

Appendix E: Stress Range Histograms for Instrumented Locations

1 Overview

As described in Section 3, strain gauge data were recorded during five hours of unladen testing, five hours of laden testing and during filling and emptying operations. The data were processed to obtain the stress acting transverse (normal) to the circumferential seam welds. The derived stress versus time series were then rain flow counted to obtain stress range histograms, ie the frequency of a given stress range acting at a particular location.

The figures presented in this appendix can be used as indicators of the severity of the fatigue stress spectra acting on each instrumented position of each of the ten circumferential seam welds. The following commentary is required to put the figures in the appropriate context:

- The curves indicated by the legend entry 'Empty' were obtained by concatenating the unladen data obtained from Test 2 through Test 11 (approximately five hours). Test 1 was omitted as this involved the technician generating vibrations of the tanker to ensure the instrumentation was active. Thus, the unladen concatenated data contains figure-of-eight manoeuvres, two emergency stops and various road conditions and events as detailed in Appendix C.
- The curves indicated by the legend entry 'Laden' were obtained by concatenating the laden data obtained from Test 13 through Test 22 (approximately five hours) *with the filling and emptying tests*. The latter was added for convenience as the events are short-term and constitute few cycles of the overall plots. The laden portion of the concatenated data contains figure-of-eight manoeuvres, two emergency stops and various road conditions and events as detailed in Appendix D. The representative duty cycle will split the contributions of the filling and emptying from the actual laden/unladen strain data.
- The curves indicated by the legend entry 'Axial' were obtained as described in Section 2.7.1.2 and 2.7.1.3 and indicate that circumferential (hoop) strains were not measured and hence were assumed to be zero.
- The curves indicated by the legend entry 'Biaxial' were obtained as described in Section 2.7.1.4 and Section 2.7.1.5 and indicate that the circumferential strains were measured at the location and therefore the derived stresses take into account biaxiality.
- Where useful, cross-sections of the tanker and the positions of the relevant gauges have been included in the plots. For more detailed information about the actual gauge identification and position, see Appendix B.

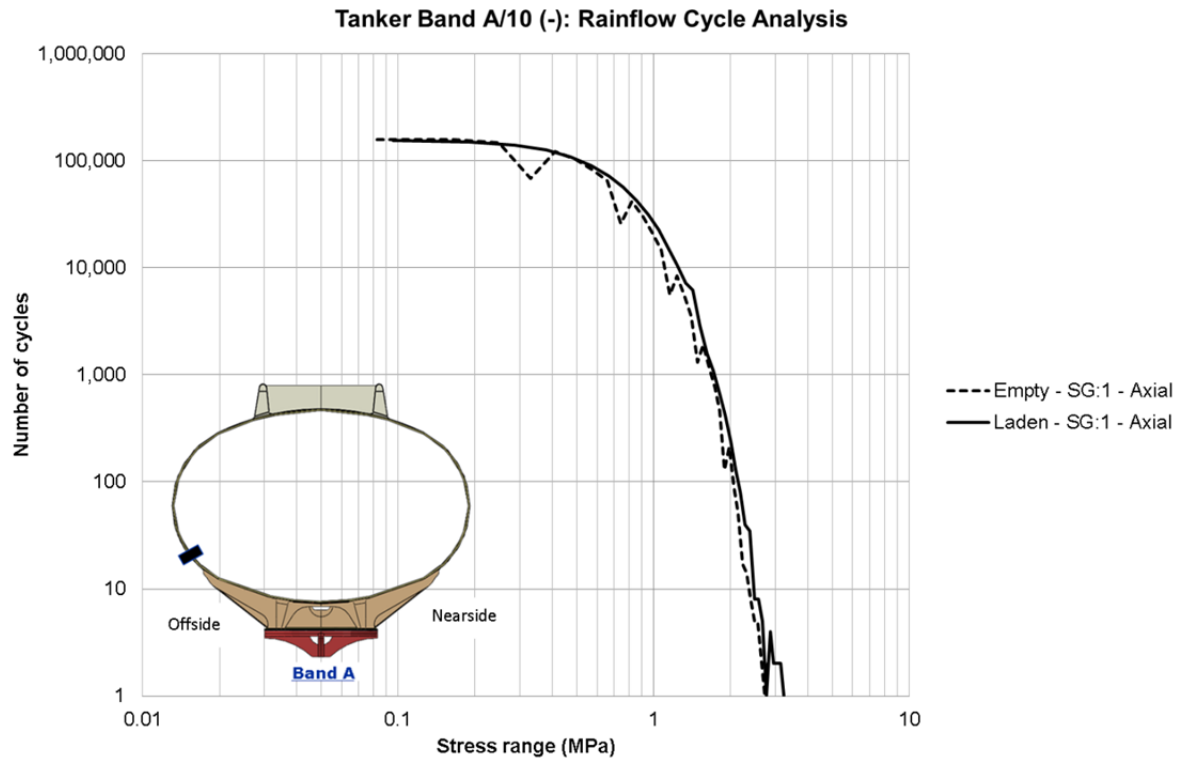


Figure E1 Stress range histogram for the one instrumented location on band A/10(-).

