



Report of MQXFA05 Structure & Shims Review

US-HiLumi-doc-2904

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US HL-LHC Accelerator Upgrade Project

Report of the MQXFA05 Structure & Shims Review

Zoom meeting, 12th of March 2020

- Peter Wanderer, BNL (chair)
- 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 MQXFA05 magnet. MQXFA05 is the third pre-series of the MQXFA low beta quadrupoles to be used in Q1 and Q3 for the High Luminosity LHC. If MQXFA05 meets MQXFA requirements [1] it will be used in a Q1/Q3 cryo-assembly to be installed in the HL-LHC.

MQXFA05 coils were reviewed on January 29, 2020 [2].

MQXFA pre-load targets and pre-loading sequence for MQXFA03 and following magnets were approved by AUP Technical Board on July 5, 2019 [3].

The goal of this review is to evaluate the MQXFA05 structure and shim plan. The reviewers are requested to assess that the MQXFA05 structure meets the MQXFA Structural Design Criteria [4], that non-conformities have been adequately processed, and that structure and shims will allow MQXFA05 to meet MQXFA requirements [1].

2. Technical details

Committee

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

Date and Time

March 12, 2020. Start time is 9:00 am (Central time)

Location/Connection

Video-link by Zoom, info

Link to agenda with talks and other documents

<https://indico.fnal.gov/event/23485/>

3. Review Charges and response

The committee was requested to answer the following questions:

1. Does the MQXFA05 structure meet the MQXFA Structural Design Criteria [4]?

Finding: The MQXFA05 structure has the same design as the MQXFA03 and MQXFA04 structures, which were found to meet the Structural Design Criteria.



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However, work instructions (WI) for several processes have not yet been put into draft form.

Comment: The QA process now includes 100% inspection of the load keys.

Recommendations:

- Prepare draft WI for flux cleaning of leads, wiring of quench protection heaters, machining of the pole keys to account for the pole keyway shift, (including how to align measurements). Obtain approval to proceed from the cognizant L2 manager before performing this work on MQXFA05.
- Study the origin of the end-plate shifts, and explore solutions to limit movements at the level of the end plate-load key alignment interface and at the level of the coil-pusher-bullets interface. Discuss at a meeting of the magnet assembly task force and obtain approval to proceed from the cognizant L2 manager before continuing with this work on MQXFA05.

2. Are there major non-conformities?

Finding: There are no major non-conformities. There are seven non-conformities. Four have been closed. Two of the remaining three are non-critical. The one that has not yet been classified, #80, dents in master keys, will be decided after inspection at LBNL.

Comments:

- The NCRs, along with the Deviations and Engineering Changes, are reported to AUP L2 management on a monthly basis in spreadsheet format. All of the travelers have been formally released for use. When appropriate, travelers are updated to take into account Lessons Learned.
- Changes have been made to correct problems with the assembly of magnet MXQFA04: an absorbent sock will be installed in the yoke to soak up any water leaks from bursting bladders and the design of the strain relief installed on a connector has been modified.

Recommendation: Prepare and carry out plan to evaluate sock performance prior to installation. Obtain approval to proceed from the cognizant L2 manager before using sock in MQXFA05. Evaluate effect of dents in master keys after inspection at LBNL; review result of evaluation with cognizant L2 manager before use in MQXFA05.

3. Are the proposed shims adequate for allowing MQXFA05 to meet MQXFA requirements [1]?

Findings: The shims were calculated using the same procedure that was used for magnets MQXFA03 and MQXFAP04. Both magnets were assembled with the axial and azimuthal preloads in the planned range. The training performance of magnet MQXFA03 met the specification.

Comment: spare keys will be available during assembly. The key insertion process will include a pressure check at the start and stable holds at intermediate pressures.



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Recommendation: Prepare and send to committee draft WI for the revised key insertion process.

4. Is there anything that could prevent MQXFA05 from meeting the MQXFA Interface Specification [5]?

Finding: Most probably, no. The information needed to evaluate whether the magnet meets the specification will be available when the magnet is completed. At present, no item on this list is known or expected to be out of tolerance.

Comment: none

Recommendation: None

5. Have all recommendations from previous relevant reviews [6] been adequately addressed?

Finding: Yes. The two recommendations from the review of magnet MQXFA04 have been followed: There is a traveler for the magnetic field measurements. The risk matrix has been reviewed and, where needed, revised.

6. Do you have any other comment or recommendation to assure MQXFA05 is going to meet requirements?

Comment: no.

4. Comments – The COVID-19 pause in work provides the opportunity to complete drafts of several WI that cover areas that have recently changed prior to the assembly of magnet MQXFA05.

5. Recommendations – After receiving L2 approval for carrying out the recommendations listed above, proceed to assemble magnet MQXFA05.

6. References

- 1) *MQXFA Functional Requirements Specification*, US-HiLumi-doc-36.
- 2) *Report of the MQXFA05 Coils Acceptance Review*, US-HiLumi-doc-2742.
- 3) *MQXFA03 pre-load targets and pre-loading sequence*, US-HiLumi-doc-2496.
- 4) *MQXFA Structural Design Criteria*, US-HiLumi-doc-909.
- 5) *MQXFA Magnet Interface Specification*, US-HiLumi-doc-1674.
- 6) *Report of the Review of the MQXFAP2 Al-Shell Issue and Lessons Learned*, US-HiLumi-doc-2192;
MQXFA04 Structure & Shims Review, US-HiLumi-doc-2505.