

CryoProbe System

Site Planning Guide

Version 2

BRUKER

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Introduction

1

BRUKER CryoProbes™ offer a dramatic increase in signal-to-noise ratio (S/N) by reducing the operating temperature of the NMR coil assembly and the preamplifier. Their spectroscopic handling is very similar to a conventional probe. While the sample temperature is stabilized at a user-defined value around room temperature, the NMR coil assembly - located a few millimeters from the sample - is cooled with cryogenic helium gas. An automatic closed-cycle cooling system controls all functions and guarantees excellent stability during short and long-term experiments. As a result, the system is easy to handle. CryoProbes open new fields for NMR applications e.g. where low sample concentration or long measurement time are critical.

How to use this manual

1.1

This *CryoProbe System Site Planning Guide* will help you to find out if an NMR laboratory qualifies as a site for a CryoProbe System, which preparations are necessary for a smooth installation and operation, and which options should be considered before placing an order.

If you have a specific question, use

- **“Contents”**,
- **“Index”** or
- **“Frequently asked questions”**

to locate the answer.

Further information can be found in the manuals listed in **“Related documents” on page 31**.

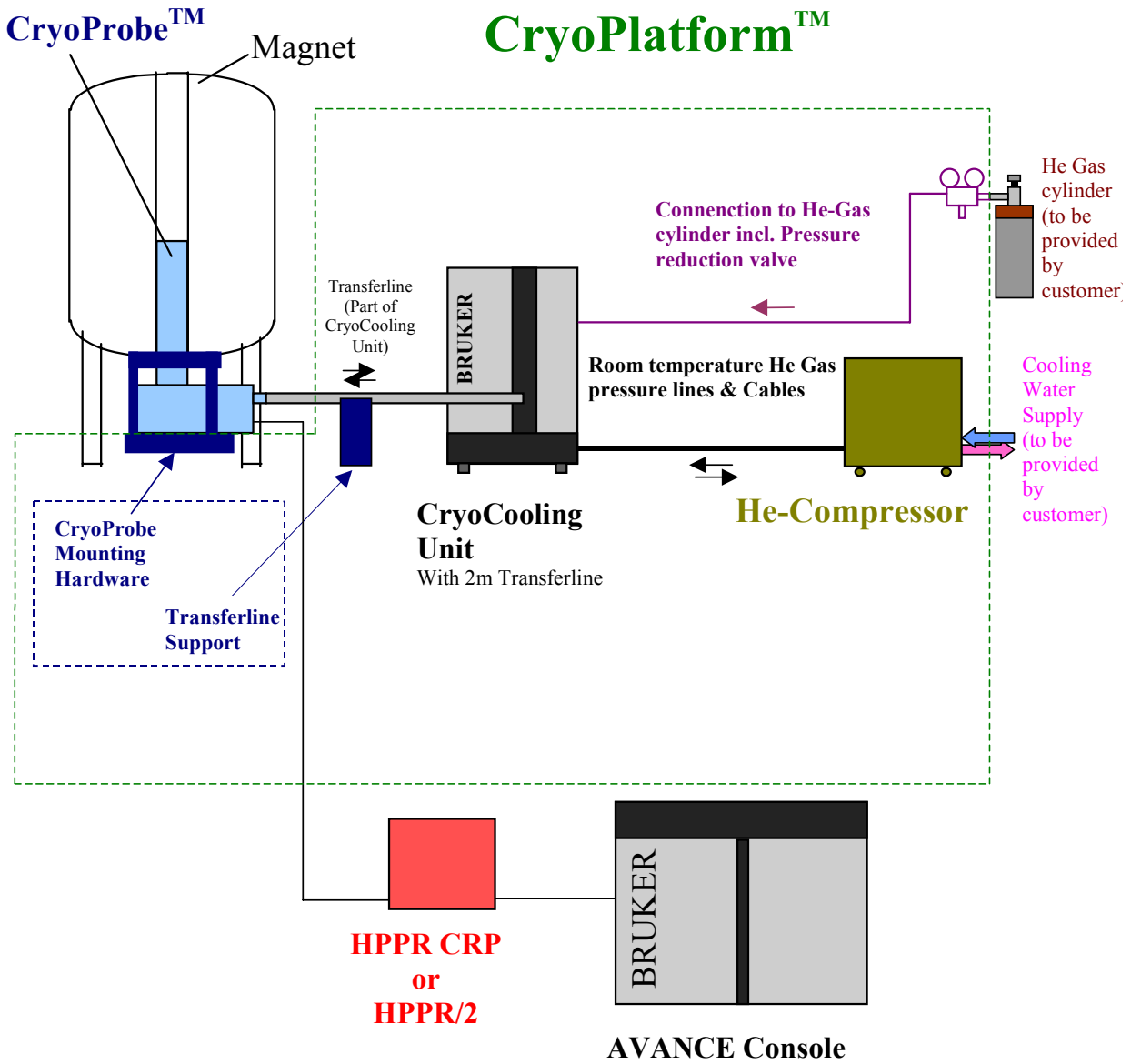
CryoProbe System overview

1.2

A CryoProbe System consists of several subunits: CryoProbe, CryoPlatform, cryo-compatible HPPR CRP, and He steel-cylinder (***Figure 1.1***).

The term ‘CryoPlatform’ summarizes the parts required to operate a CryoProbe such as the CryoCooling Unit, the He Compressor, the Mounting Hardware at the magnet etc. It is compatible with all BRUKER CryoProbes and only one per spectrometer is needed.

Figure 1.1. The CryoProbe™ System



1.3

Conventions

1.4

SMALL CAPS ITALIC

setting of a hardware switch or button

Courier small

contents of a file

<i>Courier small italic</i>	system response
Courier	file or directory name
Courier bold	Unix™ or Windows™ NT keyboard command
<i>Courier italic bold</i>	BRUKER NMR Suite keyboard command
Times bold	Unix or Windows NT object clicked with the mouse
<i>Times italic bold</i>	BRUKER NMR Suite object clicked with the mouse
<i>Times italic</i>	host name, user name etc.
< >	place holder

The "[Site planning example](#)" on page 10 shows what an NMR laboratory with a CryoProbe System could look like. "[Compatibility](#)" on page 9 will tell you if your spectrometer qualifies for a CryoProbe System. The major considerations and restrictions for the site planning are outlined in "[How to plan the positions of the units](#)" on page 13. Since the positions of the units are interdependent, there is a preferred "[Site planning sequence](#)" on page 17. For convenience, all necessary "[Supplies](#)" on page 18 are listed and a few hints for the "[Site Planning Questionnaire](#)" on page 22 are given.

The individual units are explained in more detail in "[System description](#)" on page 23.

Example

2.1

An example for a CryoProbe System siting is shown in [Figure 2.1](#).

Compatibility

2.2

Spectrometers

The CryoProbe System can be connected to BRUKER AVANCE NMR spectrometers only. It is not compatible with the hardware of other spectrometer architectures such as BRUKER AMX/ARX, AC, AM, MSL, etc. or other brands.

Magnets

The CryoProbes available fit any standard-bore magnet system.

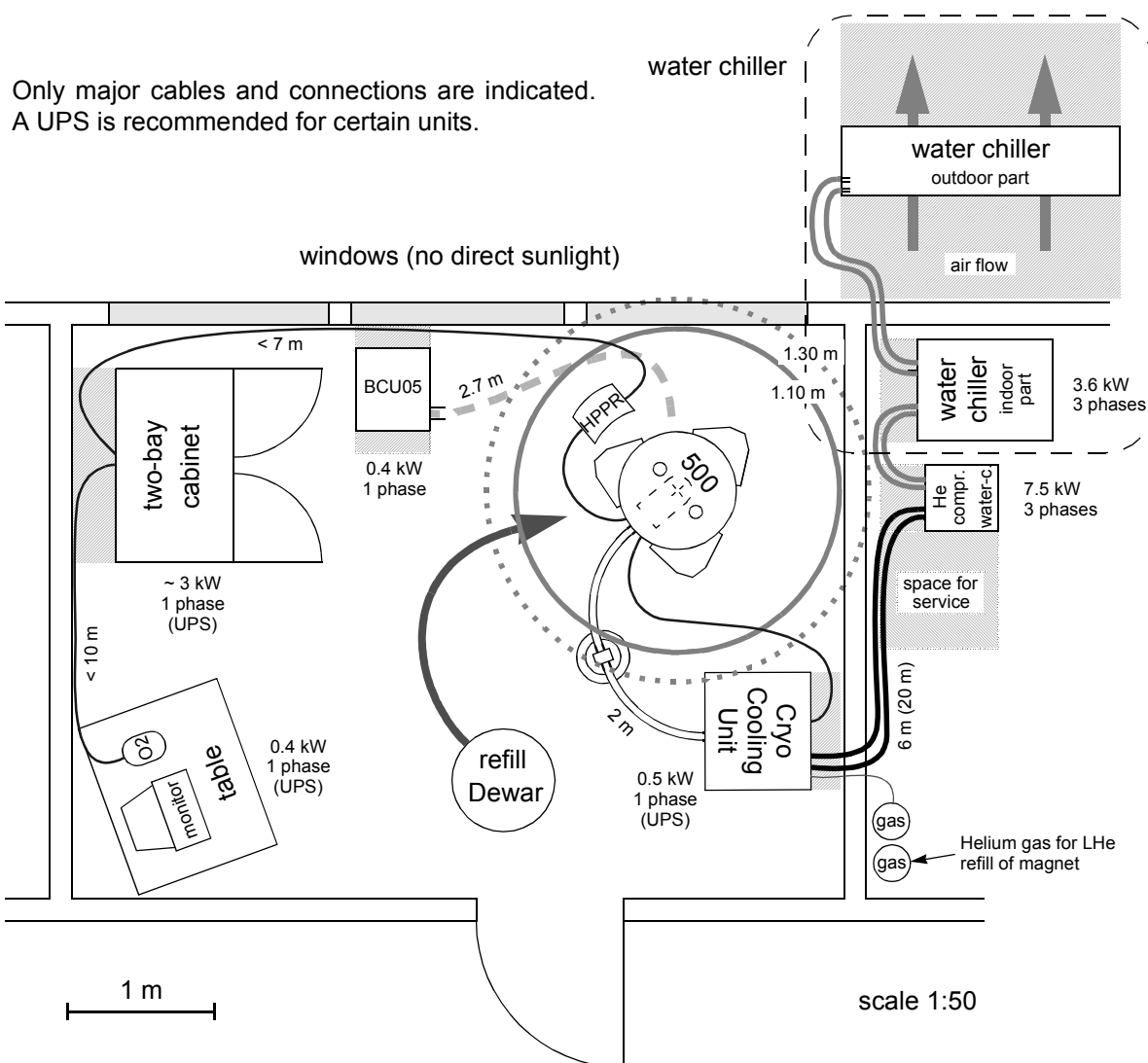
The magnet and CryoCooling Unit should be standing on the same floor level. If this is not the case, e.g. the magnet is in a small pit, BRUKER specialists need to check if the siting of a CryoProbe System is possible at all.

Free access is required to the magnet bottom for the insertion of the CryoProbe, see [Figure 2.3](#). The CryoProbe will be fixed to the magnet by special Mounting Hardware which is attached to the lower RT flange of the magnet bore (see [Figure 2.2](#)). Make sure that it will not interfere with the operation of any drop-off plate or vacuum valve.

Certain BRUKER/SPECTROSPIN 500 MHz and 600 MHz magnets (i.e. Dewar types D220, D221, D260 and D262) need a minor modification of their horizontally cross-linked magnet stand: two pillar braces in front must be exchanged for special cranked braces.

Wide-bore systems fitted with a standard-bore shim system currently cannot be used with a CryoProbe because their shim tube is longer.