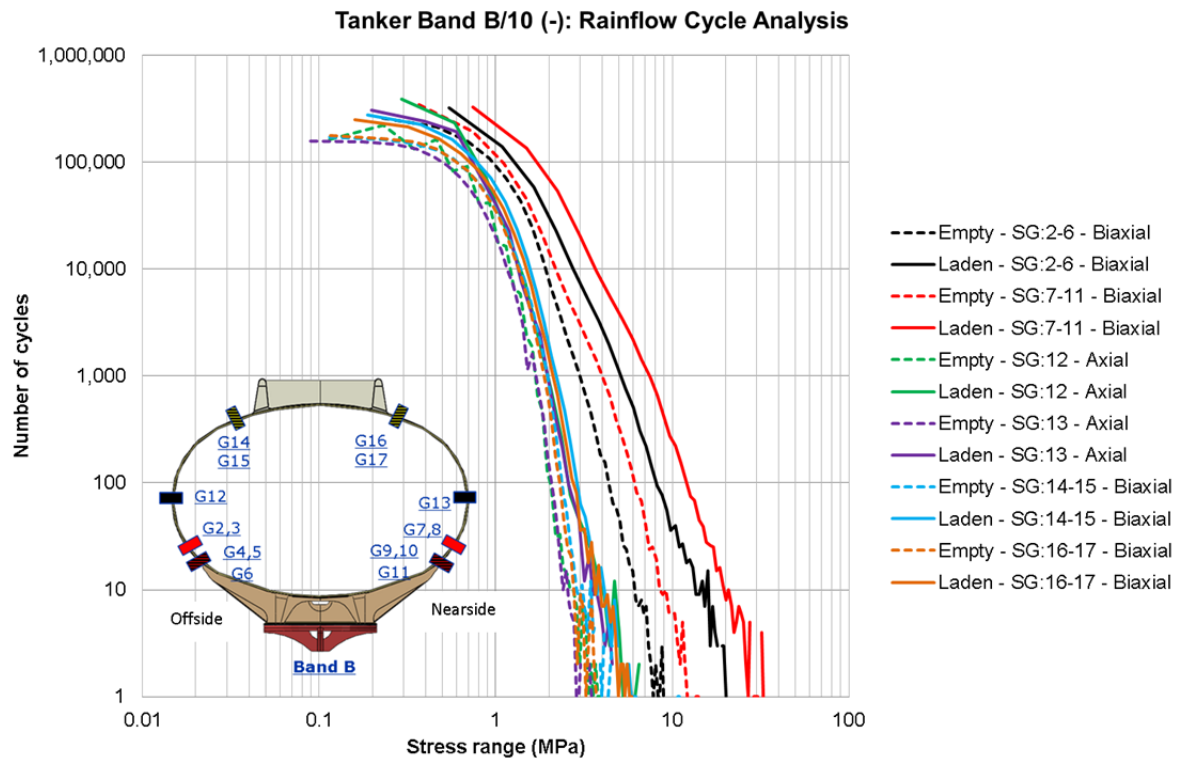


Figure E2 Stress range histograms for the six distinct instrumented locations on band B/10(-).

