

**Cryostat with Variable
Temperature Insert and 12T
Magnet**

**Procurement Specification /
Cahier des Clauses Techniques
Particulières**

Approbation F. Blondelle		Distribution
Verification F. Gay		
Author F. Blondelle / F. Gay	Date: 01/09/2025	

CHANGE RECORDS

ISSUE	DATE	EVOLUTION OF THE DOCUMENT	JUSTIFICATION

TABLE OF CONTENTS

List of Tables	4
II. ACRONYMS AND ABBREVIATIONS	5
III. INTRODUCTION / PURPOSE OF THE DOCUMENT	5
IV. TENDER FIRM OFFER	6
IV.1 CRYOSTAT PERFORMANCE REQUIREMENTS	6
IV.2 PULSE TUBE COOLER	7
IV.3 SUPERCONDUCTING SOLENOID	7
IV.4 SAMPLE PROBE	7
IV.5 MONITORING SYSTEM	7
IV.6 TEMPERATURE MEASUREMENT	8
IV.7 INTERFACE REQUIREMENTS	8
IV.7.a IMPLEMENTATION IN THE EXPERIMENTAL ROOM	8
IV.8 RELIABILITY	8
IV.9 MISCELLANEOUS	8
IV.9.a RESOURCES	8
IV.9.b DOCUMENTATION	8
V. MANDATORY OPTIONS (PSE)	9
V.1 HELIUM 3 PROBE	9
V.2 ROTATION PROBE	9
V.3 BREAKOUT BOX	9
V.4 SAMPLE PROBE	9
V.5 SAMPLE PROBE without wiring	9
VI. NON-MANDATORY OPTIONS (PSE FACULTATIVE)	9
VI.1 ADVANCED ANTI-VIBRATION SYSTEM	10
VI.2 WARRANTY EXTENSION	10
VII. DELIVERY TIME	10
VIII. WARRANTY	10
IX. APPENDIX 1 : MAINTENANCE TABLE, AN EXAMPLE	11
X. APPENDIX 2: LIST OF COMPONENTS, AN EXAMPLE	11

List of Tables

<i>Table 1: Cryogenic performance</i>	<i>7</i>
<i>Table 2: Example of table for the maintenance plan. The list of components in this table is not exhaustive</i>	<i>20</i>
<i>Table 3: Example of table for the list of components</i>	<i>21</i>

I. APPLICABLE AND REFERENCE DOCUMENTS

N°	Reference	Title	Issue
CM		Compliance Matrix	1

II. ACRONYMS AND ABBREVIATIONS

VTI	Variable temperature insert
CU	Control Unit
GHS	Gaz Handling System
LoS	Line of Sight
NA	Not Applicable
NE	Not Evaluated
PC	Partially Compliant
PSE	“Prestations Supplémentaires Eventuelles” (= Options)
PT	Pulse Tube
TBC	To Be Confirmed
TBD	To Be Defined
TC	Temperature controller

III. INTRODUCTION / PURPOSE OF THE DOCUMENT

Institut Néel Automatisation et Caractérisation team is enquiring for a cryofree with a VTI and a 12T magnet, and a top loader sample exchange mechanism.

The technical requirements for this apparatus are listed in the next sections of the document.

All technical requirements and minimum expected values shall be considered mandatory. The evaluation will also be based on the “goal” parameters, with higher scores awarded to

IV. TENDER FIRM OFFER

proposals that best fulfil these targets.

IV.1 CRYOSTAT PERFORMANCE REQUIREMENTS

The cryostat must include a superconducting solenoid as described in the part IV.3 as well as a variable temperature insert. The required performances of the cryostat are detailed in the table below.

Req. IV.1.1: Possibility to drive the temperature directly with our own software by bypassing the supplier software

Req. IV.1.2: The cryostat shall be equipped with pumps for the VTI as well as for vacuum pumping. This cryostat must be a Cryofree, meaning it does not require the user to transfer liquid helium

Req. IV.1.3: The cryostat (and thus the VTI) shall be compatible with a Helium-3 insert, enabling operation down to 300 mK. This insert may be purchased at a later stage.

Req. IV.1.4: Ergonomics and ease of use of the cryostat and inserted probes will be evaluated

Ref	Designation	Required minimal value	Goal	Comment
Req. IV.1.5	Minimum temperature	$\leq 1,6$ K	1,5 K	Temperature at the sample stage
Req. IV.1.6	Maximum temperature	≥ 300 K	360 K	Temperature at the sample stage
Req. IV.1.7	Cooling down time of the all cryostat from 300K to base temperature	≤ 72 hours	60 hours	From room temperature to 4 K with magnet
Req. IV.1.8	First cooling down time of the sample from 300K to base temperature	≤ 3 hours	2 hours	From room temperature to 4 K
Req. IV.1.9	Speed of the temperature ramp		5 K/min	
Req. IV.1.10	Continuous operation without warming up magnet	≥ 4 weeks	3 months	

Table 1: Cryogenic performance

IV.2 PULSE TUBE COOLER

The Pulse Tube cooler shall be adapted to fulfil the above requirements.

Req. IV.2.1: The pulse tube cooler should have a cooling power ≥ 1 W at 4.2K

IV.3 SUPERCONDUCTING SOLENOID

The dilution refrigerator must include a superconducting solenoid.