Figure 2.1. Site planning example



Shim systems

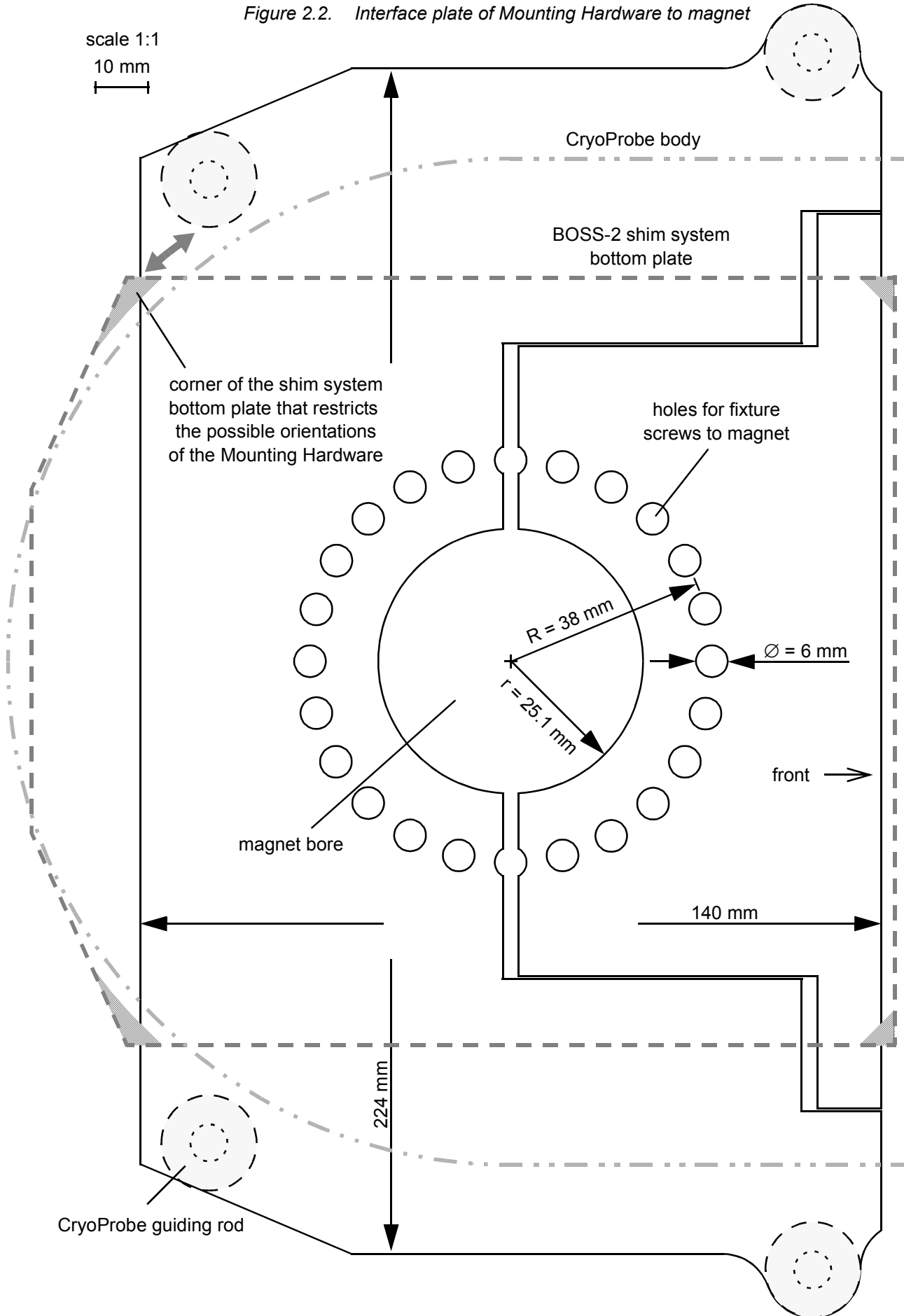
BOSS-2 shim systems should be used for optimum performance. If the shim system is equipped with a red spinner stator, it must be exchanged for a shim system with a blue one. The color of the stator can be seen easily from below the magnet using a light when no probe is in the bore.

Shim systems of other types or brands are not compatible.

If an optional ring for cooling/heating the shim system with compressed air is mounted at the magnet bore bottom, it can be left in place.

The default orientation of a CryoProbe is such that its front is parallel to the magnet front for a BRUKER/SPECTROSPIN magnet. However, all orientations are possible in which no geometrical conflict occurs between shim system bottom plate, Mounting Hardware, and CryoProbe (see [Figure 2.2.](#)). In certain cases it might become necessary to rotate the shim system. Notify BRUKER if the cable of the shim system does not point to the rear of the magnet with a precision of about

Figure 2.2. Interface plate of Mounting Hardware to magnet



$\pm 10^\circ$. 500 MHz magnets with a horizontally cross-linked stand and cranked pillar braces (Dewar types D220 and D221) permit only one orientation: the CryoProbe front must be parallel with the magnet front because it must fit into the cranked pillar braces.

Amplifiers

Standard BLAXH50 and BLAX300 amplifiers are well-suited for CryoProbes. A CryoProbe requires much less RF power than a conventional probe. Be careful with the higher output power of BLAH100, BLAX500, BLAX1000, etc.

Sample changer and automation

B-ACS 60/120 sample changers can be used with a CryoProbe provided their main vertical column ends at the height of the magnet dewar bottom and does not extend down to the floor. An existing long column B-ACS can be upgraded to a short column. The column will be attached directly to the magnet with a B-ACS holder (see [Table 2.1](#)). However, this is a major modification of the sample changer. In any case, a B-ACS must be attached to the magnet front because the magnet's helium ports and tubes do not permit access from another side.

Table 2.1. Compatible B-ACS 60/120 holders

magnet system	magnet stand	B-ACS holder
500 MHz, D120/51 (Z280120)	Z58514 (= Z26247 V2)	Z57334
500 MHz, D122/52 (Z280121, O019)	Z58514 (= Z26247 V2)	Z57334
500 MHz, D220/52 (Z29715)	any	Z51923
500 MHz UltraShield, D220/52 (Z29715)	any	Z51923
500 MHz UltraShield, D221/54 (Z54933)	any	Z51923
500 MHz UltraShield, D350/54 (Z56523)	any	Z57083
500 MHz UltraShield, D360/54 (Z56524)	any	Z57084
500 MHz Oxford 500/52, type IV, round bottom (29511, O049)	Z28518 (= Z26247 V6)	Z57810
600 MHz UltraShield, D26x/52 (Z29704)	any	Z51922
600 MHz UltraShield, D262/54 (Z54238)	any	Z51922
600 MHz UltraShield, D360/54 (Z56525)	any	Z57084
600 MHz Oxford 600/51, round bottom (29512, O109)	Z28516 (= Z26247 V4)	Z57811

NMR SIXPACK™ or NMR CASE™ sample changers are compatible without any special considerations because they sit on the magnet top.

A QNP pneumatic unit is spatially incompatible with a CryoProbe setup and has to be removed during CryoProbe operation.

VT unit

The VT unit must feature a Pt100 sensor port. Recommended units are B-VT2000 or B-VT3000. The B-VT3200 and B-VT3300 may lead to inferior results due to the more coarse steps used in their temperature regulation loop. The B-VT3300 is not able to perform a self-calibration with a CryoProbe.

The BCU05 gas cooler and a CryoProbe System can be installed side by side. See the specific CryoProbe data sheets for the allowed sample temperature ranges.

Preamplifier HPPR

An existing HPPR must be exchanged for a cryo-compatible HPPR CRP because the CryoProbes feature separate lines for transmit and receive. The HPPR CRP configuration depends on the nuclear frequencies of all CryoProbes and conventional probes which are to be used with the spectrometer. All kinds of HPPR modules can be incorporated into an HPPR CRP assembly at any time.

RF filters

All RF filters needed for the CryoProbe are built-in already or supplied with the HPPR CRP.

Receivers

A high quality receiver system is mandatory to maintain the high signal-to-noise ratio provided by the CryoProbe. The effective digitizer resolution should be 18 bit or more to keep quantization noise at a negligible level.

For small receiver gain values, i.e. $rg < \sim 256$, the signal-to-noise tends to decrease in proportion to rg . This situation typically occurs for samples containing H₂O or other concentrated substances. Then, an RX22 receiver of ECL07 or later is beneficial which can be hardware configured to introduce less noise at low rg at the expense of a reduced overall gain.

Accessories

A Radiation Damping Control Unit (RDCU) cannot be used with a CryoProbe because the current versions of the two systems are incompatible.

Software

XWIN-NMR 2.0 or later with software enhancements, XWIN-NMR 2.6 or later are fully compatible.

How to plan the positions of the units

2.3

To a certain extent the positions of the components are mutually dependent. Also, the location of the **"Supplies" on page 18** should be taken into account before sending a definite site plan to BRUKER. A drawing of your laboratory to scale 1:50 with a transparent copy of the **"Building blocks for site planning" on page 33** will help.

CAUTION: All components of a CryoProbe System (including He Compressor) are designed and specified strictly for indoor use.

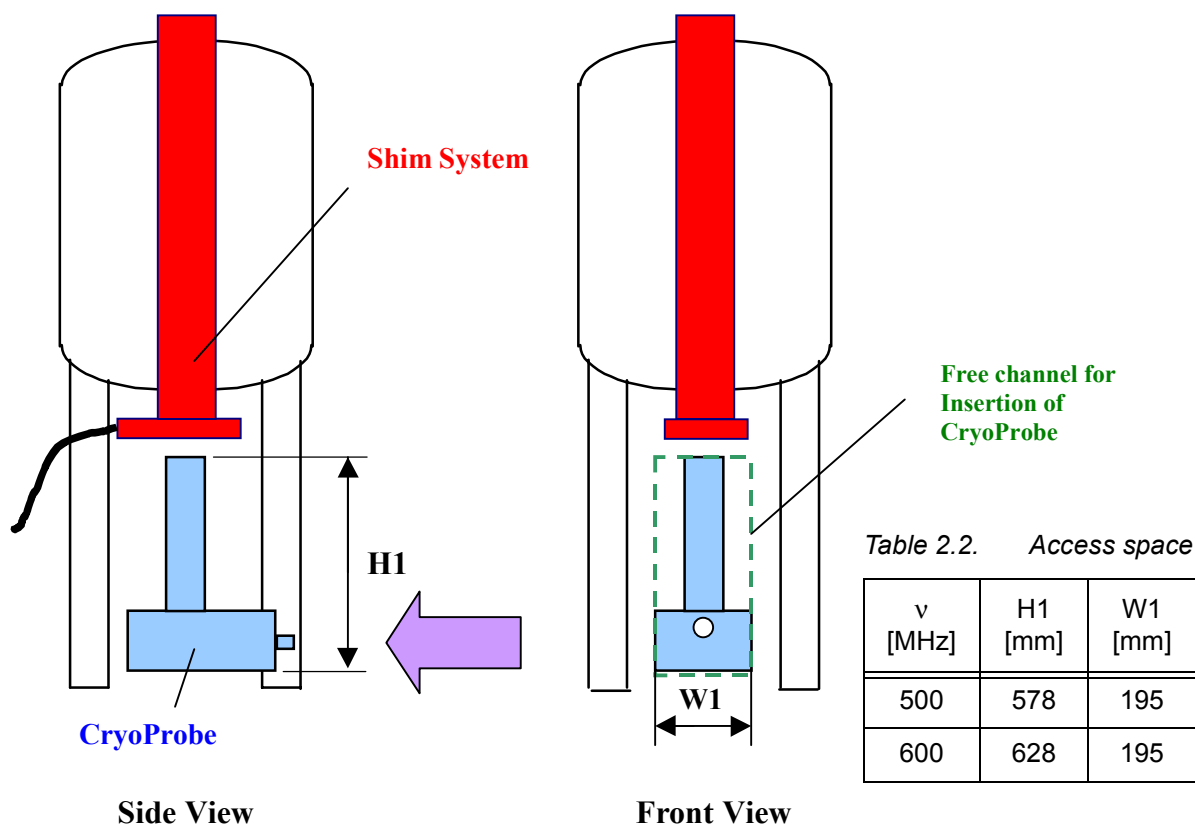
A spatial channel of e.g. at least 578×195 mm [height \times width] is needed to insert a 500 MHz CryoProbe (see **Figure 2.3.** and **Table 2.2.**). For insertion and removal of the heavy CryoProbe, there must be enough space to give two people simultaneous access to the magnet bottom. The clearing between shim system bottom plate and floor must be at least 578 mm (at 500 MHz) when the magnet anti-vibration air suspension is 'off'.

IMPORTANT: A magnet refill with cryogenic liquids must be possible at all times.

NOTE: A QNP pneumatic unit is spatially incompatible with a CryoProbe setup and has to be removed during CryoProbe operation.

The magnet and CryoCooling Unit should be standing on the same floor level. If this is not the case, e.g. the magnet is in a small pit, BRUKER specialists need to check if the siting of a CryoProbe System is possible at all.

Figure 2.3. Required access to the magnet bottom



The He Compressor, and He steel-cylinder have to be kept outside the 0.5 mT field. As a rule, all spectrometer and CryoProbe System components should be as

far away from the magnets as possible. In particular, the He steel-cylinder and its entire transport path must always be outside the 0.5 mT range. The CryoCooling Unit should be kept outside the 5 mT range.

See also the stray field considerations in 'AVANCE 200-700: Introduction to Site Planning' (on BASH CD).

