin
Connection on radio interference filter

Legend **AG 2**

(with märked positions are included
in the delivery volume of SIEMENS)

1 To extraneous conductive parts

2 Recommended GFI × 30mA
63A Type 468 KVP Manufacturer: Doepke
or 125A Type 580 KVP Manufacturer: Doepke

3 Unit breaker

4 Radio interference filter Art.No.3162567
2 filter sets included in delivery

5 Rectifier

6 Insulating transformer 8V to 24V

6a Isolating transformer with overload monitoring

7 Voltage monitoring and switching device
per VDE 107

8 Isolating monitor

9 Report and test combination

** AB Alarmbox

AT Emergency OFF button with interlocking (unit)

** B Magnet

B2 Door contact (RF-blocking)

** CCA Power cabinet / Electronics cabinet

EAT ON/OFF button

** F Filter plate

** GPA Gradient cabinet

** J Control console MRC

** J1 Imager

** J2 Host PC MRC

J3 Documentations camera

J4 Control console MRSC

J5 Host PC MRSC

M External telephone line

** MS Magnet Stop

NL Emergency room lighting in
protective isolation/protection class II

** RCA Cooling system

RB Room lighting

RV Power distributor panel
Can be ordered over MRL 1, Fax: +49 (9131) 84 8648
Part-No.: 5802827 Power distributor small
5802834 Power distributor large (with
connection for chiller)

S1 Lighting switch inside examination room

S2 Lighting switch outside examination room

** Z1 Filter plate outside RF cabin
Connection on radio interference filter

** Z2 Filter plate inside RF cabin
Connection on radio interference filter

Fig. 6 Legend AG1/AG2for MAGNETOM Harmony/Symphony/Sonata

AG2 wiring diagram (Example)

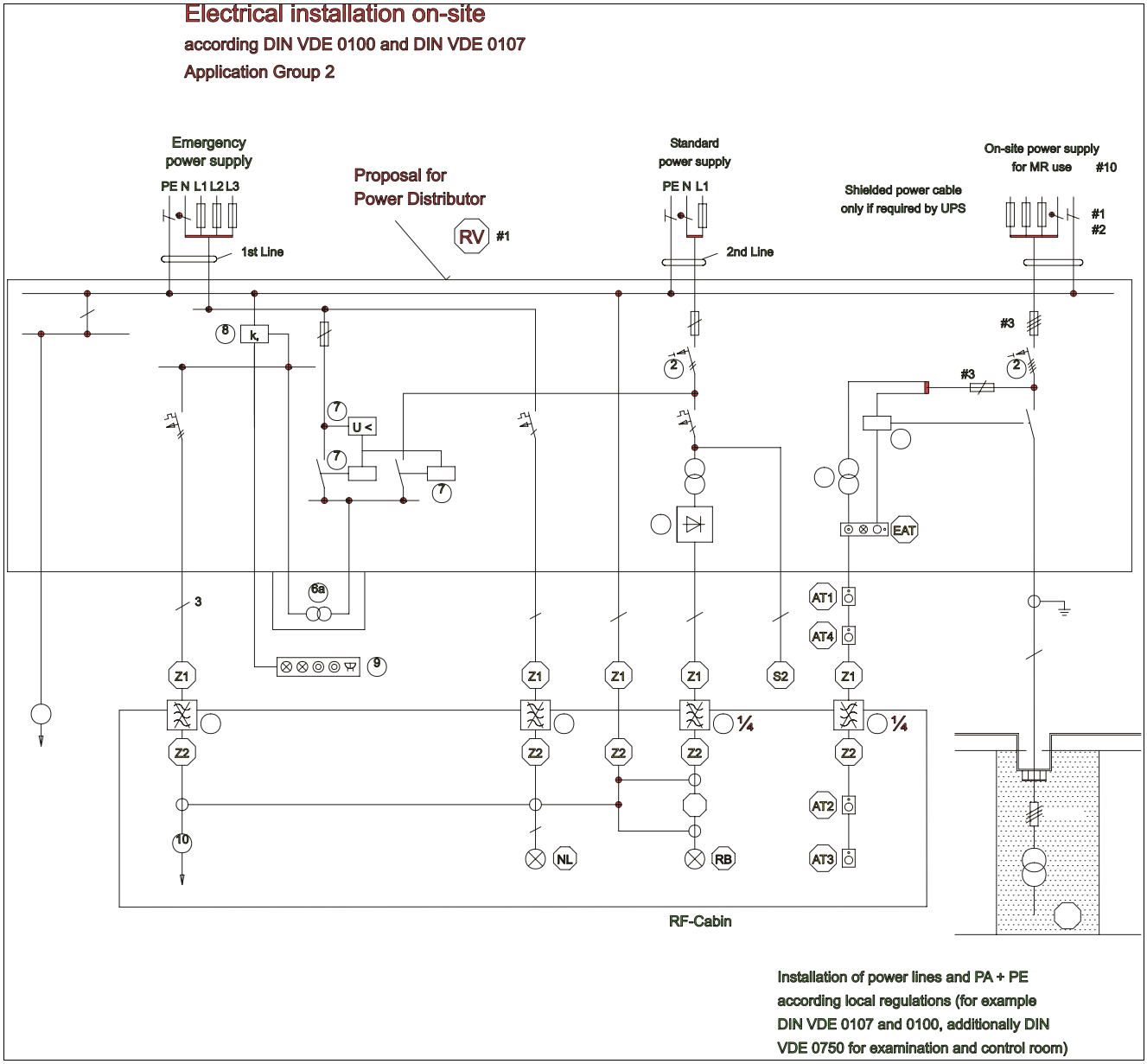


Fig. 7 On-site power supply for MAGNETOM Harmony/Symphony/Sonata AG2.

Power outlets inside the Examination room

NOTE

Hazardous conditions are created by the magnetic field when connecting devices made from magnetizable material to the receptacles installed in the examination room.

In addition, the functionality of electrical devices, e.g. servo ventilators, may be affected by the magnetic field if the devices are not suitable for this type of operation.

The user is responsible for the installation an use of receptacles in the examination room as well as damages ensuing from said use.

In addition, the on-site electrical system has to conform to Applicationgroup 2 (VDE 0107) when life supporting systems are used in the examination room.

NOTE

Power outlets inside the examination room must be connected through extra RF-filters and an insulation transformer *if* DIN VDE 0107 Applicationgroup 2 is required.

System mains connection terminal

Line power cable

Trio

A shielded cable with AWG of

50 mm^2

(per wire) has to be connected from the on-site power distribution panel to the mains connection terminals of the CCA cabinet (mains box).

T**rio a Tim system**

A shielded cable with AWG of

70 mm^2

(per wire) has to be connected from the on-site power distribution panel to the mains connection terminals of the CCA cabinet (mains box).

NOTE **A shielded power cable is required for connecting the MR-system to the mains.**

If there is a UPS system connected to the MR-System a shielded power cable is required between UPS and MR-system.

NOTE **To be able to install the 70mm² power cable the mains box has to be modified with a new strain relief.**

Service line

The permissible magnetic flux density **B** (magnetic induction) for the AC and three-phase power meters is:

B ≤ 2 mT

Magnetic shielding has to be provided at higher magnetic flux densities, because they impair the functions of the AC and three-phase power meters.

We strongly require the following FI

System	Manufacturer: Doepke		
	Current	rated residual current	Type
Trio	125 A	0.03 A / 4	DFS; surge current
Trio a Tim system	160 A	0.03 A / 4	DFS; surge current

NOTE	**The FI has to be for impulse current.**

Potential free contact

➪ The CCA cabinet is equipped with two potential free contacts.

- One contact (X4) is for Remote Alarm of the following functions:
  - Helium Low
  - Fridge Temp
  - EIS Fail
  - ERDU (Magnet Stop) Fail
- The other contact (X128) is for triggering an ON or OFF signal
  - e.g. for chiller systems
  - e.g for air conditioning systems

Contact details

Contact	Connector at CCA	Pin	techn. details
Remote Alarm Relay	**X4**	**1** Normally closed [1] **3** Common **5** Normally open [2]	
Potential free contact for e.g chiller or air conditioning systems	**X128**	**1** contact 1 [3] **2** contact 2 [4]	max. 230V / 6A

1. Connected to Common (Pin 2) for system normal (No alarm)
2. Connected to Common (Pin 2) for system faulty (Alarm)
3. System "ON" contact 1 and contact 2 closed
4. System "ON" contact 1 and contact 2 closed

Room lighting (control room)

Image screen workstations

The special requirements to be met by the human eye when working with image screen workstations are, for example, rapid image or text displays. An expert in room lighting should be consulted when determining the physical location of the MR monitors and the seating arrangement for the operator. Of special importance is the location of windows (daylight) and illumination with respect to the screen.

Planning

Reflections from light sources or daylight (windows) lead to completely false contrast and brightness settings on the MR monitor. Since the images and texts displayed on the screen are the basis for photographic documentation, the quality of images from this source will be negatively influenced. Equally important for optimal image quality on the MR monitor and thus for the most fatigue-free working conditions are such factors as reflection and glare, light density, and adequate illumination strength.

Reflections, glare

Glare considerably impairs the work performed at the screen. Direct glare due to lamps or illumination as well as various kinds of reflected glare should be prevented. Appropriate planning is therefore highly important.

Intensity of illumination

The most important factors with respect to good lighting are the **brightness level** and light density which should result in **reflection-free presentation** and **uniformity**.
According to DIN 5035, a general illumination of 300 to 500 Lux is recommended for EDP working areas. This corresponds to a fluorescent light output of approx. 30 W/m^2.

The above values are referenced to a horizontal plane located 85 cm above the floor.

The room lighting fixtures should be divided into groups so that they can be adjusted to daylight conditions.

Room lighting (examination room)

DC voltage

The magnetic field adversely affects the operating life of light bulbs located in the immediate vicinity of the magnet. The filament in the light bulb oscillates with the frequency of the power supply. It is therefore recommended to connect light fixtures in the vicinity of the magnet to a DC voltage supply. If room lighting is supplied with DC voltage, correct polarity of the sockets should be ensured during their installation.

Residual DC ripple should be ≤ 5 %.

AC voltage

Only lamps **without phase angle control** should be used.

Recommendation

- Light sources should be installed as follows:
  - The groups of lamps in the examination room are switched on/off with the main switch in the control room
  - The set of lamps above the patient table is controlled via a switch in the examination room.
  - The set of lamps next to the patient table is controlled via a second switch in the examination room.

Location of light sources

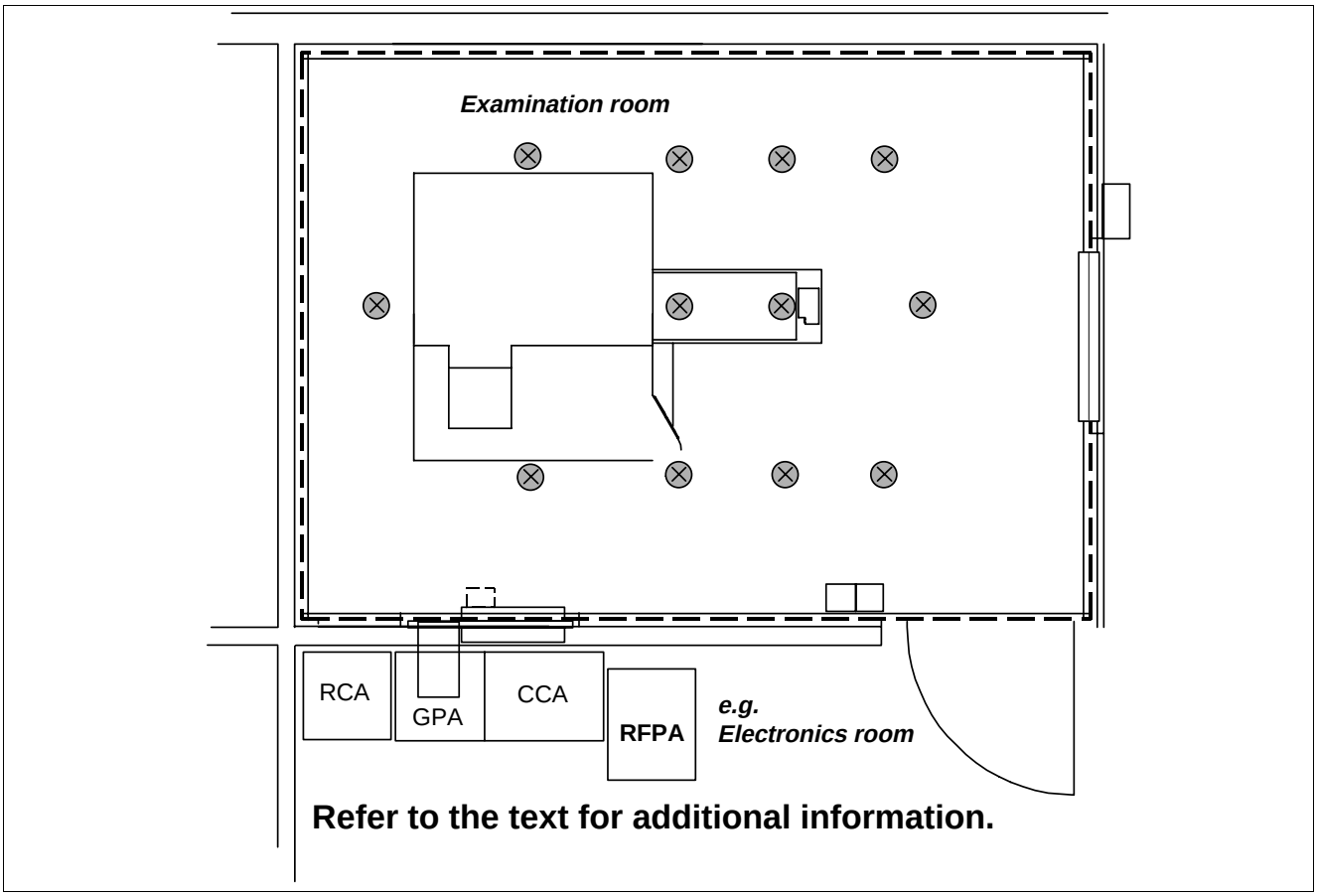


Fig. 8 Proposed lighting in the system rooms.

Protective Conductor Test

NOTE

Before performing the protective conductor test, read the operators manual of your measuring device!

For some measuring devices the resistance of the measuring leads have to be substracted from the measuring result!

NOTE

The entire grounding cabling must be installed, before this test can be performed.

NOTE

The protective conductor test has also to be performed from the on-site power distribution panel to the connection (mains box) of the CCA cabinet. This is to ensure the presence of the ground connection at the connection terminal of the CCA cabinet.

➪ Use the **protective conductor meter** and measure the **ohmic resistance** between the protective conductor connection on top of the CCA cabinet and an uncoated metallic part of the:

- RCA
- CCA
- Imager computer
- MRC Host computer
- MRC console components
- RF-room
- RF Filter plate
- Magnet
- Patient table
- Monitor
- Options (if available)

NOTE

Should the resistance exceed in one instance 200mW**, test the protective conductor in question for satisfactory galvanic connection.**

CAUTION

If this is not successful for devices with inlet-connectors (for non-heating appliances), an additional 16mm^2 protective conductor should be connected to the respective housing. Do not disconnect the protective conductor in the line voltage cable.

General

- In Germany, DIN 1988 "Technical guideline for tap water installations" should be part of the planning phase.

NOTE	**If you are using tab water you have to take in cosideration the following:** **In case of a waterleak in the primary circuit water will flood the site. There is no automatic to stop the waterflow!** **The same stands with the use of the emergency cooling connection at the water transfer panel (if used)!**

- Local regulations will apply in all other countries.
- If the country in question has not established specific regulations, DIN 1988 should be used.
- Relief valves have to be installed in the water supply pipes whenever required by local ordinance.

An on-site water supply is required for operating the RCA. The primary chilled water supplies three components:

- The water chiller for the gradient coil, gradient cabinet, and RFPA amplifier.
- The helium compressor for operating the cold head.
- The CCS cabinet for the cabinets requires water only when the system is switched on.

NOTE	**The helium compressor requires chilled water 24 hours a day.**

Requirements to the on-site chilled water supply

General requirements

- For the on-site water supply pipe installation only the following materials (for the water pipes) should be used:
  - copper
  - plastic medium pipes
  - stainless steel
  - high-grade steel
  - non-ferrous metal
- Do not use:
  - standard steel pipes
  - zinc-plated steel
  - carbon steel

NOTE

The specifications of the primary cooling water are related to the primary cooling water input at the RCA cabinet.
Pressure and temperatrure losses because of the distance and/or hoses between chiller and RCA cabinet are not included!
If the on-site cooling water does not meet our specifications, a separate water chiller for the primary cooling water has to be installed!

Water supply	pH-value	6 ... 8
	Hardness	< 178 ppm $CaCO_3$ < 10 ^{o}dH
	Filtration	5 ... 50 µm, (depending on waterquality) quantity of suspended particles: <10mg/l
Water chiller (primary side)	Water pressure (bar)	max. 6
	Differential pressure (bar)	1,5 without Glykol 2,5 with Glykol
	Water temperature of the prim. water ^{o}C (min...max)	6...12
Water / anti freeze	Volume percent Water %/ Glycol%	100 / 0 (without anti-freeze) 62 / 38 (with anti-freeze)

NOTE

The specifications of the primary cooling water pressure of 6 bar max. is very important for closed loop chillers. The reason is the pressure built up while filling up the closed loop system. The filling pressure could exceed 6 bar!

Thermal load to water (heat emission)

Trio

MAGNETOM Trio	
Heat emission to primary water	**required primary water flow**
50 kW	**min. total 90 l/min** 30 l/min cooler 1 30 l/min cooler 2 20 l/min. CCS water 10 l/min coolpack

Trio a Tim system

MAGNETOM Trio a Tim system	
Heat emission to primary water	**required primary water flow**
60 kW	**min. total 90 l/min** 30 l/min cooler 1 30 l/min cooler 2 20 l/min. CCS water 10 l/min coolpack

Chiller

KKT KPC 215-L-U/S (only for U.S.A.) 480V / 3Ph / 60Hz
KKT KPC 215-L-S/FU 380...480V / 3Ph / 50/60Hz

NOTE **If a KKT chiller of the above mentioned type is used with the Trio system you are able to use this type of chiller also for teh "Trio a Tim system" at 60kW heat load under the following conditions:**

The above mentioned KKT chiller have to be used at an ambient temperature limit of < 40°C.

NOTE **The waterflow of min. 90l/min has to be present even if the MR system is switched off.**

NOTE **Approximately 100 l distilled water is required for the secondary chilled water loop. This water should be present at the installation site prior to the installation.**

Closed chilled water system

A closed chilled water system is recommended for reasons of cost-efficiency and for locations with low water tables.

NOTE	**In UPS mode, the switch on current of the water chiller must be limited to 2 I_n.** **I_n = nominal current**

On site water supply

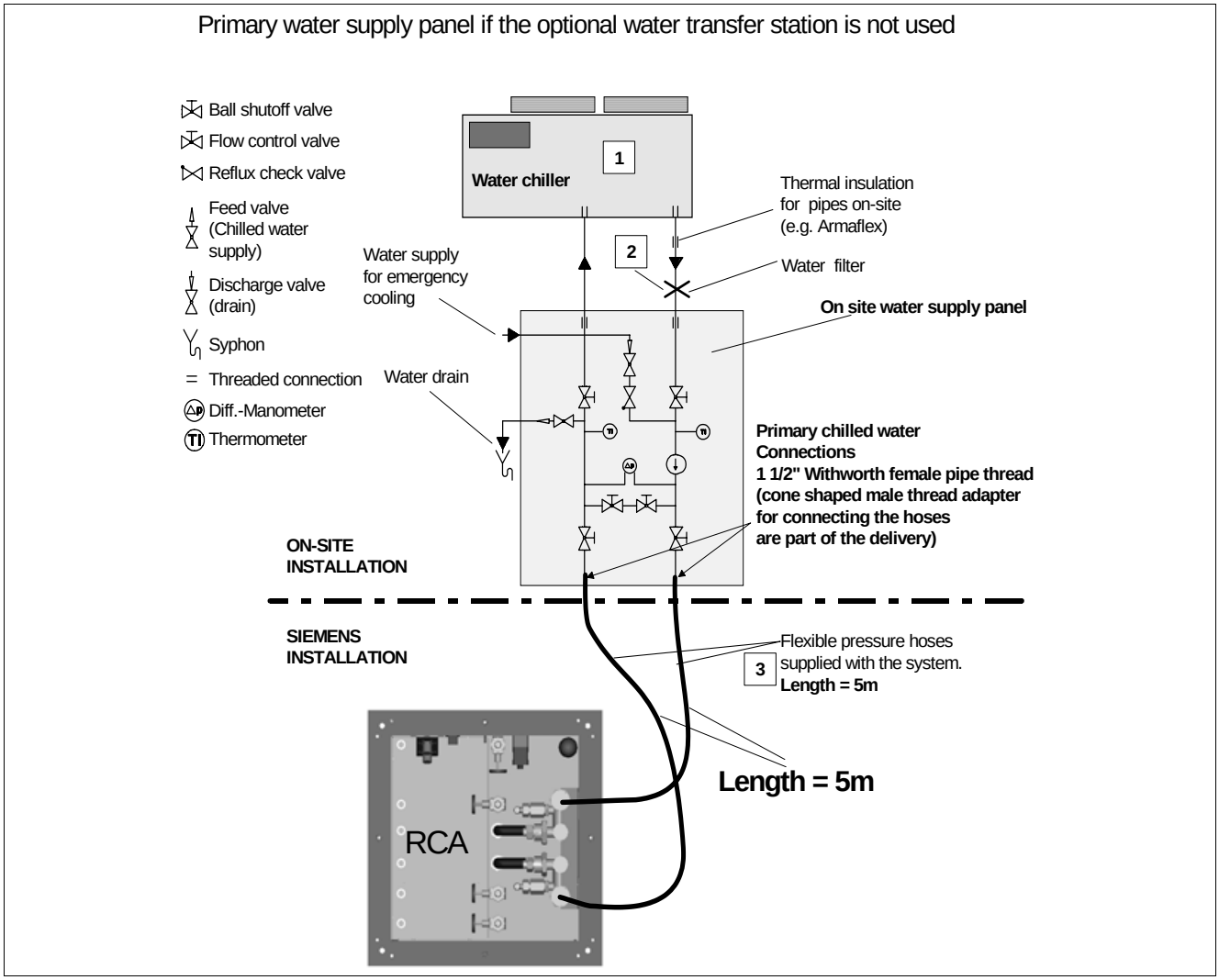


Fig. 1 Connection with closed chilled water system.

1 Internal/external capacitor can be isolated from the chiller. Chiller vibrations must not affect the building (vibration absorption).

2 An on-site water filter should be installed, if needed, to remove sediment, particularly for older water installations.

3 When routing pressure hoses, ensure that there are no loops. The ideal configuration consists of a permanent tube starting from the RCA, positioned perpendicular to the top of the cabinet and pointing upward.

General

The capacity of the air conditioning system is based on the:

- heat dissipation from the system
- heat dissipation from the lights of the room
- heat generated by adjacent rooms or sun light

The air conditioning system selected should be designed to permit future expansion. In addition, the system should be equipped with sensors which would automatically switch off the air conditioning if an error occurs. The temperature and humidity values should be recorded by a thermo-hydrograph to ensure that the data required is available for troubleshooting.

The MR system is cooled most effectively when the system components are installed at the prescribed distances from the walls or ceiling.

If the input draws upon air from outside the building, we recommend installing an on-site filter of EU filter class 4 (DIN 24185/part 2) to remove dust particles > 10 µm.

Air currents

NOTE	**The air conditioning unit must be carried out according to local/country/hospital specific regulations/codes,** **e.g. DIN 1946 (Germany).**

NOTE	**A minimum fresh air exchange rate, related to the examination room volume of six (6) times per hour is recommended.** **Higher fresh air exchange rates might be required due to local regulations or the system usage.** **It is recommended that you install fresh air systems (100% fresh air intake)**

- maximum room temperature deviations should be less than 3 ^{o}C
- air current speed in locations used by personnel should be less than 0.2 m/second

Climatic conditions

NOTE	If the values for temperature or humidity will be exceeded, condensation will be created.

NOTE	It is recommended that you install an air conditioning system for the examination room, which is separated from the other rooms. This air conditioning unit should have direct vent access to the outside of the building

NOTE	The following specifications must be achieved: Temperature gradient 1 K/5 min. for equipment room. Temperature gradient 1 K/h for examination room.

Heat dissipation to air

Heat dissipation to air	
Examination room	≤ 2.5 kW
Operating room	≤ 1.7 kW
Equipment room components	≤ 5.0 kW CCA
	≤ 1.0 kW RCA
	≤ 7.5 kW Additional RF cabinet[1]
	≤ 0.5 kW Shim PS
	≤ 0.3 kW Imager PC
Equipment room tot.	≤ 14.3 kW
Evaluation room (Option)	≤ 1.7 kW

1. The typical heat dissipation is 4.0kW (7.5kW is maximum)

Temperature / humidity

Room	Room temperature	Relative humidity	Air pressure
Examination room	**21^{0}C +/- 3^{0}C**	**40...60%**	
Evaluation room	15^{0}C...30^{0}C	40...80% [1]	600 to 1100 hPa
Control room			
Equipment room	18°C ...24°C	40...80% [2]	
	at 18^{0}C	40...80%	
	at 24^{0}C	40...70%	

1. Relative humidity of 11.5g/kg
2. See scale Fig. 1 at a relative humidity of 12.0g/kg

Scale temperature/humidity

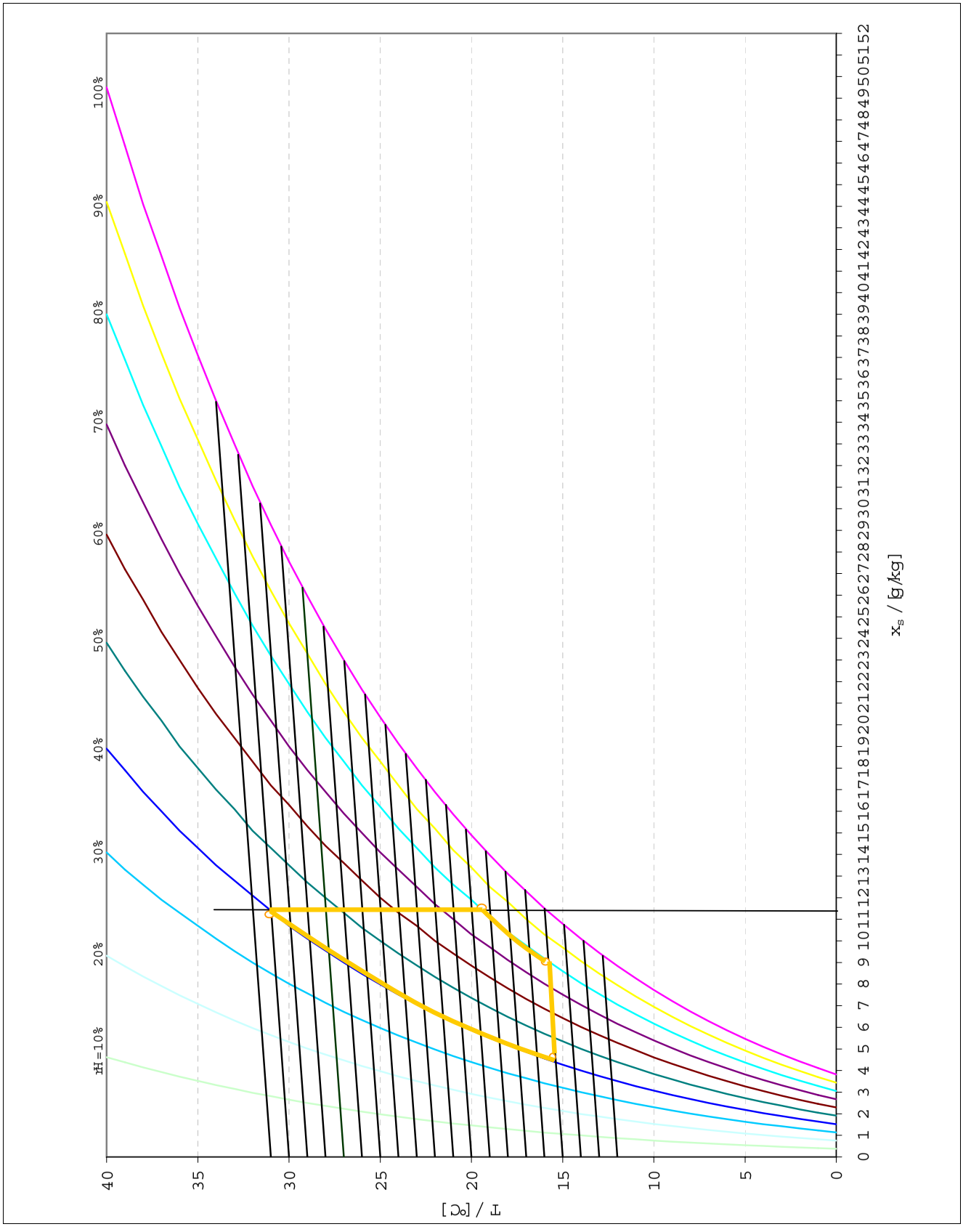


Fig. 1 Mollier

General

In the event of a quench, the thermal energy dissipated causes an extremely rapid boil off of the liquid helium. The system must be capable of venting the large volume of gas generated at the approximate expansion ratio of 1:700 from liquid to gas at 4.2 K room temperature. The exhaust system is critical to the safe operation of the magnet, and the guidelines set out in this section must be followed. Since helium vented in a quench is an asphyxiant and an extremely cold gas, the vent must always end at a point where access by people is not possible. This is a similar consideration when venting dangerous gases in chimneys.

