



**Report of the
MQXFA12b
Structure & Shim Review**

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US HL-LHC Accelerator Upgrade Project

**Report of the MQXFA12b Structure & Shim
Review**

March 6th 2024

- Rodger Bossert (chairperson), FNAL
- Mike Anerella, (BNL)
- Susana Izquierdo Bermudez (CERN)
- Helene Felice (CEA)



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1. Goal and scope

The HL-LHC AUP project is starting the assembly of MQXFA12b quadrupole magnet. This is the re-assembly of MQXFA12 with two new coils. MQXFA12 had a critical non-conformity during the final electrical QC tests performed after magnet preload. Some coil and structure strain-gauge pins had been erroneously swapped in a connector bringing those pins close to each other. During a coil-structure Hipot a failure occurred. The Hipot was repeated a few times to understand the issue. Finally, it was found that two coils (224 and 225) were no longer able to meet the coil-pole 100 V requirement [1]. These coils have been put on hold and are not going to be used in MQXFA12b. Therefore, two new coils (158 and 159) were presented and approved at the MQXFA12b Coil Acceptance Review with 148 as a spare [2].

MQXFA12b uses an entirely new structure, not the one from MQXFA12. The MQXFA12 structure was used in MQXFA14.

If MQXFA12b meets MQXFA requirements [3] it will be used in a Q1/Q3 cryo-assembly to be installed in the HL-LHC.

In order to avoid reoccurrence of the MQXFA13 issue, additional locations for CMM measurements and a specification were added to the MQXFA Series Coil Production Specification [4].

In addition, a target for the minimum size of the loading-key shims has been added to the assembly plan of subsequent magnets. The MQXFA team has prepared a draft specification for adding it to the MQXFA Series magnet specifications [5].

Discrepancy or Non-Conformity Reports are generated whenever a component does not meet specifications [6].

The goal of this review is to evaluate the MQXFA12b structure, the proposed shim plan, and the proposed change to the MQXFA Series magnet specifications. Reviewers should also assess that discrepancies and non-conformities of the magnet structure have been adequately processed to meet MQXFA requirements [3].

Committee

- Rodger Bossert (chairperson), FNAL
- Mike Anerella, (BNL)
- Susana Izquierdo Bermudez (CERN)
- Helene Felice (CEA)

Date and Time

March 6, 2024. Start time is 7:00/9:00/10:00/16:00 (LBNL/FNAL/BNL/CERN)

Location/Connection

Video-link by Zoom, info by email.

Link to agenda with talks and other documents

<https://indico.fnal.gov/event/63577/>



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2. Review Charges responses

The committee is requested to answer the following questions:

1. Have all recommendations from previous reviews [7] been adequately addressed?

Mostly. However, see comment A below.

2. Have discrepancies and non-conformities been adequately documented and processed?

Yes.

3. If there are major/critical non-conformities [5], have they been adequately documented and processed?

Yes, for the components already in house. Some structure components are still missing/being processed.

4. Are the proposed shims adequate for allowing MQXFA12b to meet MQXFA requirements [1]?

Yes.

5. Do you have any comments or recommendations about the proposed change to the MQXFA Series magnet specifications

Yes. (see comment B below)

6. Do you have any other comment or recommendation to assure MQXFA12b is going to meet requirements?

Yes. (see comments)

3. Comments

A. There was a recommendation in the MQXFA13b review report [7] alluding to nicked quench protection heater and other wires. As a response to this recommendation, a decision was made to add glass-sleeve protection to all wires. The methods of protection are currently being established, and the place where the work is done is currently being negotiated between LBNL, FNAL and BNL.

However, there was no mention of this recommendation, or the solution made at the review, and it was not clear if this will be done in MQXFA12b.

B. In section 5, page 43 of the MQXFA Series Magnet Production Specification, HiLumi doc 4009, the proposed phrasing is:



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- *At the end of the pre-loading operation, the sum of the loading shim size and the coil-pack radial dimension deviations in straight section, LE and RE shall be within the range achieved in magnets MQXFA14b and MQXFA05*

- If, with such load key shim, the coil stress measured in 2+ strain gauges at the end of the loading or during bladder inflation is above the coil stress spec., priority should be given to keeping the coil stress within the specs.

The sentence « the coil stress measured [...] is above the coil stress spec , [...]» is questionable, as the specified stress should never be exceeded. We propose the alternate wording (shown in blue):

- *At the end of the pre-loading operation, the sum of the loading shim size and the coil-pack radial dimension deviations in straight section, LE and RE shall be within the range achieved in magnets MQXFA14b and MQXFA05*

- If, with such load key shim **targets**, the coil stress measured in 2+ strain gauges **during** the loading or during bladder inflation **indicate that the coil stress may reach values** above the coil stress spec. **during subsequent loading steps or at the end of the loading**, priority should be given to keeping the coil stress within the specs.

4. Recommendations

There are no new recommendations.

5. References

- 1) LBNL MQXFA-NCR-0429
- 2) MQXFA12b Coils Acceptance Review, US-HiLumi-doc-4972.
- 3) MQXFA Functional Requirements Specification, US-HiLumi-doc-36.
- 4) MQXFA Series Coil Production Specification, US-HiLumi-doc-2986.
- 5) MQXFA Series Magnet Production Specification, US-HiLumi-doc-4009.
- 6) Handling of Discrepancies and Nonconformances, US-HiLumi-doc-2484.
- 7) MQXFA13b Structure and Shims Review, US-HiLumi-doc-4969.