He Transferline

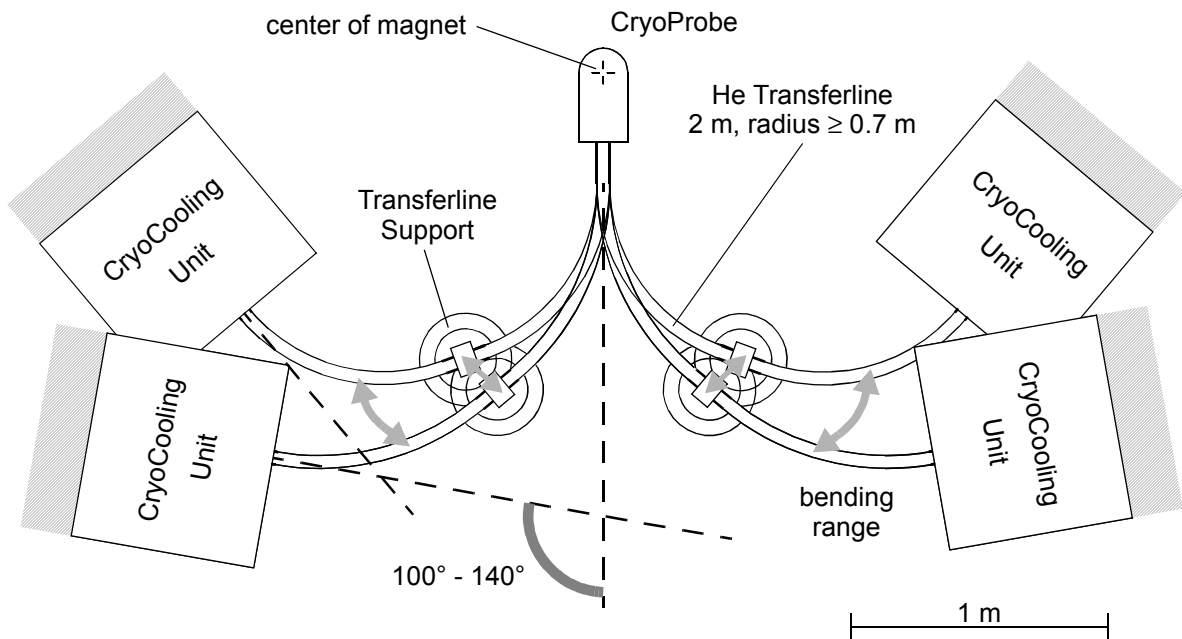
2.3.3

The He Transferline between the CryoCooling Unit and the CryoProbe must be bent to allow the insertion of the CryoProbe and to reduce spectral artefacts due to mechanical vibrations.

length:	2 m (up to 4m on request)
bending radius:	≥ 0.7 m
bending angle:	100° - 140°

The recommended bending range of the He Transferline is indicated in **Figure 2.4** by its four extreme positions.

Figure 2.4. Flexibility of the He Transferline



Remote location of the He Compressor

2.3.4

The use of extended Flexlines (20 m option instead of standard 6 m) between the CryoCooling Unit and He Compressor allows installation of the He Compressor in a remote room. Compared to a position close to the spectrometer, this offers the following benefits:

- The CryoPlatform can be installed in a very confined laboratory space by placing the He Compressor in another room.
- Acoustic noise from the He Compressor is eliminated in the lab.
- For multiple CryoPlatform installations within one laboratory or building, all He Compressors may be concentrated in one room for easy connection and maintenance.

Permanent access to the He Compressor is not necessary during normal operation, since it is remote controlled and monitored by the CryoCooling Unit. Any possible malfunction is handled by the CryoController which takes the appropriate action and notifies the operator.

If a remote location for the He Compressor is not feasible, the installation of an acoustic isolation may be considered.

Acoustic isolation

2.3.5

The He Compressor is a noisy devices and preferably kept in another room (see ***"Remote location of the He Compressor" on page 15***). However, if it has to be located in the NMR laboratory, it is convenient to put them into an acoustically insulated box.

BRUKER does not supply acoustic insulation boxes for He Compressors. A few design recommendations are given in the following.

Polymer foam with an egg crate surface absorbs sound very well when it covers the inside of the box. Design the openings for connections and ventilation carefully as tunnels without gaps.

The minimum size of the box is determined by the maintenance access and by the ventilation needs. Since the He Compressor is on wheels and connected via flexible tubes and cables, it can be moved somewhat for maintenance such that e.g. the '800 mm extra space at its left side for maintenance' (***"He Compressor" on page 17***) becomes available upon turning the unit. It would even be possible to keep the unit with some extra tube and cable length in a closet and pull it out of the closet for service. There are small ventilation slits at both left and right sides of the He Compressor which should have a free gap of at least 100 mm. A water-cooled He Compressor does not release much heat themselves. If necessary, some fans can be added to the box. To avoid stability problems in NMR experiments they must not blow in the direction of the magnet.

For the annual servicing (replacement of adsorber etc.), the He Compressor has to be disconnected completely and can be moved anywhere. Only the top and the left side panel will be taken away for this service.

NOTE: The situation is completely different for an air-cooled He Compressor which emits about 7.5 kW of heat off its top and consequently cannot be kept in an almost closed box.

Dimensions and weights

2.3.6

CAUTION: The floor must be able to support the weights listed below.

All dimensions are given in [mm], width × depth × height.

Transferline Support

height: 715 mm, diameter: 240 mm (pillar), 360 mm (base plate)

NOTE: The height of this support must meet the height of the CryoProbe in the magnet. If the magnet is not on floor level, mention it in the 'CryoPlatform Site Planning Questionnaire'.

CryoCooling Unit

device: 800 × 720 × 1300 mm [w × d × h],
site: depth: + 300 mm at back for connectors,
sides: + 300 mm for air intakes, installation, and maintenance,
weight: 400 kg.

He Compressor

a) air-cooled, USA version, P/N O00245:

device: 550 × 550 × 883 mm [w × d × h] (includes 70 mm height for wheels),
site: width: + 800 mm at left side for maintenance,
depth: + 400 mm at front for air suction,
+ 300 mm at back for connectors,
height: + free space on top for air discharge,
weight: approx. 140 kg.

NOTE: An air-cooled He Compressor will release about 7.5 kW of heat into its immediate environment which must be handled by the air conditioning.

b) water-cooled, USA version, P/N O00246:

device: 450 × 500 × 684 mm [w × d × h] (includes 70 mm height for wheels),
site: width: + 800 mm at left side for maintenance,
depth: + 300 mm at back for connectors,
weight: approx. 120 kg.

c) water-cooled, European version, P/N O00247:

device: 450 × 500 × 684 mm [w × d × h] (includes 70 mm height for wheels),
site: width: + 800 mm at left side for maintenance,
depth: + 300 mm at back for connectors,
weight: approx. 125 kg.

Site planning sequence

2.3.7

IMPORTANT: All units must be installed and connected according to local safety standards. Plan the laying of tubes and cables such that they will not cross the floor on a walkway. If a crossing cannot be avoided, bury or cover them.

Do the site planning in the following sequence and read '→' as 'affects the siting of':

1. Magnet (and spectrometer cabinet) → **CryoCooling Unit**

The distance to the magnet is restricted by the bent He Transferline to ~ 1 m (see **Figure 2.4**). Its bending angle must be 100° - 140° to allow the insertion of the CryoProbe and to reduce spectral artifacts due to mechanical vibrations.

2. CryoCooling Unit & magnet → **Transferline Support**

The Transferline Support must rest on solid ground halfway between Cryo-Cooling Unit and magnet.

3. CryoCooling Unit & magnet → **He Compressor**

Distance < 6 m (with extension option: < 20 m).

IMPORTANT: The bending radius of the Flexlines between CryoCooling Unit and He Compressor is 0.3 m, e.g. a 180° turn needs a diameter of at least 0.6 m.

Locate the He Compressor as far as possible from the magnet (floor vibrations, acoustic noise...). The He Compressor is noisy, a separate room or acoustic isolation are advantageous.

An air-cooled He Compressor will emit about 7.5 kW of heat from its top into its immediate surroundings. It needs fresh air (see **Figure 2.5.**) or powerful air conditioning.

4. CryoCooling Unit → **He steel-cylinder**

The He steel-cylinder is linked to the CryoCooling Unit by a flexible He Hose of 10 m length (20 m length on request).

NOTE: Avoid geometric conflicts with accessories such as sample changer or a BCU05.

IMPORTANT: Refilling the magnet with cryogenic liquids (LN₂ and LHe) must be possible at all times!

If the magnet stands in a narrow pit with no space to place the CryoCooling Unit, a CryoProbe System cannot currently be installed. In critical cases, a site inspection by BRUKER specialists may be necessary.

Supplies

2.4

IMPORTANT: Supplies must be installed in accordance with local regulations. All plugged connections must be accessible at all times.

Electricity

2.4.1

Mains: in total 8 kW average, 9.8 kW peak

CryoCooling Unit

500 W average, 1500 W peak, AC 230 V, 1 phase, 50/60 Hz, external fuse upstream: T 10 A (T = time-lag fuse).

The CryoCooling Unit complies with overvoltage category II and its degree of protection is IP20. A 10 m mains cable is attached to it and equipped with a standard IEC 320 C4 plug (German 'Schuko' two-pole plug with dual ground-contacts) rated 10/16 A 250 V. Wire assignments are: brown = line ('field'), blue = neutral ('field'), yellow/green = ground.

NOTE: Do not try to supply the CryoCooling Unit from the mains sockets at the rear of the spectrometer cabinet. Those sockets are intended for small loads only.

He Compressor

a) air-cooled, USA version, P/N O00245:

AC 200 V, 50/60 Hz, 3 phase, 25 A, 110 A starting current, 9 kVA,
7.5 kW average, 8.3 kW peak,
must be fused upstream with $3 \times$ max. 60 A.

Currently, an air-cooled He Compressor for AC 400 V is not available but a transformer unit AC 400 V \rightarrow AC 200 V (all 3 phase) could be used (not available from BRUKER).

b) water-cooled, USA version, P/N O00246:

AC 200 V, 50/60 Hz, 3 phase, 25 A, 110 A starting current, 9 kVA,
7.5 kW average, 8.3 kW peak,
must be fused upstream with $3 \times$ max. 60 A.

c) water-cooled, European version, P/N O00247:

AC 380/400/415 V, 50 Hz, 3 phase, 12 A, 60 A starting current, 9 kVA,
or
AC 460/480 V, 60 Hz, 3 phase, 12 A, 60 A starting current, 9 kVA,
7.5 kW average, 8.3 kW peak,
must be fused upstream with $3 \times$ max. 30 A.

Uninterruptable Power Supply

NOTE: A short mains interrupt will cause an automatic warm-up of the CryoProbe System. Since a warm-up/cool-down cycle is time consuming, mains interrupts should be avoided. A UPS is generally of advantage to bridge short mains interrupts.

UPS requirements: 500 W for CryoCooling Unit and at least 2.6 kW for the spectrometer cabinet (depends on configuration, see manual 'AVANCE 200-700 MHz, Introduction to Site Planning' on BASH-CD). The battery time should be selected according to the maximum duration anticipated for a power failure.

Air conditioning**2.4.2**

The laboratory air conditioning requirements are the same as for an AVANCE NMR spectrometer (see AVANCE Site Planning manual), i.e. a constant room temperature of 17-25°C with a variation of less than $\pm 1^\circ\text{C}$, an air humidity of 40 - 80%, and a low dust content. Operation at a room temperature above 30°C is not approved.

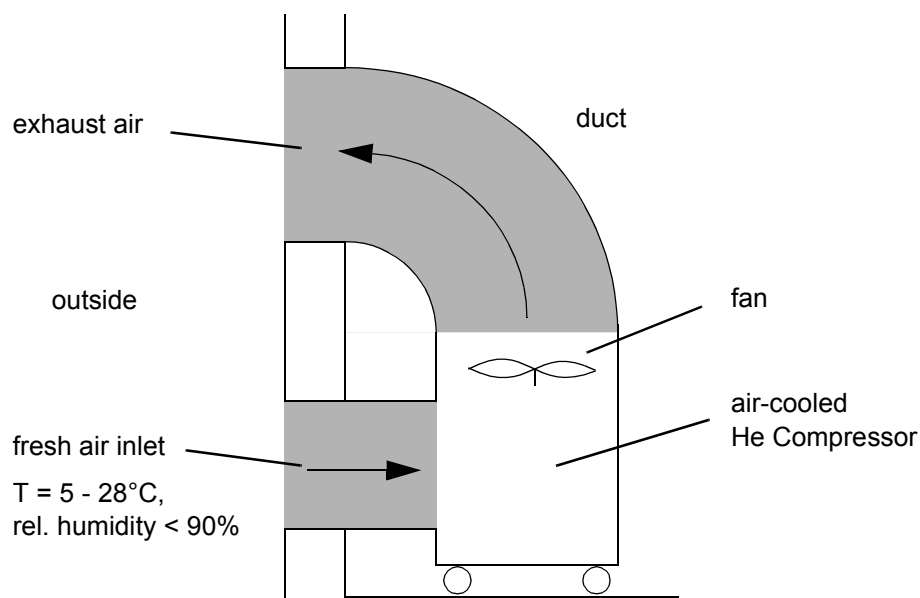
In case of an air-cooled He Compressor, provision should be made for a separate supply of fresh air as shown in **Figure 2.5**. About 7.5 kW of heat are released by a He Compressor which would put a high additional load on any room air conditioning system. Depending on the location, it might be possible to recycle the heat energy.

The amount of heat released from the CryoCooling Unit cabinet itself is rather small and needs no special consideration.

IMPORTANT: The He Compressor unit must be operated in a dry room. They are neither designed nor approved for outdoor operation.

NOTE: No cooling water is needed for an air-cooled He Compressor.

Figure 2.5. Siting proposal for an air-cooled He Compressor



Cooling water can be taken from a closed cycle cooling water supply in the building or from an water chiller. In either case, the requirements are:

minimum flow:	7 L/min (420 L/hr)
recommended flow:	10 L/min (600 L/hr)
pressure drop in He Compressor:	1.6 bar (without calcification)
recommended pressure:	3.2 bar
max. inlet pressure	7.0 bar
cooling power:	7.5 kW (+ heat from opt. chiller)
water temperature (at He Compressor inlet):	4 - 28°C
recommended water temperature:	15°C
water temperature (at He Compressor outlet):	≤ 17°C higher than at inlet
water connectors:	pipe thread 3/8"

The chemical properties of the cooling water must be within certain limits to avoid corrosion:

pH value:	6.5 - 8.2
hardness:	≤ 200 mg CaCO ₃ /L
molybdate-reactive silica:	≤ 50 mg/L
suspended matter:	≤ 10 mg/L

In the case of a split-type water chiller, its weather-proof radiator must be mounted on the outside of the building. The main unit and the radiator are usually connected by two refrigerant lines and an electrical cable which supplies and controls the radiator. Atmospheric conditions and even the altitude should be taken into account when selecting a water chiller.