Planning and installation of quench tubes must be conducted by qualified personnel.
Note that components used for other tubing, e.g., in air conditioning or room venting, are generally not suitable for quench tube construction.

It is the responsibility of the operator of the equipment to ensure that the quench vent pipe is maintained in an operable state.

NOTE	**The quench vent design has to comply with the requirements specified in this document. It is the responsibility of the Project Manager to accept the installation of the quench vent before the magnet is connected!**

NOTE	**The quench vent outlet, as well as the quench tube, must be easily accessible for visual inspection!**

Basis for design calculations

Calculating the pressure drop along the quench tube during a quench is complex due to the compressibility of gas and the heat inputs along the length of the tube, which affect the gas density.

The sizing procedure relies upon tabulated data, which is used in simple arithmetic calculations. The tables are based on empirical data derived from quench test pressure loss measurement.

An example of the sizing process is contained in the following section:
"Quench tube, sizing example" on page 9 - 14.

Quench tube components checklist

The following specific design rules apply to the components making up the quench tube:

1. The quench tube will comprise straight, hydraulically smooth tube sections, bends (up to 90°) and a diffuser if required (Fig. 7). The end of the tube must be terminated in a way to prevent ingress of rain, snow, and foreign objects (Fig. 1; Fig. 2). Flexible sections are used to connect to the magnet, and as expansion joints ("Principle layout of a quench tube, example 1." on page 9 - 14).
   If a quench line is very short and straight, a flexible tube may be used for the whole of the quench line. Note however that due to the high pressure drop, the maximum permissible length of flexible tubes is very short as compared to straight tubes.
2. The quench tube **must be made from a non-magnetic material**. **Only stainless steel** grades AISI 304, 309, 316, and 321 [EN 1.4301, 1.4828, 1.4401, and 1.4878] may be used.
3. Due consideration must be given to thermal contraction (**up to 3 mm/meter for stainless steel**). Stainless steel bellows sections must be used to allow for adequate contraction. Bellows are to be fitted **at a minimum of every 10 m**. The movement of the bellows must be limited so that the pipe does not expand excessively under internal pressure.

   NOTE **Flexible tubes and bellows may only be made of stainless steel.**
   (For material grades, see paragraph 2.)

   The length of the bellows sections in total may **not exceed 2%** of the allowed maximum pipe length, in order that the pipe pressure drop does not increase excessively.

   The weight of the tube must be supported against the building. In order that the line suspension is not overstressed due to the thermal contraction, the suspension needs to be flexible enough to accommodate the movements. Also, the wall exit in general should not be secured fully to the wall.

   The maximum internal pressure of the pipe in the **design calculations is 0.1 bar**. The maximum **permissible pressure, however, needs to be 0.45 bar**.
   The quench line has to be constructed in accordance with sound engineering practice.
4. There must be a flexible section at the quench valve in order to reduce noise transmission, ease the fitting of the quench valve, and so that the quench valve does not carry any load from the weight of the quench pipe.
   The flexible section at the quench valve must be no longer than 0.5 m, the internal diameter must be at least 0.152 m (6") and made of stainless steel, and has to be able to withstand a maximum **permissible pressure of 0.45 bar** internal overpressure.
   The bellows have to be installed nominally straight, i.e., to allow for minor misalignment. It must not be bent in a way to replace an elbow. The length of this section should be accounted for according to Tab. 2.
5. Joints may only be made by welding (by qualified welders of stainless steel), or by bolted flanges. Rotary flanges are permitted to ease the installation process. Vee clamped flanges may not be used. Gaskets used to seal section joints are to be made of either UHMW-PE [Cestilene HD1000, Hostalen GC579, or Hostalen GUR812], PTFE [BS EN 13000-1:1998, BS EN 13000-2:1998], or fiber [ASTM F36, BS 7531, DIN 3754P]. **No other materials are permitted**.

6. The end of the quench pipe must be protected from outside elements such as rain or snow, and is therefore fitted with a wire mesh. **The mesh size has to be 10±1 mm** [3/8"], **with 1 mm round wires**, to prevent ingress of foreign bodies [e.g., birds and rodents]. The area of the **mesh must be at least 2.5 times the cross-section area** of the quench tube (Fig. 2).

NOTE	**The area of the mesh must be at least 2.5 times the cross-section area of the quench tube.**

7. If the quench tube exits through a flat roof, the outlet must be above a level where water could enter it, in the event the roof drains become blocked. If the quench tube exits vertically, a rain shield must be attached (Fig. 1).

   A deflector plate must be welded to the tube where it exits the roof to prevent helium from re-entering the building (Fig. 1). The deflector plate must be at least the same diameter as the rain guard. It must be located at least two pipe diameters above the roof, and two diameters below the bottom of the rain guard.

   In the case of a horizontal exit through a wall, the outlet must be turned down by not less than the pipe diameter to prevent rain ingress (Fig. 1). The exit must be situated where it cannot be blocked by drifting snow.

NOTE	**Only the examples of pipe exits in this guide may be used.**

8. To avoid the risk of injury from cold burns and asphyxiation, access to the quench vent must be **restricted by 3 m** each side and below, **and 6 m vertically above the exit**; warning signs must also be posted (Fig. 1). The exit must not be situated where, in case of a quench, helium gas might be drawn into an air inlet, or where gas might enter open windows. Note that helium is lighter than air, even when very cold. The cold gas must not be allowed to blow directly onto a window.

NOTE	**Where windows are within the restricted access area, they must be sealed and permanently closed. Means of opening the windows must be removed.**

9. All bends must be smooth walled and have a centerline radius to internal pipe diameter ratio in the range **1.5 to 5.0**. Where a one-piece bend is not readily available, a fabricated bend using straight sections is permissible (Fig. 5).
10. Mitred elbows may be used, but be aware of the much greater equivalent length (Tab. 3), which makes them very unfavorable.
11. Expansion from a small to a large tube diameter is achieved using a diffuser. Diffusers have to conform to the geometric parameters shown in Fig. 7. **Never reduce the diameter of a line in the downstream direction.**

12. The pipe has to be insulated along its full length. This is to avoid condensation of liquid air in case of a quench, as well as water condensation on the inside in humid weather conditions. A double-walled structure is allowed. Mineral fiber insulation (brands such as Rockwool Ductwrap or other) may not be less than 25 mm thick. The insulation must conform to local regulations for fibrous insulation materials.

    Within the RF room, the pipe has to be insulated with one layer of mineral fiber insulation 25 mm thick with vapor barrier, covered with one layer of 25 mm thick Class O Armaflex [Armacell]. Vapor barriers cannot create electrical contact between the magnet pipework and the wave guide, in order to avoid RF disturbance to the imaging system. The outside may be covered with an aesthetic finish.

    Outdoor pipes must be covered if access cannot be excluded at the pipe or below (dripping liquid air in case of a quench). Outside insulation must be weatherproof [e.g., Armafinish FR paint, or Arma-Chek insulation].

13. The pipe must be marked along its length with a warning tape stating its function, e.g., **"WARNING: Vent pipe for extremely cold helium gas - work only by authorized personnel."**

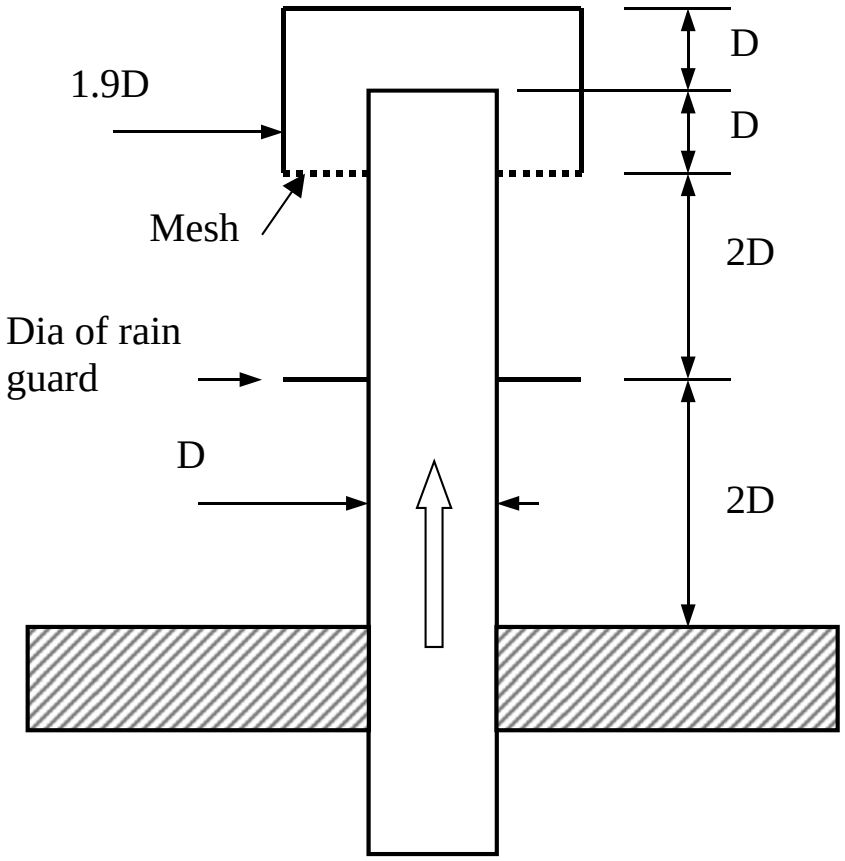
14. In order to achieve galvanic separation between the imaging system, the RF room (cabin), and the building, two galvanic separations are required. The separation at the magnet has to be made at the magnet exhaust flange, using stainless steel bolts, insulating bushes and nuts. The same principle has to be used outside the cabin.

NOTE	**For safety reasons, no other designs are permitted.**

15. The quench vent design has to comply with the requirements specified in this document. It is the responsibility of the Project Manager to accept the installation of the quench vent before the magnet is connected!

16. **Documentation: The design and construction of the quench pipe needs to be documented in drawings and calculations, and this data has to be stored with the installation documents.**

Quench Tube Outlet to Atmosphere - Vertical.



Quench Tube Outlet to Atmosphere - Horizontal.

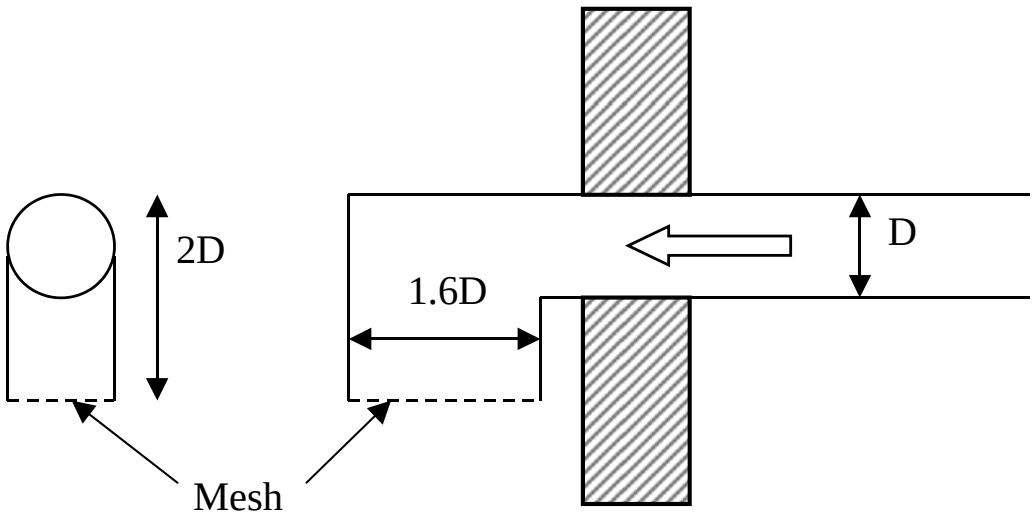


Fig. 1 Example of a vertical quench tube exhaust

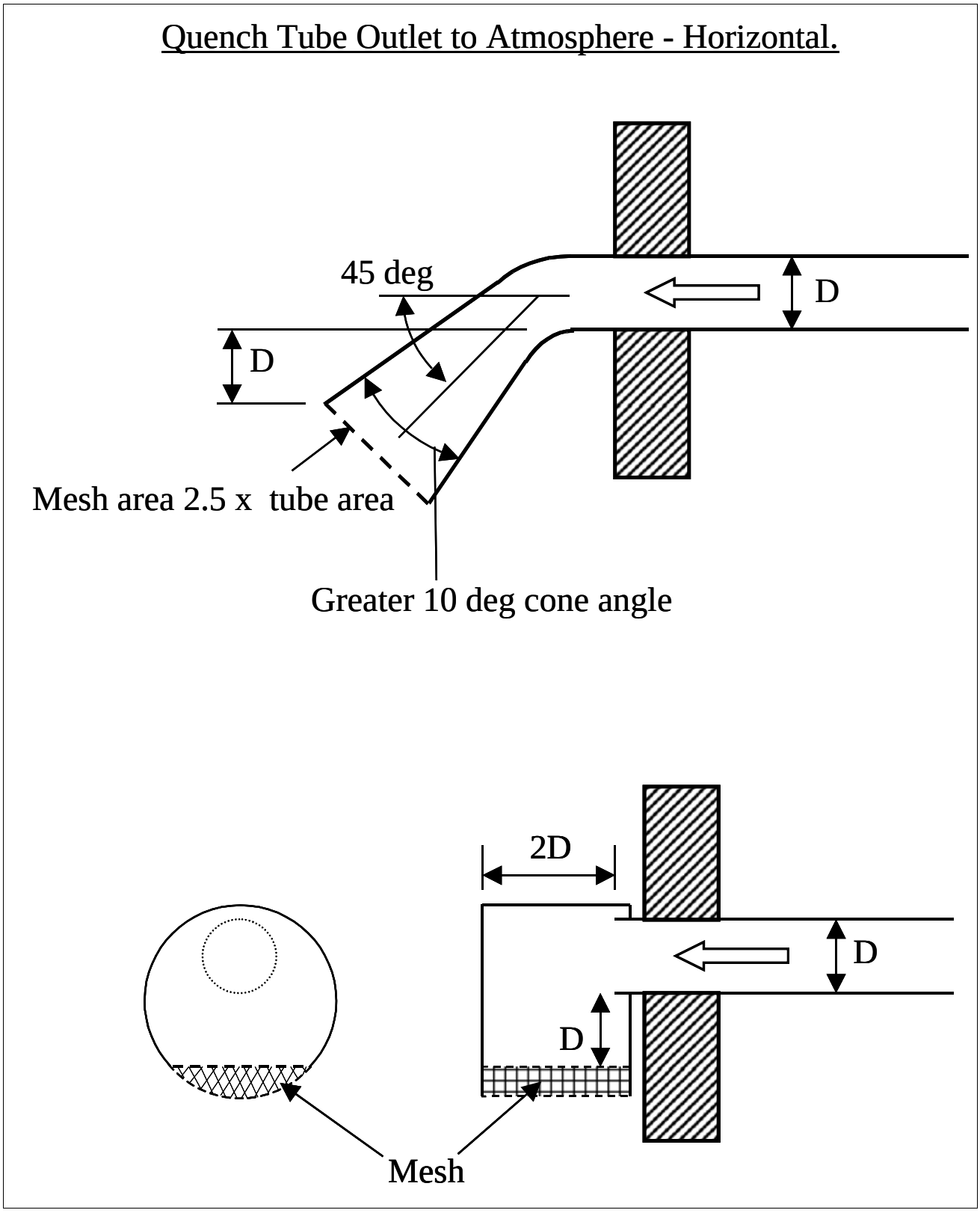


Fig. 2 Example of a horizontal quench tube exhaust

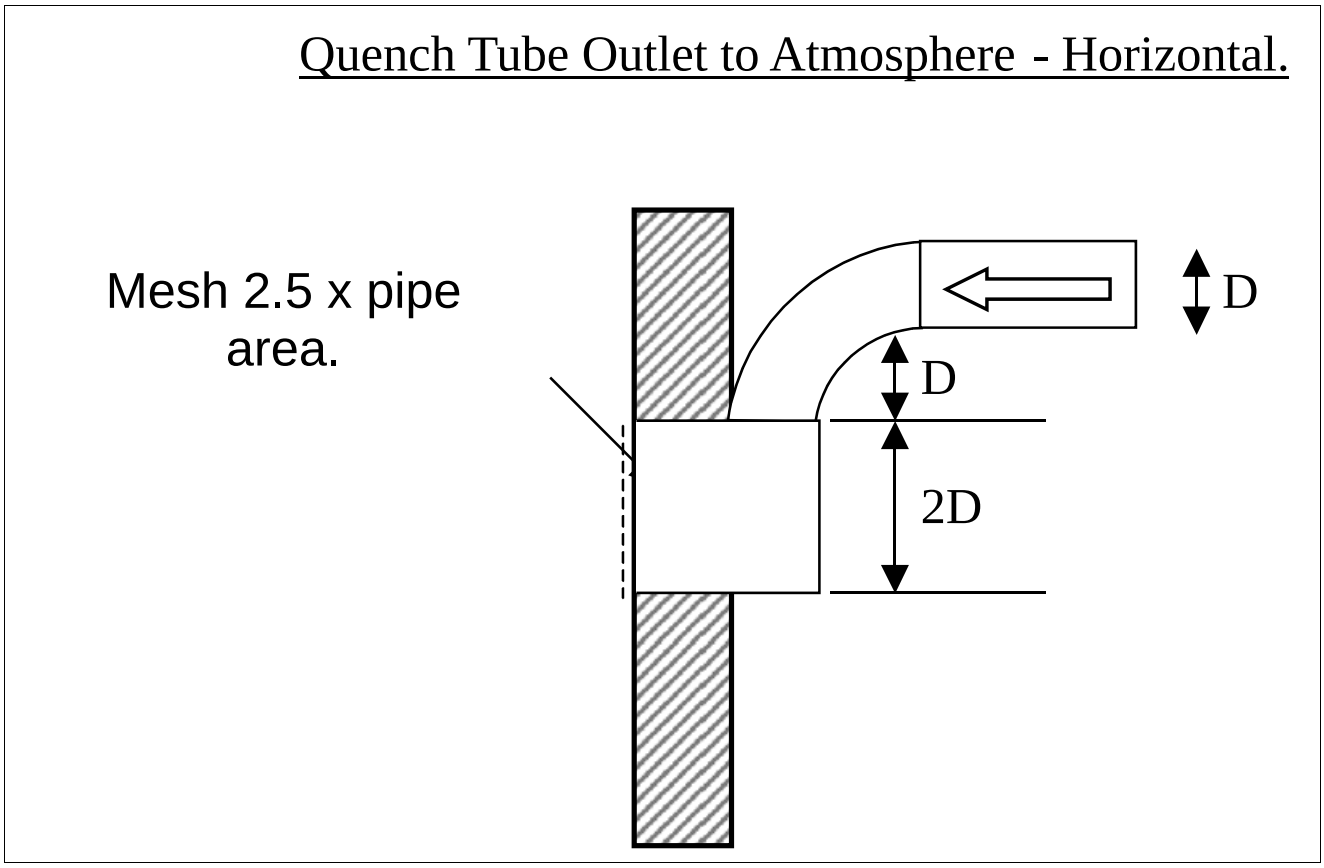


Fig. 3 Example of a horizontal quench tube venting to the outside.

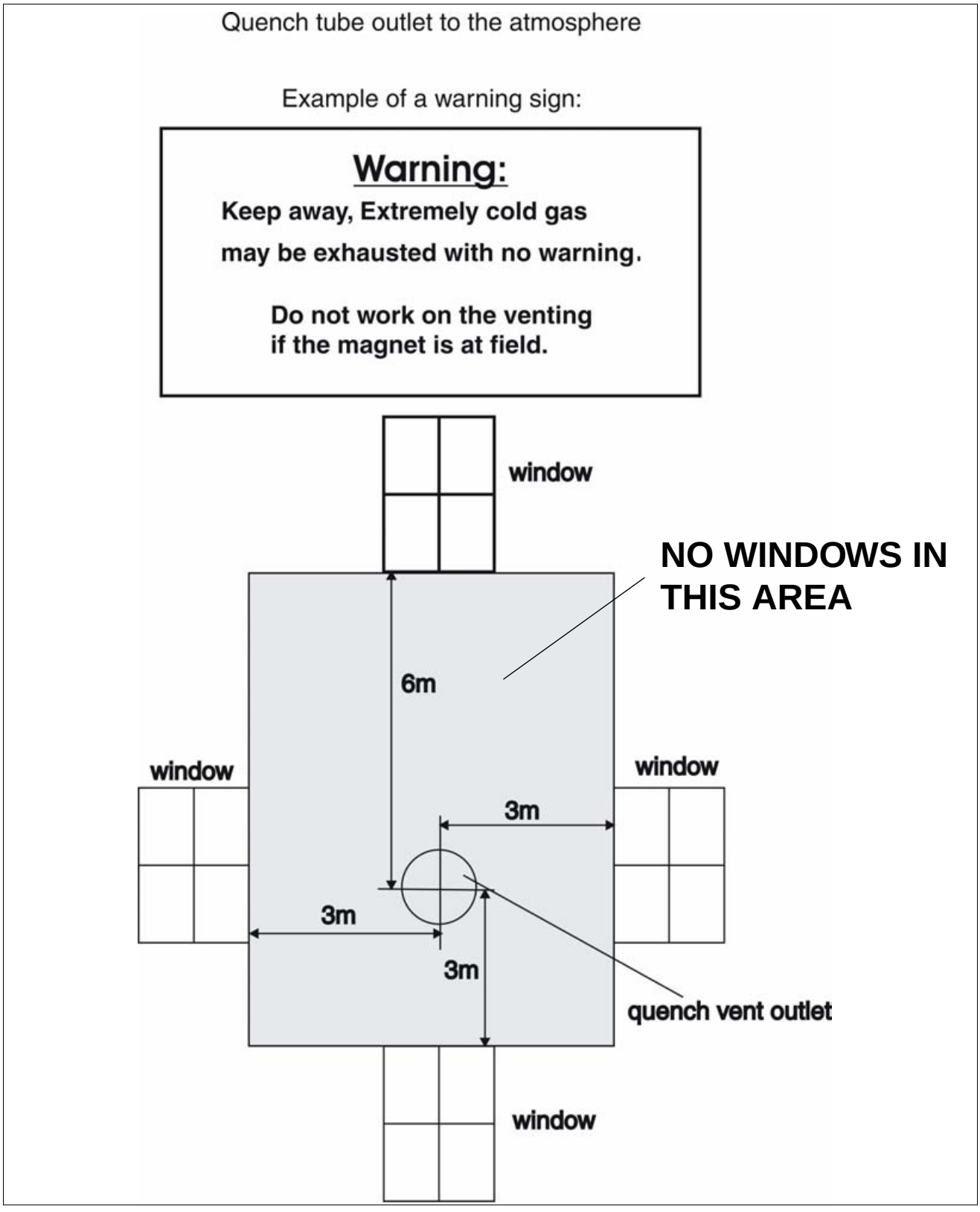


Fig. 4 Example of quench tube venting to the outside.

Sizing procedure

The sizing procedure for the quench tube must follow the steps outlined below.