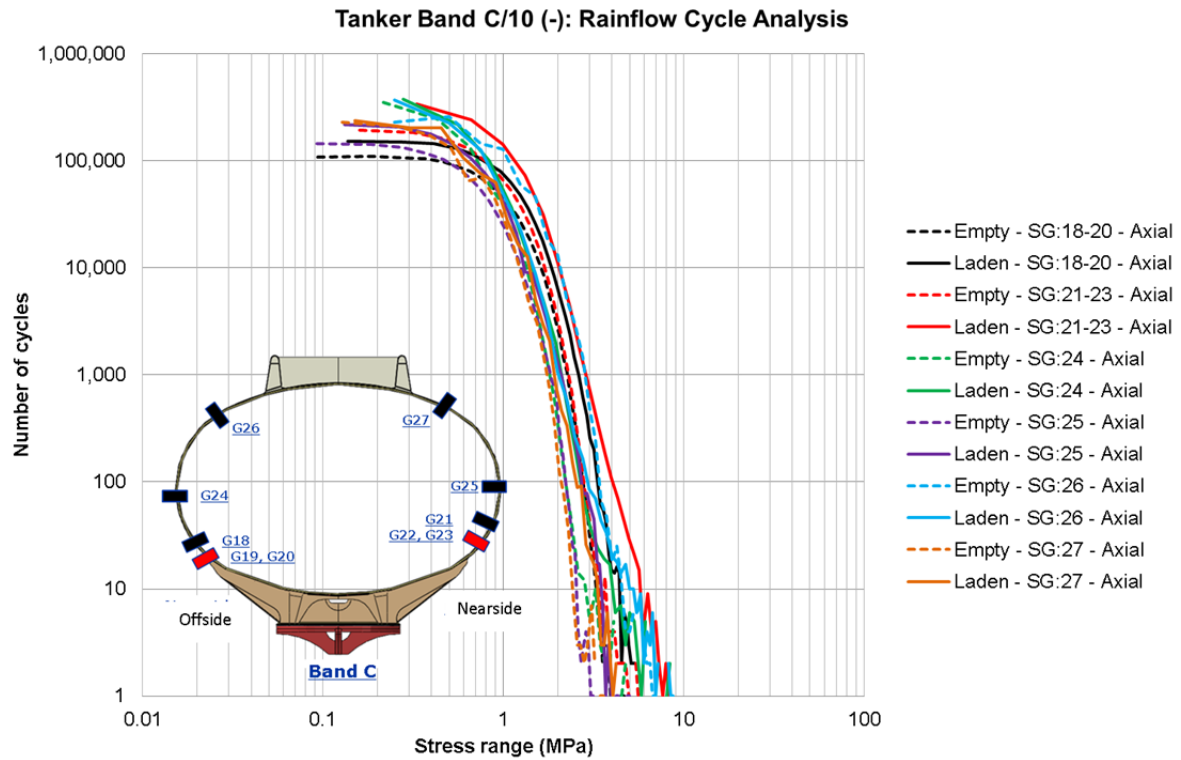


Figure E3 Stress range histograms for the six distinct instrumented locations on band C/10(-).

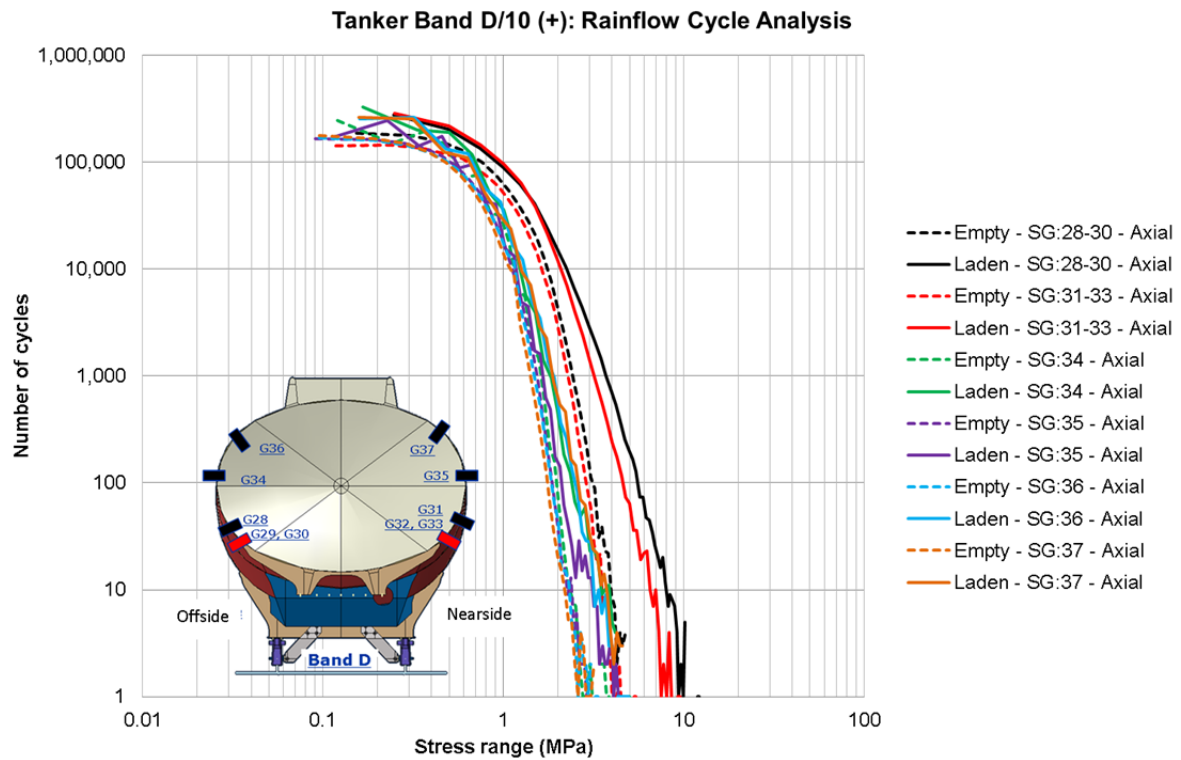


Figure E4 Stress range histograms for the six distinct instrumented locations on band D/10(+).