A mixture of 70% water / 30% glycol (antifreeze) can be circulated directly through the He Compressor provided that the chemical specifications given above are obeyed.

VT gas

2.4.4

Requirements are the same as for an AVANCE NMR spectrometer with BCU05 (see AVANCE Site Planning manual), i.e. dry gas with a dew point of $< -50^{\circ}\text{C}$, oil-less to $< 0.005 \text{ mg/m}^3$, and dust free. For a CryoProbe, there is no difference between N_2 gas and dry air with respect to shimming or RF performance.

CAUTION: The VT gas must not be interrupted or switched off at any time while the CryoProbe is in cold operation. Samples with high melting points such as water or benzene may freeze within a few seconds if the VT gas flow is missing! Furthermore, the potential condensation of water from air inside the CryoProbe cavity is avoided by the constant flow of dry VT gas. For each type of CryoProbe, a minimum gas flow is defined.

A sample safety enhancement option is available.

Pneumatic gas

2.4.5

The CryoCooling Unit needs a pneumatic gas pressure of at least 4.5 bar for proper operation of its valves. Either an optional air compressor must be built into the CryoCooling Unit (P/N BH0421) or an external supply should be used. The pneumatic gas inlet at the CryoCooling Unit is similar to the one on the AVANCE spectrometer backpanel and accommodates 8 mm gas tubes. It can be branched off the spectrometer gas supply if pressure and flow permit. Care must be taken if the magnet air suspension and the spectrometer cabinet use the same gas source as the Cooling Unit. However, the air consumption is rather small during cool-down/warm-up and negligible during cold operation.

IMPORTANT: Occasional short interruptions or pressure drops in the pneumatic gas supply should be avoided because they can trigger an automatic safety warm-up.

Helium gas

2.4.6

Helium gas (He) Grade 6.0 (i.e. 99.9999% purity, 'electronic grade') is required, an inferior quality cannot be used. The customer has to supply a full standard size cylinder (typically 50 L at 200 bar). The He supply system comprises a He Regulator and a charging hose which are delivered with the CryoPlatform. The He steel-cylinder must be located as far as possible outside the 0.5 mT stray field of the magnet at a fixed position.

IMPORTANT: Different national standards exist for the threads on the He steel-cylinders. The type of connection must be specified in the Site Planning Question-

naire such that BRUKER can equip the He Regulator with the correct joint. Common outlet standards are listed in **Table 2.2**.

Table 2.2. Common outlet types on He gas steel-cylinders

standard	designation	dimension	thread
DIN 477, AFNOR	No. 6	21.8 mm × 1/14"	right, external
BS 341	No. 3, 5/8" - BSP 14	22.92 mm	right, internal
ANSI	NGO 14	0.965" (24.51 mm)	right, internal
JIS	W-20.9-14	20.9 mm × 1/14"	left, external

Estimated He consumption: a standard size (50 L) He steel-cylinder with 200 bar initial pressure suffices for at least 40 cool-down cycles. The He steel-cylinder must be exchanged when its pressure has decreased to below 30 bar.

At any time during charging and operation, the loss of He is very small. Consequently, no provisions were made on the CryoProbe System for hooking up a helium recovery system.

NOTE: The He steel-cylinder must not be detached from the CryoProbe System while in cold operation because the He system would be contaminated with air upon reconnecting. Consequently, this He steel-cylinder cannot be used for e.g. magnet refill while the CryoProbe is cold.

Site Planning Questionnaire

2.5

IMPORTANT: Before a definite CryoProbe System *order* can be *accepted*, the latest 'CryoPlatform Site Planning Questionnaire' (available from the local BRUKER representative) must have been processed thoroughly: all questions answered by the customer, form sent to BRUKER, reviewed by BRUKER, and finally accepted.

Some spectrometer components, such as magnet stands, sample changers, or VT units may need a modification for hosting a CryoProbe System. Therefore, it is mandatory to answer all questions carefully and to report all uncertainties or special circumstances to BRUKER as soon as possible.

Include a site drawing for your laboratory and the CryoPlatform to scale 1:50 (use the elements in "**Building blocks for site planning**" on page 33). Your answers are needed to decide if your spectrometer configuration is suitable to host a CryoProbe, which parts are required, and what preparations will have to be done at your NMR lab.

The exact orientation of the magnet in the laboratory is of great importance for the site planning. It determines the alignment of the He Transferline between Cryo-Cooling Unit and CryoProbe and thus the position of the CryoCooling Unit. Specify the distance from each magnet pillar to the laboratory walls and other immobile objects with a precision of at least ± 5 cm.

System description

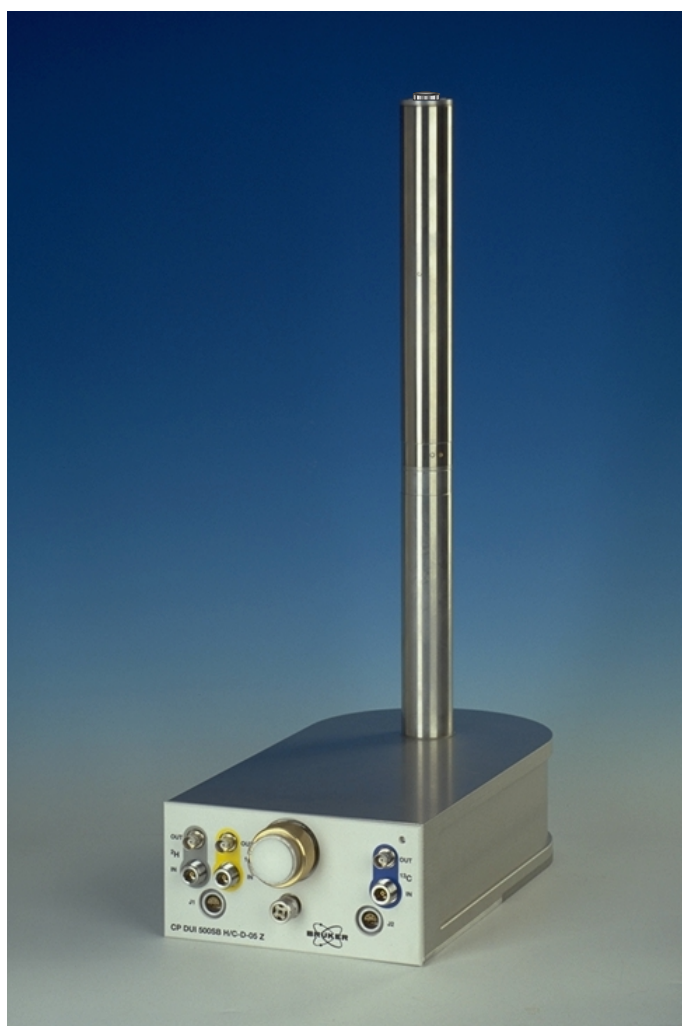
3

CryoProbe

3.1

The CryoProbe™ is an NMR probe with the essential parts of the RF preamplifier integrated. Both the NMR coil assembly and the CryoPreamp are cooled by cryogenic helium gas (He) to achieve an extremely efficient operation of the NMR coil assembly and to significantly reduce thermal noise. Thus, the overall signal-to-noise ratio is dramatically enhanced.

Figure 3.1. A CryoProbe™



System description

Where applicable, the CryoPreamps, transmit/receive switches, RF filters for the receiver pathways, and control circuits are built into the CryoProbe body.

The CryoProbe is connected to the CryoPlatform with the standardized CryoCoupler and He Transferline for cooling as well as with several sensor cables. It requires special interface cables for the z-gradient and for the VT unit.

Technical data

Dimensions	190 × 365 × 95 mm [w × d × h] (body only, excluding connectors) length including front connectors: 383 mm
Overall height	578 mm (500 MHz), 628 mm (600 MHz)
Weight	~12 kg

CryoPlatform

3.2

The CryoPlatform™ is required once per spectrometer and supplies the entire infrastructure for the operation of CryoProbes, i.e. the cooling and all control functions. It is a push-button system which performs all operations needed for an entirely automatic cool-down, cold operation, and warm-up of the probe. Although capable of stand-alone operation, the CryoPlatform is fully integrated into the AVANCE spectrometer system.

A CryoPlatform (**Figure 3.2.**) consists of CryoProbe Mounting Hardware at the magnet, a CryoCooling Unit with an integrated He Transferline to the CryoProbe, a Transferline Support, a separate He Compressor with water- or air-cooling, Flexlines between He Compressor and CryoCooling Unit, a He Regulator on a He steel-cylinder, an interface cable for the VT unit, and an optional magnet stand modification for certain magnet types.

Not considered part of the 'CryoPlatform' are the CryoProbe, the cryo-compatible HPPR CRP, the He steel-cylinder, and the Gradient Filter Box.

Mounting Hardware

3.2.1

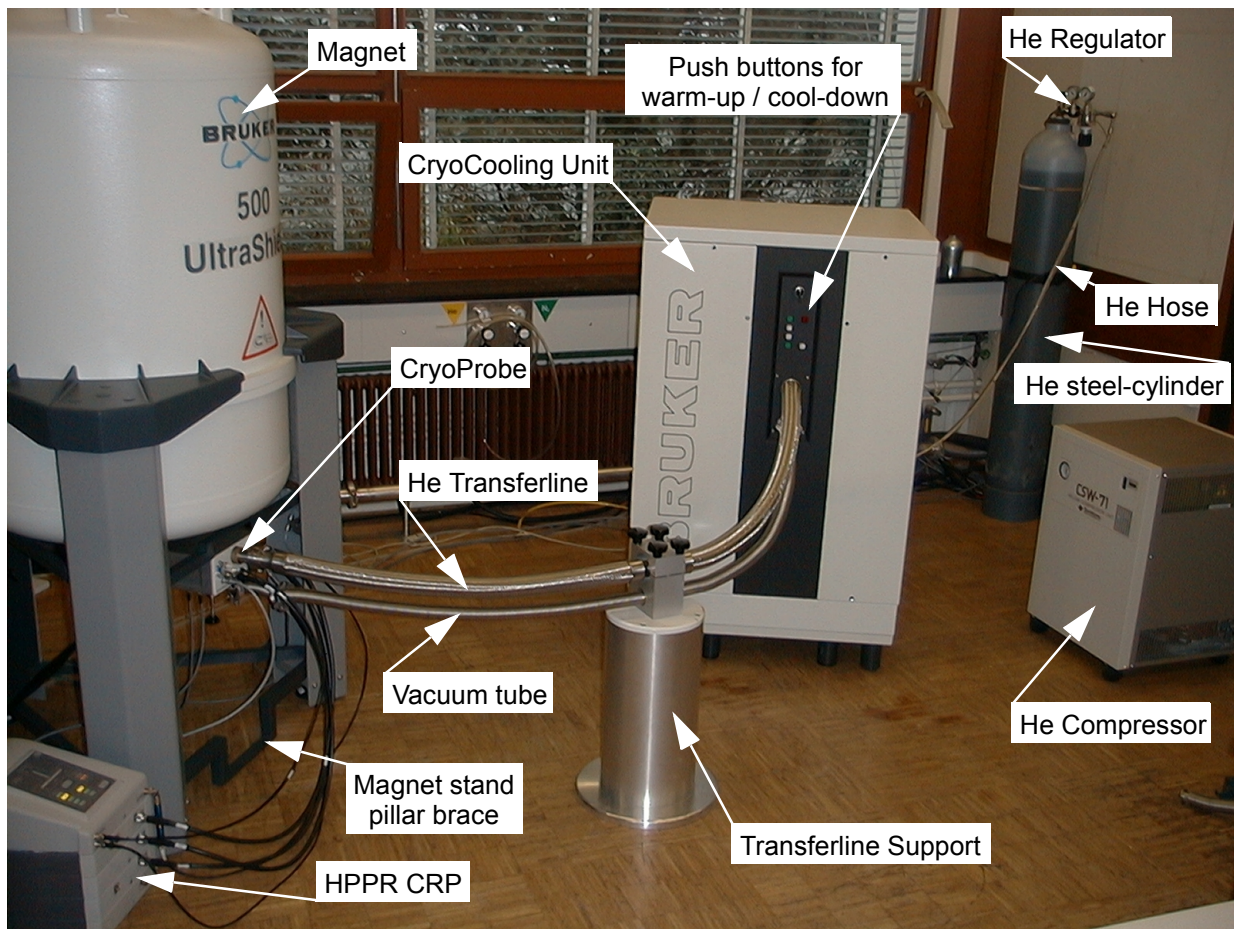
A special fixture must be mounted to the lower RT flange of the magnet bore to carry the weight of the CryoProbe. The Mounting Hardware is attached to the magnet flange with an interface plate (see **Figure 2.2.**) which takes over the carrying function of the lower shim system attachment ring. When not used for CryoProbe mounting, this plate does not interfere with conventional probes.