Req. IV.3.1: Possibility to drive magnet power supply with own software

Ref.	Designation	Required minimal value	Goal
Req. IV.3.2	Superconducting solenoid equipped with persistent switch, diode quench protection, current leads and electrical feedthrough	≥ 12 T at 4.2 K	
Req. IV.3.3	Magnet power supply	Enables reaching 12 T in 1h (from 0 T).	30 min
Req. IV.3.4	Homogeneity		≤ 0.5 % sur 10 mm
Req. IV.3.5	Magnetic field stability in persistent mode		10^{-4} relative/h at 12T

IV.4 SAMPLE PROBE

A probe shall be supplied with the cryostat to enable basic measurements.

Ref.	Designation	Required minimal value	Goal
Req. IV.4.1	Minimum size of sample carrier	≥ 10 mm x 10mm	max
Req. IV.4.2	Number of DC lines	≥ 20	25

IV.5 MONITORING SYSTEM

The monitoring system main requirements are:

Req. IV.5.1: Elapsed time for each of the components requiring maintenance (Pulse tubecooler, pumps, etc) shall be recorded and easily accessible.

IV.6 TEMPERATURE MEASUREMENT

The system shall include a temperature control. The temperature control main requirements are:

Req. IV.6.1: The system shall comprise at least the following thermometers

- 1 thermometer on the VTI
- 1 thermometer on the probe

IV.7 INTERFACE REQUIREMENTS

IV.7.a IMPLEMENTATION IN THE EXPERIMENTAL ROOM

Req. IV.7.a.1: The supplier shall provide the main dimensions of the major components: at least cryostat, pulse tube, etc.

Note that the PT compressor will be located in the basement, beneath the experiment room. The distance between the PT remote valve and the compressor is estimated to be about 20 meters.

Req. IV.7.a.2: The ceiling height of the experimental room is 3.5m, installation and cryostat operation must be possible with this ceiling height.

IV.8 RELIABILITY

Reliability / maintenance issues are of outmost importance.

Req. IV.8.1: The supplier shall provide, within the technical proposal, the list of elements requiring maintenance and provide technical details on the maintenance to be performed. An example of table is given in Appendix (§IX).

IV.9 MISCELLANEOUS

IV.9.a RESOURCES

The system will need power supply as well as compressed air or water and other potential resources.

Req. IV.9.a.1: The supplier shall indicate, within the technical proposal, the necessary resources: number and type (mono-phase, 3-phase, type of plug) of power supplies, number of lines for compressed air and associated technical specifications (e.g. nominal pressure), number and type of water lines and associated technical specifications (e.g. flowrate), any other resources needed to operate the system.

IV.9.b DOCUMENTATION

Req. IV.9.b.1: The supplier shall provide, in the course of the project, all necessary documentation to operate the system and ensure proper maintenance. This includes at least:

- User Manual with detailed operation instructions, troubleshooting, software description
- Maintenance plan
- Calibration data for thermometers, etc
- Interface drawings updated according to the “as built” system
- Factory test report (at supplier’s premises).
- Test protocol (for the test at customer’s premises)
- Acceptance test report (after successful tests at customer’s premises)
- All required documentation in English: certificates of conformity, calibration certificates, etc

For an easier implementation of the experiment (coils, samples, etc) 3D STEP files of the system would be helpful.

V. MANDATORY OPTIONS (PSE)

V.1 HELIUM 3 PROBE

Probe to cooldown sample around 300mK.

V.2 ROTATION PROBE

Probe to rotate the sample in-situ.

V.3 BREAKOUT BOX

At room temperature to address the DC lines with ground switches.

V.4 SAMPLE PROBE

Quote an additional sample probe

V.5 SAMPLE PROBE without wiring

Quote an additional sample probe without wiring

VI. NON-MANDATORY OPTIONS (PSE FACULTATIVE)

In this section, we define a list of non-mandatory options that can be proposed by the supplier.

VI.1 ADVANCED ANTI-VIBRATION SYSTEM

CNRS may want to minimise the level of exported vibrations. Systems such as a very low vibration support structure might be proposed.

Req. VI.1.1: The supplier shall provide the basic list of components / features comprised in the option.

Req. VI.1.2: The supplier shall provide all technical details relative to this option e.g.:

- Performance
- Drawings
- Update of mass budget

VI.2 WARRANTY EXTENSION

Costs of possible warranty-related extensions.

VII. DELIVERY TIME

Req. VII.1: Important evaluation criterion will be the delivery time. 12 months maximum and ideal delivery time is 6 months.

VIII. WARRANTY

Req. VIII.1: Important evaluation criterion will be the warranty. Minimum warranty is 2 years.

IX. APPENDIX 1 : MAINTENANCE TABLE, AN EXAMPLE

An example of table for the maintenance activities is provided below:

Component	Type of activity	Frequency	Estimated cost	Comment
Temperature sensors	Calibration	TBD	TBD	
Turbo Pump				
Scroll pump				
PT Compressor				
PT Cold head				

Table 2: Example of table for the maintenance plan. The list of components in this table is not exhaustive.

X. APPENDIX 2: LIST OF COMPONENTS, AN EXAMPLE

Designation	Comments / Details
Pulse Tube Cooler Assembly	Compressor + Cold Head + Flex lines + Documentation
Current leads	Type of materials, etc
Support plate	
Auxiliary pumping unit	Option
Monitoring software	

Table 3 : Example of table for the list of components.

END OF THE DOCUMENT