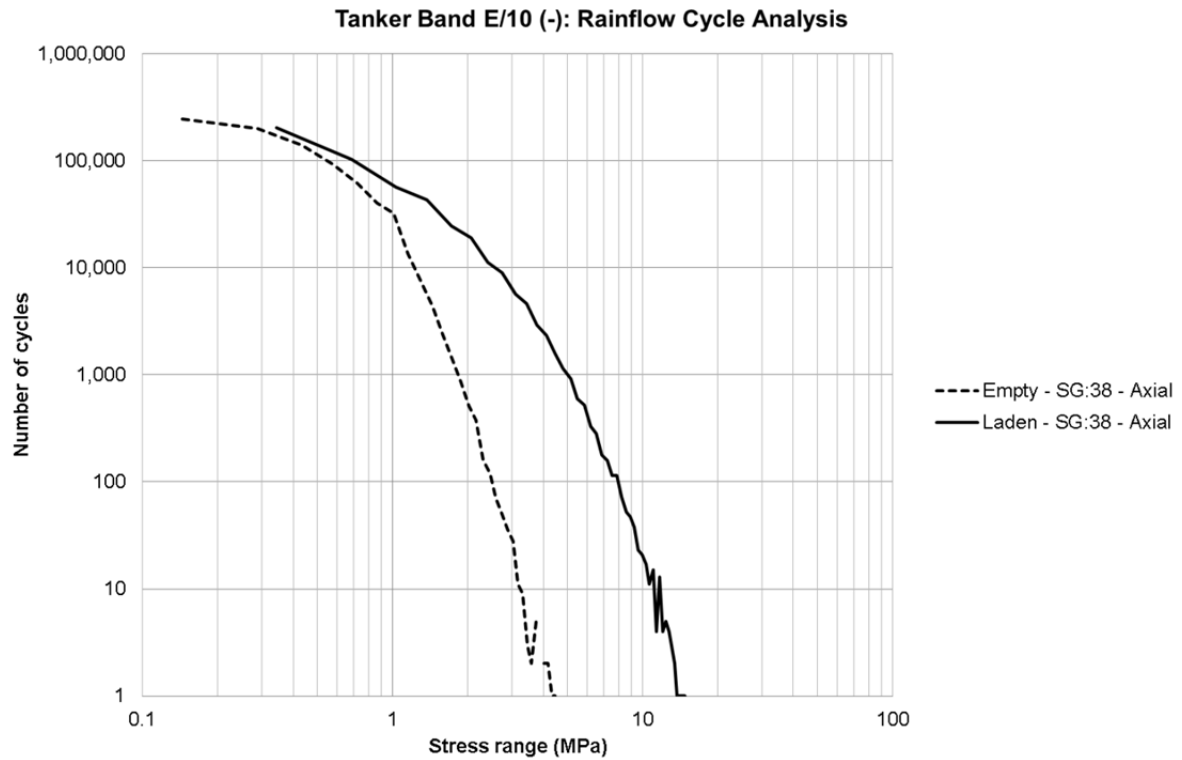


Figure E5 Stress range histogram for the one instrumented location on band E/10(-).