CryoCooling Unit

3.2.2

The most prominent part of the CryoPlatform is the CryoCooling Unit. Inside, a so-called 'Coldhead' expands compressed He and thereby cools it to cryogenic temperatures. Cold He is then circulated through the CryoProbe via an insulated He Transferline. Vacuum pumps maintain insulation of the CryoProbe and the CryoCooler. All operations are supervised by the built-in CryoController unit.

Figure 3.2. A CryoPlatform™



Controls on the CryoCooling Unit

Technical data: CryoCooling Unit

Dimensions	800 × 720 × 1300 mm [w × d × h]
Weight	400 kg
Electricity	AC 230 V (1 phase) 50/60 Hz, 500 W average, 1500 W peak, required external fuse upstream: T 10 A (T = time-lag fuse).
Acoustic noise	max. 61 dB(A) 2 m distant (CryoCooling Unit only)

The CryoCooling Unit complies with overvoltage category II and its degree of protection is IP20.

The He Compressor unit provides compressed He and electrical power to the Coldhead inside the CryoCooling Unit.

Technical data

Dimensions		(w × d × h in mm)
P/N O00245	(3 × 200 V AC, air-cooled)	550 × 550 × 885
P/N O00246	(3 × 200 V AC, water-cooled)	450 × 500 × 684
P/N O00247	(3 × 400 V AC, water-cooled)	450 × 500 × 684
Weight (approx.)		
P/N O00245	(3 × 200 V AC, air-cooled)	140 kg
P/N O00246	(3 × 200 V AC, water-cooled)	120 kg
P/N O00247	(3 × 400 V AC, water-cooled)	125 kg
Ambient operating temperature		5 to 28°C
Air humidity (relative)		max. 90%
Electricity		
line voltage (± 5%)	P/N O00245 P/N O00246 P/N O00247	AC 200 V, 50/60 Hz, 3 phase, AC 200 V, 50/60 Hz, 3 phase, AC 380 - 415 V @ 50 Hz, 3 phase, AC 460 - 480 V @ 60 Hz, 3 phase.
operating current	P/N O00245 P/N O00246 P/N O00247	25 A (110 A starting current) 25 A (110 A starting current) 12 A (60 A starting current)
power requirement		9 kVA
power consumption maximum		8.3 kW
steady state		7.5 kW
Pressure relief valve setting		27.3 bar (390 psi)
Cooling water requirement (P/N O00246 and P/N O00247 only)		
minimum flow		7 L/min (420 L/hr)
recommended flow		10 L/min (600 L/hr)
pressure drop in He Compressor		1.6 bar (without calcification)
recommended pressure		3.2 bar
max. inlet pressure		7.0 bar
cooling power		7.5 kW (+ heat from opt. chiller)
water temperature (at He Compressor inlet)		4 - 28°C
recommended water temperature		15°C
water temperature (at He Compressor outlet)		max. 17°C higher than at inlet
pH value		6.5 - 8.2
hardness		≤ 200 mg CaCO ₃ /L
molybdate-reactive silica		≤ 50 mg/L
suspended matter		≤ 10 mg/L
connector type		pipe thread 3/8"

Each cooling water connector is fitted with a complete set (male+female) of self-sealing couplers that end in another pipe thread 3/8".

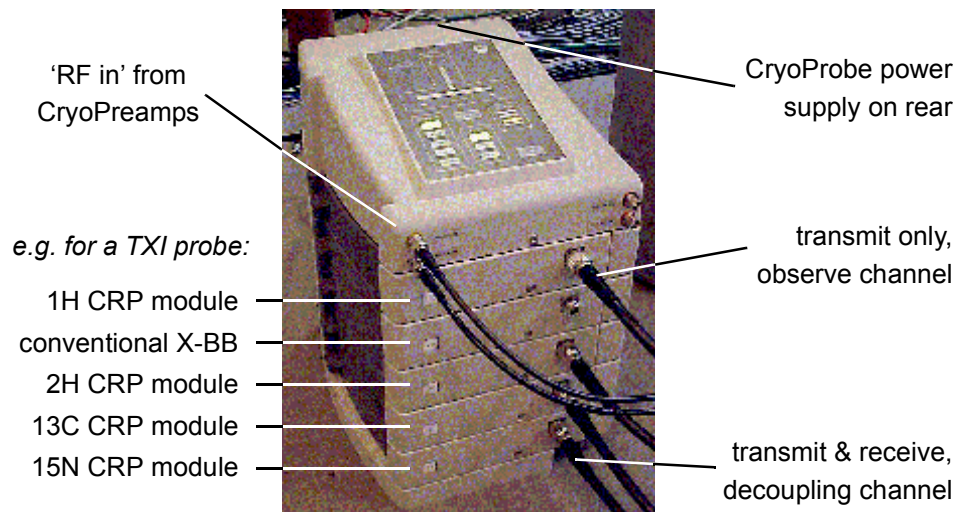
Acoustic noise ca. 65 dB(A) 2 m distance

Cryo-compatible preamplifier assembly 'HPPR CRP'

3.3

Although a CryoProbe has its own set of cold preamplifiers built-in, some HPPR functions such as RF filters in the transmission path, probe tuning, and selection of the received signal must be handled externally by a modified HPPR CRP assembly. Besides being suited for the operation with CryoProbes, this HPPR CRP can be used with all conventional probes. An existing HPPR will be exchanged for an HPPR CRP (see "**Compatibility**" on page 9).

Figure 3.3. Cryo-compatible preamplifier assembly 'HPPR CRP'



Technical data

Data for TXI configuration (cover and 5 HPPR modules), an X-BB module is included by default:

Dimensions (w × d × h in mm)	260 × 350 × 420
Weight	25 kg

Software

3.4

The CryoController can be interfaced to a computer running Windows™ 95/NT4 or later. Monitoring software is delivered with the CryoProbe System.

BRUKER contact

4

Submit your enquiries about CryoProbe sales and service to your local BRUKER representation. Use the following address only if they cannot help you.

CryoProbe information

4.1

CryoProbe information head offices:

BRUKER AG
Probe Department
Industriestrasse 26
CH-8117 Fällanden
Switzerland

phone: ++41-1-825 91 11
fax: ++41-1-825 96 96
e-mail: cryoprobe.info@bruker.ch
www: <http://www.bruker.de>

BRUKER Instruments, Inc.
44 Manning Road
Billerica, MA 01821
U.S.A.

phone: ++1-978-667-9580
fax: ++1-978-667-0985
e-mail: sales@nmr.bruker.com
www: <http://www.bruker.com>

CryoProbe service

4.2

CryoProbe service head offices:

BRUKER AG
Service Department
Industriestrasse 26
CH-8117 Fällanden
Switzerland

phone: ++41-1-825 91 11
fax: ++41-1-825 96 96
e-mail: cryoprobe.service@bruker.ch
www: <http://www.bruker.de>

BRUKER Center
BRUKER Instruments, Inc.
15 Fortune Drive
Billerica, MA 01821
U.S.A.

phone: ++1-978-667-9580, then press 2
fax: ++1-978-667-6168
e-mail: center@nmr.bruker.com
www: <http://www.bruker.com>

Related documents

A

The following documents contain further information.

CryoProbe Site Planning Questionnaire

A questionnaire for potential CryoProbe customers about their NMR laboratory and spectrometer. BRUKER needs this information for tailoring the CryoProbe System to the customer's needs and for preparing its installation.

CryoProbe System Site Preparation Manual (P/N Z31553)

This manual accompanies the *Site Preparation Set* which is delivered before other devices are sent. After being installed by the customer, the set provides the infrastructure for the actual CryoPlatform.

CryoProbe System User Manual (P/N Z31551)

Describes the setup and operation of a CryoProbe system.

CryoProbe data sheets

RF power limits, sample temperature range etc. specific for the actual CryoProbe.

He Compressor technical manual

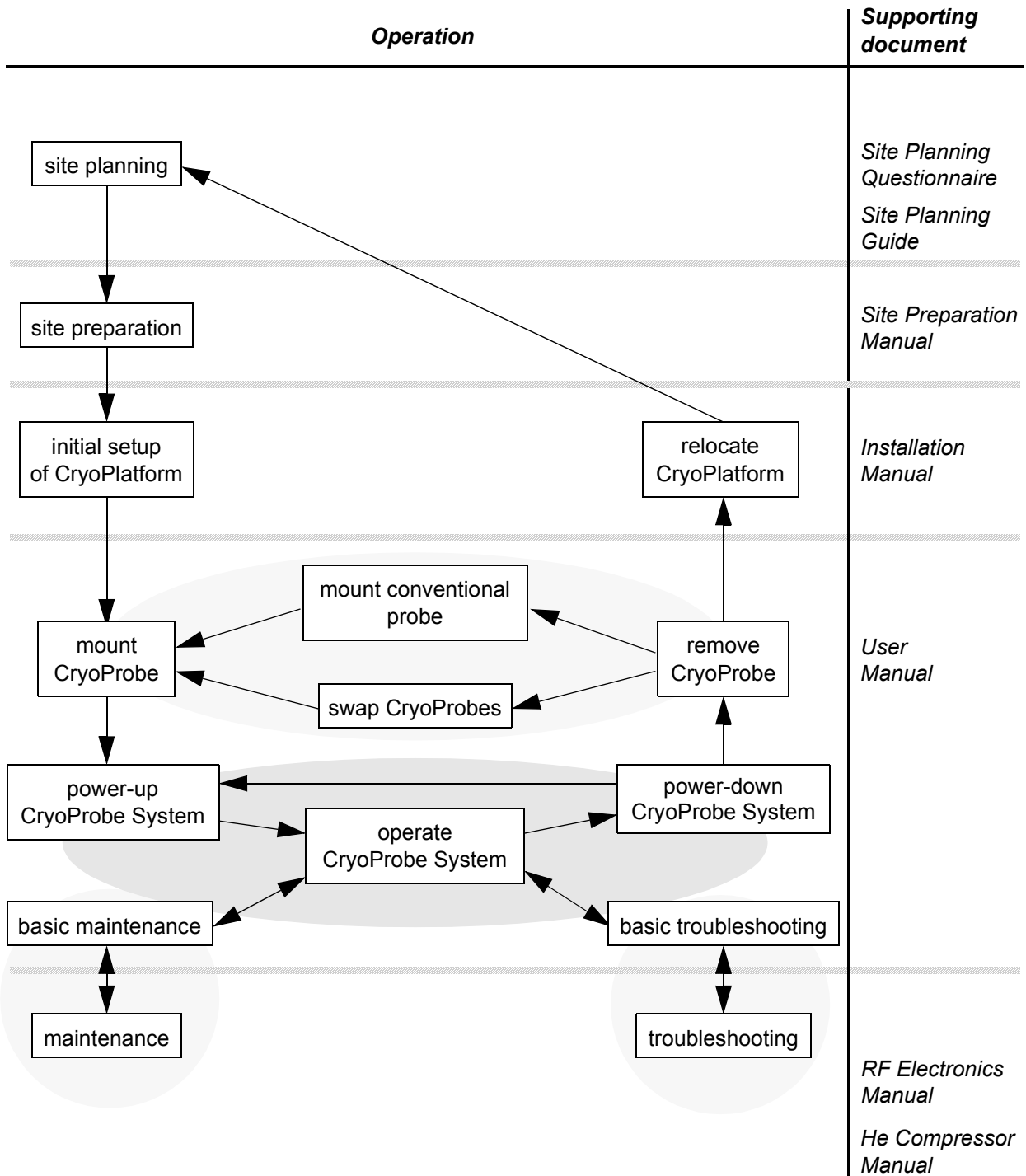
The operation manual is delivered with the He Compressor.

CRP RF Electronics Technical Manual (P/N Z31474)

Describes the RF wiring between CryoProbe and spectrometer, explains how to configure the HPPR CRP, lists technical data, and contains service information for the preamplifier system.

Related documents

Figure A.1. When to use which CryoProbe document



Building blocks for site planning

B

The following building blocks are useful for NMR laboratory site planning at a 1:50 scale. Make a copy of these pages, e.g. on transparent foil, and verify that the '1 m' reference measure in the drawings is still = 2 cm. Use a 1:50 plan of the laboratory to optimize the positions of the units.

