Cryostat design and heat loads

Alexey Bragin, Mikhail Kholopov Budker Institute of Nuclear Physics, Novosibirsk, Russia

CDR meeting, May 2017



Cryogenic diagram

For the transfer line the most tubes were chosen to be DN15 STD, so OD = 21.34 mm, ID = 15.8 mm.

The valves are of PN25 type. Valves stems have interceptions at ~ 65 K temperatures.

Pressure drop about 0.006 bar at nominal operation

Heat transfer to the radiation shields is on return 50 K line.

The return line will have about 60 K



Total heat loads

Table 3 Heat loads on 4.5 K helium from both coils and the cryostat		Table 4 Heat loads on 50 K helium from both coils and the cryostat	
Heat load from	Values	Heat load from	Values
Thermal radiation on the LHe case, W	0.12	Thermal radiation on the shields from the vacuum vessel, W	10
Support struts, W	13	Support struts, W	38
Tie rods, W	0.05	Tie rods, W	0.5
Soldering connection of the cable (at least 6 short splices), W	0.12	Thermal radiation on the cryostat shield, W	1.5
Thermal radiation on the cryostat, W	0.015	Cryostat suspension, W	2
Cryostat suspension, W	< 0.1	Current leads, W	50
Current leads, W	0.5	Measurements wires, W	0.5
Measurements wires, W	< 0.1	Heat bridges of the cryostat neck and others connections, W	1
Heat bridges of the cryostat neck and others connections, W	< 0.1	Total, W	~ 104
Total, W	~ 14.1	*) It will be corrected after detailed design of the current leads	•

Table 5 Heat loads on 4.6 K helium from the Branch Box, the Feed Box and the transfer line			
Heat load from	Values		
Thermal radiation on 4.5 K surfaces from the shields on the FB and BB, W	0.15		
Supports and suspensions, W	< 2		
Control Valves, W	15.2		
Check Valves, W	0.9		
Measurement wires, W	< 0.01		
Heat bridges of the cryostat neck and others connections, W	< 1		
Total, W	19.26		

Total heat loads:

for 4.6 K He is 33.4 W

for 50 K He is 186 W

Mass rates: for 4.6 K He is 1.7 g/s for 50 K He is 1.8 g/s

Table 6 Heat loads on the 60 K helium (return line) from the Branch Box, the Feed Box and the transfer line

Heat load from	Values
Thermal radiation on the shields from the vacuum vessel, W	7
Support and suspensions, W	20
Control valves, W	38
Check valves, W	11
Measurement wires, W	< 1
Heat bridges of the cryostat neck and others connections, W	5
Total, W	82

Design of the Branch Box, view 1





Design of the Branch Box, view 2



Design of the Feed Box, view 1





Design of the Feed Box, view 2















Interface (as example)



The working folder contains:

- T_test.exe executable code;
- Server.uir user interface resources;
- Port.cfg configuration file for RS232 connection;
- T_data.cfg configuration file for temperature sensors (JB channels, data files etc.);
- Mntr.cfg configuration file for JB channels (Pressure, GHe Flow, Vacuum);
- Field.dat field ramping table;
- T_PROBES temperature response curves folder.

SCW server application main functions:

- Monitoring of all cryostat & magnet parameters;
- PSU's control & monitoring;
- Cryo-compressors monitoring;
- Field ramping task;
- Software interlock logic;
- Client/Server communication.