1. Define the length of the flexible tube to be used (typically 0.5 m). Calculate the share of the maximum permissible length used by the flexible tube connecting the quench tube to the outlet of the quench valve (Tab. 2).
2. Determine the approximate length of tube required to reach from the flexible tube to the end of the quench tube, where it exits to atmosphere. In terms of the pressure loss along the tube during a quench, the apparent length of the tube is longer due to the extra frictional losses around the bends. As a first approximation, pick a diameter from Tab. 1, Tab. 2.
3. Lay out line with bend elbows. Check bend radius to diameter ratio for all elbows (Fig. 5; Fig. 6)
4. The apparent length (L_A) is calculated as $L_A = L_1 + L_2 + ... + L_m + E_1 + E_2 + ... + En$, where $L_1..m$ are the straight lengths and $E_1..n$ are the effective bend loss lengths from table Tab. 3.
5. Check whether the resulting L_A is within the limit allowed in Tab. 1, Tab. 2. If the line is longer than allowed, go to a larger diameter and repeat steps 2,3 and 4.
6. Determine the correct length for a diffuser, if required.
7. Determine the required size for the protective rain guard.
8. If there is a need to use more than one diameter for the line, calculate the percentages of the maximum permissible tube lengths for each diameter from table Tab. 1, Tab. 2. The sum of all percentages, including the flexible section at the magnet needs to remain **below 100%.**

Quench line elbows

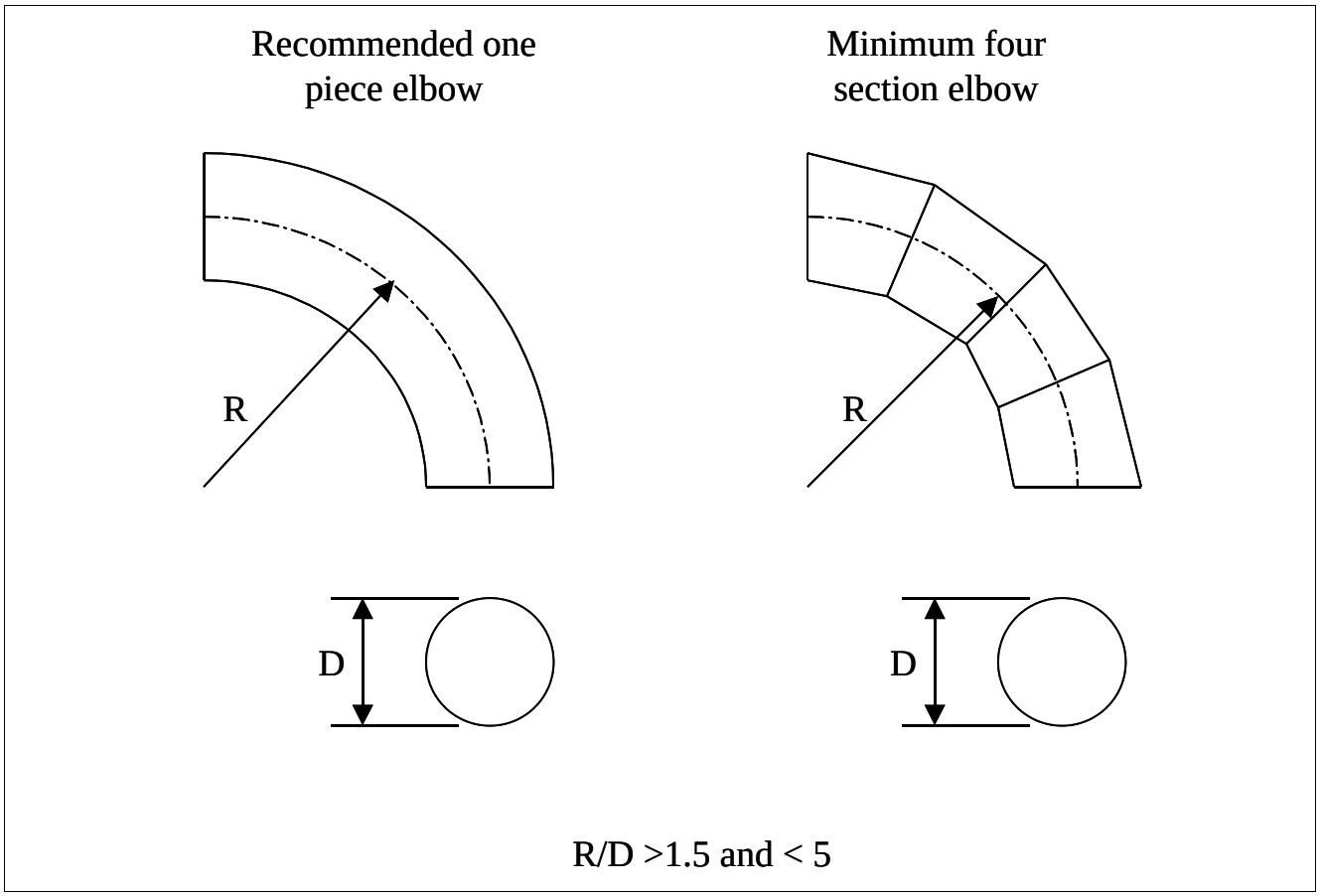


Fig. 5 Quench line elbow types

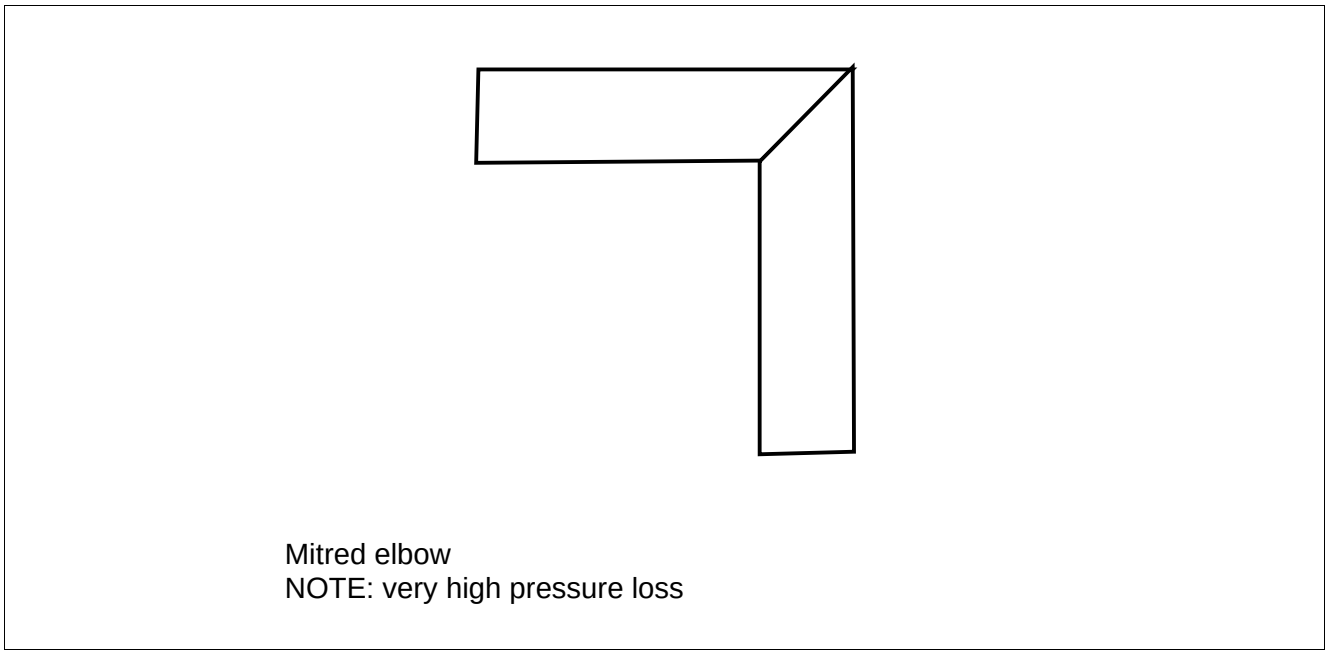


Fig. 6 Mitred elbow

Diffuser

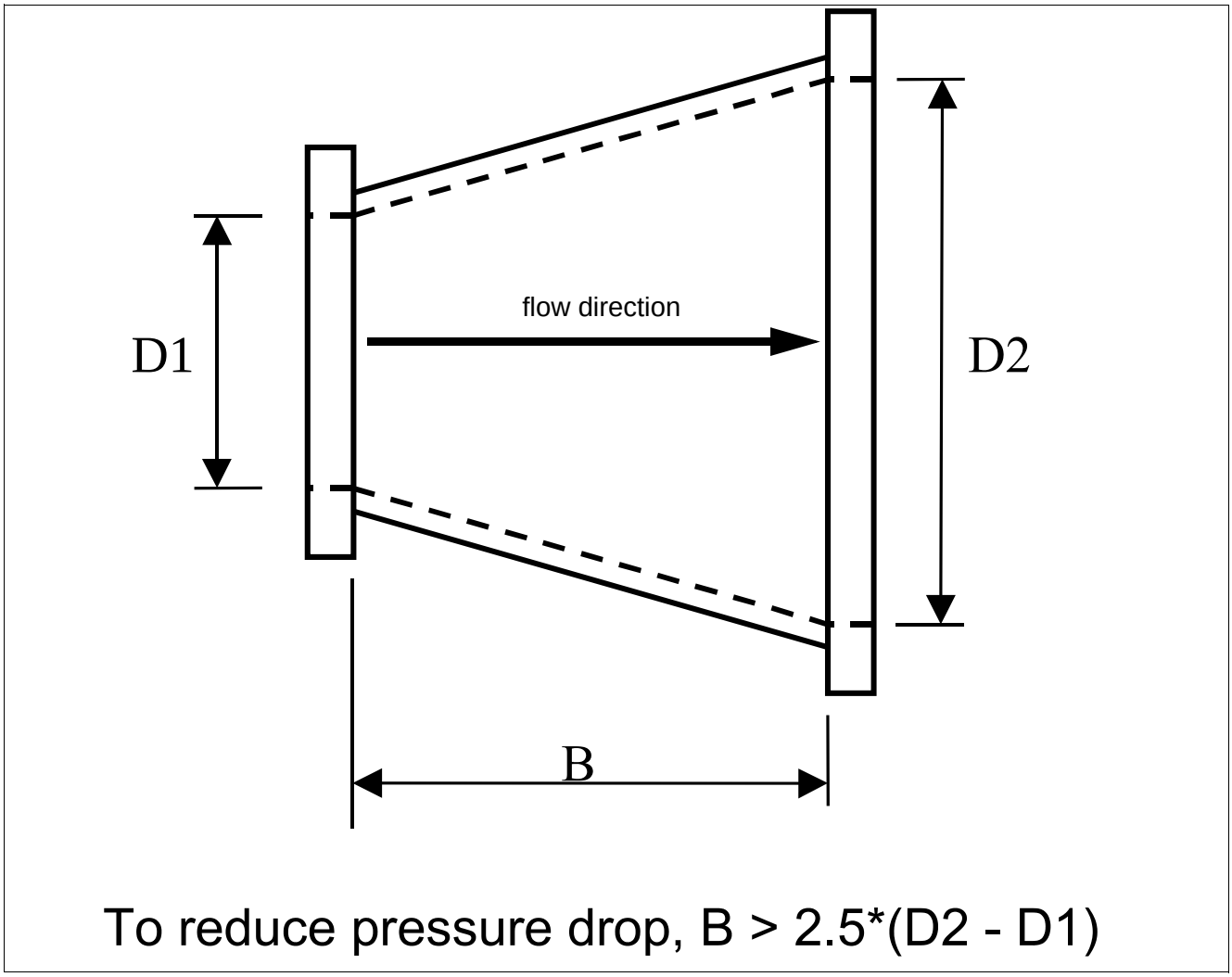


Fig. 7 Diffuser

Maximum permissible tube lengths

Smooth pipe

Smooth pipe			
Diameter of pipe		**Length of pipe**	
m	**inches**	**m**	**feet**
0.152	6	10.0	40
0.178	7	16.5	68
0.203	8	26.0	108
0.229	9	39.0	164
0.241	9.5	47.0	199
0.254	10	57.0	241
0.267	10.5	68.0	290
0.279	11	80.0	365
0.292	11.5	97.0	458
0.305	12.0	121.0	570
0.318	12.5	149.0	704

Tab. 1 Maximum permitted tube lengths smooth pipe

Flexible convoluted tube

Flexible convoluted tube			
Diameter of pipe		**Length of pipe**	
m	**inches**	**m**	**feet**
0.152	6	2.7	8.7
0.165	6.5	3.5	11.5
0.178	7	4.5	14.7
0.191	7.5	5.7	18.6
0.203	8	7.1	23.4

Tab. 2 Maximum permitted tube lengths flexible convoluted tube

Effective length of bends

EFFECTIVE LENGTH PER ELBOW, meters (m)						
Pipe diameter		90^o	45^o	90^o	45^o	90^o
meters	inches	smooth	smooth	segmented	segmented	Mitred
0.152	6	1.73	1.12	3.0	2.0	10.1
0.178	7	2.07	1.35	3.6	2.3	12.1
0.203	8	2.42	1.57	4.2	2.73	13.4
0.229	9	2.65	1.73	4.6	3.0	15.4
0.254	10	2.94	1.91	5.1	3.32	16.9
0.279	11	3.23	2.10	5.61	3.65	18.6
0.305	12	3.52	2.29	6.12	4.0	20.3

Tab. 3 Effective length of bends (total frictional loss of bend)

NOTE

Interpolate for values between 0^o - 45^o and 45^o - 90^o.

Data only to be used for bends where R/D is in the range 1.5 to 5.0, except for right angle mitred joints.

One Quench valve elbow (the 90^o bend delivered as part of the magnet) could be used and is accounted for in these calculations. Note that a second quench valve elbow would take 25% of the maximum permissible length.

Quench tube, sizing example

It is determined that the quench tube will need to be about **14 m** in length. The tube includes **two elbows.** A 0.152 m (6") flexible tube of the length L_f = 0.5 m connects the quench tube to the outlet of the quench valve (Fig. 8).

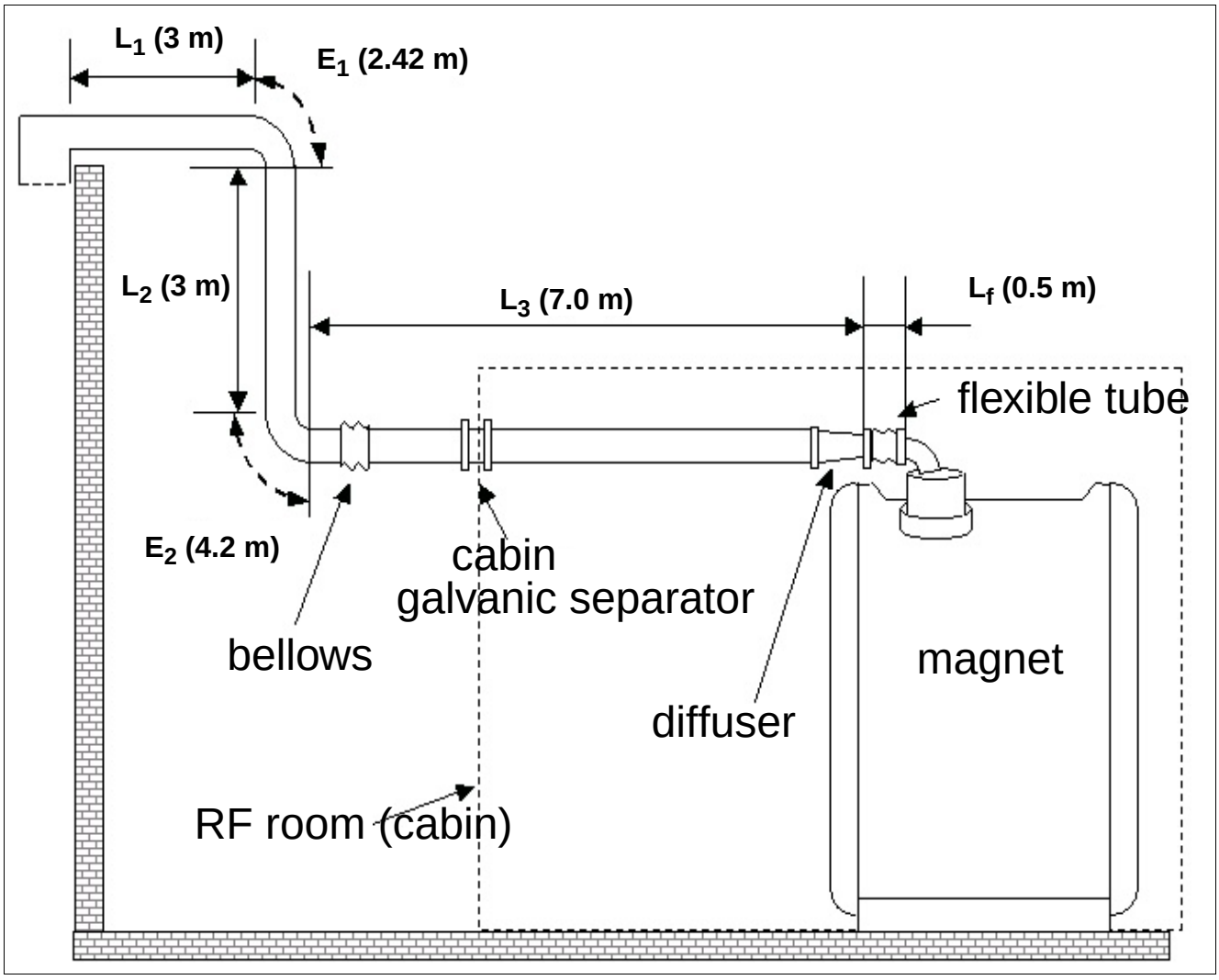


Fig. 8 Principle layout of a quench tube, example 1.

DEFINITIONS:

L_1.....Lm	Straight section length
E_1.....En	Effective length per elbow

1. From Tab. 2 the permissible length of the 0.152 m (6") flexible tube is 2.7 m. A 0.5 m long tube accounts for 0.5 m/2.7 m = 18.5% of the total permissible length.
2. The required 14 m of the quench tube should not exceed the remaining 81.5% of the total permissible length. Take 14 m * 100% / 81.5% = 17.18 m. From Tab. 1 select a diameter for the tube that will contain the length required. In this case 0.203 m (8") gives a maximum permissible length of 26 m.
3. Check if bend radius to diameter ratio is larger than 1.5 (Fig. 5; Fig. 6). A commercially available smooth walled elbow has an R/D ratio of 2. It can be used for bend 1. It is necessary to use a tighter elbow for bend 2. Since a one-piece pipe is not available, a 5 segment fabricated pipe will be used where R/D = 1.5. The effective lengths are taken from Tab. 3.
4. Determine apparent length L_A.
   $L_A = L_1 + E_1 + L_2 + E_2 + L_3 =$
   $= 3 + 2.42$[1] $+ 3 + 4.2$[2] $+ 7 =$
   $= 19.62$ m

section	effective length
1	3.00 m
2	3.00 m
3	7.00 m
Elbow 1	2.42 m
Elbow 2	4.20 m
Total	**19.62 m**

5. The apparent length of 19.62 m should take less than 81.5% of the permissible length. Take 19.62 m * 100% / 81.5% = 24.1 m. This is less than the maximum permissible length of 26 m (Tab. 1) and the pipe size selected is acceptable.
6. A diffuser is required to connect the 0.152 m outlet on the quench valve to the 0.203 m ID pipe. From Fig. 7 the length of the diffuser is 0.128 m min. The longer the diffuser, the better. Since space permits in this instance, a diffuser 0.5 m long has been used.
   It is acceptable to count the diffuser length to the straight length.

1. from table "Effective length of bends (total frictional loss of bend)" on page 9 - 13
2. from table "Effective length of bends (total frictional loss of bend)" on page 9 - 13

7. A horizontal outlet is chosen, dimensions as in Fig. 9

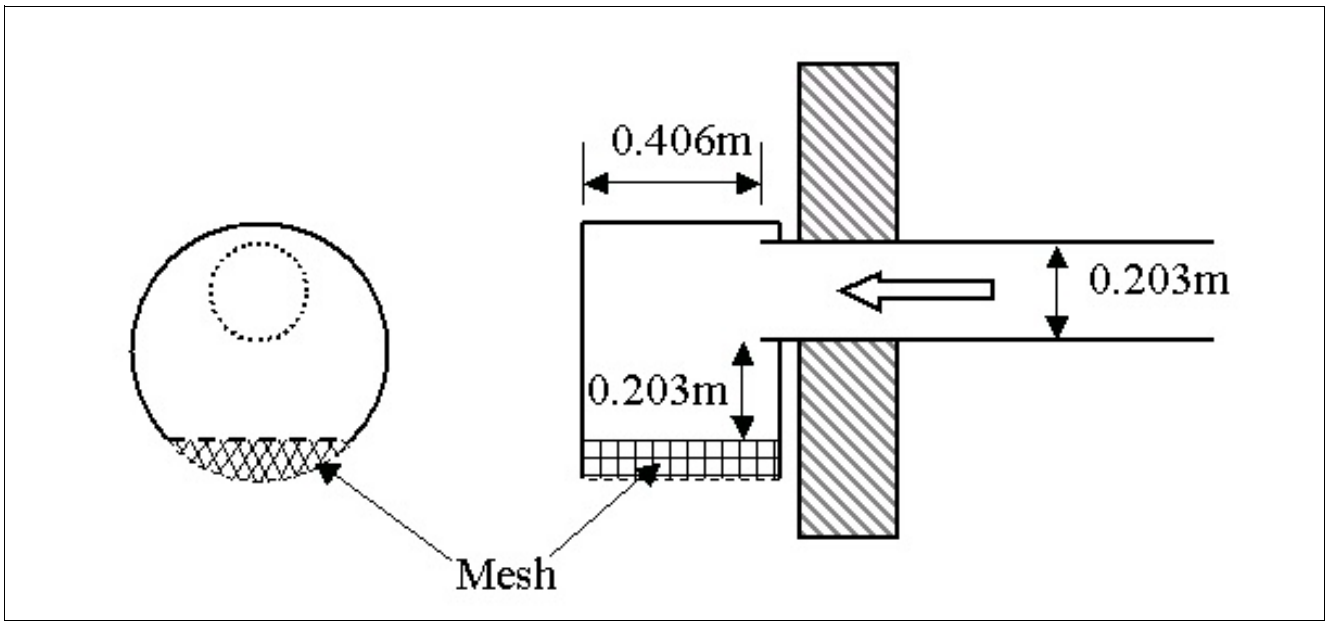


Fig. 9 Principle layout of a quench tube outlet.

8. The total percentage used so far is 19.62 m/26 m + 0.5 m/2.7 m = 75.5% + 18.5% = 94%. Any further length tubing may only use the remaining 6% of its permissible length.

Galvanic separation

The galvanic separation has to be installed to guarantee an electrical separation of the magnet for the Quench vent and the RF room.

The parts to be used are included in the delivery volume of the magnet.

The sketch below (Fig. 10) shows the installation sequence for the galvanic separation.

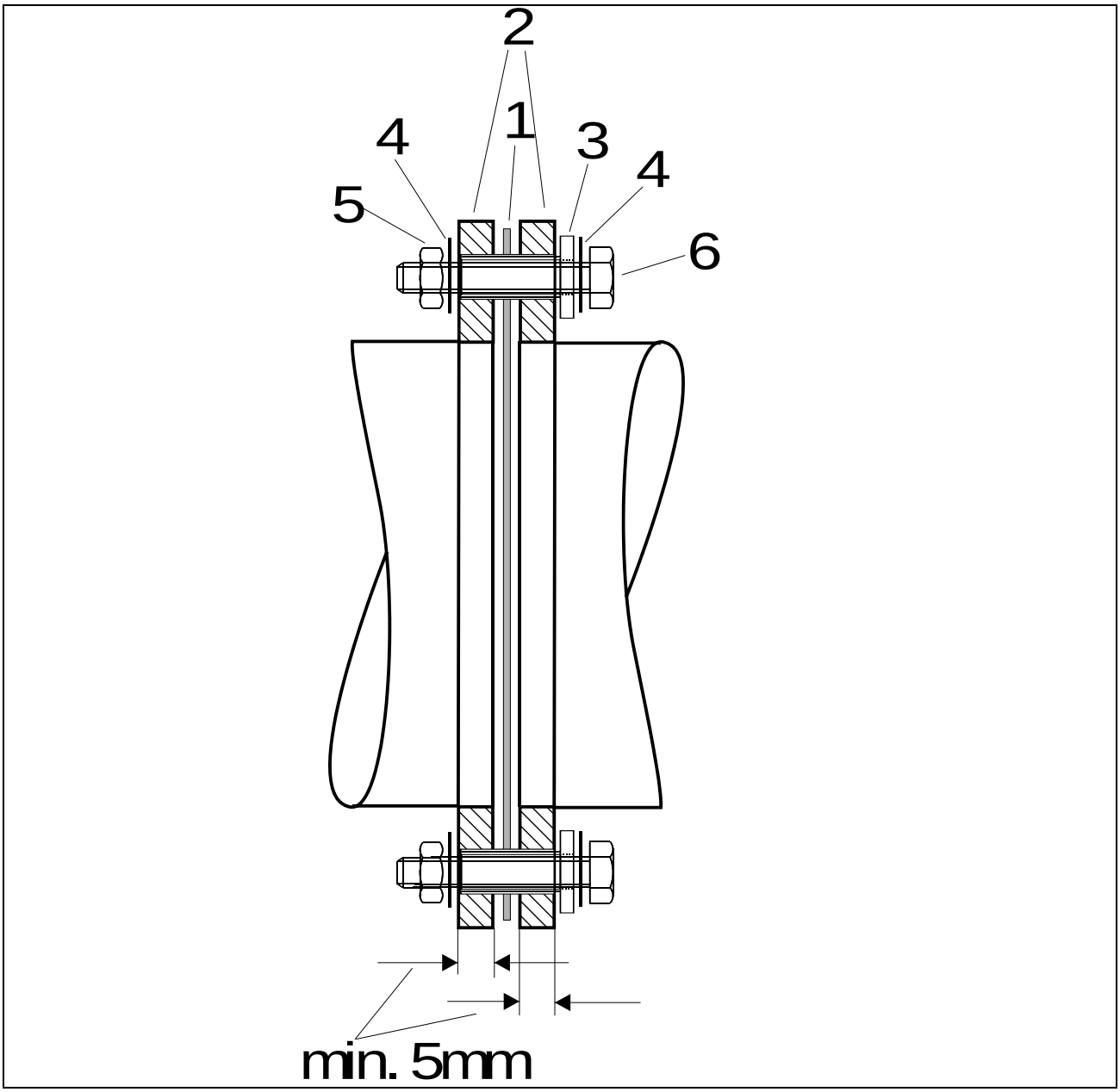


Fig. 10 Galvanic separation

1. Gasket	4. Stainless steel spring washer
2. Stainless steel flange	5. Stainless steel locking nut
3. UHWPE bushing	6. Stainless steel screw

Quench vent, drawing example

Quench vent RF wave guide

Quench vent wave guide with two galvanic separations:

- Inside the examination room
- Outside the examination room

➪ As a function of the inner pipe diameter d_i the following applies to the minimum pipe length L_{min} for frequencies up to 128 MHz and 110 dB attenuation:

$$L_{min} = 4.0 \times d_i$$

whereby: $d_i \leq 300$ mm

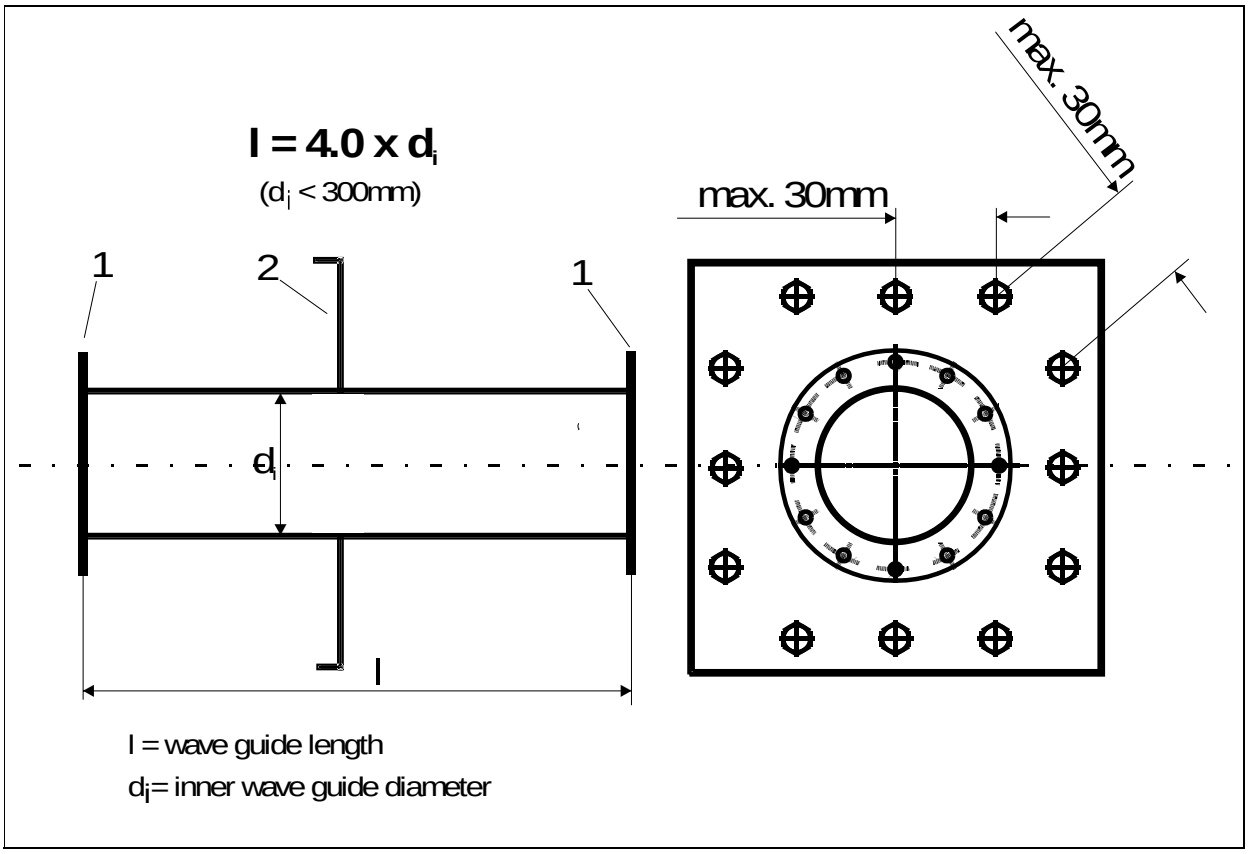


Fig. 11 RF wave guide

1. Connection flange	2. Connection plate to the RF room

Quench vent drawing

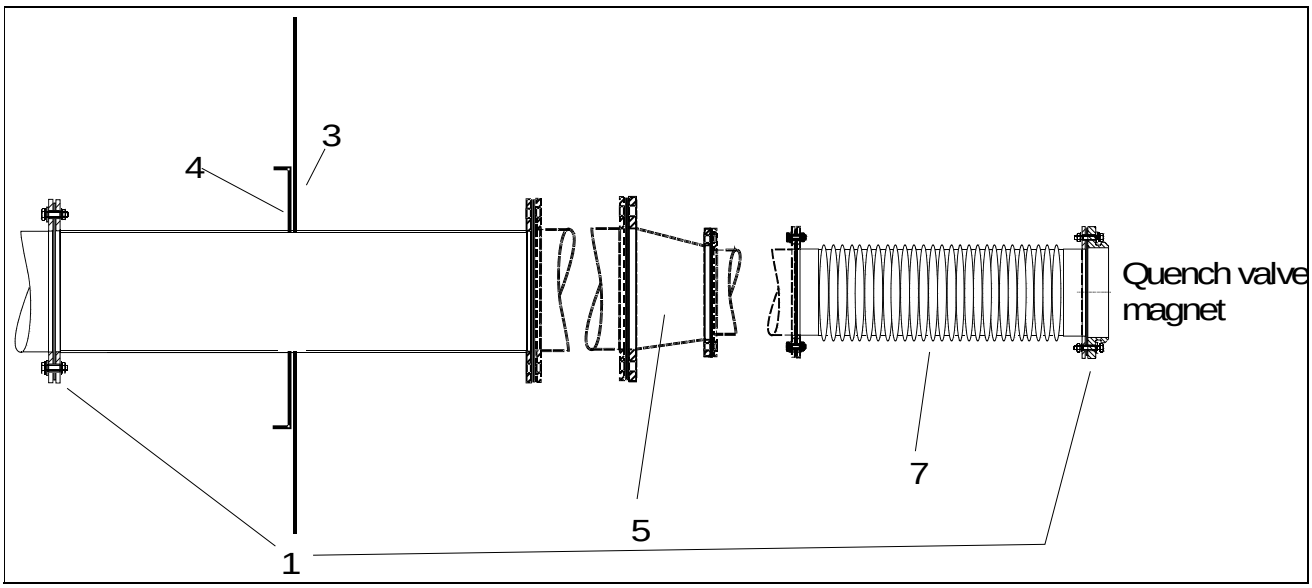


Fig. 12 Quench vent, example horizontal

1. Galvanic separation	5. Diffuser (Optional)
2. RF feed-through	6. Flange (e.g., welded, screw connection)
3. RF room	7. Flexible tube
4. Connection to RF room	

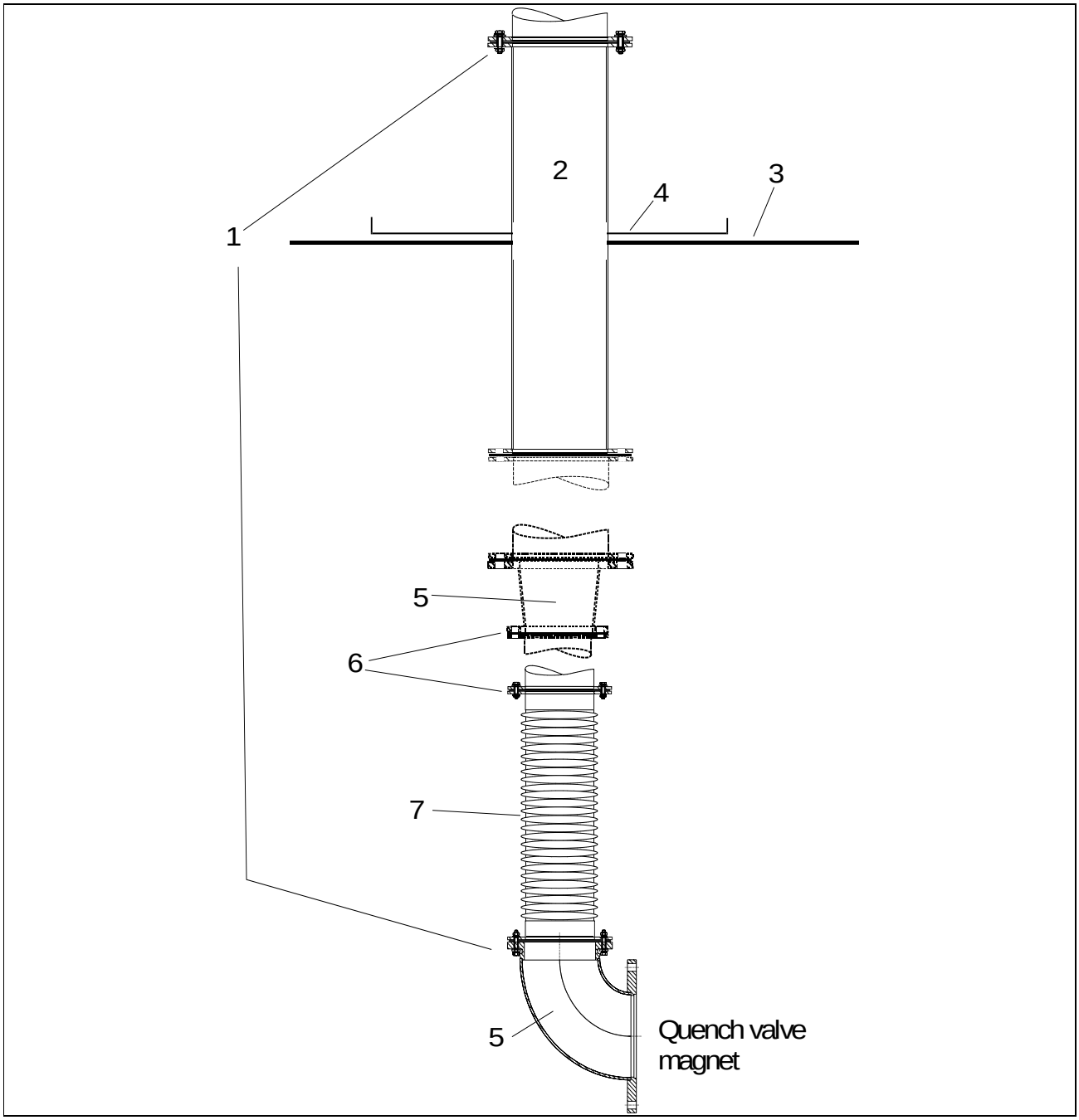


Fig. 13 Quench vent, example vertical

1. Galvanic separation	6. Flange (e.g., welded, screw connection)
2. RF feed-through	7. Flexible tube
3. RF room	
4. Connection to RF room	
5. Diffuser (optional)	

General

- RF-shielding is required in the examination room, because
  - all international and/or national RF-guidelines for the prevention of RF-interferences caused by MR system operation have to be observed
  - interference-free operation of the MR system despite RF-interference in the operating frequency range of the installation has to be ensured.
    Route all electrical lines in the RF-room via RF filters.
- Equip doors leading to the RF-room with a limit switch.
- To prevent extraneous electrical fields in the examination room, the following should not be installed or used:
  - Telephone connections
  - Extensions for in-house intercom systems
  - Fluorescent lights
  - Energy saving light bulbs
    Refer to **"On-site electrical installations**" on page 6 - 1
- The RF-integrity has to be tested and the filter plate must be installed after completion of the RF-room. Requirements regarding RF-shielding.

NOTE	**By using a suitable design as well as maintenance plan, the manufacturer of the cabin has to ensure that the following operate without fail: the door locking, especially the door handle and locking mechanism so as to secure continuous access to the patient in the examination room for emergency care and evacuation.**

NOTE	**For the Quench vent installation refer to the following chapter:** **"Quench Tube" on page 9 - 1.**

NOTE	**The opening direction of the RF-door has to be to the outside of the RF-room. As an alternative other appropriate means have to be provided in a way that pressure built up during a quench, when the venting fails to work adequately, will not prevent the RF door of the examination room from being opened.** **An opening in the RF room (e.g flap in the door, honeycomb waveguide) of 600mm x 600mm *must* be installed if the RF door opens to the inside of the examination room! This is mandatory!** **The opening of 600mm x 600mm is *recommended* even if the door opens to the outside.**

➪ **An adequate pressure equalisation alternative could be a sliding RF door, a RF window which can be opened or a flap (700X700mm) built into the RF door.**

NOTE	The air conditioning system for the examination room has to be a separate system with a direct air vent connection to the outside of the building.

NOTE	If required, the RF-room manufacturer has to perform a separate/additional RF attenuation measurement after the complete installation of the RF cabin (Magnet is positioned; RF filter plate is installed).

NOTE	To operate the MR-system, the RF-room has to be grounded at the points specified in the installation instructions. All other ground connections are unacceptable.

NOTE	The RF attenuation of the RF-room must be min. 90dB in the 15-128 MHz frequency range. The measured value (after installation of the RF-room on-site) must be stated in the handing over protocol of the RF-room manufacturer. A copy of this protocol has to be inserted into the system owners manual.

NOTE	All components of the RF-room and the interior fittings/accessories of the examination room have to be made from non-magnetizable material. Follow manufacturers specifications and instructions.

Additional information

Checklist

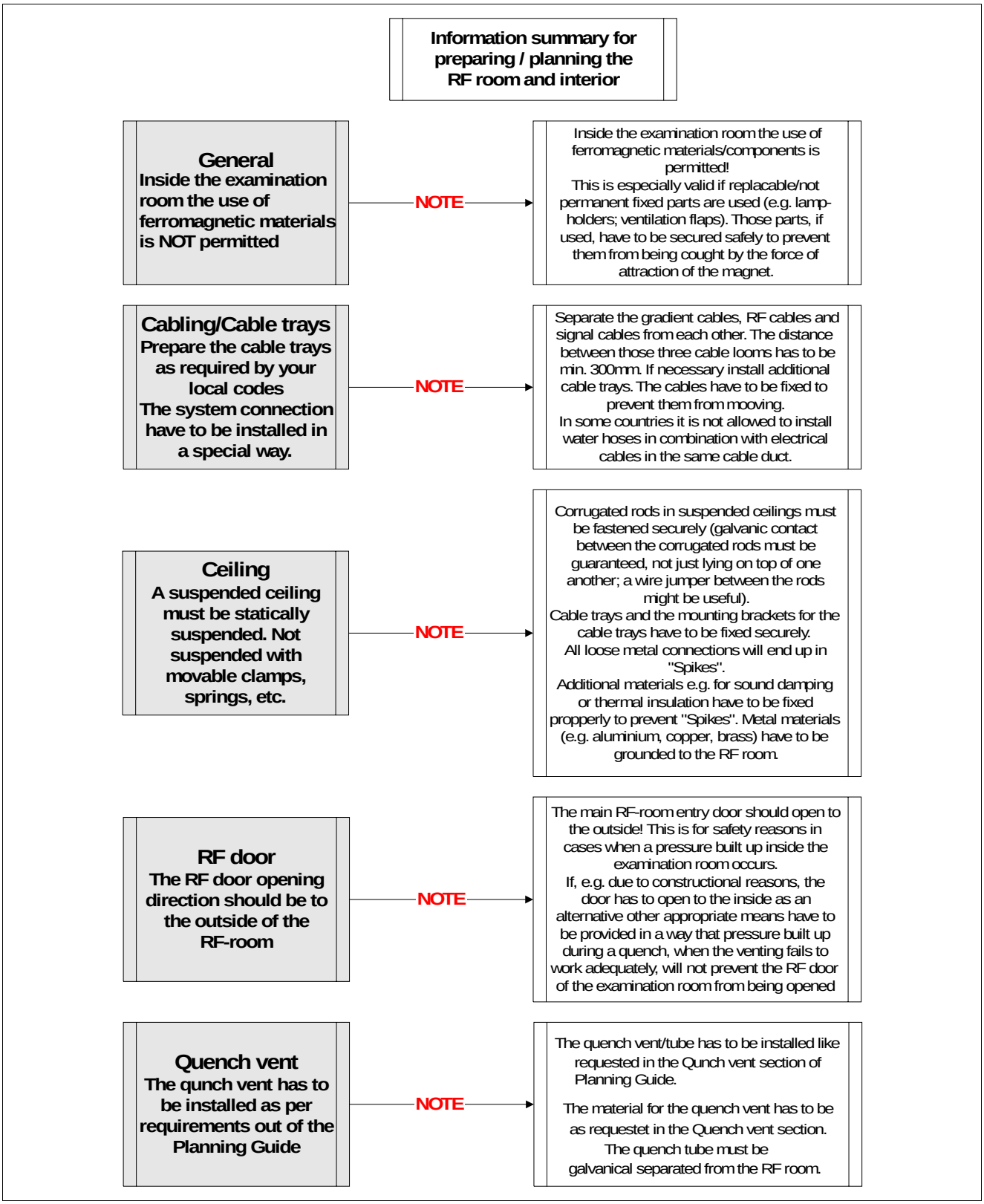


Fig. 1 Checklist

Controlled access area

For MR EQUIPMENT that generates a stray field exceeding 0,5 mT outside its permanently attached cover, and/or an electromagnetic interference level that does not comply with IEC 60601-1-2; 1993, the technical description

- shall indicate the necessity to define and permanently install a CONTROLLED ACCESS AREA around the MR EQUIPMENT such that outside this area

  a) the magnetic fringe field strength shall not exceed 0,5 mT and

  b) electromagnetic interference level complies to IEC 60601-1-2: 1993;

- shall give clear recommendations as to how this CONTROLLED ACCESS AREA shall be delimited, e.g. by markings on the floor, barriers and/or other means to allow the responsible staff to adequately control access to this area by unauthorized persons; and

- shall state that the CONTROLLED ACCESS AREA should be labelled at all entries by appropriate warning signs, including an indication of the presence of magnetic fields and their attractive force or the torque on ferromagnetic materials.

When the MR EQUIPMENT is designed for installation in a room in which audio visual contact to the PATIENT is likely to be limited, the technical descriptions shall specify provisions in the design of the room and in the EQUIPMENT to enable audio and visual contact with the PATIENT during the MR EXAMINATION. The audio visual contact shall be sufficient not to hamper the possible need for MEDICAL SUPERVISION of the PATIENT.

When the installation of a CONTROLLED ACCESS AREA is required for the MR EQUIPMENT, the INSTRUCTIONS FOR USE

- shall state clearly, that it is the responsibility of the USER to follow local statutory requirements with respect to access to the CONTROLLED ACCESS AREA;

-shall specify, preferably accompanied by a sketch, the size and shape of the CONTROLLED ACCESS AREA;

- shall indicate the need to establish adequate rules for controlling access to the CONTROLLED ACCESS AREA in terms of the potential risk to PATIENTS and staff within the CONTROLLED ACCESS AREA from the attraction of objects containing iron or other magnetically active materials or from torque on such metallic materials and the potential risk to persons inadvertently entering the area who may be affected by the possible dysfunction of their medical implants such a pacemakers;

NOTE	**For magnetic field strengths less than 0,5 mT no administrative controls are required.**

- shall list EQUIPMENT and tools specified or recommended by the MANUFACTURER for use in the CONTROLLED ACCESS AREA. For all EQUIPMENT, ACCESSORIES or tools listed, a description should be given of special measures that are needed, if any, for its installation as well as special precautions, if any, for their use

- shall state clearly that peripheral equipment, including PATIENT monitoring, life supporting devices and emergency care equipment, which are not specified or recommended for use in the CONTROLLED ACCESS AREA, may be disturbed by the radio frequency field or the magnetic fringe field of the MR EQUIPMENT and that this peripheral equipment may also disturb the proper function of the MR EQUIPMENT.

Used DIN norms

Shielding attenuation measurements are normally carried out in compliance with the following standards:

- EN 50147-1 (European standard)
- NSA 65-6 (American standard)
- MIL STD 285 (American standard)
- IEEE 299 (1997)

The various methods for measuring are established and described within the standard. It is, therefore, common for us to determine certification measurements with the respective customer as early as the quotation and planning phase.

Medical gases

Our information on medical gases is as follows:

Only licensed firms (e.g., Dräger) are permitted to perform installations.

Up to now there were actually three ways of laying medical gas lines:

- Pipes were comprised solely of plastic tubing and were introduced into the RF-room through a 76mm feed-through. This is actually the simplest solution from a technical standpoint.
- Complete line voltage supply in copper tubing within the hospital. Copper tubing also installed inside the RF-room. The RF feed-through from the outside to the inside was established using the 76mm feed-through and synthetic tubing. In the area of the feed-throughs inside and outside of the RF room, inspection ports are required inside the suspended ceiling. Dräger performed the installation of the copper tubing and the transition with plastic tubing.
- Introducing the copper tubing directly into the RF-room via an RF-sealed copper tube had been planned several times but never implemented. A type of mounting plate was planned upon which the necessary number of copper tubes of the appropriate diameter would be located. In the majority of cases, diameters of 8, 10, 12, and 14mm are required for the gases, while diameters of 20 or 25mm are required for suction. RF integrity can be calculated precisely using the diameter and length of the tubing.

The tubing could be connected directly to the mounting plate via the respective fittings. The only problem with this solution is the galvanic separation of the RF-room from the rest of the building.

Prerequisites for establishing the RF shielding

Prerequisites

- The shell of the examination and magnet room has been completed
- The concrete has been covered with a vapor barrier for MR-suites located in the basement
- All openings have been made (door frames, view window, air intake and exhaust, etc.)
- If required, magnetic room shielding has been installed and prepared for attaching the RF-shielding

NOTE **The floor in the vicinity of the magnet (2.2m x 4.5m) must be leveled within maximum +/- 2.0mm**

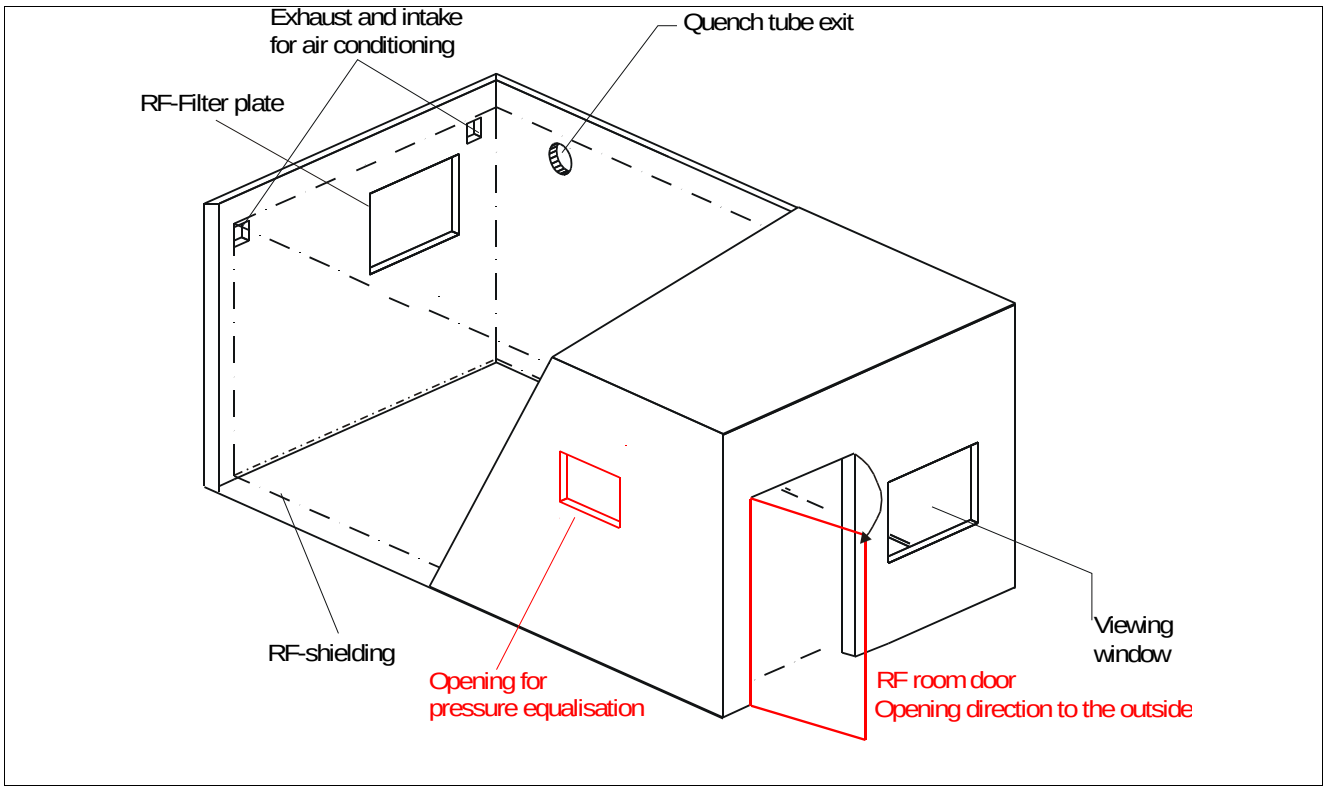


Fig. 2 Shell of the examination room including the wall openings

NOTE

The opening direction of the RF-door has to be to the outside of the RF-room. As an alternative other appropriate means have to be provided in a way that pressure built up during a quench, when the venting fails to work adequately, will not prevent the RF door of the examination room from being opened.

An opening in the RF room (e.g flap in the door, honeycomb waveguide) of 600mm x 600mm *must* be installed if the RF door opens to the inside of the examination room! This is mandatory!

The opening of 600mm x 600mm is *recommended* even if the door opens to the outside.

RF-sealed wave guides

NOTE	**Refer to "Quench Tube" on page 9 - 1 for planning details!**

➪ As a function of the inner pipe diameter d_i the following applies to the minimum pipe length L_{min} for frequencies up to 128 MHz and 110 dB attenuation:

$$L_{min} = 4.0 \times d_i$$

whereby: $d_i \leq 300$ mm

To ensure a total attenuation of ≥ 90 dB, the attenuation for individual components must exceed 90 dB.

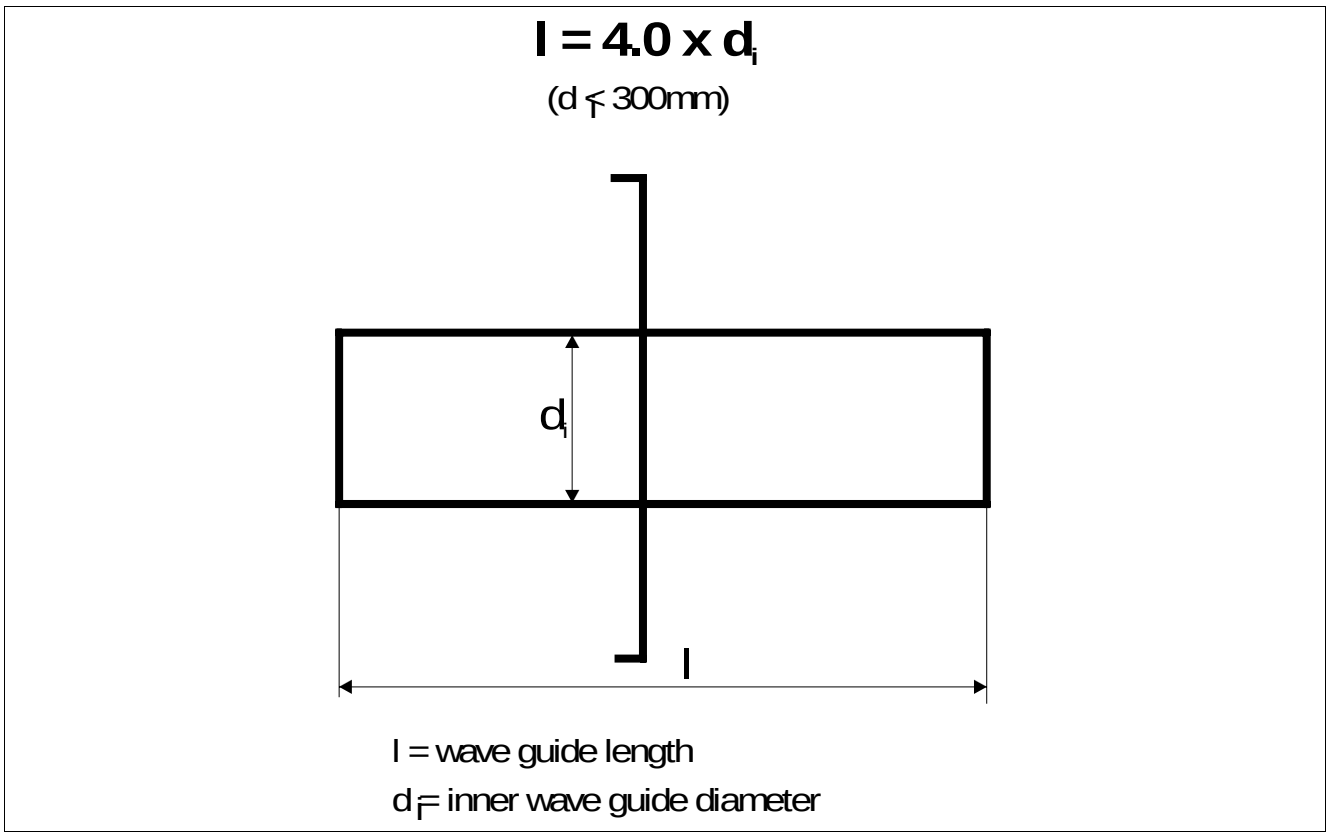


Fig. 3 Example: RF-sealed wave trap for quench tube.