AVANCE spectrometer

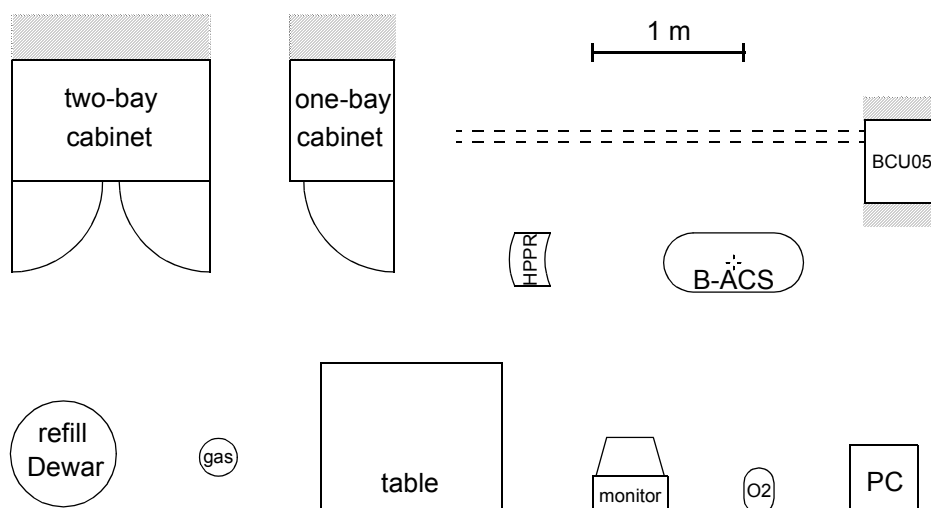
B.1

See also the *AVANCE 200-700 MHz Introduction to Site Planning* manual on the BASH-CD. In general:

1.0 mT = 10 Gauss: all equipment including shielded monitor

0.5 mT = 5 Gauss: an unshielded monitor will be slightly distorted

Figure B.1. AVANCE spectrometer components (scale 1:50)



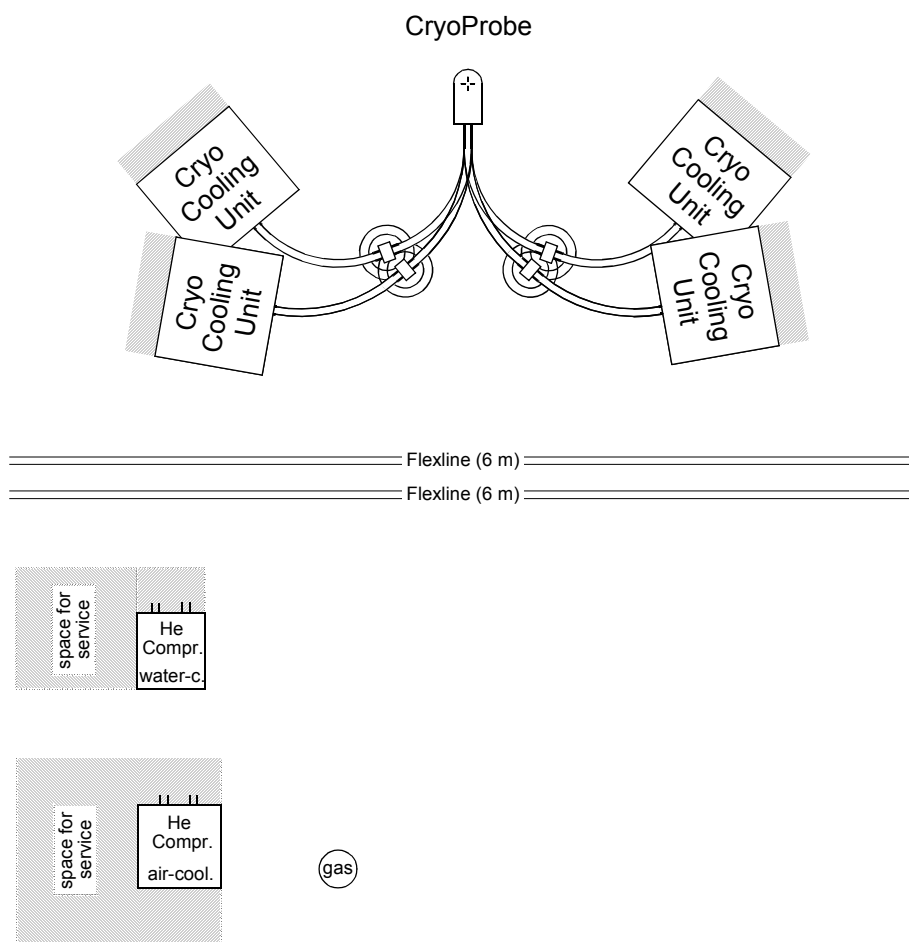
Magnetic stray fields

He Compressor, He steel-cylinder, and optional water chiller have to be kept outside the magnet's 0.5 mT field. As a rule, all spectrometer and CryoProbe System components should be as far away as possible from the magnets. In particular, the He steel-cylinder and its entire transport path must always be outside the 0.5 mT range.

Legend

 open space for ventilation

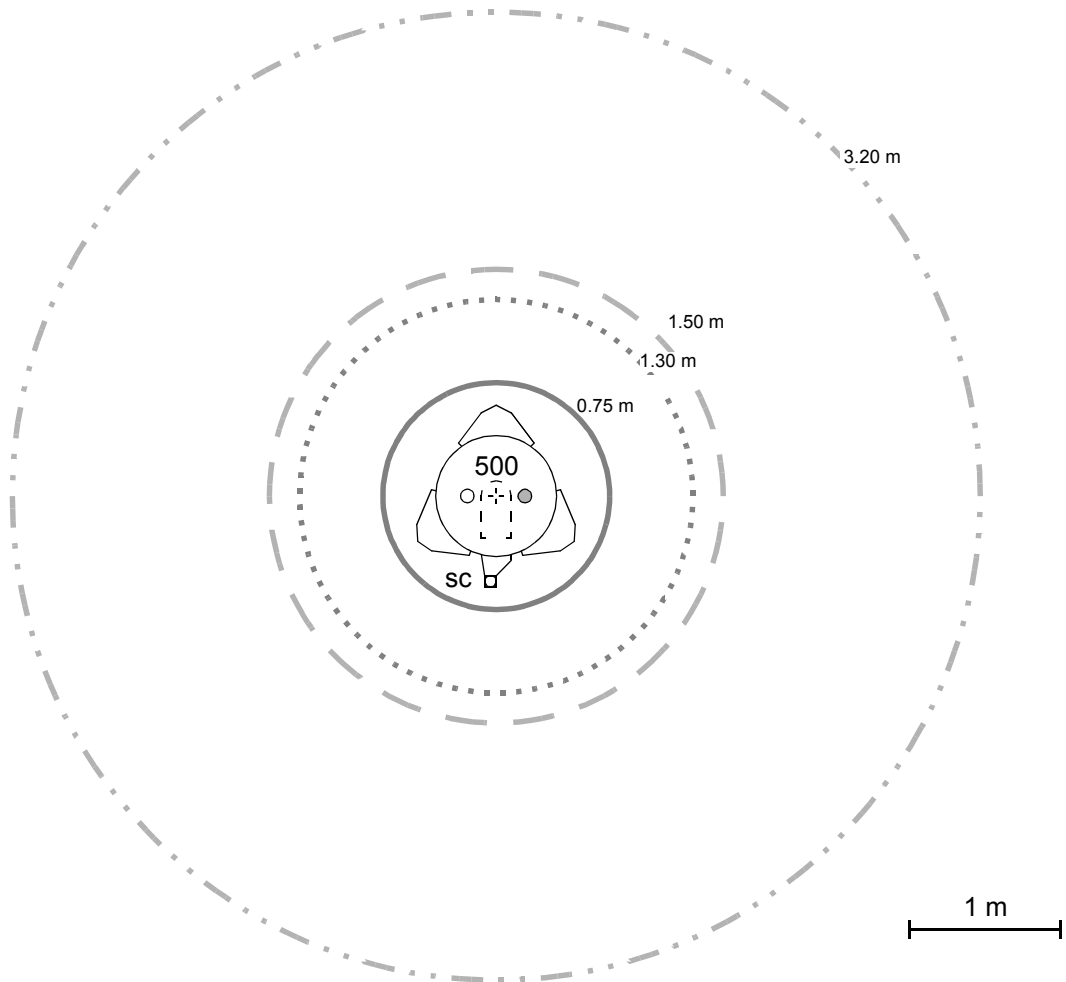
Figure B.2. CryoProbe System components (scale 1:50)



Legend

- 5.0 mT for ultrashielded™ magnet
- 0.5 mT for ultrashielded™ magnet
- - - - - 5.0 mT for non-shielded magnet
- · - · - 0.5 mT for non-shielded magnet
- ● magnet helium turrets (refill turret: grey)
- sc sample changer foot (optional)

Figure B.3. BRUKER 500 MHz magnet (scale 1:50)



The most common BRUKER/SPECTROSPIN magnet types are included with their stray field data to facilitate site planning in NMR laboratories with more than one magnet.

Figure B.4. BRUKER 300 MHz magnet (scale 1:50)

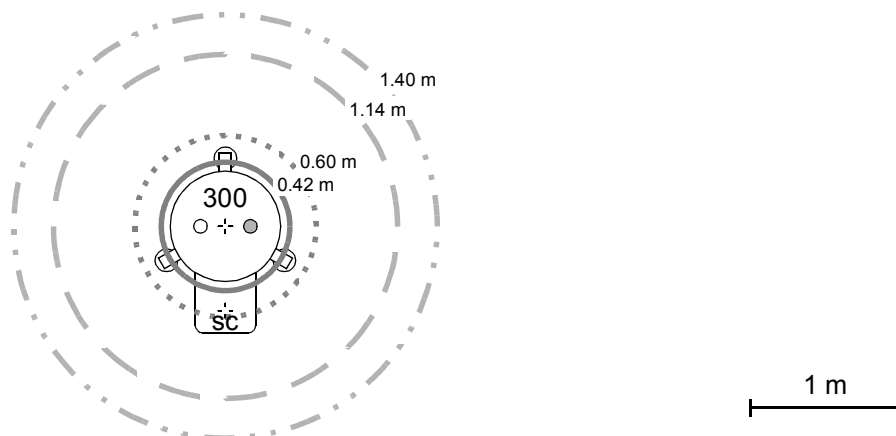


Figure B.5. BRUKER 400 MHz magnet (scale 1:50)

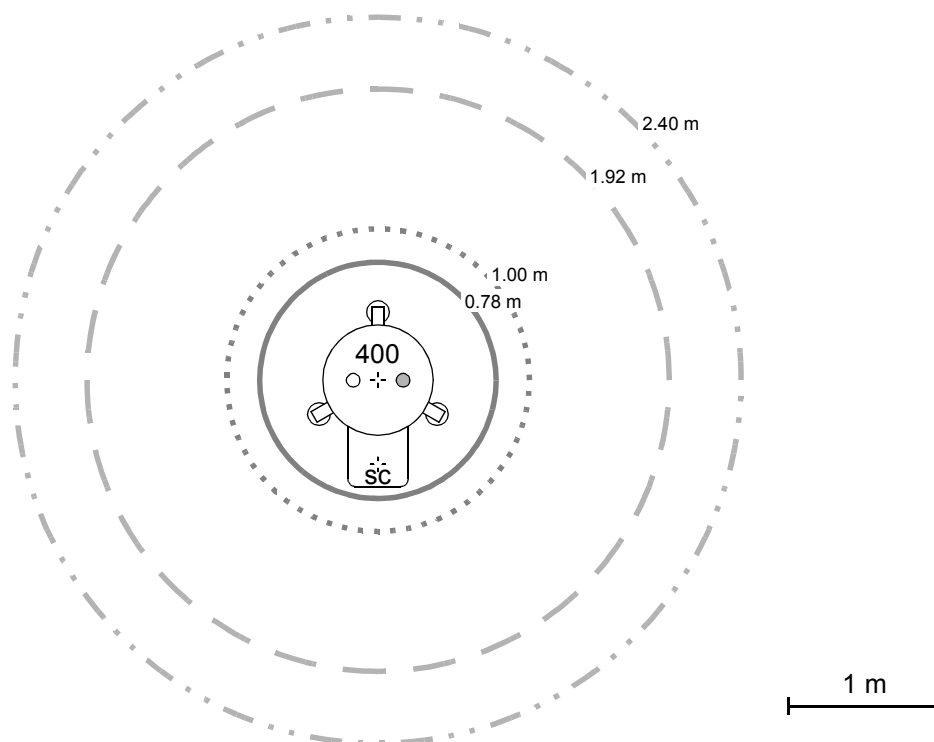


Figure B.6. BRUKER 600 MHz magnet (scale 1:50)

