



**Report of the
MQXFA12b**

Coils Acceptance Review

US-HiLumi-doc- 4937

Other:

Date: 02/20/2024

Page 1 of 5



US HL-LHC Accelerator Upgrade Project

**Report of the MQXFA12b Coils Acceptance
Review**

February 20, 2024

- Arup Ghosh (Chairperson), BNL retired
- Susana Izquierdo Bermudez, CERN
- GianLuca Sabbi, LBNL



Report of the MQXFA12b

US-HiLumi-doc- 4937

Other:

Date: 02/20/2024

Page 2 of 5

Coils Acceptance Review

1. Goal and scope

The HL-LHC AUP project is planning to start assembly of MQXFA12b. MQXFA12 had an electrical issue caused by misplaced connector elements that triggered a coil-pole breakdown during an hi-pot test [1]. Two coils were not able to meet hi-pot specs after this issue and were put on hold. The other two coils of MQXFA12 (224 and 225) still meet all electrical specs and will be re-used in MQXFA12b.

In MQXFA12b AUP is planning to use these new QXFA coils: 158, 159, and 150 as spare.

Coil 150 was presented at the MQXFA17 Coil Acceptance Review [2]. At that time, it was recommended not using it because of small arc length in the ends. Updated analysis of this issue was presented during the MQXFA13b Coils Acceptance Review, and coil 150 was accepted as spare for MQXFA13b [3]. Therefore, it is assumed accepted as spare for MQXFA12b.

If MQXFA12b meets MQXFA requirements [4] it will be used in a Q1/Q3 cryo-assembly to be installed in the HL-LHC.

Conductor and series coil specifications are presented in [5-9]. Discrepancy or Non-conformity Reports are generated whenever a component does not meet specifications.

The reviewers are requested to review discrepancies and non-conformities in these coils and their strands and cables: 158 (cable P43OL1257) and 159 (cable P43OL1192).

2. Review Charges responses

The committee is requested to answer the following questions:

1. Have all recommendations from previous reviews [3] been adequately addressed?

The recommendations have all been incorporated for the processing of the coils. In particular, the arc-length at the ends have been measured in some detail to ensure that the arc-length excess at the ends compared to the straight section is less than 210 μm . The coils under consideration for this magnet meet that criterion. It is noted in the presentation that, when remeasured, coils 241 and 150 do not meet this specification by a small amount. However, coil 241 is being used in MQXFA13b. Also, at the time of this writing we understand that Coil 150 will be used to replace Coil 241 in MQXFA13b to eliminate some field quality issues. Under this circumstance another spare needs to be identified for MQXFA12b.

It is also noted that documentation for the coils have been substantially completed. Those for the new coils 158 and 159 are being completed.

Since Coils 224 and 225 (which were in Position P1 and P3 in the scheme of coil assembly) are being reused and if this is preserved, Coils 158 and 159 can be used



Report of the MQXFA12b

US-HiLumi-doc- 4937

Other:

Date: 02/20/2024

Page 3 of 5

Coils Acceptance Review

in either P2 or P4 position. It is noted that (as presented), coils ordered as such will meet the Voltage criterion of <350 V during a quench.

2. Have Discrepancies and Non-conformities been adequately documented and processed (all DR/NCR for coils 158 and 159), and new DR/NCR for the other coils)?

There were several DR's for cable 1192 used for winding coil 159. There were some issues with the following:

- a) recording of the reaction temperature during sample reaction,
- b) strand sample I_c measurements,
- c) accelerometer failure in the shipment of the cable due to battery failure.
- d) Issues during the braiding of the insulation on the cable at the vendors.

Corrective actions were taken for the DR's. It is noted that the cable collapse during the braiding operation at the vendors (DR #13171 and # 13348) were recorded in the cable travelers going to FNAL. These defects ended up in the cable drop-off during coil winding of coil 159. At FNAL No DR's were recorded for this coil.

For Cable 1257 used in Coil 158, there was a DR recorded during the heat-treatment of samples and the cable residual twist being 155° which is greater than the 150° specification. It is noted that an earlier cable 1167 with a residual twist of 170° was successfully used in a coil.

In all cases the cable DR's were addressed satisfactorily.

During coil fabrication, there were three DR's recorded for coil 158, one of which was deemed critical. Corrective action was implemented which is deemed satisfactory. The other 2 DR's were minor requiring no corrective action except documentation in the traveler.

No DR's were recorded for Coil 159.

3. If there are critical Discrepancies/Non-conformities, have they been adequately documented and processed?

Yes, the corrective actions taken are sufficient to meet coil performance.

4. Is there any coil that you recommend not to use in MQXFA12b?

All Coils were judged to be suitable for use in the assembly of Magnet 12b.



Report of the MQXFA12b

US-HiLumi-doc- 4937

Other:

Date: 02/20/2024

Page 4 of 5

Coils Acceptance Review

5. Do you have any other comment or recommendation regarding these coils and their conductor for allowing MQXFA12b to meet MQXFA requirements [1]?

See Below

3. Comments

A comparison of the Impulse test of coils 224 and 225 shows that after these coils have been assembled in the mechanical structure and then re-measured after disassembly, the zero crossing is longer than in the virgin test. Although not a particular issue of concern, if possible, can any coils from magnet 7 or 8 be remeasured to see if this occurs in coils that have been previously stressed in a structure.

It is noted that the Δ (arc length excess) at the ends compared to the average straight section arc-length excess for coils 224 and 225 are different from earlier measurements. We understand that additional measurements are being performed to better understand these variations. It is also planned to correct for the arc length excess by implementing end shims on the loading keys as discussed in previous reviews.

4. Technical information

Committee

- Arup Ghosh (Chairperson), BNL retired
- Susana Izquierdo Bermudez, CERN
- GianLuca Sabbi, LBNL

Location/Connection

Video-link by Zoom, info by email.

Link to agenda with talks and other documents

<https://indico.fnal.gov/event/62950/>

7. References

- 1) [MQXFA12 electrical issue and plans \(November 16, 2022\) · INDICO-FNAL \(Indico\)](#)
- 2) *MQXFA17 Coils Acceptance Review*, US-HiLumi-doc-4937
- 3) *MQXFA13b Coils Acceptance Review*, US-HiLumi-doc-4956
- 4) *MQXFA Functional Requirements Specification*, US-HiLumi-doc-36
- 5) *Specification for Quadrupole Magnet Conductor*, US-HiLumi-doc-40
- 6) *Cable Specification*, US-HiLumi-doc-74



Report of the MQXFA12b

US-HiLumi-doc- 4937

Other:

Date: 02/20/2024

Page 5 of 5

Coils Acceptance Review

- 7) *Quadrupole Magnet Cable Insulation*, US-HiLumi-doc-75
- 8) *QXFA Series Coil Production Specification*, US-HiLumi-doc-2986
- 9) *QXFA Series Coil Fabrication Electrical QC plan*, US-HiLumi-doc-521