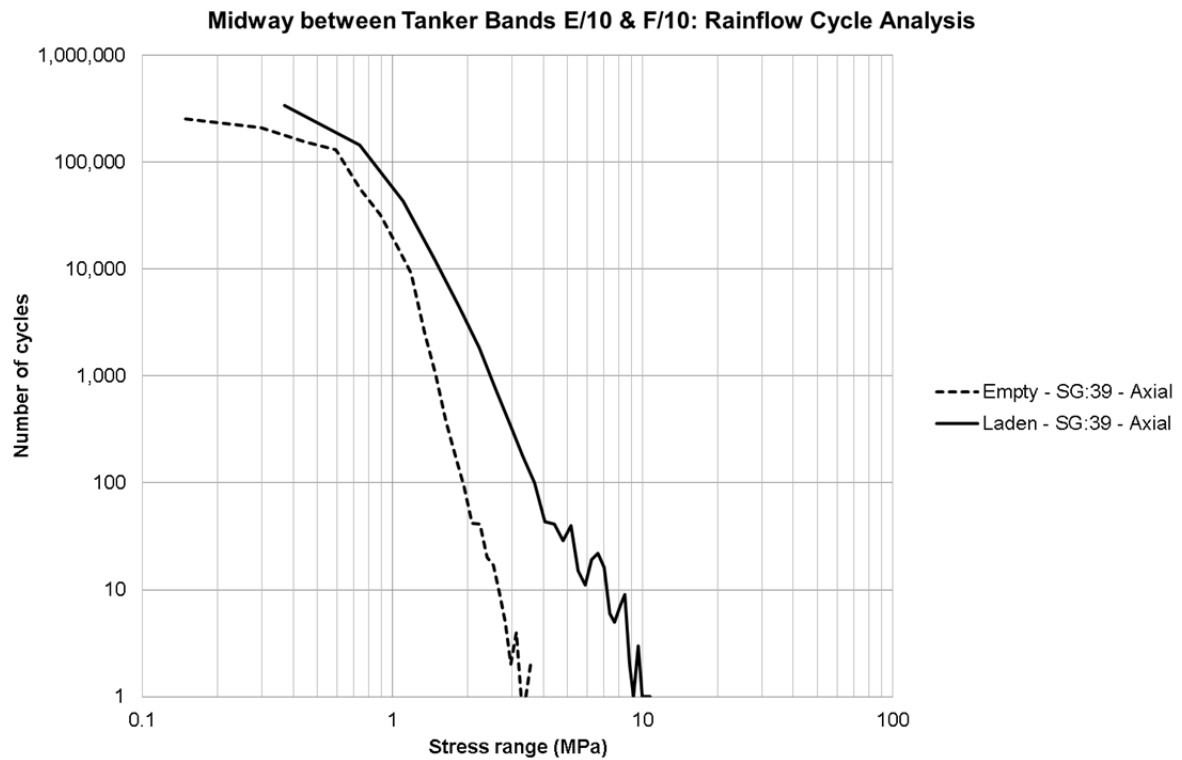


Figure E6 Stress range histogram for the 'remote' gauge located between bands E/10 and F/10.

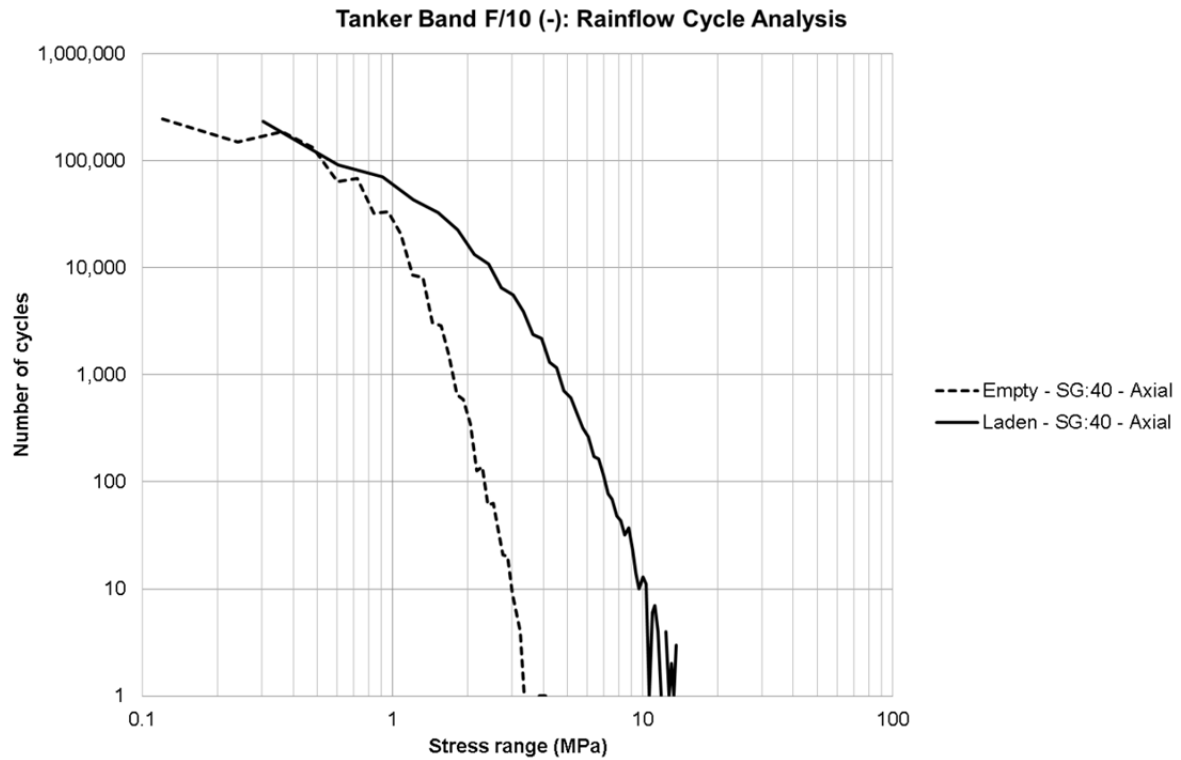


Figure E7 Stress range histogram for the one instrumented location on band F/10(-).