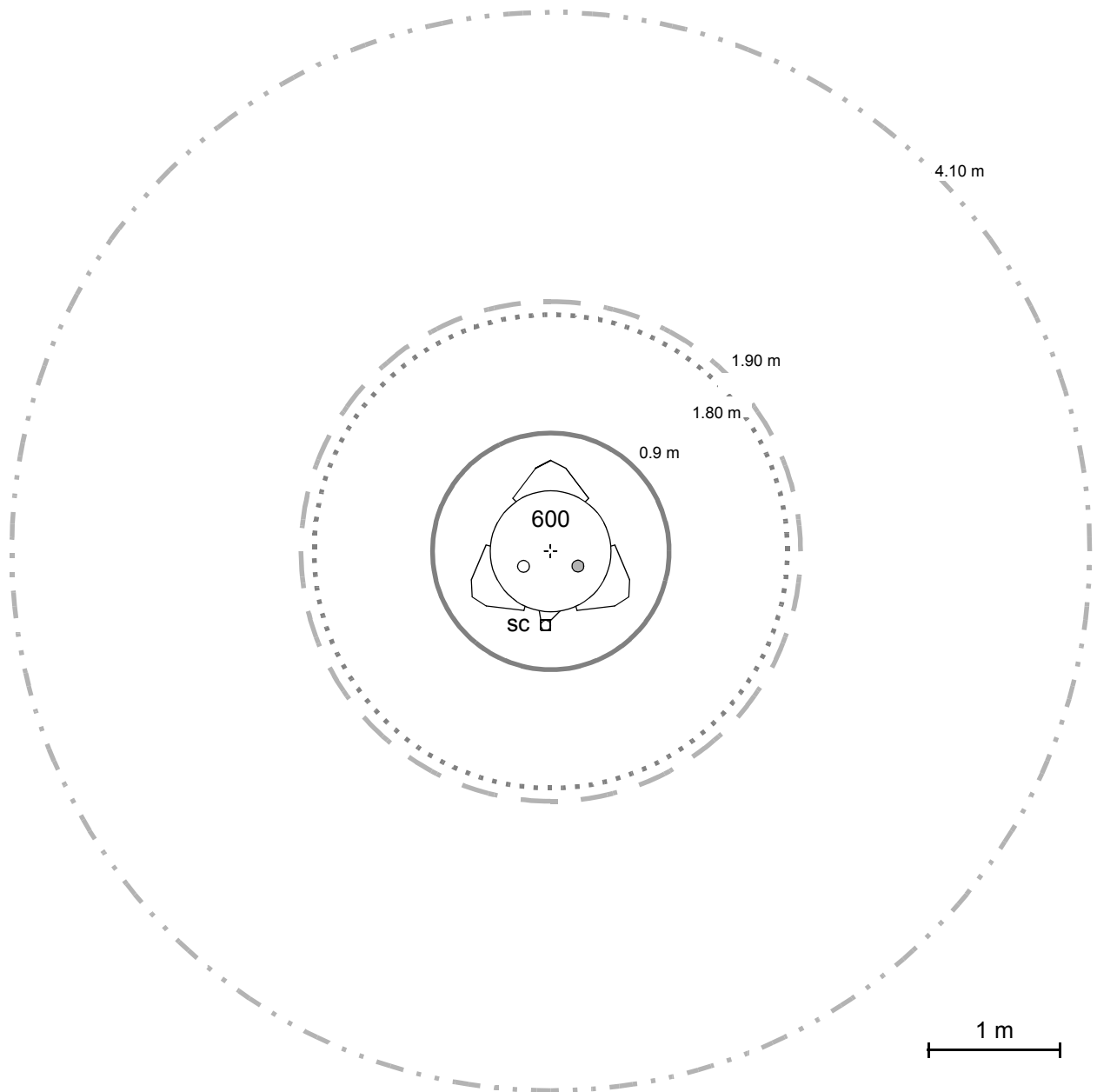


Figure B.7. BRUKER 700 MHz magnet (scale 1:50)

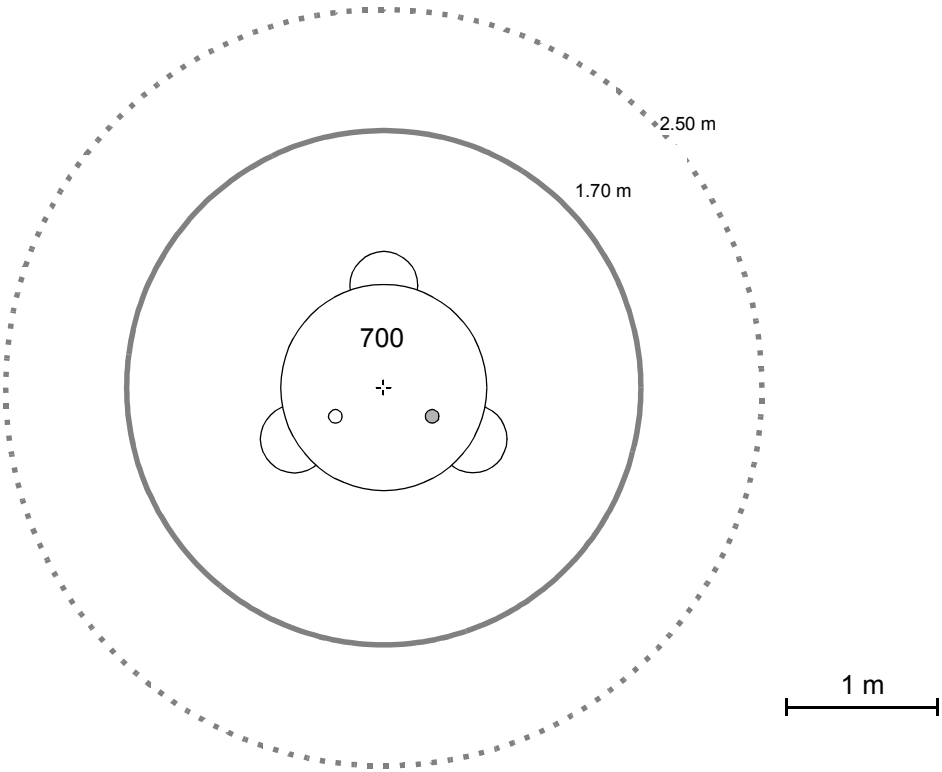


Figure B.8. BRUKER 800 MHz magnet (scale 1:50)

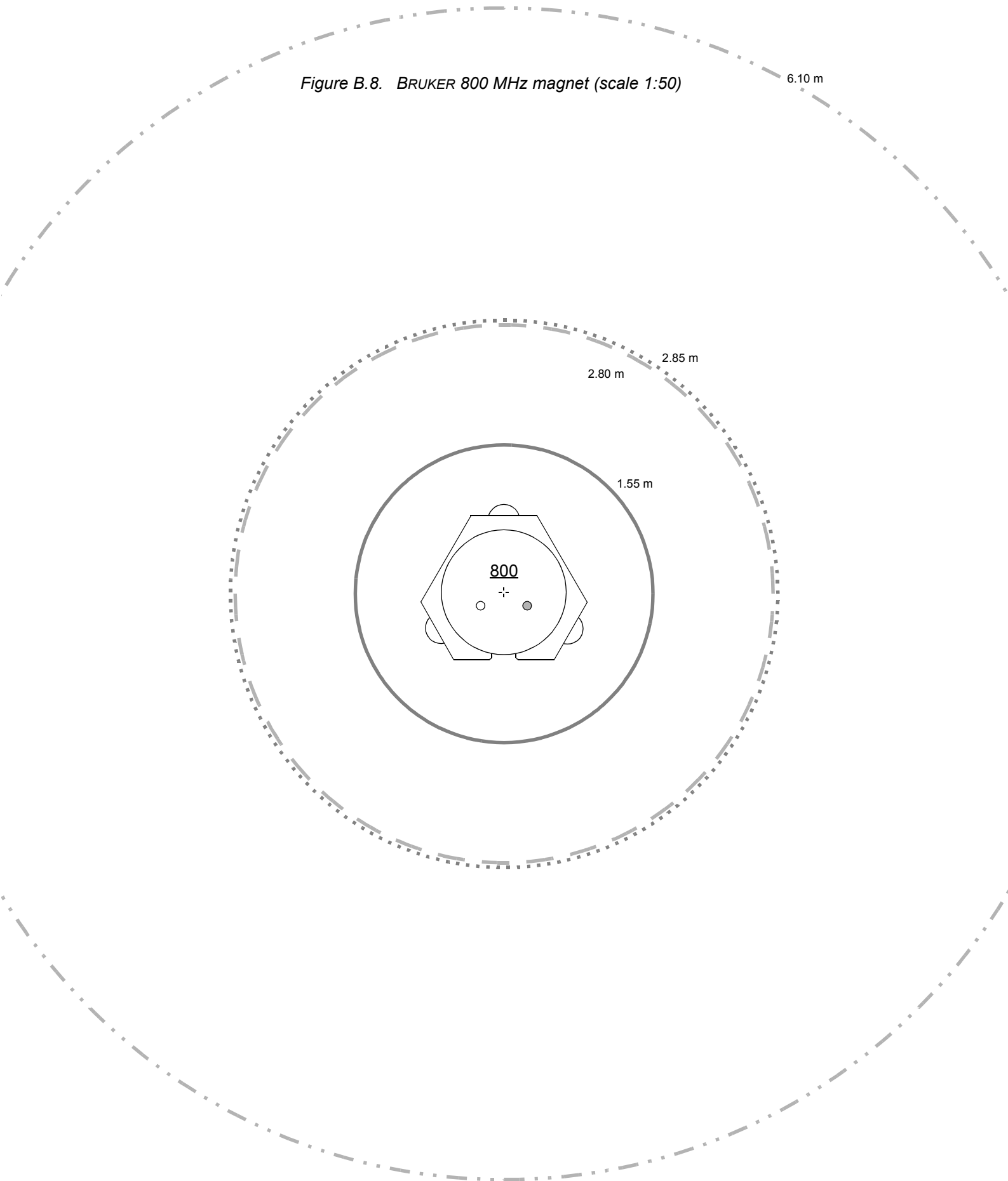
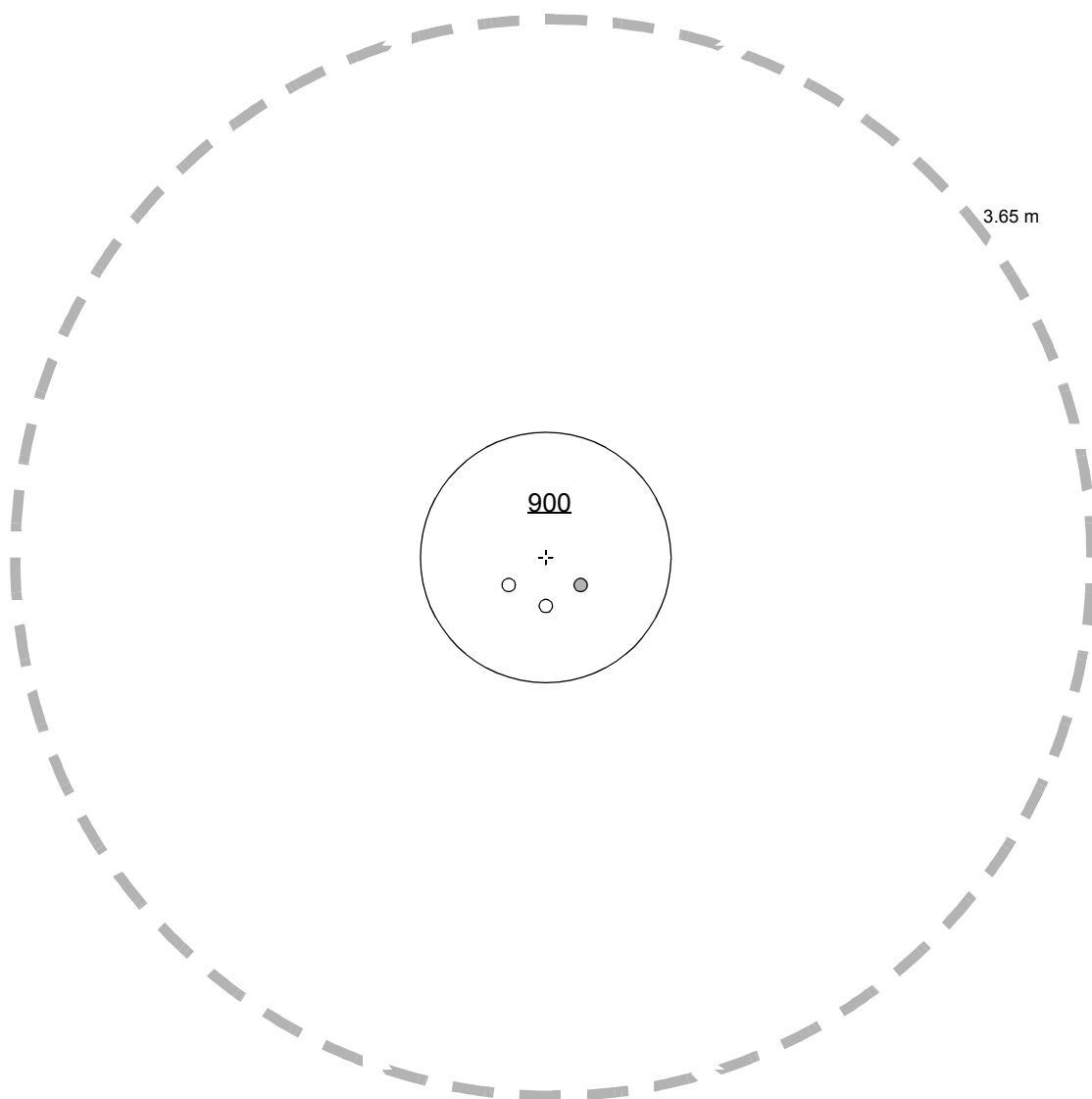


Figure 0.1. BRUKER 900 MHz magnet (scale 1:50)
0.5 mT line not shown (Radius 7.85 m)



Conversion of metric units

C

- 1 bar \equiv 0.1 MPa
- 1 bar \approx 14.5 psi
- 1 bar \approx 1.02 kgf/cm²
- 1 kg \approx 2.2 lb
- 1 mm \approx 0.04 inch
- 1 m \approx 3.28 feet
- 1 Nm \approx 8.85 lbf-inch
- 1 L (liter) \approx 0.264 gallon (U.S.)
- 1 L (liter) \approx 0.220 gallon (Brit.)
- 1 kWh \approx 3.6 MJ
- 1 kWh \approx 3412 btu
- 1 mT \equiv 10 Gauss
- $^{\circ}\text{C to }^{\circ}\text{F:}$
 $T_{^{\circ}\text{F}} = (T_{^{\circ}\text{C}} \times 1.8) + 32$
- 1 Pa \equiv 0.01 mbar
- 1 psi \equiv 68.95 mbar
- 1 kgf/cm² \approx 0.98 bar
- 1 lb \equiv 0.4536 kg
- 1 inch \equiv 25.4 mm
- 1 foot \equiv 0.3048 m
- 1 lbf-inch \approx 0.113 Nm
- 1 gallon (U.S.) \approx 3.79 L
- 1 gallon (Brit.) \approx 4.55 L
- 1 MJ \approx 0.278 kWh
- 1 btu \approx 0.293 Wh
- 1 Gauss \equiv 0.1 mT
- $^{\circ}\text{F to }^{\circ}\text{C:}$
 $T_{^{\circ}\text{C}} = (T_{^{\circ}\text{F}} - 32) / 1.8$

Table C.1. Conversion between $^{\circ}\text{C}$ and $^{\circ}\text{F}$ temperature scales

$^{\circ}\text{C}$	-30	-20	-10	0	10	20	30	40	50	60	70	80	90	100	110
$^{\circ}\text{F}$	-22	-4	14	32	50	68	86	104	122	140	158	176	194	212	230

Frequently asked questions

D

System configuration

D.1

Which CryoProbe types are or will be available?