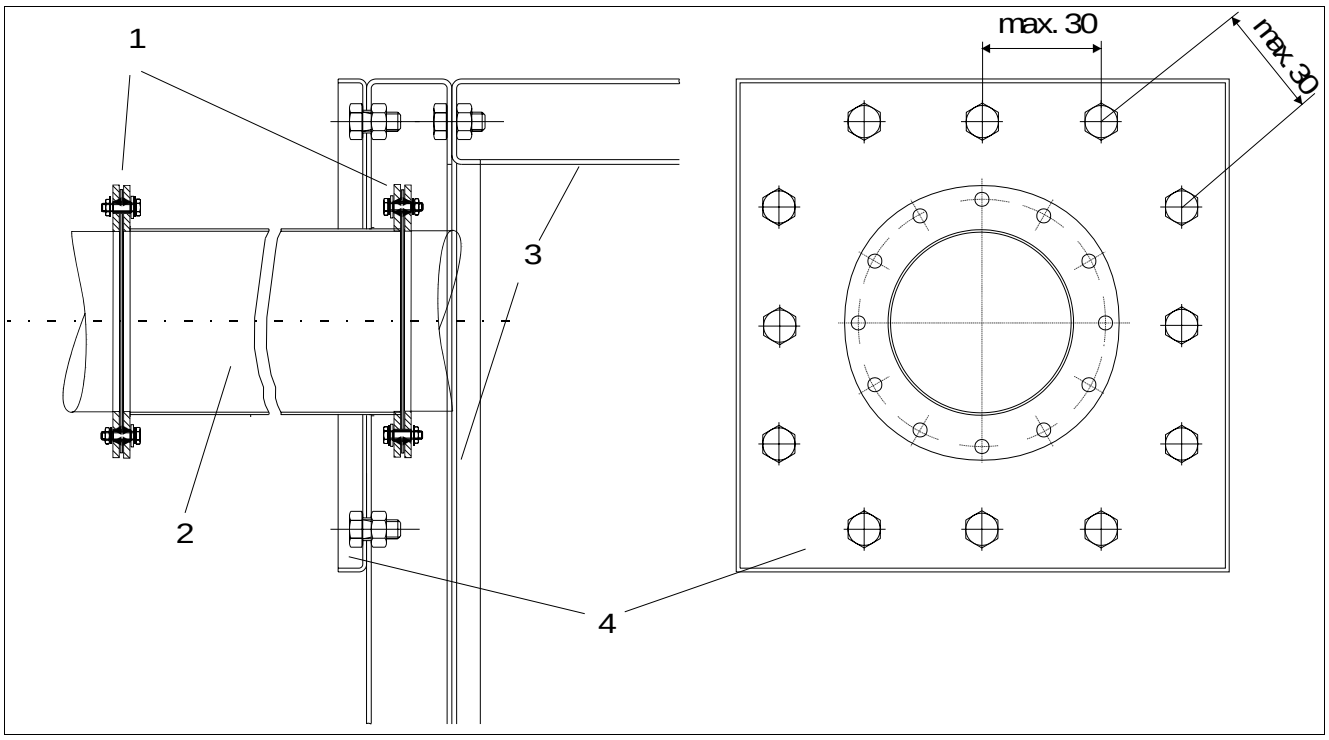


Fig. 4 Example: RF-sealed wave guide for quench tube.

1. Galvanic separation	
2. RF-feed through	
3. RF room	
4. Connection to RF room	

Galvanic separation

The galvanic separation has to be installed to guarantee an electrical separation of the magnet for the Quench vent and the RF room.

The parts to be used are included in the delivery volume of the magnet.

The sketch below (Fig. 5) shows the installation sequence for the galvanic separation.

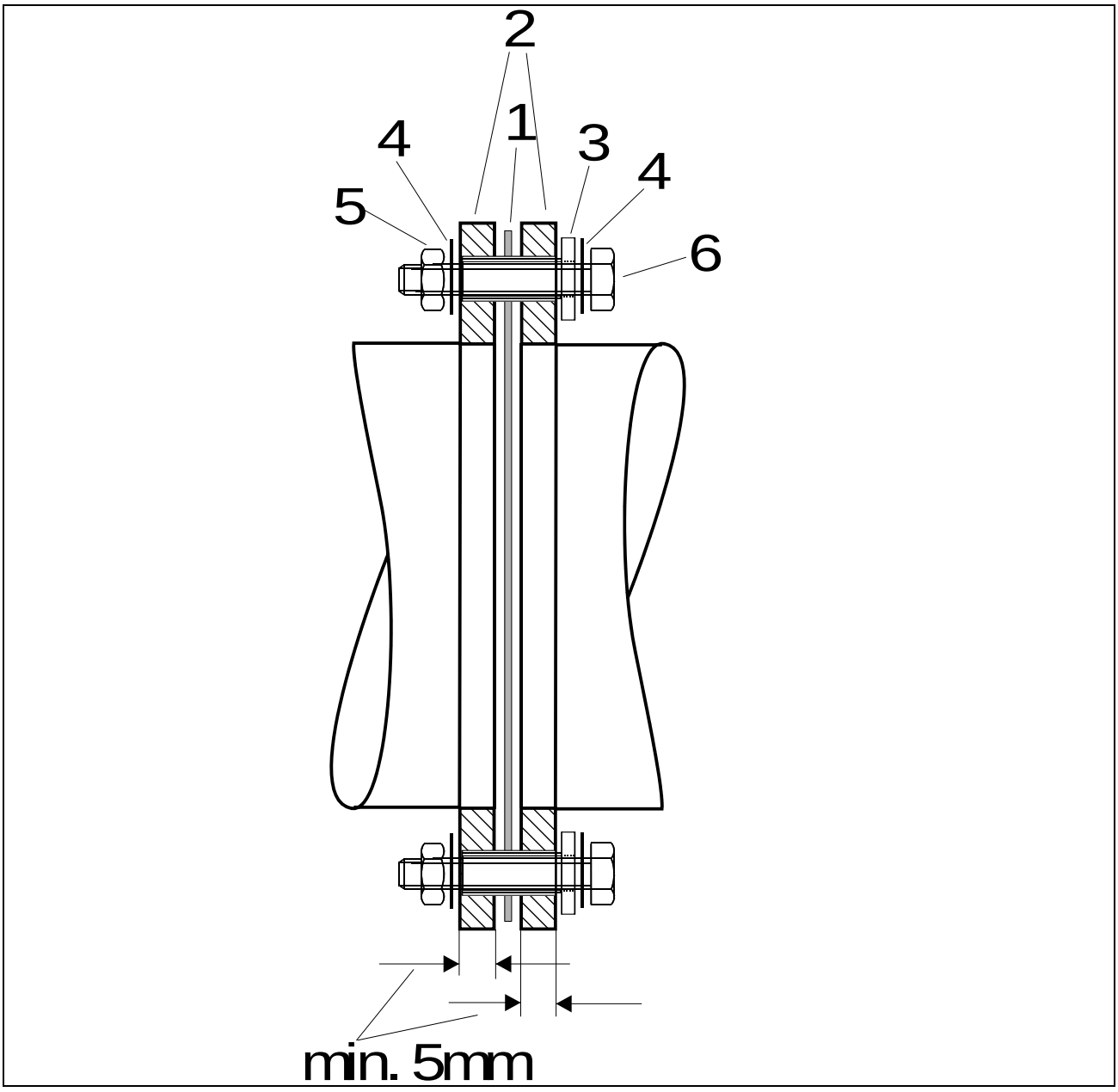


Fig. 5 Galvanic separation

1. Gasket	4. Stainless steel spring washer
2. Stainless steel flange	5. Stainless steel locking nut
3. UHWPE bushing	6. Stainless steel screw

RF-sealed wave guides e.g. for medical gases

All electrically non-conductive supply lines for

- oxygen, anesthetics or
- fiber optic cables, etc.

routed from the outside into the RF-room must be fed through electrically conductive pipes also known as RF-sealed wave guides. They must be either welded to the RF-shielding or attached to it with screws. The RF-sealed wave guide function is as hollow wave guide which is blocking certain frequencies.

Metal pipes (e.q. technical / medical gases, water...) must be grounded at the RF-wave guide.
All international / national RF-regulations and ordinances must be followed. A proper and disturbance free operation of the MAGNETOM system must be guaranteed.

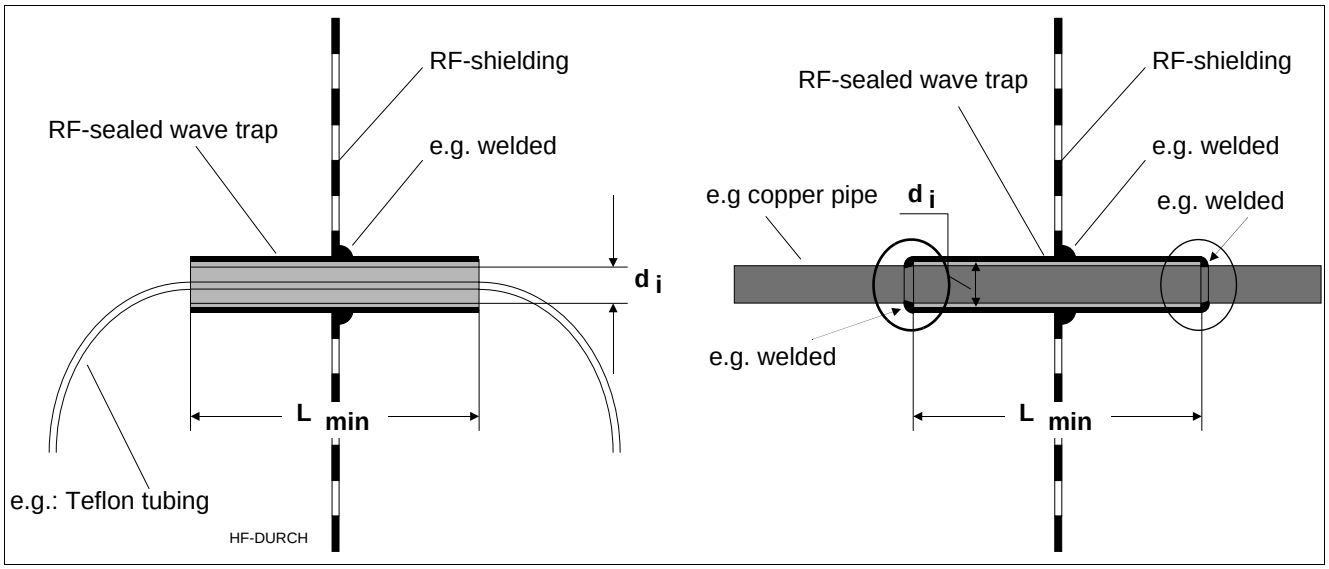


Fig. 6 Diagram of RF-sealed wave guide.

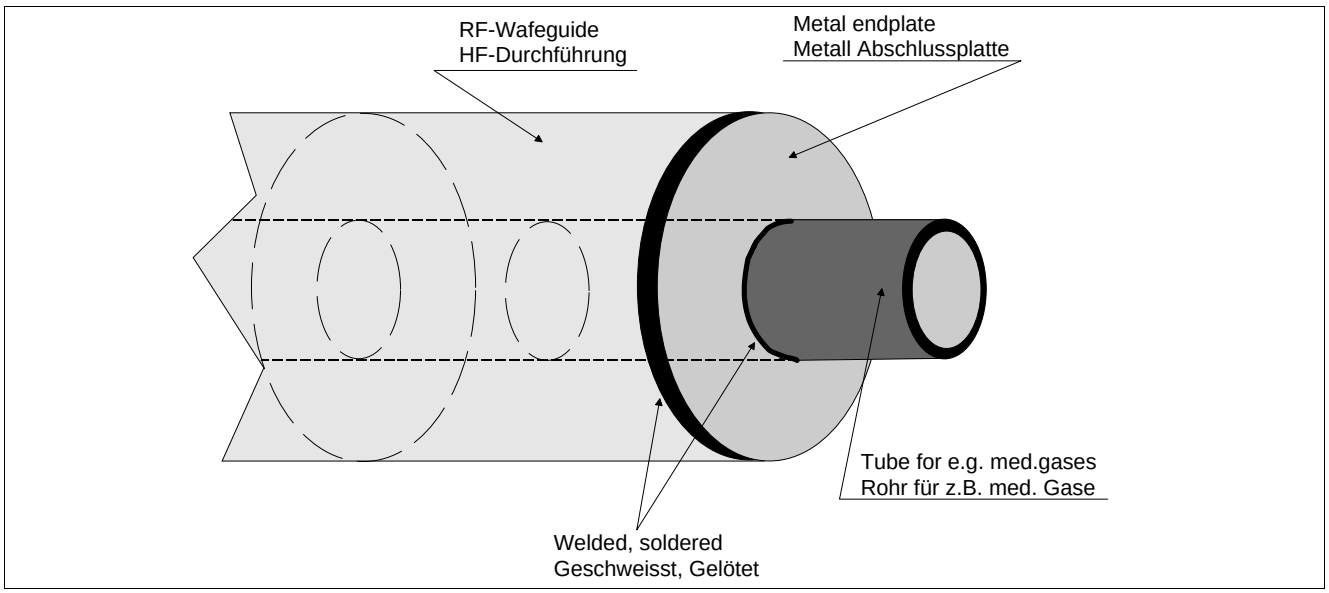


Fig. 7 Med. gases

RF-sealed wave guides for e.g. air conditioning

Honeycomb wave guides consist of a large number of small hollow wave guides. Depending on their dimensions, the honeycomb wave guides block certain frequencies. The honeycomb wave guides are used as RF-sealed feed-throughs for e.g. the air intake and exhaust ducts of the air conditioning unit. Refer to the data sheets of the manufacturer for additional details.

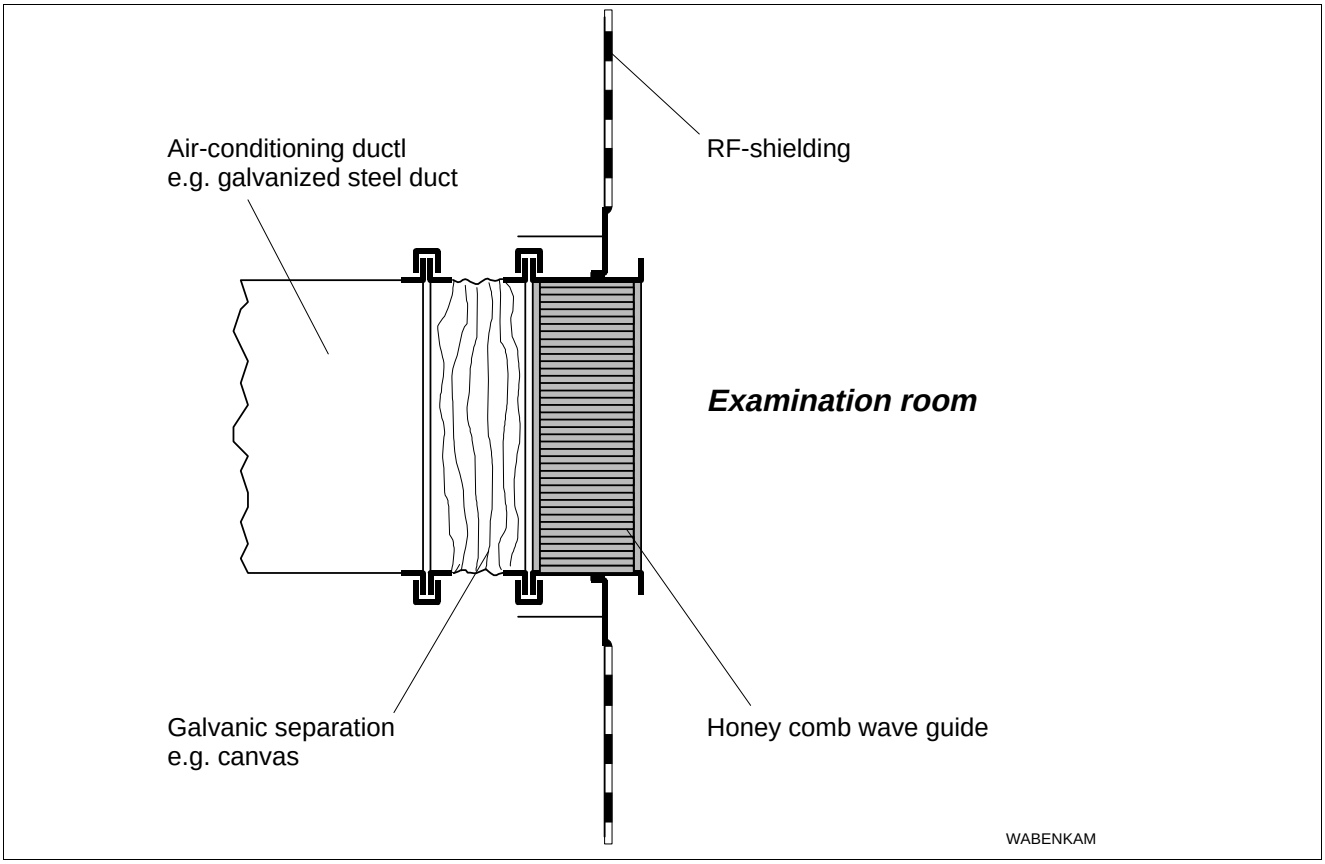


Fig. 8 Example: RF-sealed wave guides for air intake and exhaust ducts for the air conditioning unit.

NOTE

The air conditioning system for the examination room has to be a separate system with a direct air vent connection to the outside of the building.

Testing the RF-room for isolation from on-site ground

Definition

The RF-room is isolated from on-site ground, when the resistance between any of the points in the RF-room and the central protective conductor of the system is **greater than or equal to 100 Ohms**.

Measurement devices

Protective conductor meter.

Preferred method of measurement

- Construct the RF-room and measure the resistance between the RF-room and the central protective conductor of the system.
- Measure the resistance between the RF-room and the central protective conductor of the system each time an anchor has been set into the floor.
- After completion of the RF-room, the resistance between the RF-room and the central protective conductor of the system **must exceed 100 Ohms**.
- **The RF-room cannot be connected to the on-site ground.**
- Final measurements with the protective ground meter
  - Remove all protective conductor connections to the RF-room.
  - Measure the resistance between the RF-room and the on-site ground with the protective ground meter.

    ➪ **The resistance must be >100 Ohms.**

RF-room designs

NOTE

The opening direction of the RF-door has to be to the outside of the RF-room. As an alternative other appropriate means have to be provided in a way that pressure built up during a quench, when the venting fails to work adequately, will not prevent the RF door of the examination room from being opened.

An opening in the RF room (e.g flap in the door, honeycomb waveguide) of 600mm x 600mm *must* be installed if the RF door opens to the inside of the examination room! This is mandatory!

The opening of 600mm x 600mm is *recommended* even if the door opens to the outside.

RF-Room interior

NOTE

By using a suitable design as well as maintenance plan, the manufacturer of the cabin has to ensure that the following operate without fail: the door locking, especially the door handle and locking mechanism so as to secure continuous access to the patient in the examination room for emergency care and evacuation.

➪ **The following informations are important for a faultless operation of the imaging system!**

- Only non-magnetic materials are to be used and installed within the RF cabin.
- A suspended ceiling must be statically suspended, i.e., not suspended with movable clamps, springs, etc.
- Corrugated rods (e.g. for air conditioning systems) in suspended ceilings must be fastened securely (galvanic contact between the corrugated rods must be guaranteed, not just lying on top of one another; a wire jumper between the rods might be useful).
- Electrical wiring, e.g. for lights, must not be resting unsecured on the suspended ceiling.

NOTE

If you expect noise problems the RF-Room manufacturer you are using might be able to deliver noise reduction components with the RF-room(e.g. interior; RF-window; RF-door etc.).

NOTE

Adhere to the manufacturers guidelines, specifications and/or installation manuals.

Be aware to add the weight of the RF-Room and / or external iron shielding and / or noise reduction material into your static calculations!

NOTE

Special devices like medical gases feed through or RF-filters for e.g. room lights could be possibly ordered from your RF-cabin supplier/manufacturer.

Modular RF-rooms

The shell of the examination room must have been completed prior to assembling and installing the RF-room. The wall openings for e.g. RF-room door, view window, air intake and exhaust ducts, etc.have been made.

The modular RF-room consists of individual sections (modules) made from non-magnetizable material.

- No special structural requirements are needed for the ceiling and the walls.
- If sections of the completed modular RF-room have to be disassembled for installation-related reasons, new contact springs have to be used when re-assembling the sections.
- The modules have to be disassembled in groups from the floor to the ceiling or up to the respective corner of the RF-room. The same applies to the ceiling panels.

RF room construction (Example)

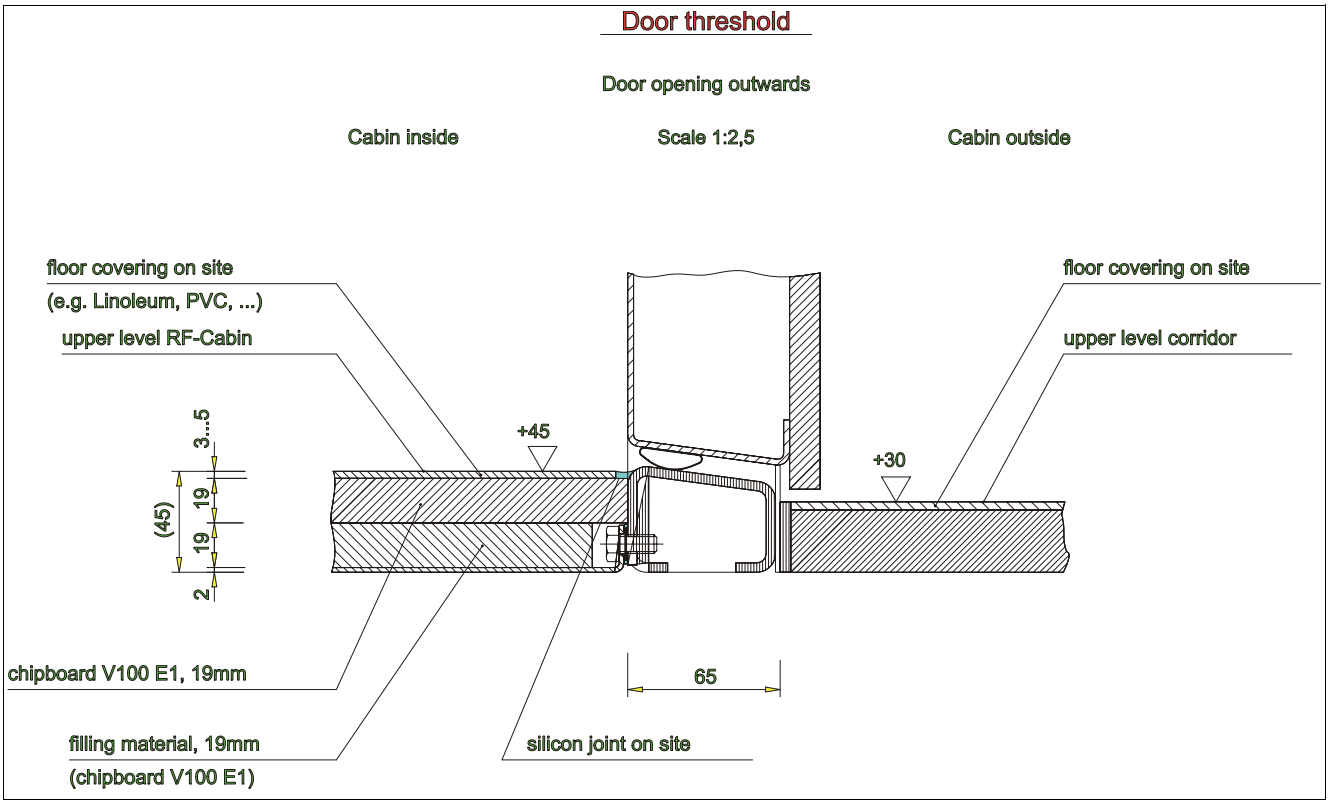


Fig. 9 door OUT

RF room floor construction (Example)

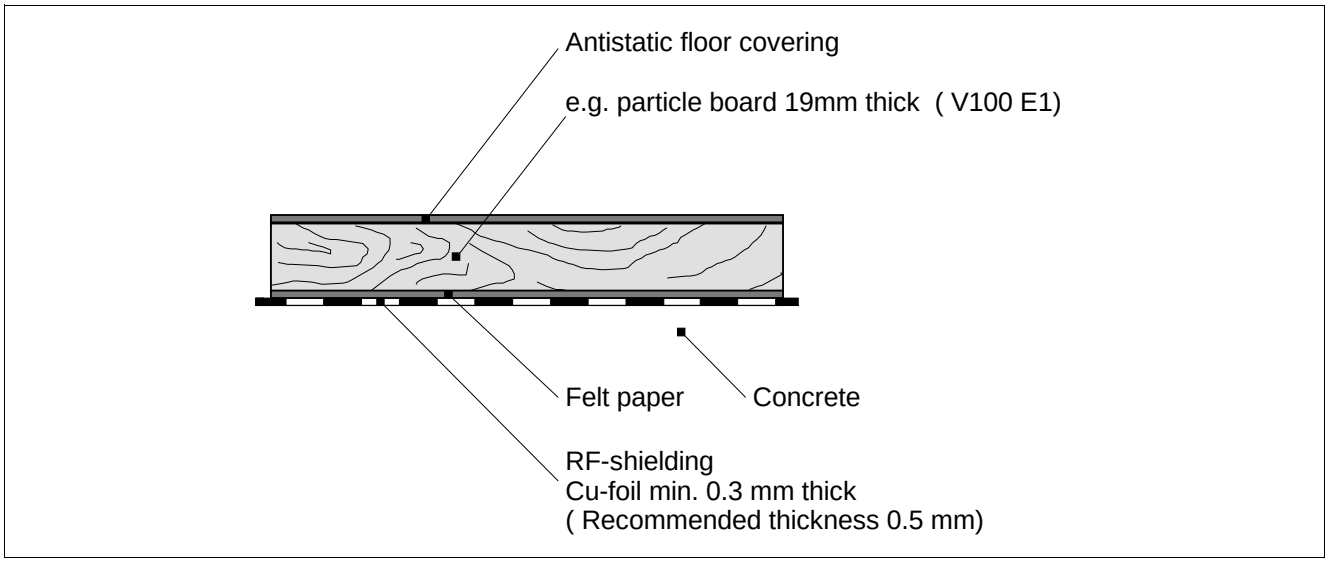


Fig. 10 Example: Floor construction for a copper-clad examination room (RF-room).

