ESS Magnet Interface Description

D1, Q8 and C8 interfaces to external equipment.

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1. Scope

This document describes the type and number of the interfaces between the magnets listed in Tab. 1 and the external equipment.

2. Context

This Interface Description Document applies to the following magnets.

Magnet	Magnet type
D1	DC dipole
Q8	DC quadrupole
C8	DC corrector

Tab. 1 – List of the magnets

3. Interfaces description

4.1. Mechanical interfaces

The magnets will be assembled on their relative girders via suitable support plates and will be provided with dedicated interfaces for the alignment tools and with eyelifts for proper handling.

4.1.1. Magnet support plates

The detailed design of the support plates must follow the mechanical design of the magnet girders (in charge to STFC Daresbury); the interfaces between the two must be defined in agreement with STFC Daresbury and the Supplier. A further comment concerning the girders is that the D1 dipoles have to be tilted in the vertical direction by 2 deg., being their deflection equal to 4 deg.

4.1.2. Alignment tools

Each magnet will be provided with a set of calibrated holes that will allow inserting suitable mechanical tools to be used for the alignment of each magnet. The layout of such holes is part of the mechanical design of each magnet and will be defined with the Supplier.

4.1.3. Eyelifts

Each magnet will be provided with eyelifts (exact number to be defined) which will allow proper handling during transportation or opening. The eyelifts will be inserted in suitable threaded holes. The positions will be defined with the Supplier.

Expected overall dimensions.

Magnet	Transverse (w x h)	Longitudinal
D1	606 x 742 mm	1792 mm
Q8	800 x 800 mm	930 mm
C8	320 x 320 mm	350 mm

Expected magnet weights.

Magnet	Exp. weight
D1	5000 – 5500 kg
Q8	2400 – 2500 kg
C8	120 – 150 kg

4.2. Electrical interfaces

The interfaces relative to every type of electrical conductor, namely connections to the power supply, connections to the interlock system, etc. including the absolute maximum ratings (where applicable) are described in the following.

The latest details concerning the connection block for both the power converters (PC) and the interlock system shall be discussed with the Supplier.

4.2.1. Magnet connection to the power converter

The dipoles D1, the quadrupoles Q8 and the Correctors C8 will be connected to the relative power converters by cables. Suitable holes are foreseen at the magnet terminal blocks, allowing the cable connection by means of bolts and nuts; dimensions to be defined with the Supplier. The connection terminals will be protected against accidental contacts with exposed conductors, according to the IP20 protection grade.

Magnet	Hole diameter	I max.
D1	tbd	400 A
Q8	tbd	400 A
C8	Connection block	16 A

Tab. 2 – Magnets connections to the power converters.

4.2.2. Dipole polarity

Referring to the accelerator reference frame (x,y,z) where z is the direction of the beam, x is the horizontal axis (left oriented) and y is the vertical axis (up oriented), D1 dipoles will deflect the proton beam in the vertical direction (i.e. along the y direction) The terminals of each dipole shall be marked by the [+] and [-] symbols. The polarity of the dipole is defined as follows (this definition is subject to eventual discussion with ESS):

- The positive cable from the PC, connected to the [+] terminal will result in a LEFT direction of the magnetic field (UP deflection for positive charges).

- A RIGHT direction of the magnetic field is obtained connecting the positive cable to the [-] terminal (DOWN deflection for positive charges).

This convention requires that the cables from the relevant PC must be univocally identified with special care for what concerns their polarity.

4.2.3. Quadrupoles polarity

The terminals of each quadrupole shall be marked by the [+] and [-] symbols. The polarity of the quadrupole is defined as follows (this definition is subject to eventual discussion with ESS):

- The positive cable from the PC, connected to the [+] terminal will result in a focusing quadrupole.
- A defocusing quadrupole is obtained connecting the positive cable to the [-] terminal.

This convention requires that the cables from the relevant PC must be univocally identified with special care for what concerns their polarity.

4.2.4. Correctors polarity

The terminals of each channel of the correctors shall be marked with the [+] and [-] symbols. The positive correction of each channel is defined as follows:

- The positive cable from the PC, connected to the [+] terminal will result in a positive deflection (i.e. in the same direction of the relevant axis) of the proton beam referring to the accelerator reference frame (x,y,z) where z is the direction of the beam, x is the horizontal axis and y is the vertical axis.
- The negative deflection (i.e. in the opposite direction of the relevant axis) of the proton beam will be obtained acting on the PC which will be bipolar devices.

This convention requires that the cables from the relevant PC must be univocally identified with special care for what concerns their polarity.

4.2.5. Magnets connection to the interlock system

The magnet coils are protected against over-temperature by means of suitable thermal-switches. These protection devices are connected in series within each magnet and the terminals are then connected to a dedicated connection block, where the interlock system can access the information. The following table lists the thermal switches connection method.

Magnet	Temp. threshold	Cables termination
D1	60 °C	Connection blocks
Q8	60 °C	Connection blocks
C8	60 °C	Connection blocks

Tab. 3 – Magnets connections to the Interlock System

4.2.6. Magnet grounding

Grounding connections will be made using a suitable bolt and nut specifically placed on the magnet yoke; further details shall be defined with the Supplier.

4.3. Cooling System interface

D1 and Q8 magnets will be cooled by dedicated hydraulic circuits. Further details, concerning the type of connectors and hoses, will be defined with the Supplier.

C8 correctors will be air cooled.

Hydraulic parameters (evaluated by simulations).

Magnet	Max. flow	Pressure drop	DT
D1	12 l/min	4.5 bar	14 deg C
Q8	8.7 l/min	3.8 bar	13 deg C

4. References

N.	Title	Code number	Rev. n.
2	Magnet Design Report – Quadrupole magnet Q8	E-ST ESS MGN DRD 003	1
3	Magnet Design Report – Dipole magnet D1	E-ST ESS MGN DRD 004	1
4	Magnet Design Report – Corrector magnet C8	E-ST ESS MGN DRD 005	1

5. Revision history

Rev. n.	Changes from previous revision	Author	Date
0	First issue	R. Fabris	20-06-2017