Please ask your local BRUKER representative for the current choice of probes and accessories.

Can the CryoProbe be used with any magnet and spectrometer?

Any standard bore magnet can host a CryoProbe. However, specifications are guaranteed only if the B_0 homogeneity of the magnet suffices (i.e. if it allows to reach specifications with recent conventional BRUKER probes) and if a BOSS-2 shim system is present. One mechanical restriction is given by the clearance below the magnet between shim system and floor that is needed for insertion of the CryoProbe. Another restriction can be vacuum valves, drop-off plates or the like at the magnet dewar bottom. Ask your BRUKER representative for compatibilities.

Since the CryoProbe System must interact with an AVANCE spectrometer, it cannot be connected to other spectrometer types.

How much space is required by the CryoProbe System?

Rough estimate: 6 m². If the He Compressor is located in an adjacent room, about 4 m² suffices.

Can conventional probes still be used on a spectrometer that is equipped with a CryoProbe System?

Yes. A conventional probe can be connected to the spectrometer as usual. However, certain special probes or auxiliary devices might cause geometrical conflicts which can be easily and quickly resolved by removing the guiding rods of the CryoProbe Mounting Hardware.

Is a VT gas cooler recommended?

The CryoProbe can be operated with and without a VT gas cooler. Currently, only the BCU05 is approved. It is needed for measurements below room temperature and slightly above room temperature (i.e. up to 2 - 5°C higher). A nitrogen evaporator must not be used.

Do any experimental restrictions result from the high Q factor of the CryoProbe?

The Q factor is optimized for each NMR coil assembly to minimize any problems with ring-down times, radiation damping, or excitation bandwidths, still allowing maximum gain in sensitivity.

Is the CryoProbe more sensitive to external disturbances?

Just in proportion to its higher signal-to-noise ratio.

Is it possible to measure water samples?

Yes.

Is it possible to measure samples with a high salt concentration?

Yes, but the usual restrictions apply: the higher electrical conductivity of a salt solution reduces the penetration depth of the RF, spoils the Q factor of the resonance circuit, and introduces additional spectral noise.

Is shimming more difficult?

Manual shimming is not much different from conventional probes. There are no particularly strong shim gradients to be set. Gradient shimming is possible.

Does the user have to modify the pulse programs?

Usually not. Of course, those conventional pulse sequences that are optimized for high signal-to-noise and suppression of spurious signals are still highly recommended.

Which experimental parameters do I have to be careful with to avoid damage to the CryoProbe?

Maximum RF power. In general, a CryoProbe requires significantly less RF power to achieve the same pulse lengths as conventional probes.

Does the CryoProbe change its characteristics during long decoupling or spin-lock periods?

Long decoupling or spin-lock periods tend to warm-up the RF components in any probe. For such experiments, it might be advisable to equilibrate the CryoProbe with dummy scans before data acquisition starts. Significant changes in tuning & matching are not to be expected.

Do experimental parameters like shims and pulse angles change after a warm-up/cool-down cycle? Is the sensitivity preserved?

Parameters like shim, tuning & matching, or pulse angles are constant with minor variations as known from conventional probes. Experience so far indicates that the excellent sensitivity of the CryoProbe does not suffer from repeated warm-up/cool-down cycles if the recommended operation procedures are obeyed.

Is the CryoProbe performance stable and reproducible in the long term?

Experience so far: Yes.

Will the CryoProbe be damaged if the cryocooling is accidentally interrupted during a measurement?

An interrupt in the cryocooling should not break the CryoProbe.

Basic aspects

D.3

Why does the CryoProbe have such a high signal-to-noise ratio?

Thermal noise is greatly reduced by cooling the NMR coil assembly and the preamplifiers to cryogenic temperatures. Furthermore, the low electrical resistance enhances the Q factor of all resonant circuits in the probe and its filters.

What is inside a CryoProbe?

The CryoProbe contains a tuned NMR coil assembly, a gradient coil, preamplifier electronics, and supervisor electronics inside a vacuum isolated dewar. Cold helium gas is circulated to cool the NMR coil assembly and the preamplifier electronics while the sample is kept at ambient temperature. All the common probe functions needed for RF transmission, tuning, gradient pulses, and VT gas duct are built into the CryoProbe, while the sample lift and spinning are provided as usual by the shim upper part.

What does the NMR coil look like?

The NMR coil assembly generates a transverse B_1 -field for the tuned frequencies. Its material, geometry, and associated RF circuits are optimized for each type of probe. Details of the coil assembly design are proprietary knowledge of BRUKER.

What is the helium consumption of the CryoProbe System?

No liquid helium is used whatsoever. Helium gas (He) is needed for the initial fill of the closed-loop system and for flushing the system before each cool-down. During cold operation, the He consumption is negligible. A standard He steel-cylinder (50 L) can last for more than 40 cool-down/warm-up cycles.

Can the user repair any part of the CryoProbe?

No, there are no user-serviceable parts on or inside a CryoProbe. Essential parts of a CryoProbe may easily be broken during opening or closing. Therefore, service actions on the CryoProbe can only be done at the factory. **BRUKER warranty expires if the CryoProbe is opened by unauthorized personnel.**

Glossary

E

Adsorber

Device inside the He Compressor that adsorbs oil and other impurities from the circulated helium gas (He).

BBIS

BRUKER Board Information System

Coldhead

Cools down compressed He in a Gifford-McMahon expansion cycle. Its two stages are the primary cooling devices of the CryoCooler.

CryoController

Controls all functions of CryoProbe and CryoPlatform. It communicates with the spectrometer and is located inside the CryoCooling Unit.

CryoCooler

The CryoCooler cools and circulates the cold He. It consists of the Coldhead in a cold box unit and a gas circulation unit with valves and gauges. In contrast, the term 'CryoCooling Unit' denotes the whole cabinet including vacuum system etc.

CryoCooling Unit

A cabinet that contains the CryoCooler, the CryoController, a vacuum system, and the He Transferline. It is labelled 'CryoPlatform' because it is the most prominent part of a CryoPlatform.

CryoCoupler

Standardized interface between the He Transferline from the CryoCooling Unit and the CryoProbe that connects both forward and backward streams of cold He at once.

CryoPlatform

All parts needed for operating a CryoProbe with a spectrometer, i.e. CryoProbe Mounting Hardware, CryoCooling Unit, He Compressor, He Transferline, Transferline Support, VT Interface Box, and optional magnet stand modifications. However, the HPPR CRP, and the He steel-cylinder are not parts of the CryoPlatform.

CryoPreamp

A cryogenically cooled preamplifier module inside the CryoProbe housing. There is a frequency-specific preamp module for each channel of a CryoProbe. A CryoPreamp cannot be separated from its CryoProbe. It always requires an additional external HPPR assembly, the cryo-compatible HPPR CRP.

CryoProbe

Although the CryoProbe System is often colloquially referred to as 'CryoProbe', this term designates the probe part only.

CryoProbe RF Unit

All CryoPreamps, transmit/receive switches, RF filters for the receiver pathways, and control circuits that are built into the CryoProbe body.

CryoProbe System

A CryoProbe and all components necessary for its operation.

CryoTool

A software interface for monitoring the CryoProbe System parameters. It runs on a separate laptop or PC.

Dump Tool

A short gas tube with a silencer. This service tool is used to release the He supply pressure at the joint between He Regulator and He Hose before the He steel-cylinder is exchanged.

Flexlines

A pair of flexible tubes that guide pressurized He at ambient temperature from the He Compressor to the CryoCooling Unit and back. Pressurized He at 15 to 30 bar is kept inside these gas tubes at all times - even when disconnected! They are isolated to reduce thermal disturbances and acoustic noise.

Gradient Filter Box

Small box to interface a standard BRUKER gradient cable to the CryoProbe.

He

Gaseous helium of high purity, used for cryogenic cooling of the CryoProbe.

He Compressor

Warm He from the CryoProbe is routed through the CryoCooling Unit to the He Compressor. The compressed He is sent back to the CryoCooling Unit, circulating in a closed loop.

The He Compressor serves two functions: (1) It provides the primary energy (in form of compressed He) for the cooling action of the CryoCooler. (2) It circulates the He between the CryoCooling Unit and the CryoProbe, providing the transport of 'the cold' to the CryoProbe.

He Hose

Flexible hose for pressurized helium gas that connects the He steel-cylinder with the CryoCooling unit.

He Regulator

A pressure reduction valve with two gauges that is mounted on the He steel-cylinder.

He steel-cylinder

Standard helium gas steel-cylinder (50 L) for the initial fill of the CryoProbe System and for flushing the closed-loop He cycle before each cool-down.

He Transferline

Isolated tube through which the cold He from the CryoCooling Unit flows to the CryoProbe. The He Transferline is part of the CryoCooling Unit and cannot be detached from the cabinet. It goes in parallel with the vacuum tube.

HPPR CRP

Cryo-compatible preamplifier assembly located close to the magnet that is a stack of frequency-specific preamplifier modules, a cover module, and a base plate. Together with the CryoPreamp inside the CryoProbe, the HPPR CRP forms the NMR preamplifier system. Although it looks very similar to a conventional HPPR, its components are modified for interacting with both a CryoProbe or a conventional probe. When operating with a CryoProbe, the HPPR CRP performs the RF filtering in the transmitter pathway, selects the received signal, handles the probe tuning, and supplies the CryoProbe electronics. An HPPR CRP can be used with conventional probes just like a conventional HPPR.

HPPRtool

Software tool on the spectrometer workstation Unix/NT level that interacts with all HPPR types.

Magnet stand pillar braces

Horizontal metal braces that connect the anti-vibration stands of certain BRUKER/SPECTROSPIN magnets. Two braces at the magnet front must be replaced by cranked ones to enlarge the gap for introducing the CryoProbe.

Mounting Hardware

Special assembly that is attached to the magnet bottom to hold the CryoProbe in position.

PIC

Probe Identification and Control system that transmits probe-specific data to the spectrometer.

Pneumatic gas

Usually compressed air or nitrogen gas at 4.5-6 bar for the operation of the pneumatic valves inside the CryoCooling Unit.

Protection Cap

A white plastic cap to protect the CryoProbe sample cavity against dirt during transport, testing, or storage.

Q factor

The quality factor Q is a measure of the efficiency of reactive devices such as inductors, capacitors, or resonant circuits.

RF

Radio frequency

Transferline Support

A heavy upright cylinder that supports the He Transferline about halfway between the CryoCooling Unit and the CryoProbe. It also isolates the CryoProbe from mechanical vibrations of the CryoCooling Unit.

Tuning Adapter

Removable assembly of tuning and matching knobs. A VT gas connector is also included. Its geometry depends on the type of CryoProbe.

Tuning Tool

A special blue screwdriver to operate the tuning and matching knobs of a CryoProbe's Tuning Adapter.

UniTool

Software tool on the CryoProbe System laptop to interact with the CryoController or other units. Under Windows NT **Start->BrukerAG->UniTool**.

UPS

Uninterruptable Power Supply, a kind of battery that compensates for fluctuations and interruptions in the mains.

Vacuum Adapter

Adapter for evacuation of the CryoProbe insulation, connected to its bottom. It features an airtight actuator screw to move the CryoProbe's Vacuum Plug in and out.

Vacuum Plug

A small metal plug with an o-ring and an inner thread that closes the CryoProbe vacuum chamber against moisture and dirt.

Vacuum tube

Flexible metal vacuum tube that connects the CryoProbe isolation to the vacuum system inside the CryoCooling Unit. It is parallel to the He Transferline.

Vacuum system

Vacuum pumps and valves that evacuate the dewar insulations of CryoProbe, He Transferline, and CryoCooler. Located inside the CryoCooling Unit.

VT gas

Usually nitrogen gas or dry air at a controlled variable temperature that flows through a probe to heat or cool the sample. Its function must not be confused with the 'pneumatic gas' used for operating valves inside the CryoCooling Unit or with the helium gas circulated through the CryoProbe for cryogenic cooling.

VT Interface Box

A small box with two cables which interfaces heater and temperature sensor between CryoProbe and VT unit.

VT unit

A device that controls the flow and temperature of the VT gas, e.g. a B-VT3000.

Water chiller

The water-cooled versions of the He Compressor require cooling water to remove 7.5 kW of heat. A water chiller is recommended if no closed cycle cooling water is available in the laboratory building.

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