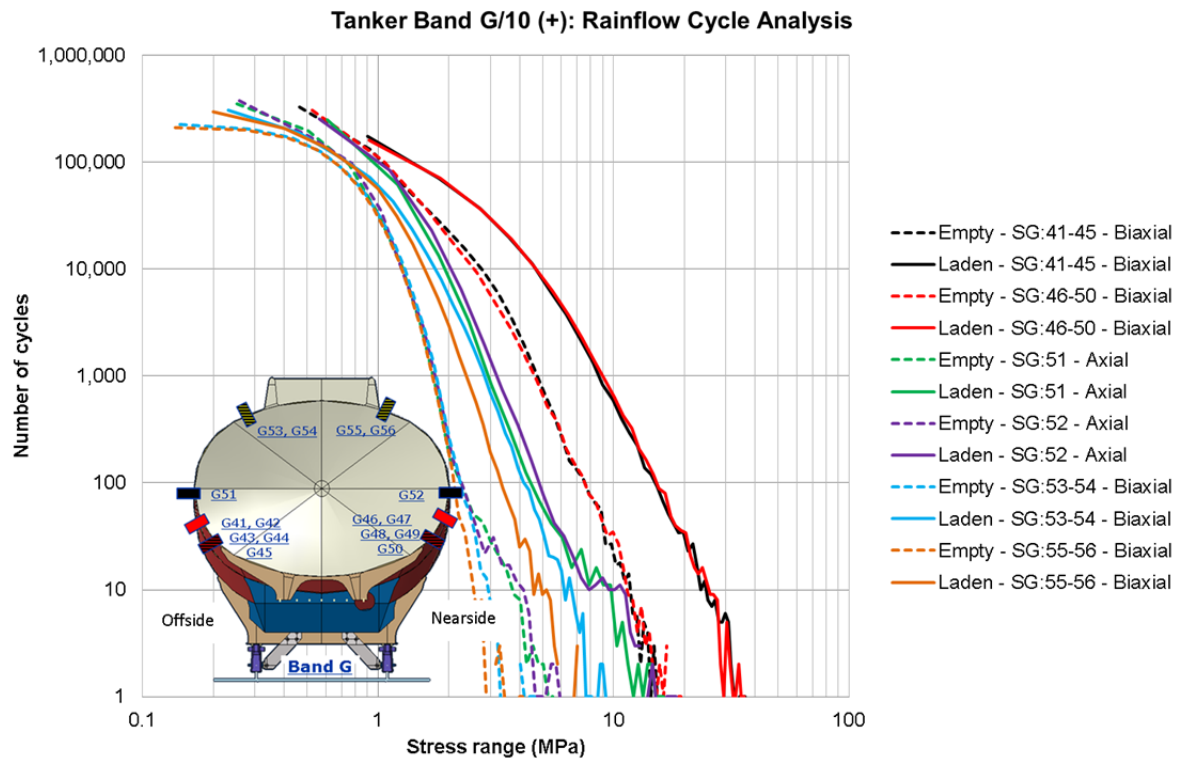


Figure E8 Stress range histograms for the six distinct instrumented locations on band G/10(+).

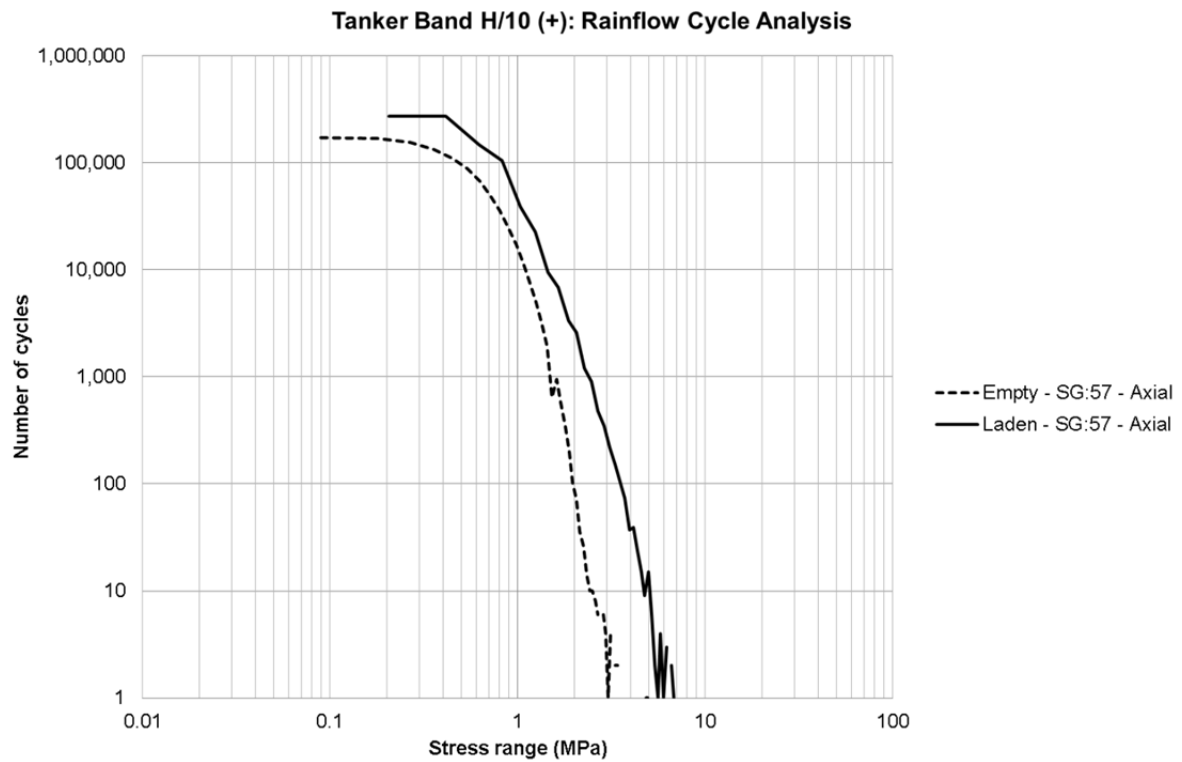


Figure E9 Stress range histogram for the one instrumented location on band H/10(+).