NOTE	**The floor in the vicinity of the magnet (2.2m x 4.5m) must be leveled within maximum +/- 2.0mm**

NOTE	**Use antistatic floor covering in any case!** **If particle board is used/installed make sure to reach the specifications of V100 E1(density 620...800 kg/m^3; DIN 52361).**

NOTE	**Additional information regarding the shielding for modular RF-rooms may be obtained from the manufacturer.**

List of RF-room manufacturers

RF foom manufacturers	
Siemens AG Medical Solutions Department MRL A2 Allee am Röthelheimpark 2 91052 Erlangen phone: +49 (0) 9131/84-7747 fax: +49 (0) 9131/84-3910	**Albatross Projects GmbH** Daimlerstrasse 17 89564 Nattheim / Germany phone: +49 (0) 7321 / 730-543 fax.: +49 (0) 7321 / 730-590 http://www.albatross-projects.de
Lindgren-Rayproof Ltd (Europe) Boulten Road, Pin Green Industrial Aerea Stevenage, Hertfordshire SG1 4th England phone:+44 1438-730-700 fax:+44 1438-730-750 www.lindgren-rayproof.com	**Lindgren RF Enclosures, Inc. (Rest of World)** 400 High Grove Blvd. Glendale Heights IL 60139 U.S.A. phone: +1 630-307-7200 fax: +1 630-307-7571 www.lindgrenrf.com
IMEDCO AG Medical RF and Magnetic Shielding Specialists Industriestrasse West 14 CH 4614 Hägendorf Switzerland phone.: +41 62-20940-20 fax.: +41 62-20940-29 e-mail: imedco@imedco.ch http://www.imedco.ch oder http://www.imedco-shielding.com	**MR-Schutztechnik** Kabinenbaugesellschaft MBH Dammweg 13 D 64807 Dieburg phone: +49 (0) 6071 985710 fax: +49 (0) 6071 985711 e-mail: mr-schutztechnik@t-online.de http://www.mr-schutztechnik.de
Schwarz GmbH& Co. KG HF- Abschirmtechnik Löhestrasse 49 D 53773 Hennef phone: +49 (0) 2242 96978-0 fax: +49 (0) 2242 96978-79 e-mail: schwarz@schwarz-elektroanlagen.de	

➪ Upon request some of the RF-room manufacturers will install the quench tube, air conditioning and the interior of the RF-room. A fringe field measurement and RF measurements after the complete installation can be ordered at some of the RF-room manufacturers as well.

NOTE

The RF room manufacturers ensure compliance with the specifications, e.g. 90 dB attenuation from 15 to 128 MHz of the installed RF-shielding (depending on the system operating frequency). The RF shielding will be tested by the manufacturer of the RF-room using special measurement devices after the RF room is installed. The test will be confirmed via a protocol which has to be filed in the customers logbook.

Wall opening for the RF-filter plate

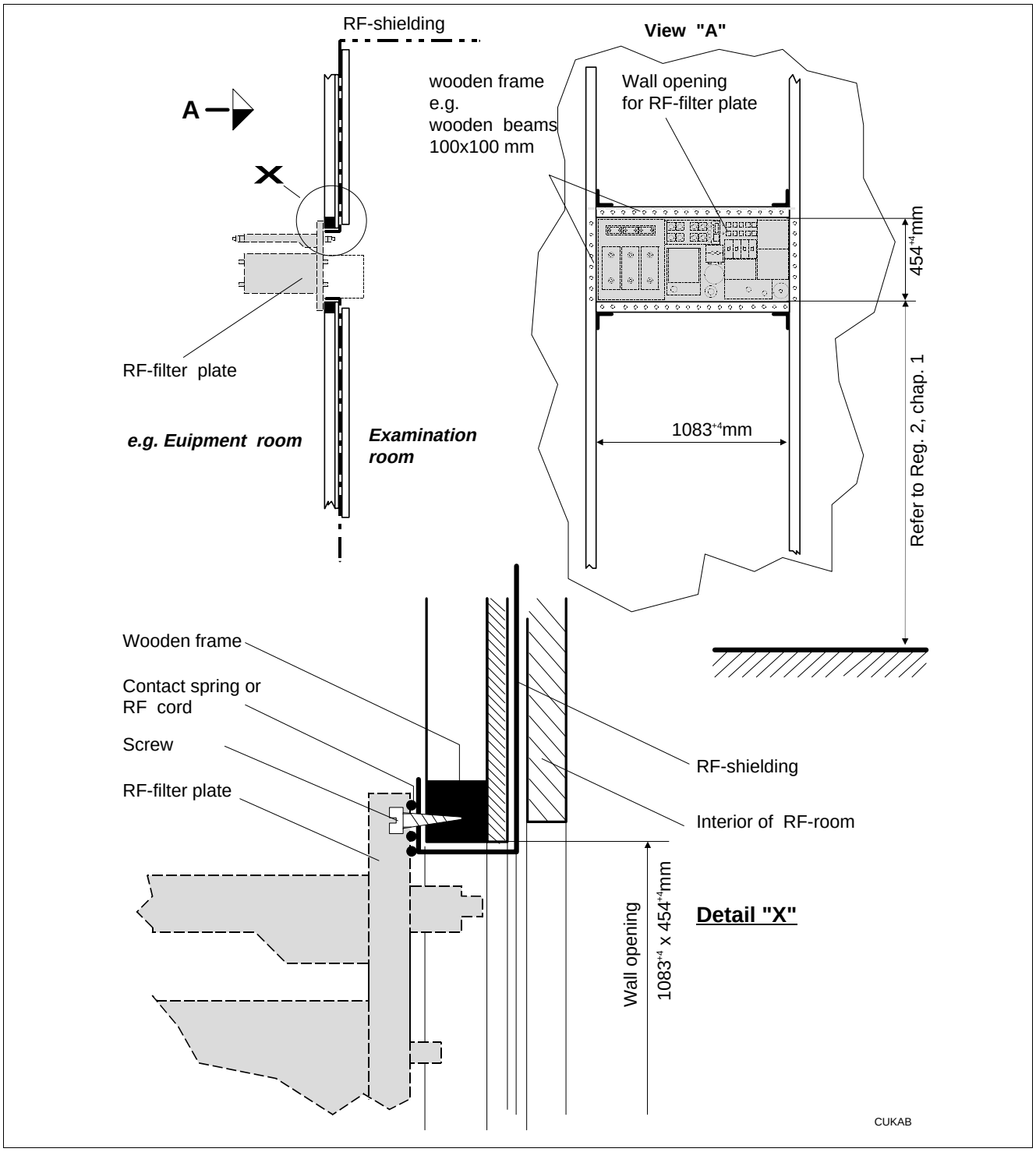


Fig. 11 Size of wall opening for the RF-filter plate.

Cutout in the RF shielding for the filter plate

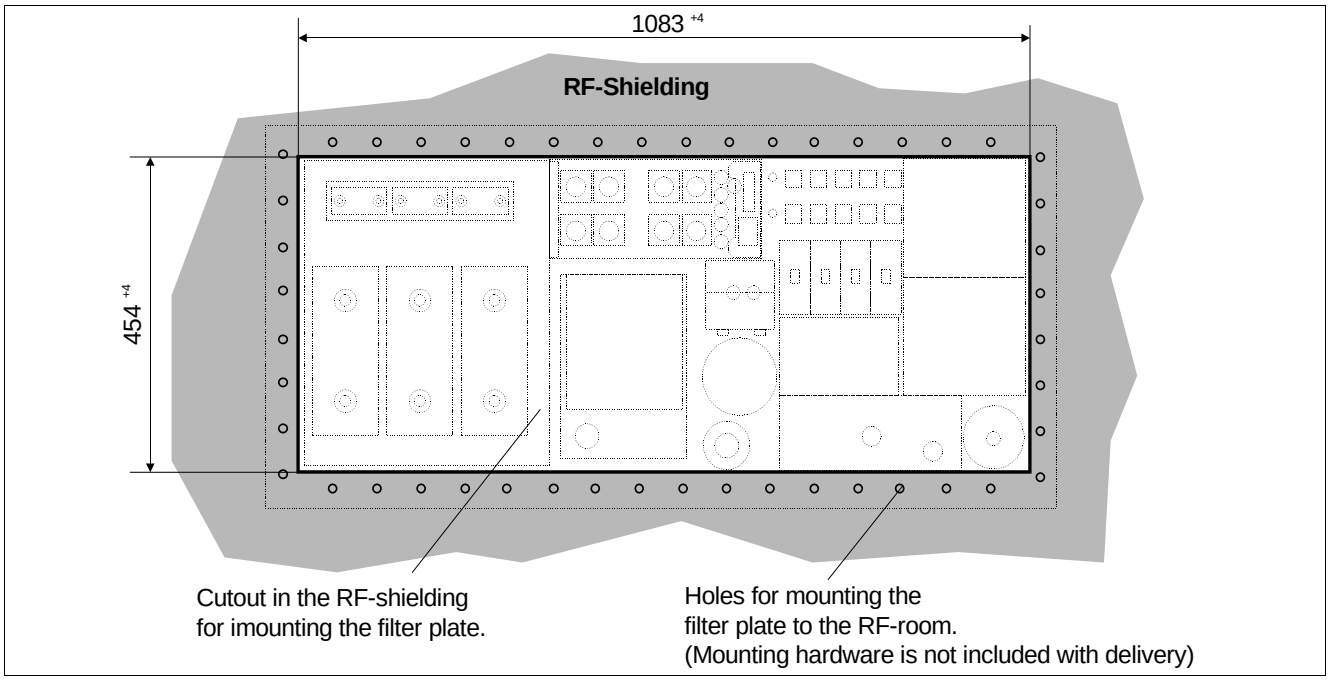


Fig. 12 Cutout in the RF shielding for the filter plate

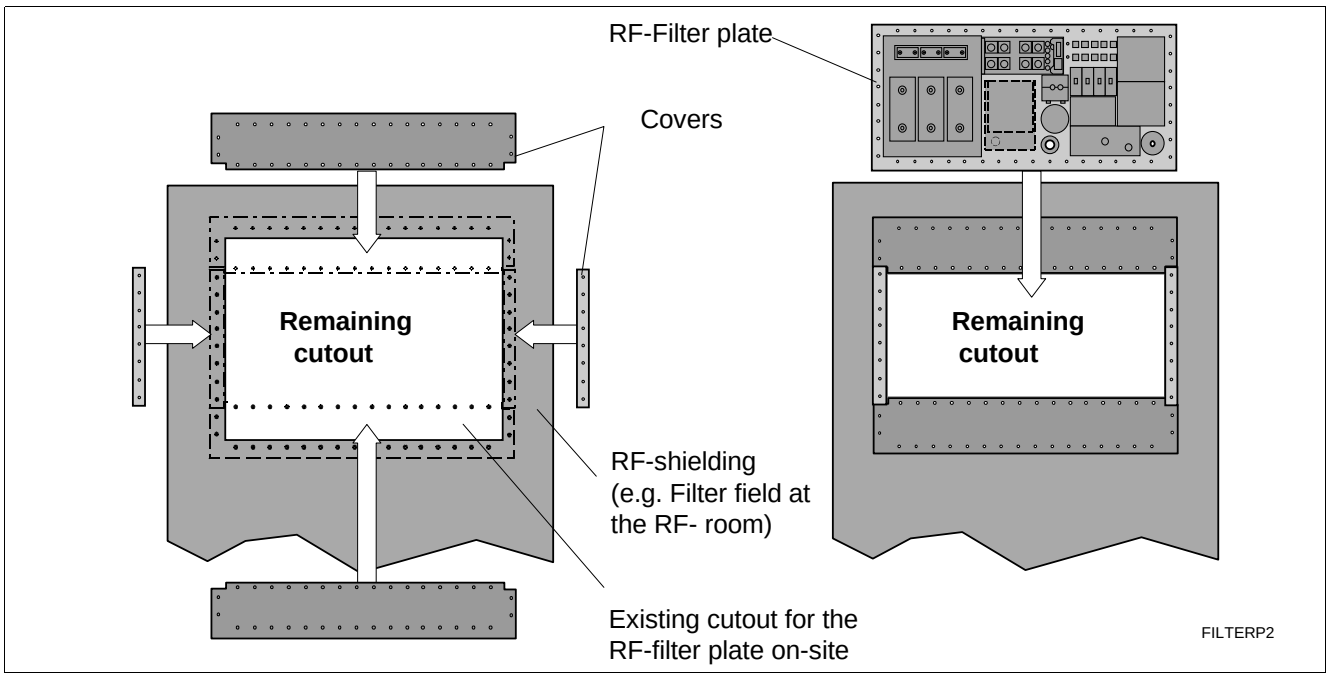


Fig. 13 Cutout in the RF shielding for the filter plate on upgrade systems.

NOTE

There is an adapter kit available for mounting the Harmony/Symphony/Sonata filterplate into already existing RF-cabins in which SIEMENS MR systems like GBS 1+2, SP, Vision and Impact systems used to be installed. The part number is: 564 1316.

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MAGNETOM Trio cabling

Maximum cable length

NOTE	The total cable length must not exceed 20.0m (outside RF-cabin + inside RF-cabin) due to the RF performance.

Available cable sets

NOTE	The required cable set (cable length) inside the equipment room is determined by the additional 35 kWA RFPA.

Cable sets (cable length in m / ft.)		
Set No.	**outside RF-cabin**	**inside RF-cabin**
1	1.5m / 4.92ft	7.0m / 22.96ft
2	13.0m / 42.65ft	7.0m / 22.96ft
3	10.0m / 32.80ft	7.0m / 22.96ft
4	1.5m / 4.92ft	10.0m / 32.80ft
5	10.0m / 32.08ft	10.0m / 32.08ft

NOTE	An additional cable set 5m/15m (outside/intside of the RF cabin) is available. Refer to the PM for ordering informations.

NOTE	The gradient cables inside the RF-cabin are 2m shorter then the other system cables: Cable set length is 7.0m, the gradient cable length is 5.0m. Cable set length is 10.0m, the gradient cable length is 8.0m.

NOTE

The cable set length identifies the "free cable length", this means from connection point to connection point! The cable length is not the distance between the components! You have to conciderate the cable feeding!

Again, one important information is:

The gradient cables inside the RF-cabin are 2m shorter then the other system cables:
This means for example:
If you have ordered cable set Nr. 1 (1.5/7m) the configuration could be as follows:
Outside the RF-cabine:
The electronics cabinet is positioned underneath the RF-filter plate attached to the RF-cabine wall.

Inside the RF-cabine:
The gradient cables are 5m (the rest of the cables is 7m). The gradient cables have to go from the filter plate 1.5m up into the ceiling and at the magnet side 1.5m down; this means the distance of the filter plate to the magnet is app. 2m!

MAGNETOM Trio cable set (example)

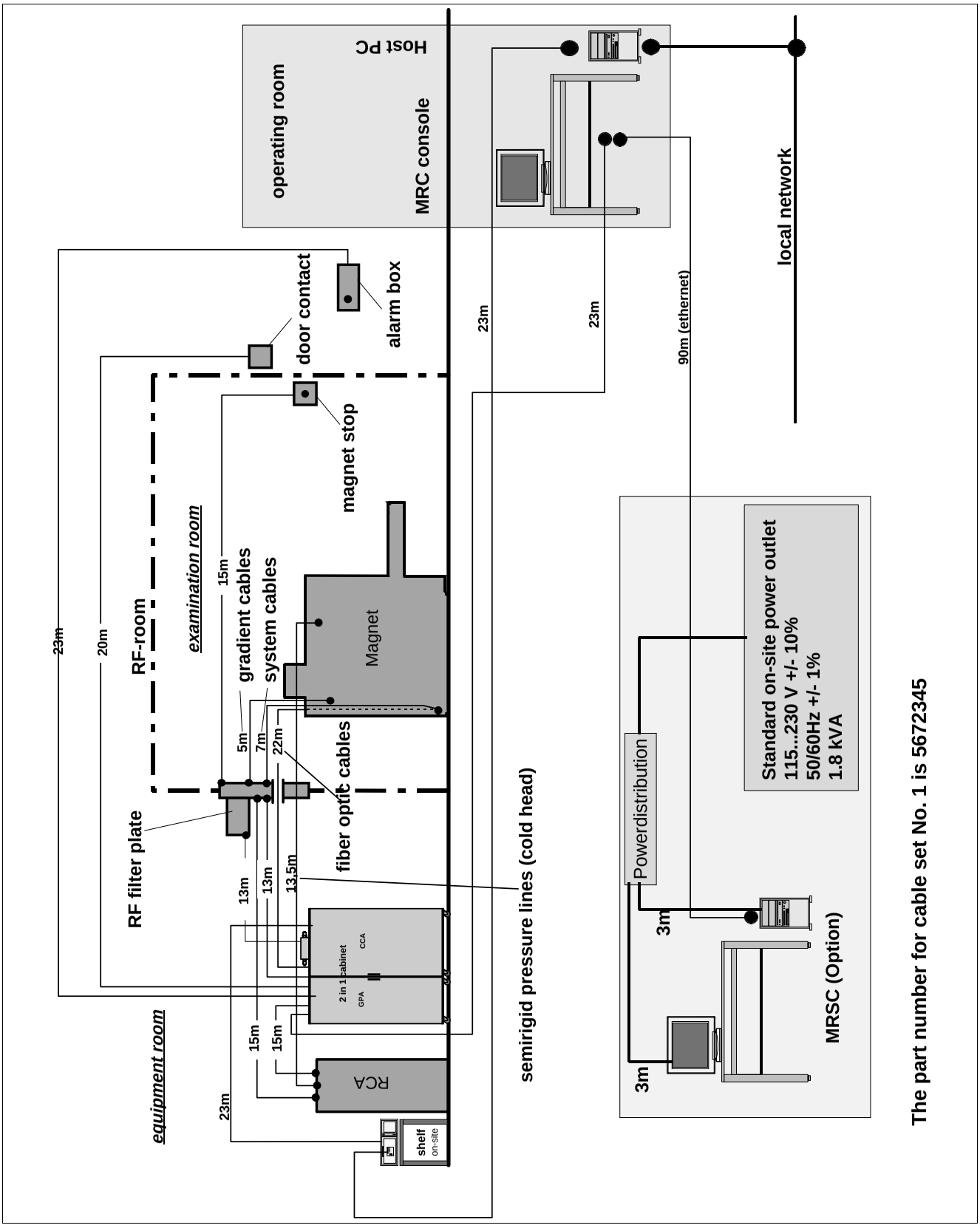

Fig. 1 Free cable length.

MRC Host PC and Imager PC environment

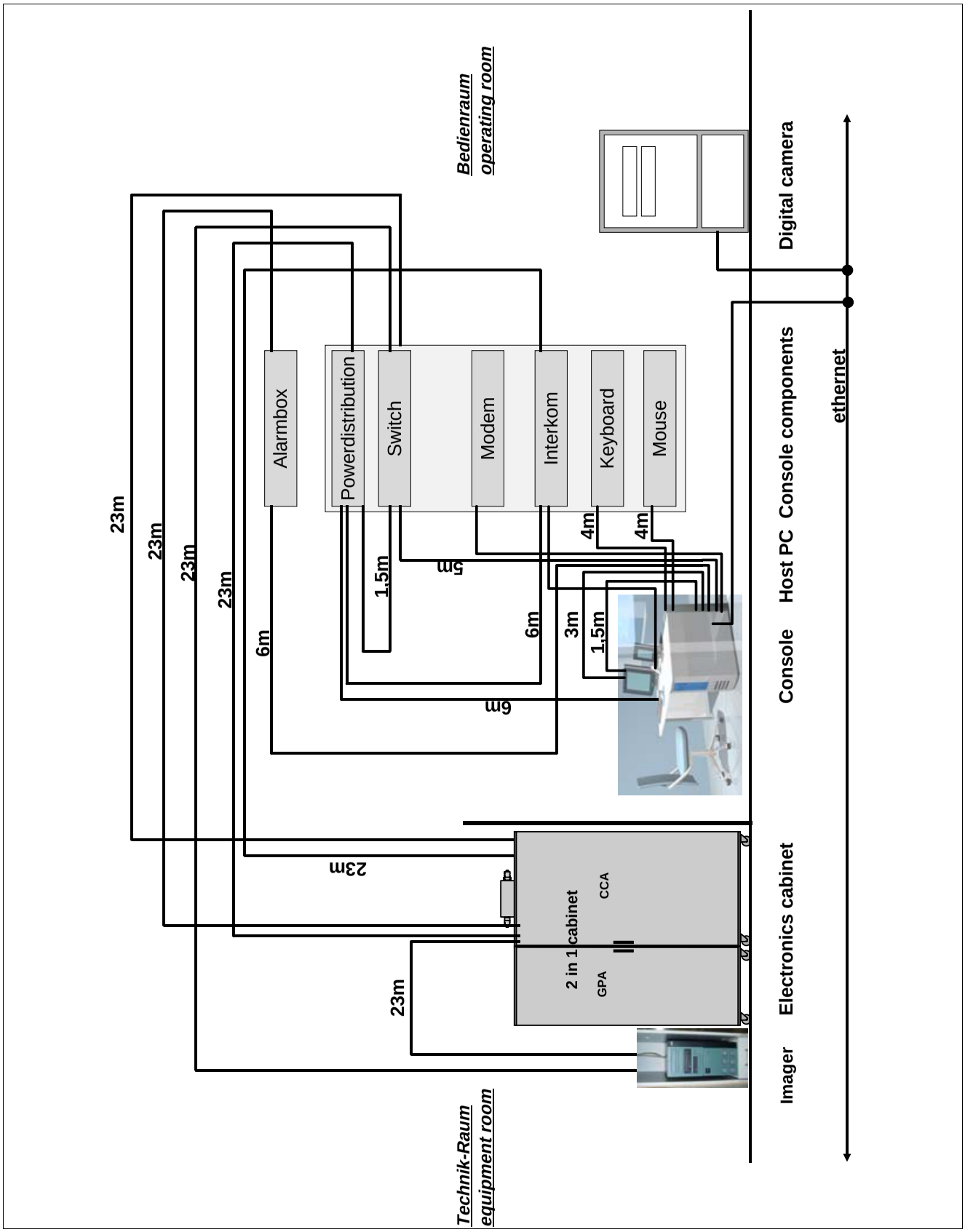

Fig. 2 Free cable length.

RFPA, Shim power supply, Shimtray heating system

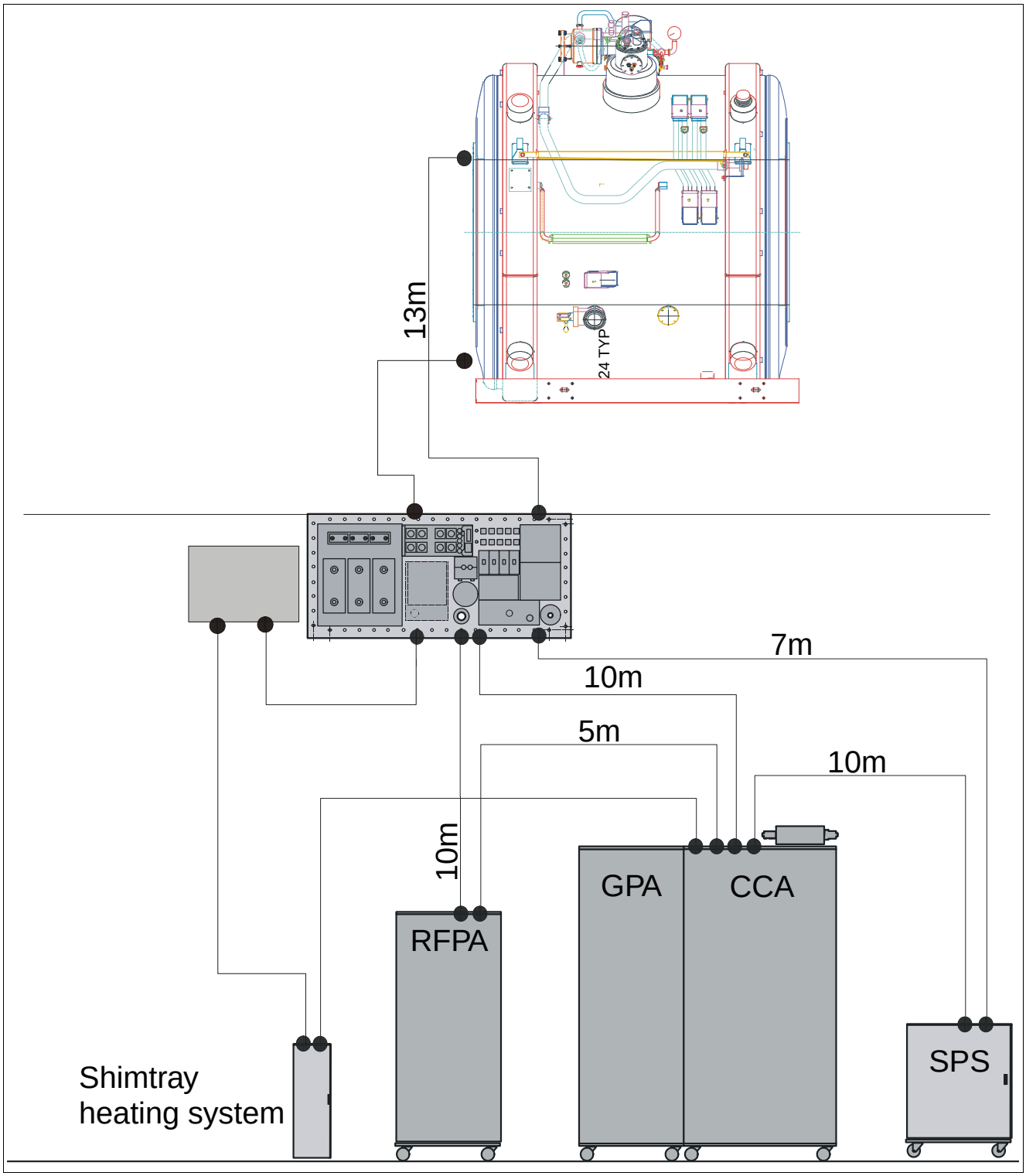

Fig. 3 Free cable length.

NOTE

The required cable set (cable length) inside the equipment room is determined by the additional 35 kWA RFPA.

