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<u>Title</u> SUPERCONDUCTING MAGNET PROGRAM / LARP QXF LQXF - MAGNET OFF-NORMAL MQXFA12B TAPER KEY DEMONSTRATION				


Off-Normal Tapered Key Demonstration Operations

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Revision History

Revision	Issued	Changes
A	04-08-2024	Original issue.

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Purpose

The purpose of this Work Instruction is to describe the Off-Normal procedures that will take place during the preload operations of MQXFA12b. This off-normal task will be to demonstrate the use of “tapered” load key stacks after the half-way preloading load step has been achieved. Once the data from this demonstration is taken the tapered load keys will be removed and the rest of the normal preload operations will continue until the proper preloads have been achieved.

Scope

The scope of this off-normal work instruction is limited to a single temporary, special shim stack cycle during the preload operations after the preload operations have reached the half-way preload step. This temporary set of key shims will be installed only on the Lead End of the magnet, in all four quadrants, and will be removed after the set of measurements have been taken, and replaced with the nominal half-preload stacks, after which the magnet preload operations will continue as normal.

Definitions

Reference Documents

- SU-1011-5637 Magnet Integration and Loading WI (Rev L, April 2024)



1 Preload to half-way point in Magnet loading

1. Follow all operations in the SU-1011-5637 MQXFA Magnet Integration and Loading WI through Section 9.3 (the Axial loading to half-way).
2. Take a screenshot of the primary SG system screen.
3. Record the Load Key shim stack present and final quadrant pressure required to achieve that shim stack.

Half-way Bladder Pressure, final quadrant	Load Key Shim stack	Shell 1 T Stress	Shell 1 Z Stress	Coil T Stress	Coil Z Stress
		Top: Left: Bot: Right:	Top: Left: Bot: Right:	Q1: Q2: Q3: Q4:	Q1: Q2: Q3: Q4:

2 Prepare Taper Shims

4. Prepare the set of 0.002" taper key sections and punch the ¼" holes 0.625" and 2.0" from the end. Deburr all edges, and wipe down with alcohol. 8 pcs. each of the following:
 - a. 0.002" SST x 19.25" long
 - b. 0.002" SST x 16.25" long
5. Based on the actual shim stack at the half-way point (typically 0.030" to 0.033"), pick a thick key shim (for instance, 0.010"); 8 pcs are needed. Wipe down and clean this shim with alcohol.

Thick Key shim thickness	
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3 Prepare Tapered Key Shim Stack

6. Prepare a set of eight load key pairs (enough for ½ of a magnet's worth)
7. Using the thick shim prepared from Step 5, apply a small dot of CA glue approximately 10" from the end.
8. Align the 19.25" long 0.002" shim with the holes of the thick shim and press and hold in place until the CA glue sets
9. Apply a small dot of CA glue on top of this stacked shim at about 8" from the end



10. Align the 16.25" long 0.002" shim with the holes of the stack, and press and hold in place until the CA glue sets
11. Repeat Steps 7-10 for a total of 8 glued stacks.
12. Prepare the load key pair + tapered shims stack to match the build up of the keys described in the Step 2 table (same nominal half-way stack, except with the additional taper 0.002" layers replacing one of the thick shims)
13. Once stacked, apply colored tape to the end of this key stack as a visual indication this is a different stack from the nominal ones.
14. Repeat Steps 11 and 13 for a total of eight special load key stacks.

4 Perform tapered preload operation cycle

15. Per the cognizant engineer's direction for quadrant ordering and pressures, perform a preload step cycle replacing only the LE load key stacks with the tapered stacks. Reference SU-1011-5637 as needed for operations.
 - a. Set aside the nominal keys intact in such a way that each quadrants' key stacks are identifiable for ease of re-insertion in their respective quadrants.
 - b. Note that each of the tapered keys, identified by their colored tape ends, have been inserted into the magnet.
16. Record the data in the table below

Tapered Stack Bladder Pressure, final quadrant	Shell 1 T Stress	Shell 1 Z Stress	Coil T Stress	Coil Z Stress
	Top:	Top:	Q1:	Q1:
	Left:	Left:	Q2:	Q2:
	Bot:	Bot:	Q3:	Q3:
	Right:	Right:	Q4:	Q4:

17. Take a screenshot of the primary SG system screen.

5 Perform normal half-way preload operation cycle

18. Per the cognizant engineer's direction for quadrant ordering and pressures, perform a preload step replacing the tapered load key stacks from the LE of the magnet.
 - a. Insert all the nominal keys back in the slots that they were removed from
 - b. Reference SU-1011-5637 as needed for operations.
19. Verify that all the key stacks with the color tape on the ends have been removed; 8 total.



20. Record the data in the table below. Comparing the readings from this table with those taken in Step 3 above should verify (with some small variances expected) that the same loads as before are still being applied to the magnet at these locations.

Half-way Bladder Pressure, final quadrant	Shell 1 T Stress	Shell 1 Z Stress	Coil T Stress	Coil Z Stress
	Top:	Top:	Q1:	Q1:
	Left:	Left:	Q2:	Q2:
	Bot:	Bot:	Q3:	Q3:
	Right:	Right:	Q4:	Q4:

21. Take a screenshot of the primary SG system screen.

6 Demonstration Completion

22. Once these Off-Normal steps have been completed, the preload process may restart from Section 9.4 in the SU-1011-5637 work instruction.

23. Inspect the tapered key stacks for any deformation in the load keys. If any are noted, identify them and set these keys aside so they will not be used inadvertently.

24. Sign off

Cognizant Engineer: _____

Date: _____

7 Gauge and Wiring Removal

After the preload operations have been completed and bladders have been removed from the magnet, the special gauges shall be removed from Shell 1 and the Coil LE before shipping.

25. For each coil, remove the pieces of tape from the ID that are holding the SG wires of the Coil LE gauge.

26. Carefully insert the long bar “chisel” into the LE bore of the magnet. Carefully tap under the solder pad wiring of the gauge to remove the gauge from the pole island.

a. *Do not tap more than necessary*, which may damage the epoxy-impregnated glass fiber layer of the coil.

b. Ensure that the gauge comes up and is removed with the wiring.



27. Cut the wires leading to the temperature compensator pad; label the backside of the pad with the gauge factor and set aside (since these may be reused).
28. Pull the cables through the wire guides and outside the magnet. Ensure that nothing is caught/stuck in the wire guides after everything has been pulled through.
29. Wipe any remaining debris from the pole island where the gauge was removed; finish with an alcohol wipe and let dry.
30. Repeat Steps Step 26-29 for each coil.
31. Remove the Kapton window coverings of all the Shell 1 gauges.
32. Using an appropriate tool, carefully scrape the solder pad and gauge foil off of the shell. Ensure that the tool does not nick the shell at any point.
33. Pull the wiring away along with the temperature compensators. Label the backside the compensator pad with the gauge factor and set aside for possible reuse.
34. Wipe down the surface of any debris where the gauges were removed, and with a final alcohol wipe and let dry.
35. Repeat Steps 32-34 for each station of Shell 1.
36. When all gauges have been removed from both Shell 1 and the Coil LE, sign and verify that this work has been completed satisfactorily.

Cognizant Engineer: _____

Date: _____