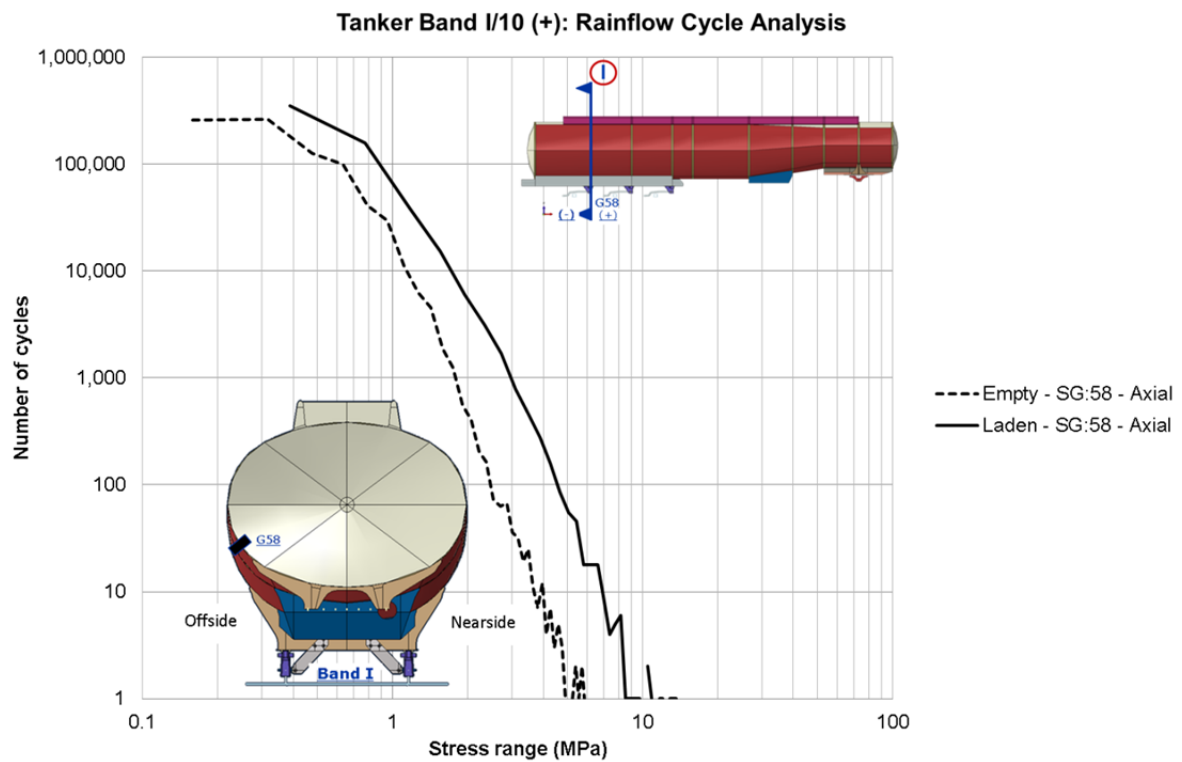


Figure E10 Stress range histogram for the one instrumented location on band I/10(+).