MRSC Host PC and Imager PC environment

NOTE	**If the control room is used as a patient preparation room and the MRSC is located inside this room a patient or other persons which are not members of the operators team must not be able to reach the MRSC console within 1.5m for safety reasons.**

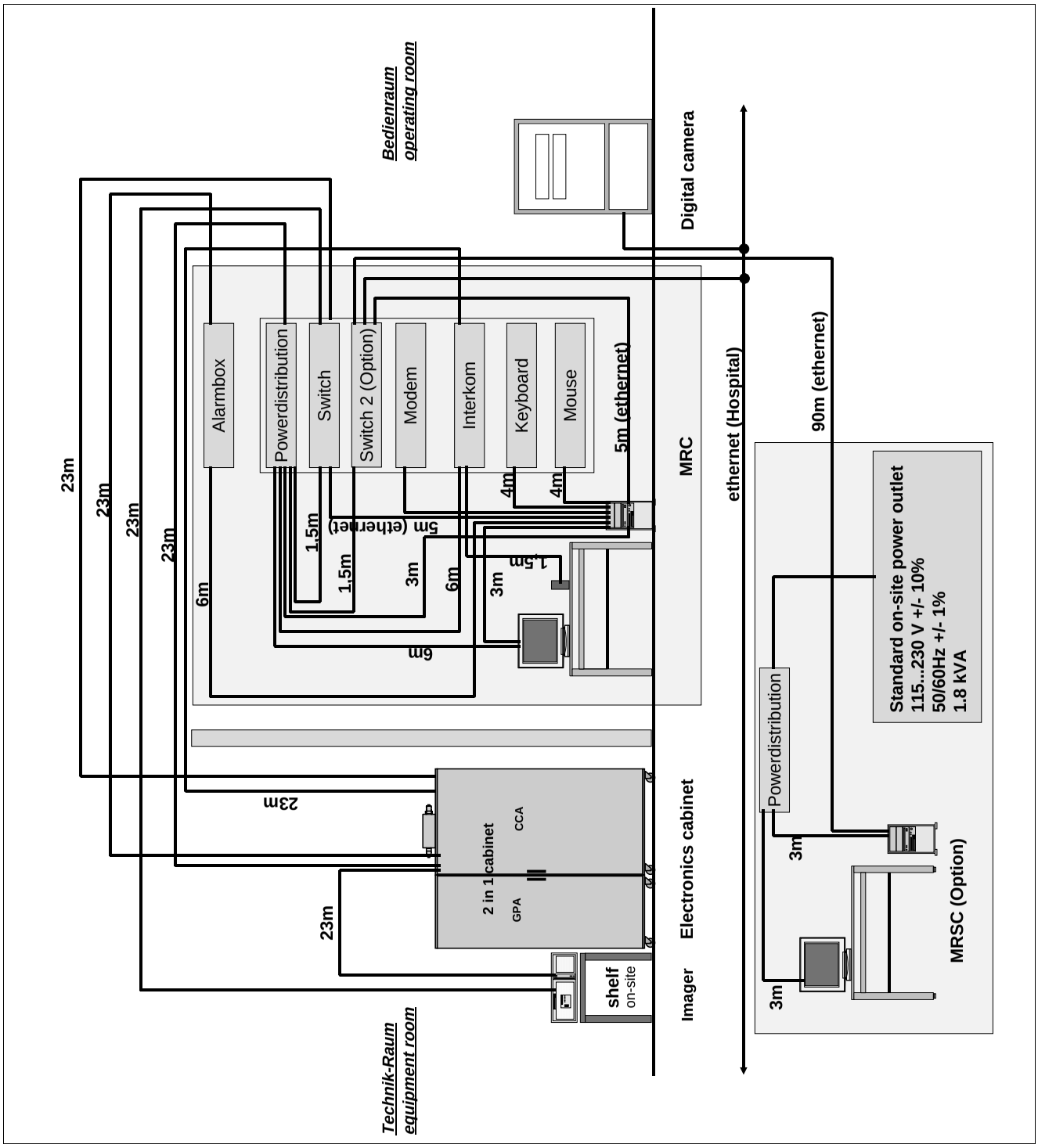

Fig. 4 The distance between the components depends on the free cable length.

Connectivity Concept

NOTE	It is absolutely necessary to prepare for the remote diagnostic connection prior the installation starts.

NOTE	Refer to the SRS Planning Guide to be found under the following URL: http://cs.med.siemens.de/For Service/Planning/General/Planning Guide Siemens Remote Services (TDIT-000.891.01.xx.02)

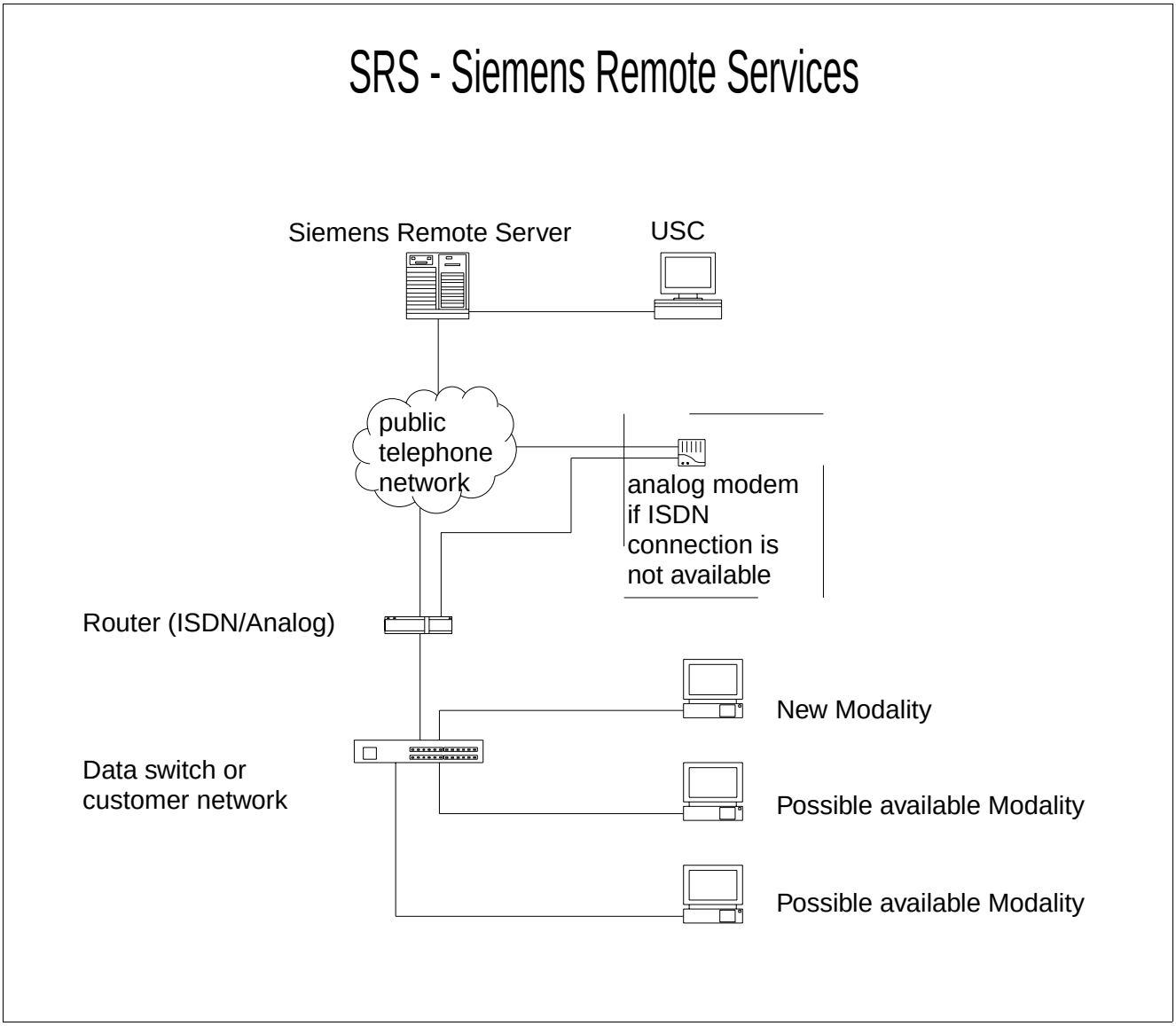

Fig. 5

Explanation of the diagram:

It is necessary to have a router that can be left with the customer at no extra charge during the warranty period and beyond with a service agreement. The router remains the property of Siemens AG.

- ➪ Router shall be installed in a central location (e.g. hospital computer room to avoid physical access to the router for security reasons)
- ➪ Router can be connected to either the ISDN or analog connection.

Remote diagnostics and "Pro-active Event Management" require remote LAN access to our systems. A router is required for this which we provide to our customers at no charge during the warranty period and beyond that period if a service contract is concluded.

The router remains the property of Siemens AG. The required telephone connection (preferably ISDN) and the power supply must be provided on site. Even if several Siemens systems are connected to the same data net, only a single central router is required.

Of course, we observe the confidentiality of patient data in the framework of remote diagnostics and have provided security against access to it. Further information on the topic of data security can be found in the system-specific publications.

NOTE	**For detailed information about SIEMENS Remote Services (SRS), see PG TDIT-000.891.01... (http://cs.med.siemens.de/Planning/General/Planning Guide Siemens Remote Services (TDIT-000.891.01.xx.02)**

Network

The image system is equipped with a network card for Fast Ethernet (100 BaseT).

Cable routing

NOTE	**The proper routing of the cables is absolutely important to achieve good image quality!**

The total cable length consists of the cable length required between the components.

The free cable length is the length between the exit points for the cables at the components.

NOTE	**When planning the final location of the system components, do not exceed the maximum distance which is determined by the cable length. Take in consideration the required additional length for routing the cables e.g. through a cable tray at the ceiling.**

NOTE	**Adjust the openings (wall, ceiling) to the size of the cable connectors**

Bending radius for cables

Observe the following minimum bending radius R_B
for the cables listed below:

- Gradient cable $R_B \geq$ ***135 mm (only with set of extended cables)***
- Transmitter cable $R_B \geq$ ***120 mm***, when bent once
- Transmitter cable $R_B \geq$ ***360 mm***, when bent several times
- Fiber optic cable $R_B \geq$ ***150 mm***
- Fiber optic cable for the patient supervision $R_B \geq$ ***45mm.***

Door switches at the RF-room

NOTE	**All doors of the RF-room must be equipped with a door switch.** **(In the case of several doors, the switches must be connected in series.)**

Cable routing

- The cables are routed via cable trays or ducts.
  Install the cable tray to achieve the distance of 300mm between the cable types (See table below).
- In general, the cables are routed from the top of the cabinet. The cables can be routed to the top part of the cabinet in cable ducts.
- The minimum bending radius for gradient cables, RF-cables and fiber optic cables must be achieved.

	Cable separation			
		Gradient cables	**RF transmit cables RF receive cables**	**Fibre optic cables Power cables Signal cables**
1	**Gradient cables**	-	300mm	300mm
2	**RF transmit and receive cables**	300mm	-	300mm
3	**Fibre optic cables Power cables Signal cables**	300mm	300mm	-
4	**Water hoses pressure hoses**	300mm	-	-

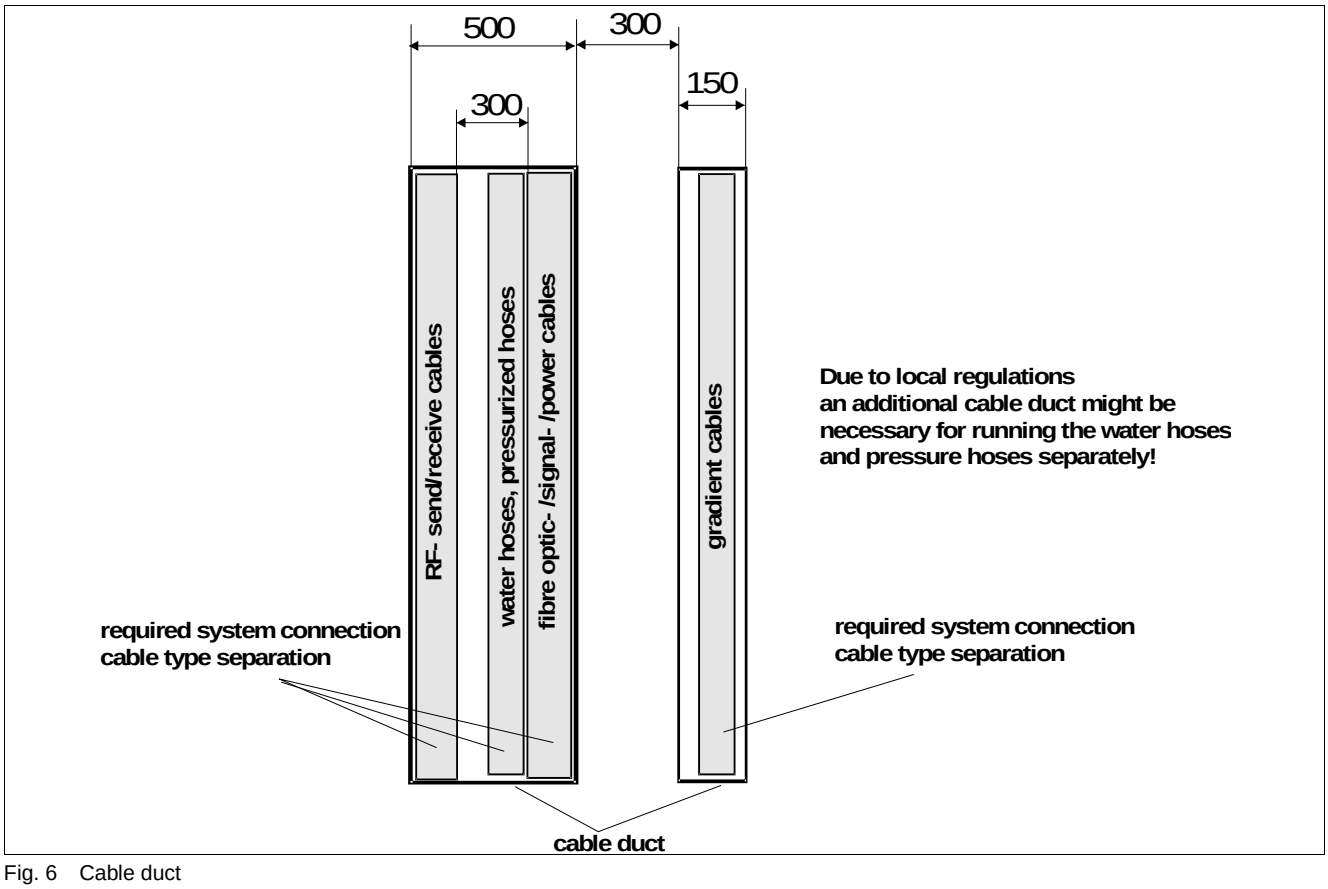

Fig. 6 Cable duct

NOTE

Separate the three different cable types from each other (See table on next page).

The cable duct must not be installed across the magnet area (false ceiling).

Feed the cable ducts to the magnet in a way that the ducts are not crossing the magnet!

If necessary install additional cable trays!

DO NOT COMBINE ALL CABLES TOGETHER!

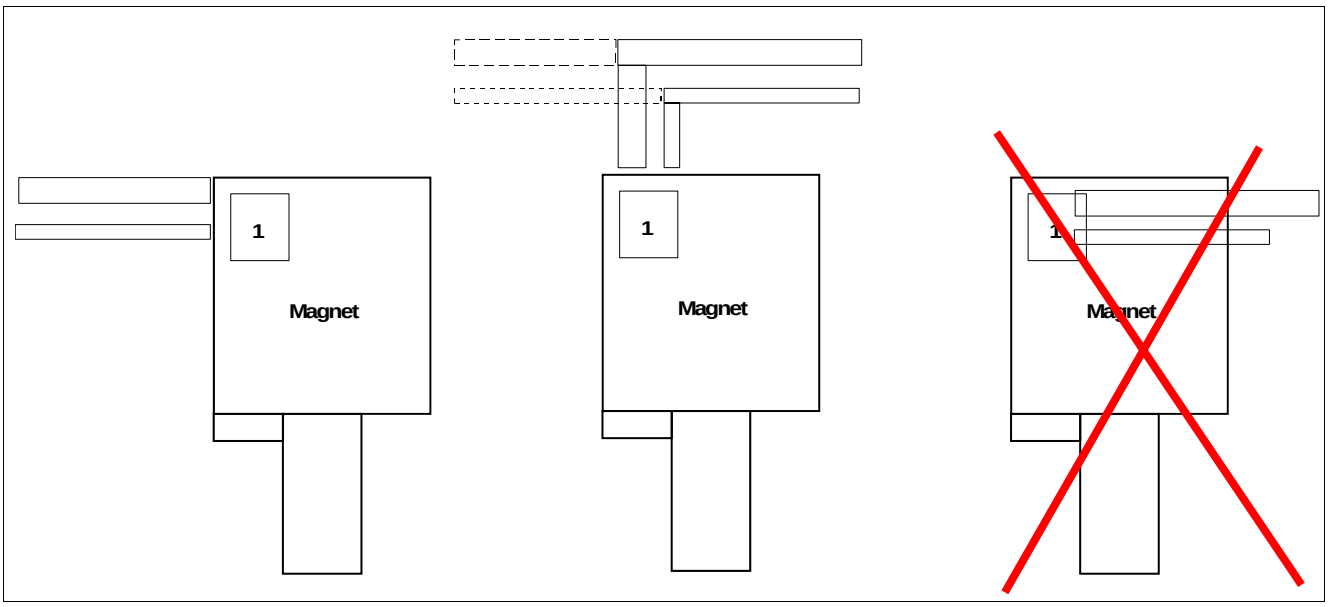

Fig. 7 Duct

[1] Cable feed to the magnet

NOTE

The left over cable length must not be rolled in loops at all.

Use a meandering technique for the left over cable length.

Never store left over cable length at the magnet!

1. Cable feed to the magnet

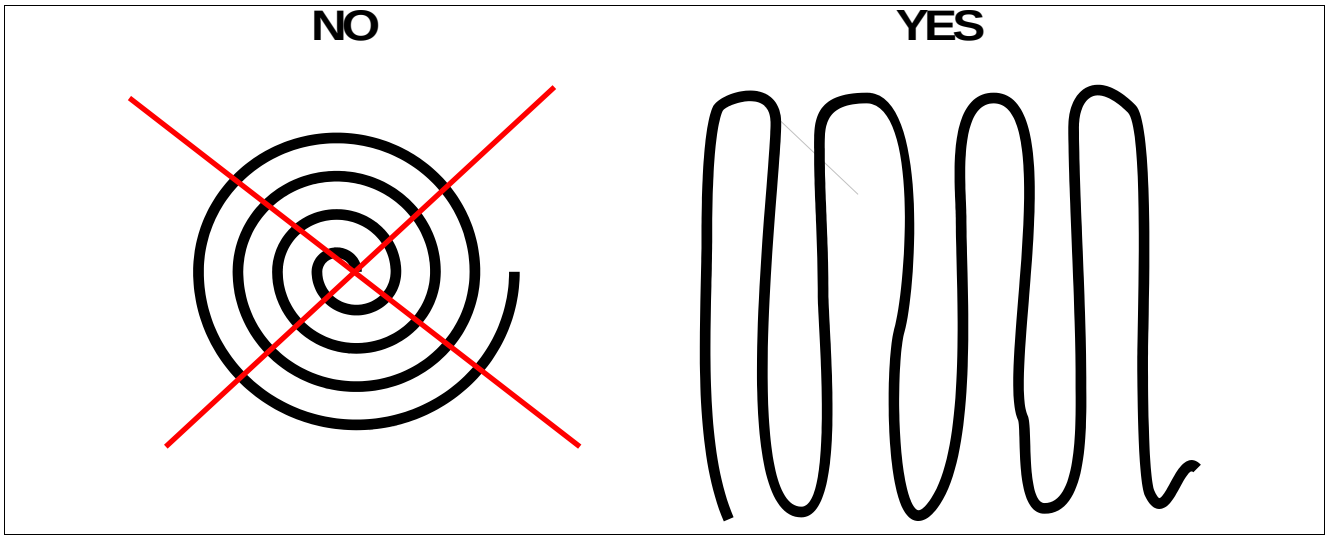

Fig. 8 NO LOOPS

Free length for water hoses and He pressurized hoses

Water hoses

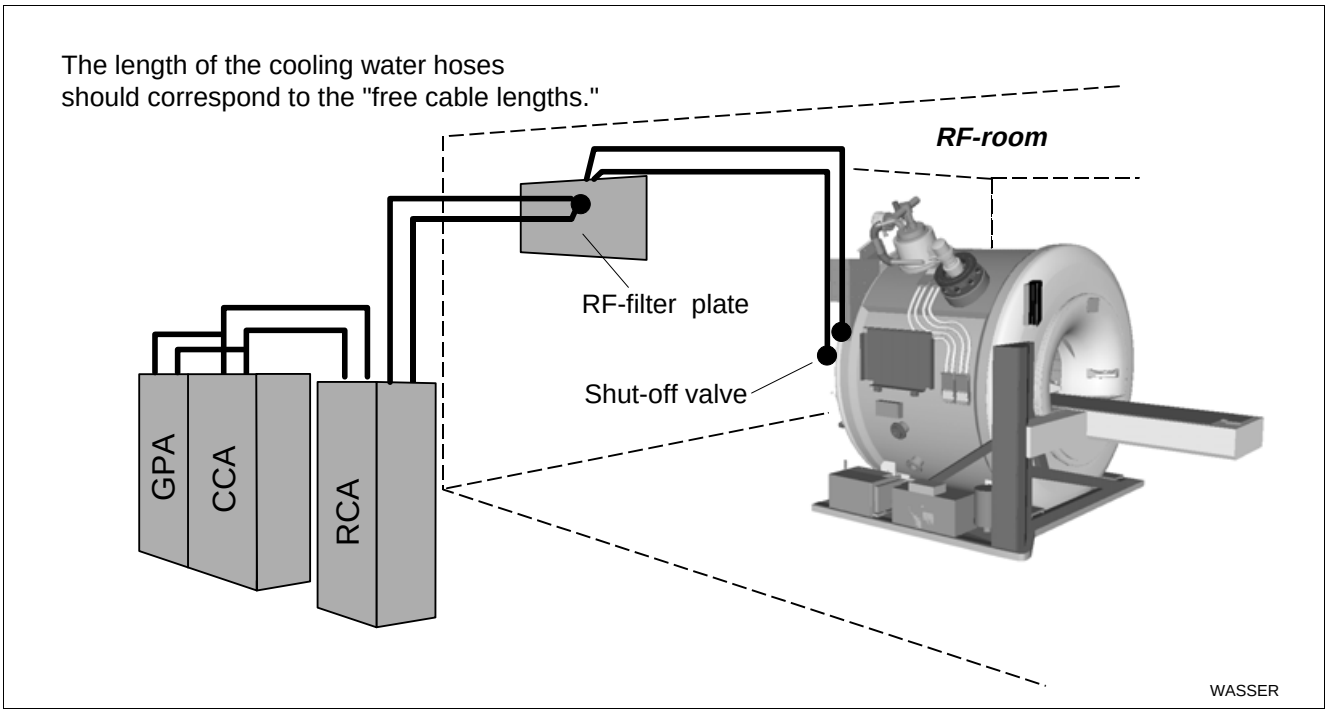

Fig. 9 Chilled water tubing between the components.

NOTE	**The delivered water hoses are already equiped with a connection flange installed at one side. The required hose length must be cutted on-site. The second connection flange has to be installed on-site too !**

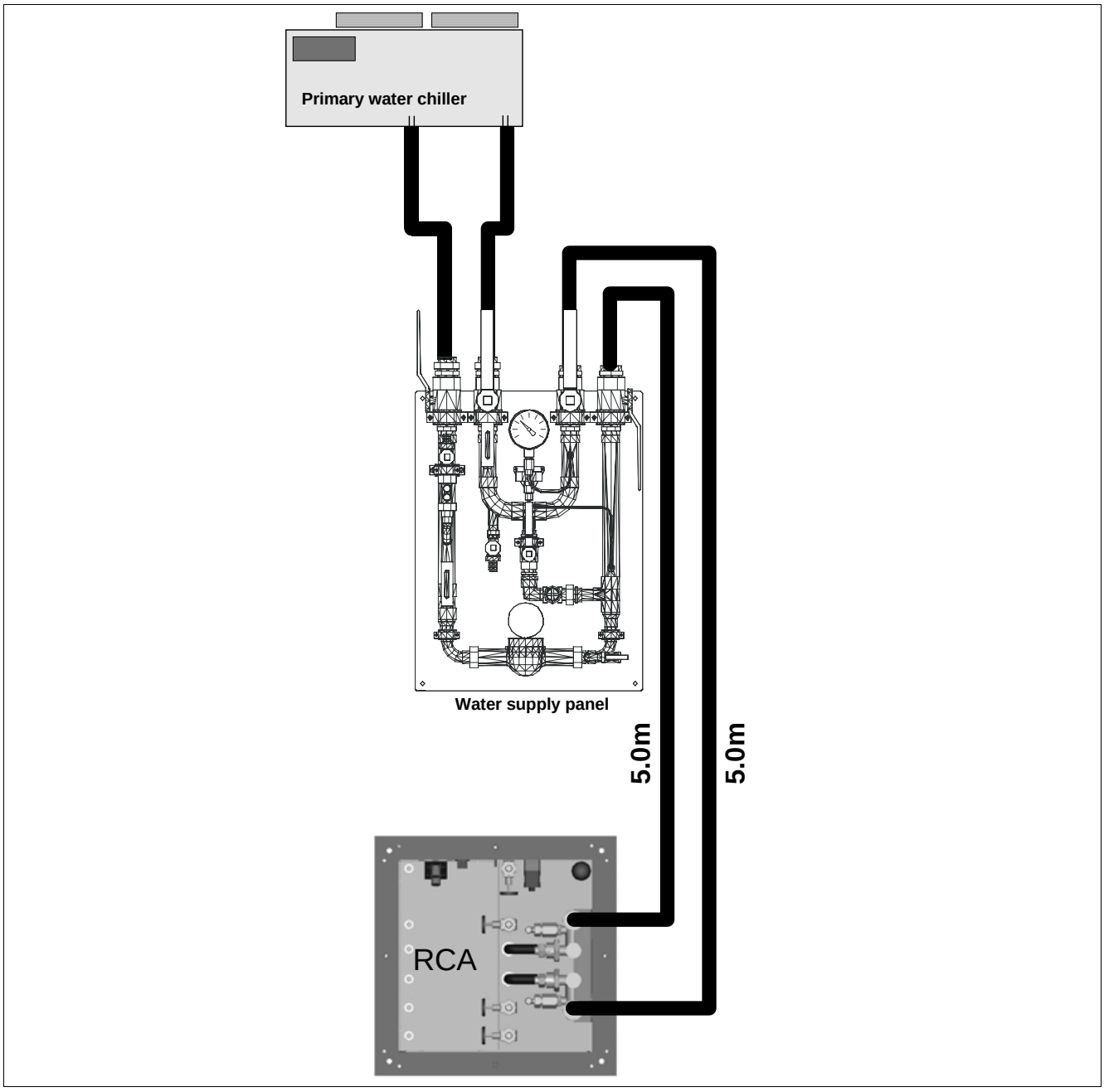

Fig. 10 primary water connection

NOTE	**The delivered primary water hoses (forward / return) are 5.0m long.**

Pressurized hoses (APD Cold head)

SC-10/SC-10L Shield Cooler System

Function

The SC-10 or SC-10L Shield Cooler is a two-stage refrigeration system that conductive cools the warm (77 K) and cold (20 K) radiation shields of the MRI Cryostat, maintaining the shields at cryogenic temperatures and reducing the loss of liquid helium.

The SC-10 Shield Cooler mates with the cryostat interface flange and shields provided by the magnet manufacturer.

The system consists of a helium compressor (either HC-10 or HC-10L), interconnecting gas lines, cables and the shield cooler. The helium compressor uses high purity helium gas for its refrigerant. There is no co-mixing of the helium refrigerant with the helium in the cryostat. The equipment is designed for continuous operation. Electricity and cooling water for the compressor are the only required utilities.

