

Report of the Review Committee for
Readiness Review for SS Shell Welding on MQXFS1d
December 15, 2017
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Answers to Charge Questions

1. Are the requirements for the interference between SS-shell and magnet structure well defined and achievable?

The requirements were based on an analysis presented during the review. There was a plan presented showing the shell sizing calculations to meet the numbers shown in the analysis. A formal written requirements document was not presented.

2. Are the welding equipment and fixtures to perform the weld adequate to assure high probability of success?

There were bench tests completed on the welding equipment that show the equipment is capable of making the weld.

3. Is the measurement plan adequate for a good assessment after welding, and for providing feedback when the welding will be performed during LMQXFA fabrication?

Additional measurements are recommended below.

4. Do you have any other comment or recommendation to assure successful welding of SS shells and cold test of MQXFS1d?

See comments and recommendations below.

Recommendations

The committee has the following recommendations to be completed for this short model welding test.

1. An inspection of the first half shell should be completed prior to final machining of the second half shell to ensure proper fit.
2. Add fiducials to the shell and survey before and after welding to check for twist and deformation of the weldment due to welding. If necessary, a survey between weld passes could also be performed.
3. Add temperature sensors to measure the aluminum shell temperature during welding.
4. Document the technique that will be used to monitor weld shrinkage. Based on materials presented, a circumferential shell interference of 0.4 mm to 1 mm is desired so measurements of the shrinkage must be accurate to this level.
5. If not already part of the welding system, develop a system to ensure the welding heads are in sync within specified tolerances.

Additional Comments

The committee has the following comments related to the shell welding. These comments should be completed prior to the production readiness for the shell welding.

1. A formal written requirements document for the cold mass / shell interface should be completed, reviewed and approved by all stakeholders.
2. ASME Code calculations for the helium vessel shell were not shown during the review. The total stress in the shell due to the interference fit and the pressure loading should be determined to ensure (1) the stress is within the allowable stress dictated by the Code and (2) the shell thickness specified meets the Code.
3. There should be a test campaign to qualify the weld joint design and welding process. A similar campaign was completed for the previous generation of LHC magnets, the report will be shared with the design engineer.
4. A formal QA/QC plan for shell welding should be completed, reviewed and approved. This should include the inspection plan for the final production shell welds.
5. Qualify at least 3 welders on the welding equipment to ensure welder availability during production.

Appendix

Goal & Charge

The helium vessel of LMQXFA cold masses is going to be assembled around the MQXFA magnets. The straight section of the helium vessel is made of two half shells which will be welded together (through two longitudinal welds) and connected to the yoke of the magnets.

The welding of the two half shells is going to be performed on a short model (MQXFS1d) in order to test procedures and the possible impact on magnet training/performance during cold test.

The goal of the review is to assess readiness to perform the welding of the two half shells on MQXFS1d.

The committee is requested to answer the following questions:

- Are the requirements for the interference between SS-shell and magnet structure well defined and achievable?
- Are the welding equipment and fixtures to perform the weld adequate to assure high probability of success?
- Is the measurement plan adequate for a good assessment after welding, and for providing feedback when the welding will be performed during LMQXFA fabrication?
- Do you have any other comment or recommendation to assure successful welding of SS shells and cold test of MQXFS1d?

Committee

D. Cheng, A. Nobrega, T. Page (chair).

Date and Time

December 15, 2017 starting at 8:30/10:30/11:30am (LBNL/FNAL/BNL)

Location/Connection

The review is by video-mtg. FNAL people may use IB3 mezzanine mtg room.

Video-link is by Zoom, info by email.

Link to talks

<https://indico.fnal.gov/event/15934/>