



**Report of the
MQXFA17
Structure & Shim Review**

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US HL-LHC Accelerator Upgrade Project

**Report of the MQXFA17 Structure & Shim
Review**

October 18th 2023

- Peter Wanderer, chairperson (BNL)
- Mike Anerella, (BNL)
- Rodger Bossert, (FNAL)
- Susana Izquierdo Bermudez (CERN)



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1. Goal and scope

The HL-LHC AUP project is starting the assembly of MQXFA17 magnet. This is the 10th series magnet of the MQXFA low-beta quadrupoles to be used in Q1 and Q3 for the High Luminosity LHC. If MQXFA17 meets MQXFA requirements [1] it will be used in a Q1/Q3 cryo-assembly to be installed in the HL-LHC.

AUP is planning to install MQXFA16 and MQXFA17 in a cold mass without previous vertical test.

MQXFA17 coils were reviewed on October 6, 2023 [2].

MQXFA Series magnet specifications are presented in [3]. Discrepancy or Non-Conformity Reports are generated whenever a component does not meet specifications [4]. The goal of this review is to evaluate MQXFA17 structure and shim plan. Reviewers should also assess that discrepancies and non-conformities of the magnet structure have been adequately processed, and that the shims will allow MQXFA17 to meet MQXFA requirements [1].

Committee

Peter Wanderer, chairperson (BNL)

Mike Anerella, (BNL)

Rodger Bossert, (FNAL)

Susana Izquierdo Bermudez (CERN)

Date and Time

October 18, 2023. 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/61724/>



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2. Review Charges responses

The committee is requested to answer the following questions:

- 1) Have all recommendations from previous reviews [5] been adequately addressed?

Yes.

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

Yes.

- 3) If there are major/critical non-conformities [4], have they been adequately documented and processed?

Yes.

- 4) Are the proposed shims adequate for allowing MQXFA17 to meet MQXFA requirements [1]?

Yes.

- 5) Do you have any other comment or recommendation to assure MQXFA17 is going to meet requirements?

Yes (see below)

3. Comments

- The effort to increase the prestress in the ends is underway but incomplete.
- In the straight section, no correlation was found between the coil size and quench location.
- The method of calculating shims first used for the assembly of MQXFA16 was also used for MQXFA17.
- Pions re-machining: The AUP process includes a local geometrical measurement of the inner radius of the coil in the longitudinal sections where pions are installed. In the case of geometrical deviations, pions are re-machined accordingly. AUP could consider a systematic reduction of the pion thickness to simplify the process. This must be iterated with CERN, since it has implications on the alignment cold bore to magnet.
- Target key size: Based on the recent analysis, a new target for pre-load has been established, aiming at a given key size based on geometrical measurements. For the case of A17, the target key size is 13.77 – 13.84 mm. Coils are typically undersized radially 25-50 um. This is neglected when defining the shimming plan, since it was considered to be in the noise of the measurements/assembly. If the target is now to be precise to a level better than 0.1 mm on the final key size, this should be re-visited, together with the overall precision of the geometrical measurements.



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4. Recommendations

- Measure the return end of the coils using the same strategy as used for the lead end.

5. References

- 1) *MQXFA Functional Requirements Specification*, US-HiLumi-doc-36.
- 2) *MQXFA17 and MQXFA13b Coils Acceptance Review*, US-HiLumi-doc-4937.
- 3) *MQXFA Series Magnet Production Specification*, US-HiLumi-doc-4009.
- 4) *Handling of Discrepancies and Nonconformances*, US-HiLumi-doc-2484.
- 5) *MQXFA16 Structure and Shims Review*, US-HiLumi-doc-4912.