77 K FATIGUE LIFE OF MATERIALS USED IN THE 60 T LONG-PULSE MAGNET PROGRAM

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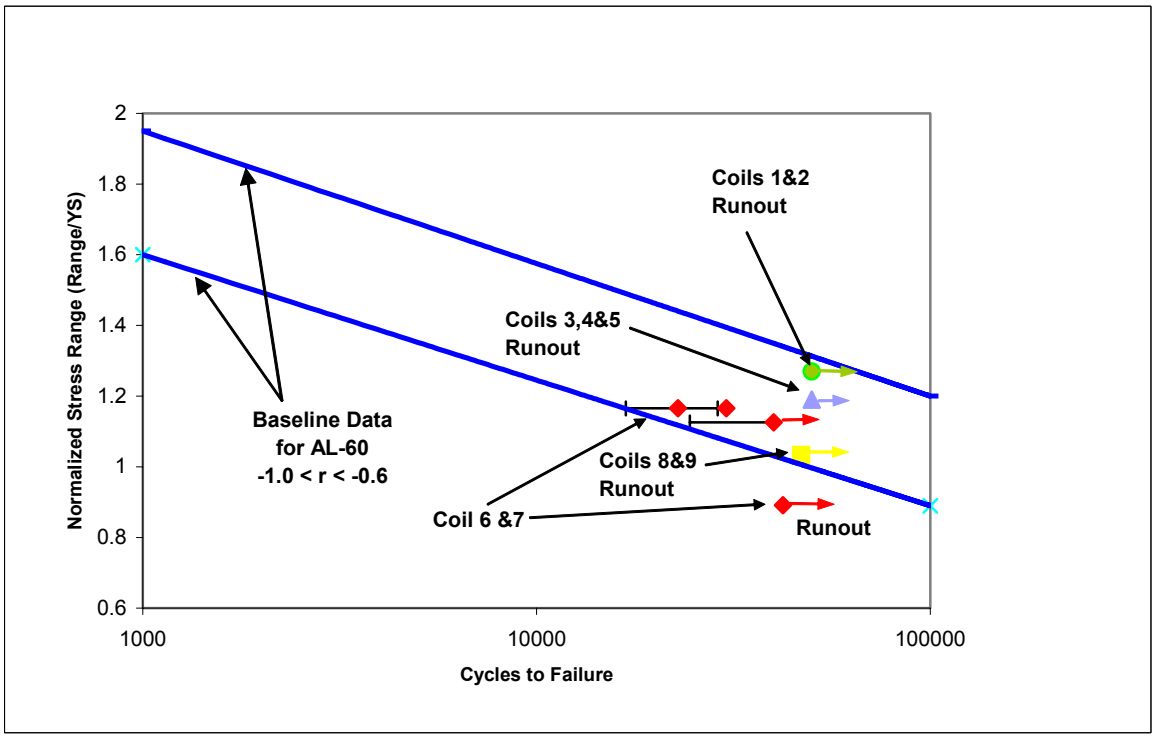
Introduction

Conductor materials used in high field pulse magnets require a combination of high strength and high conductivity (HSHC). The 60T outsert coil conductors are made from commercially available HSHC dispersion strengthened copper, Glidcop Al-60 and Al-15. The HSHC materials have limited engineering data available thus their characterization is an ongoing research effort at the NHMFL. Here we report the generation of a fatigue life database as part of an applied test program for the 60 T Long- Pulse Magnet Rebuild Program. The operation of the 60 T pulse magnet imposes plastic strain in the conductor that has a detrimental effect on its fatigue life. A unique test fixture and procedure has been developed (Ref. 1) that allows precise strain controlled fatigue cycling at 77 K.

Results and Conclusions

The fatigue results are shown (Figure 1) and compared to baseline data from approximately 50 fatigue tests performed on Glidcop AL60 (Ref. 1). The test results for the 60 T materials (average values from ~ 30 tests) are grouped on the right hand side of the graph. The data agree well with baseline data and show that the expected lives of these materials easily exceed 10,000 cycles. Runout tests, where the specimen survives 40,000 cycles without fracture, are terminated before specimen failure. The reference data is from tests of Glidcop AL-60 with larger absolute r-ratio's ($\sigma_{min}/\sigma_{max}$) of $-1.0 < r < -0.6$. The tests conducted here are typically have r-ratio's from 0.1 to –0.2 with the exception of Coil 1&2 material which experiences a large compressive component during service resulting in a r-ratio = -0.55.



References

[1] Walsh, R. P., *et al*., Adv. In Cryo. Engr, **50**, 59-66 (2004).