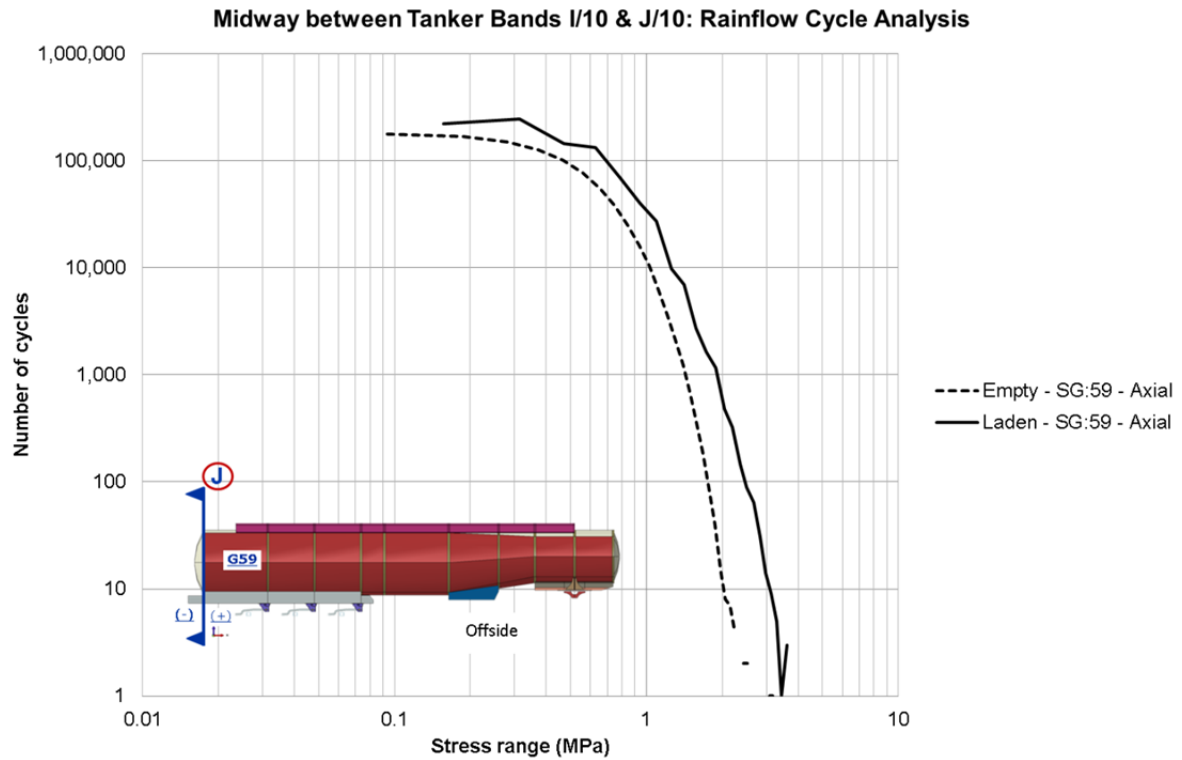


Figure E11 Stress range histogram for the 'remote' gauge located between bands I/10 and J/10.

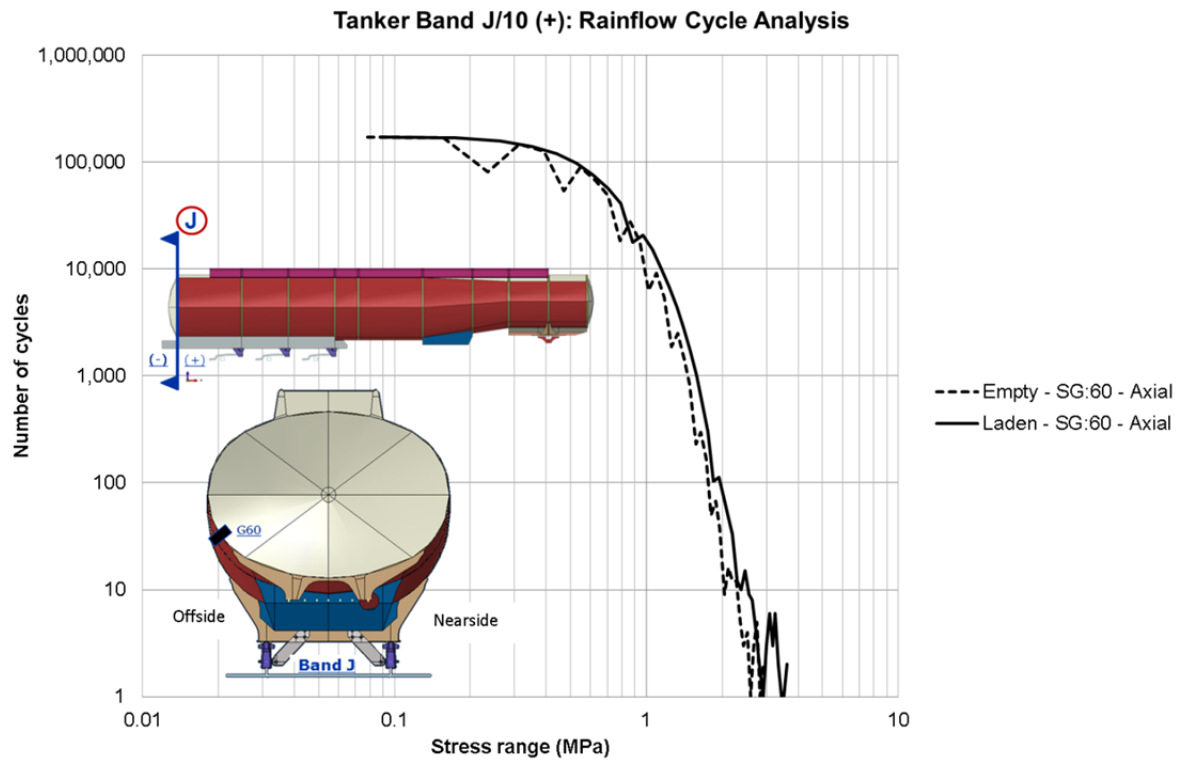


Figure E12 Stress range histogram for the one instrumented location on band J/10(+).