Pressures are stated as gauge, not absolute. Pressure units are bar and pounds per square inch (psig). For reference:

1 bar = 14.5 psig

1 MPa = 10 bar

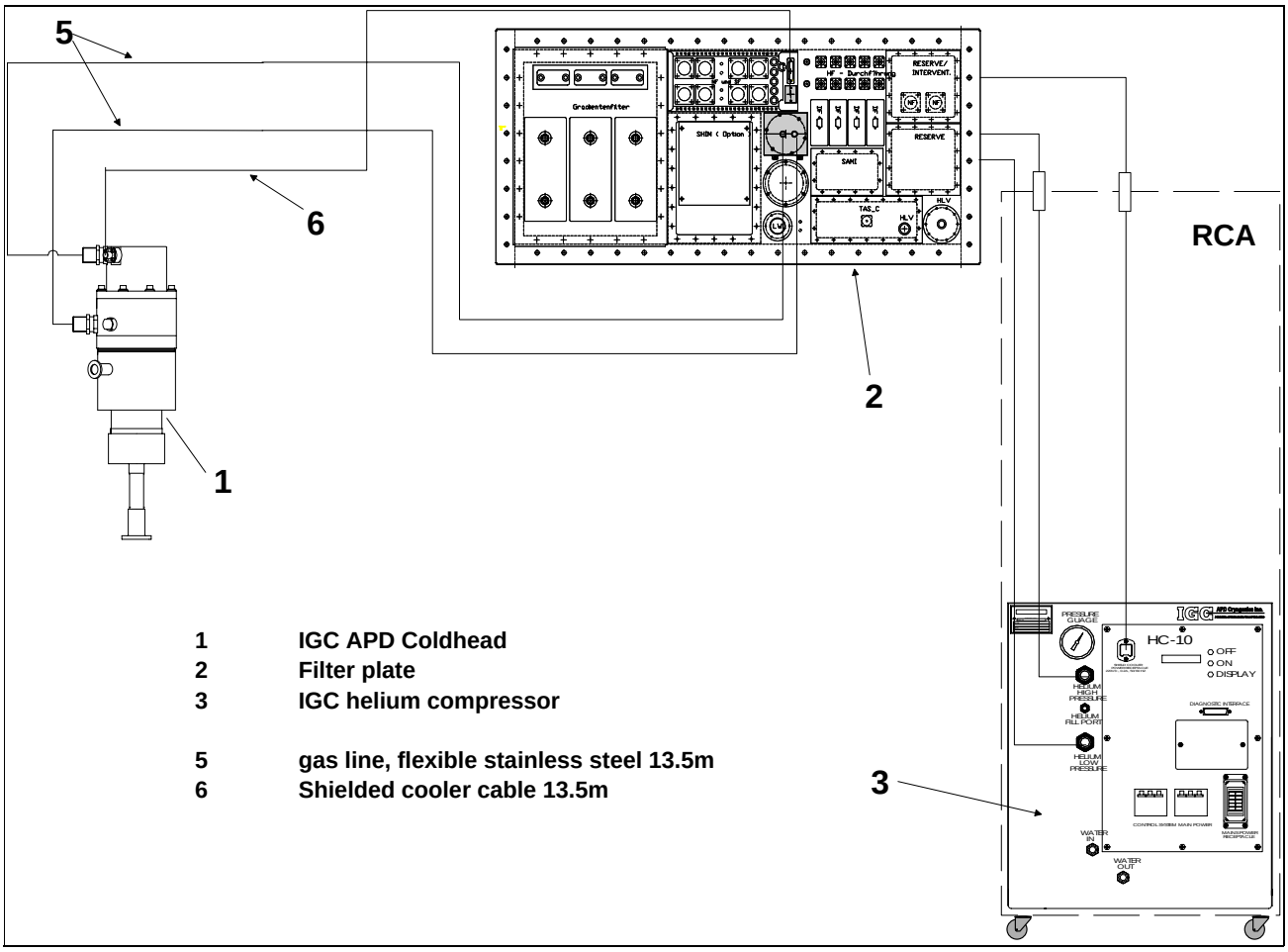

Fig. 11 Configuration

APD system connection

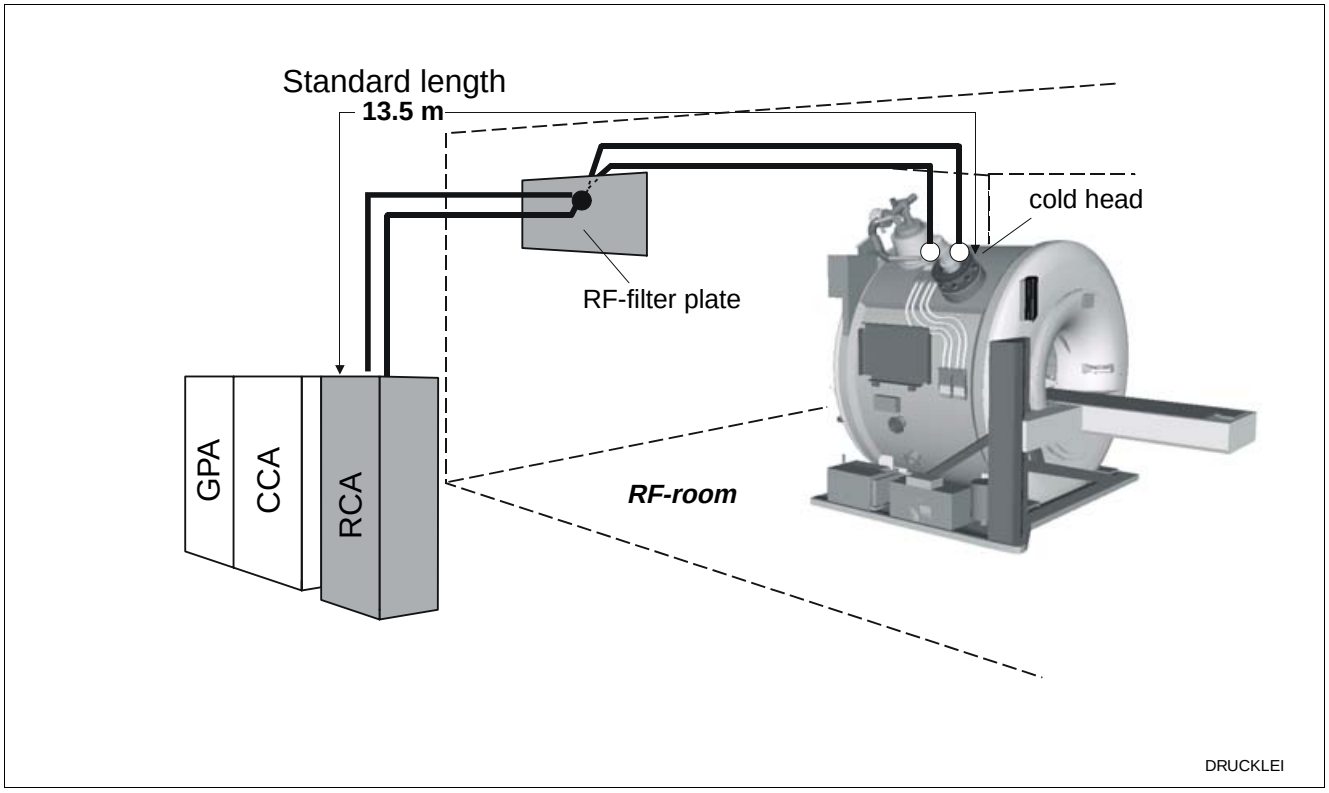

Fig. 12 Free length for He pressurized hoses between the RCA and the cold head.

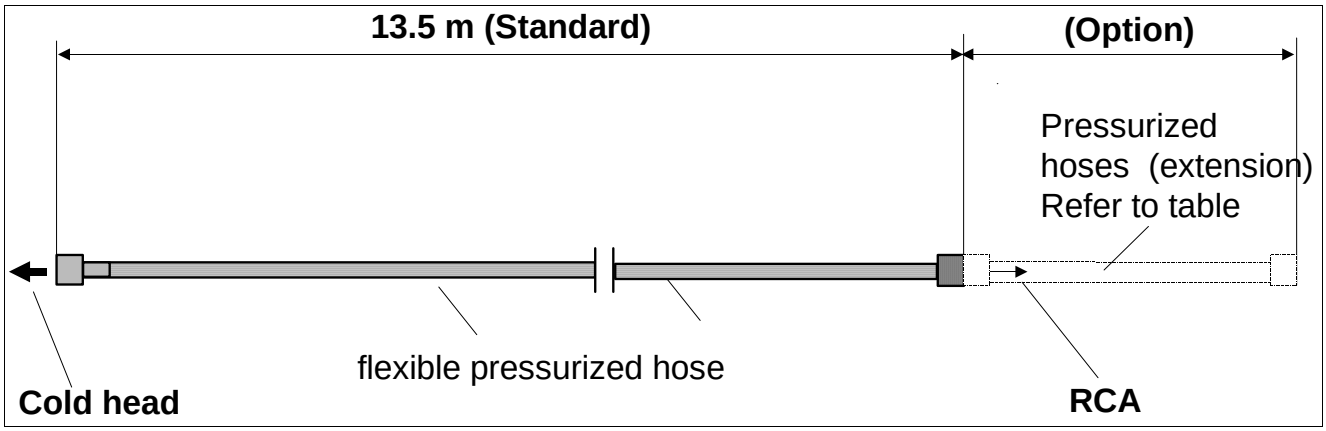

Fig. 13 Length of the He pressurized hoses

Extensions for pressurized hoses

➪ The pressurized hoses can be extended to a total of **max. 27 m**. (RCA cabinet to Cold head)
The extensions and adapters are optional and have to be ordered separately.

Part numbers

Quantity to order for extension	Siemens item no.	Description
2	74 61 341	APD gas line 9m
2	74 61 358	APD gas line 4,5m
2	74 61 457	APD gas line connector
2	74 61 242	APD gas lines 13,5m (standard)

NOTE **One adapter must be ordered for each extension.**

NOTE **If you order a system cable set with more than 11.5m total length you have to order the required extension (2.0m, 4.5m, 9.0m, 13.5m) for the pressurized hoses separately.**

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Overview of technical data

General classifications

Protection class	1
Application parts protection class	Type B
Patient table	Type B
Local coils	Type BF
ECG electrodes	
IP protection class according to IEC 60529	IP XO
Explosion protection	The MR system is not intended for operation in areas prone to explosion (e.g., highly flammable mixtures of anaesthesia gases with air or oxygen or nitrous oxide)
Operating mode	Continuous operation duty-type
Sterilization method (receptors)	Gas sterilization
Disinfection Receptors / system components	Disinfectants without alcohol, ether

Power requirements

- Refer to: "On-site electrical installations" on page 6 - 1

Heating/air conditioning

- Refer to: "Air conditioning" on page 8 - 1

Heating/air conditioning		
Ambient temperature	Equipment room	18....24^{o}C
	Examination room	21^{o}C +/- 3^{o}C
	Control room	15....30^{o}C
	Evaluation room	15....30^{o}C
Temperature gradient	all rooms	3^{o} C/h
Filtration	DIN 1946-4	or local requirement/codes

Relative humidity

- Refer to: "Air conditioning" on page 8 - 1

Relative humidity		
Relative humidity	Equipment room	Refer to: "Air conditioning" on page 8 - 1
	Examination room	40...60%
	Control room	40...80%
	Evaluation room	40...80%

Primary water specifications

- Refer to: "On-site water supply" on page 7 - 1

Primary water specifications		
Primary water specifications	Primary water pressure	max. 6 bar
	Water consumption	90l/min
	Temperature of primary water at RCA inlet	6...12^{o}C
	Heat dissipation in water	50kW
	Differential water pressure	1.5 to 2.5 bar (typical 1.2 bar)
	Hardness	< 178 ppm $CaCO_3$ (1^{o} dH = 17.8 ppm $CaCO_3$) < 10°dH
	Filtration (see also "Primary water filter system" on page 4 - 29	5...50µm quantity of suspended particles < 10mg/l
	pH level	6 to 8

Heat dissipation to air

- Refer to: "Climatic conditions" on page 8 - 2

Heat dissipation to air	
Examination room	≤ 2.5 kW
Operating room	≤ 1.7 kW
Equipment room components	≤ 5.0 kW CCA
	≤ 1.0 kW RCA
	≤ 7.5 kW Additional RF cabinet
	≤ 0.5 kW Shim PS
	≤ 0.3 kW Imager PC
Equipment room tot.	≤ 14.3 kW
Evaluation room (Option)	≤ 1.7 kW

Audible noise

Audible noise		
Audible noise	Equipment room	≤ 65 dBA CCS water
	Examination room	Refer to: "Sound emission" on page 2 - 23
	Control room	≤ 60 dBA
	Evaluation room	≤ 60 dBA

RF-shielding

RF-shielding		
RF room attenuation	at 15...128 MHz	90 dB (See also: "Co-Siting" on page 2 - 2

MPS (Magnet Power Supply)

Application

The **M**agnet **P**ower **S**upply consists of the unit which energizes/deenergizes the magnet, including the charge cable to the magnet, the cabling for the voltage supply and magnet supervision. As a service tool, the MPS is brought on-site only as required.

Ordering information

Ordering information		Ordering address
Type	Article number	Siemens AG Medical Solutions Department CS ML (Like a normal sparepart)
MPS	**74 61 960**	

Transport box dimensions

Box Nr.	Size L x W x H in mm	Weight in kg / lb
1	920 x 730 x 1210	196 / 432
2	920 x 730 x 1210	264 / 581
3		50 /

Array Shim Device

Application

The Array Shim Device is a service and installation tool for magnet shimming. It consists of mechanical supports, MR probes, preamplifier, multiplexer, etc. required to measure the magnetic field via the shim plot. The Array Shim Device is brought to the site by Customer Service and is not part of the delivery volume of the MR-system.

The Array Shim Device is shipped in its own crate together with the additional passive Shim Kit.

Ordering information

Ordering information		Ordering address
Type	Article number	Siemens AG Medical Solutions Department CS ML (Like a normal sparepart)
Array shim device	**77 12 651**	

Transport box dimensions

Box Nr.	Size L x W x H in mm	Weight in kg / lb
1	1125 x 635 x 680	65 / 143

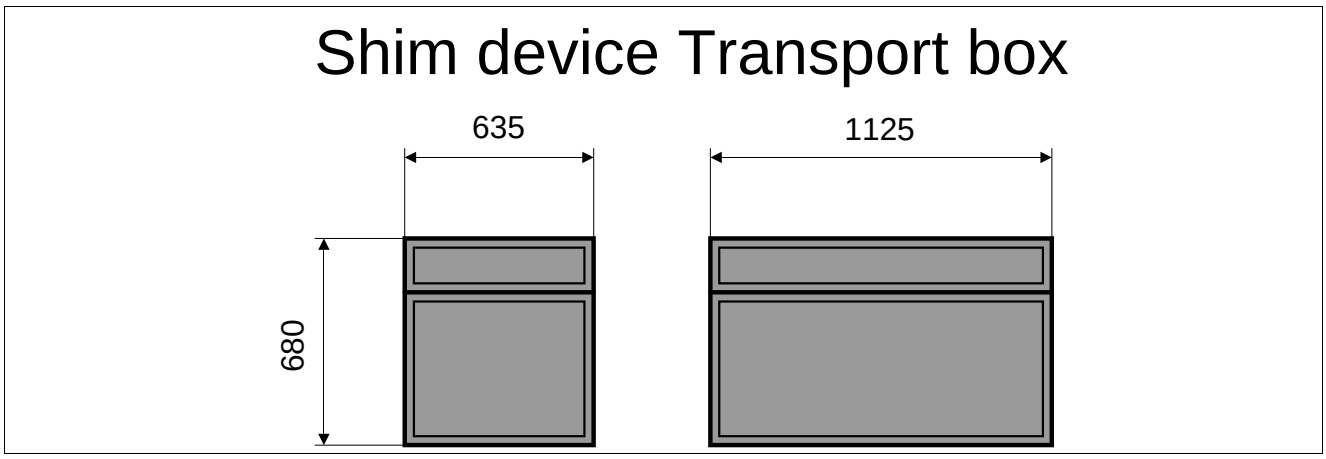

Fig. 1 Shim device Transport box

Magnet transportation tool

⚠CAUTION

For transporting the magnet only the transport device (Part.No. 74 61 408) has to be used.

If other devices are used damages to the box sections might occure.

Do not use other than specified transport tools.

In Fig. 2. the complete transport kit is be show.

Fig. 2 Transport kit

- 4 long goosenecks and 2 short ones
- 4 hydraulic jacks
- 4 transport rollers
- 4 handle bars
- level shim irons

NOTE

Due to the weight of 13 tons and the longer box sections only this special transport device has to be used for transporting the MAGNETOM Trio magnet.

If this transport device is not used, the boxsections will be bended or even destroyed!

Ordering information

Ordering information		Ordering address
Type	Article number	Siemens AG Medical Solutions Department CS ML (Like a normal sparepart)
Magnet transport kit	**74 61 770**	

Transport box dimensions

Box Nr.	Size L x W x H in mm	Weight in kg
1		404

Overview of the service tool needed for the installation

Magnet cold shipment

needed service tools	
Item	description / SNr.
Magnet power supply	74 61 960
Helium syphon (Dewar side)	11 94 344 K2097
Helium service levelmeter	99 00 176 RE999
ERDU testload	47 65 819 KE999
liquide Helium	ca. 500-1500 l (depending to the level on arriving, but minimum 500 l)
Magnet transport device	74 61 770

Magnet warm shipment

needed service tools	
Item	description / SNr.
Magnet power supply	74 61 960
Helium syphon (Dewar side)	11 94 344 K2097
Helium service levelmeter	99 00 176 RE999
ERDU testload	47 65 819 KE999
liquid Helium	ca. 2500 l
liquid Nitrogen	ca. 2500 l
Helium gas with the quality of 99,9999%	8 bottles 200 bar / 50l
Turbopump set with leakdetector	The cooling down process could be ordered from OMT
Transfer syphon magnet side	
PODO valve adapter	

Transport and storage specifications

Mechanical conditions

During transport, the components are subject to mechanical stress. The recommended reference values for various mechanical environmental parameters are specified in IEC 721-3-2 (Transport) and IEC 721-3-5 (Load in Road Vehicles).

However, these reference values significantly exceed the acceleration rates measured on loaded trucks with an air suspension system. According to experts who routinely perform vibration experiments in test labs, the guidelines of IEC 721 cannot be practically applied to components with mass ratios such as those found in MR systems.

With regard to impact loads, the maximum acceleration duration on the loaded trucks with an impact duration of 20ms is 1.4g on the tractor and 4.7g on the trailer. Our current specification for the magnet is 2g horizontally (x, y) and 5g vertically (z).

Transport and storage specifications for the magnet

Transport and storage specifications Magnet	
Acceleration amplitude	2 m/s^2 (2-100Hz)
Peak acceleration	5g vertical, 2g horizontal (20 ms time period)
Temperature range (Climate category N)	-40°C to +70°C
Rel. humidits (Climate category N)	10% to 100%
Barometric pressure (Climate category N)	50kPa to 106kPa

Transport and storage specifications for the system components

Transport and storage specifications System components	
Acceleration amplitude	2 m/s^2 (2-100Hz)
Peak acceleration	5g vertical, 2g horizontal (20 ms time period)
Temperature range (Climate category N)	-25°C to +60°C
Rel. humidits (Climate category N)	10% to 95%
Barometric pressure (Climate category N)	70kPa to 105kPa

NOTE

For transporting the magnet only the transport device (Part.No. 74 61 770) has to be used. See also "Magnet transportation tool" on page 13 - 3.

NOTE **All transport activities including delivery of the magnet and the system components into the MR-suite have to be performed by a licensed carrier only.**

Transport equipment for the magnet and electronics cabinets

- If a service provider (e.g. UNI DATA; HEGELE) is contracted to carry in the system, the service provider must provide the corresponding tools and special equipment as required.
- If the system is brought in by the local field office, they should ensure that the corresponding tools and special equipment are ordered and available as required.

Transport route

NOTE **For the transportation of the MAGNETOM Trio Magnet it is not allowed to exceed an angle of 15^0 for example a ramp.**

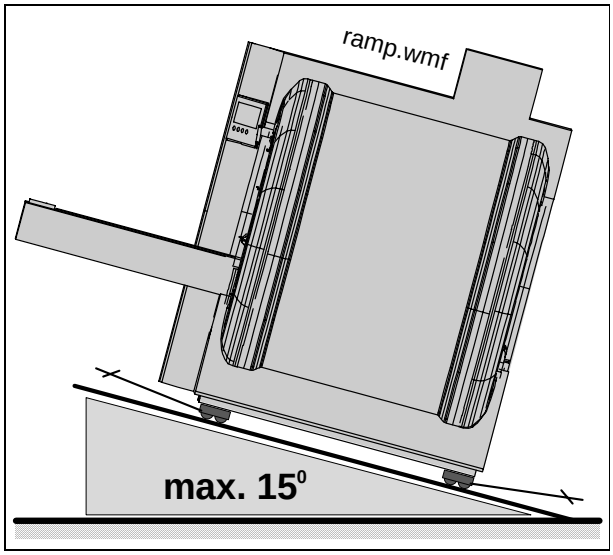

Fig. 1 Maximum transportramp angle

- Prior to requesting the services of a licensed carrier, the project manager and the architect/ construction engineer must determine the floor loading of the transport routes and the temporary storage areas.
- The architect/construction engineer must confirm in writing that the floor loading of the transport routes/storage areas selected will suffice for moving the magnet and the system components.
- It is the responsibility of the carrier to obtain information concerning the various transport routes before the actual transport.

Transport dimensions

Magnet

➪ The magnet is delivered with the patient table, front funnel and rear funnel installed.

➪ Pay attention to the following dimensions for preparing/checking your on-site transport route.

direction	delivery dimensions (standard)	min. achievable dimensions
height	2550 mm	2420 [1] mm
width	2400 mm	2165 [2] mm
length	3580 [3] mm	2080 [4] mm
diagonal	4330 [3] mm	3085 [4] mm

1. This measure is without any transport device! You have to add the dimension of the transport device you will use.
2. This measure is valid after removing the cover, the cover frame and the electronic components.
3. With patient table and funnels, without covers
4. This measure is valid if the patient table and electronics is removed (magnet only).

NOTE	**All dimensions shown without transport devices and safety space!**

Hatch size (e.g. for Roof opening)

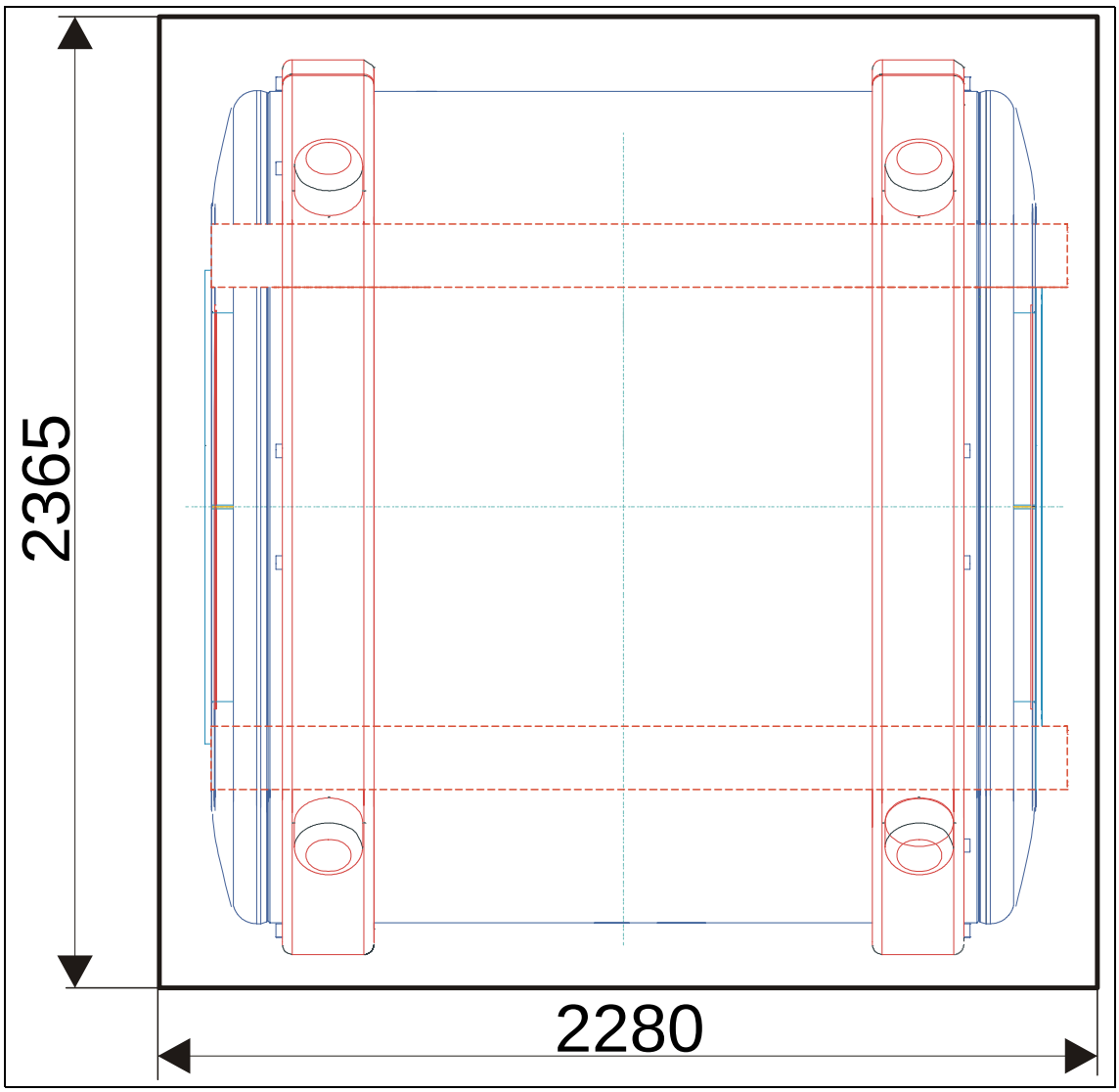

Fig. 2 Roof opening

NOTE	**All dimensions shown without cover frame, cover, funnels, patient table and transport devices!**

Electronics cabinet

To transport the GPA/CCA cabinet, the minimum finished room height must be **2040 mm**

To permit transport of the GPA/CCA cabinet to the installation location (equipment room), the height of the transport route must be ≥ **2040mm** (with transport rollers) or ≥ **1950mm** (without transport rollers).

NOTE	**If a transport height of 1950 mm (without rollers) is not available, the connection box (line voltage mains box) can be removed from the CCA cabinet.** **In this case, a transport height of 1860 mm will be adequate for the CCA/GPA cabinet.**

Helium dewars

NOTE	**The total height of the helium dewar with the helium syphon inserted must be 1-2 cm smaller than the lowest doorway used to transport the dewar.**

Please observe the minimum finished room height required to insert the helium syphon into the dewar. If the finished room height is too low, the helium syphon can be inserted outside the building.

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"Safety" on Page 1 - 1	Safety link updated
"Project Manager Information" on Page 1 - 3	Trio a Tim system implemented
"Magnet distances" on Page 2 - 2	Table modified for Avanto
"Magnet siting requirements" on Page 2 - 10	Table update
"Additional RF-cabinet (Standard delivery)" on Page 3 - 17	500mm service area on both sides added
"System components" on Page 3 - 1	Removing of Shim Tray Heating
"UPS-systems for the complete system" on Page 4 - 22	Trio a Tim system added
"Chiller-Systems recommended by Siemens Medical Solutions" on Page 4 - 30	Information on 60kW chiller implemented.
"Helium level and boil off" on Page 5 - 3	New table
"On-site electrical installations" on Page 6 - 1	Trio a Tim system values added
"On-site water supply" on Page 7 - 1	Trio a Tim system values added
"RF-Room" on Page 10 - 1	RF-door requirement implemented
"List of RF-room manufacturers" on Page 10 - 17	List modified

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