


Appendix H Result of seismic test for Gas Turbine Engine and Gearbox Assembly

Table H.1.0-1 List of the Test Run



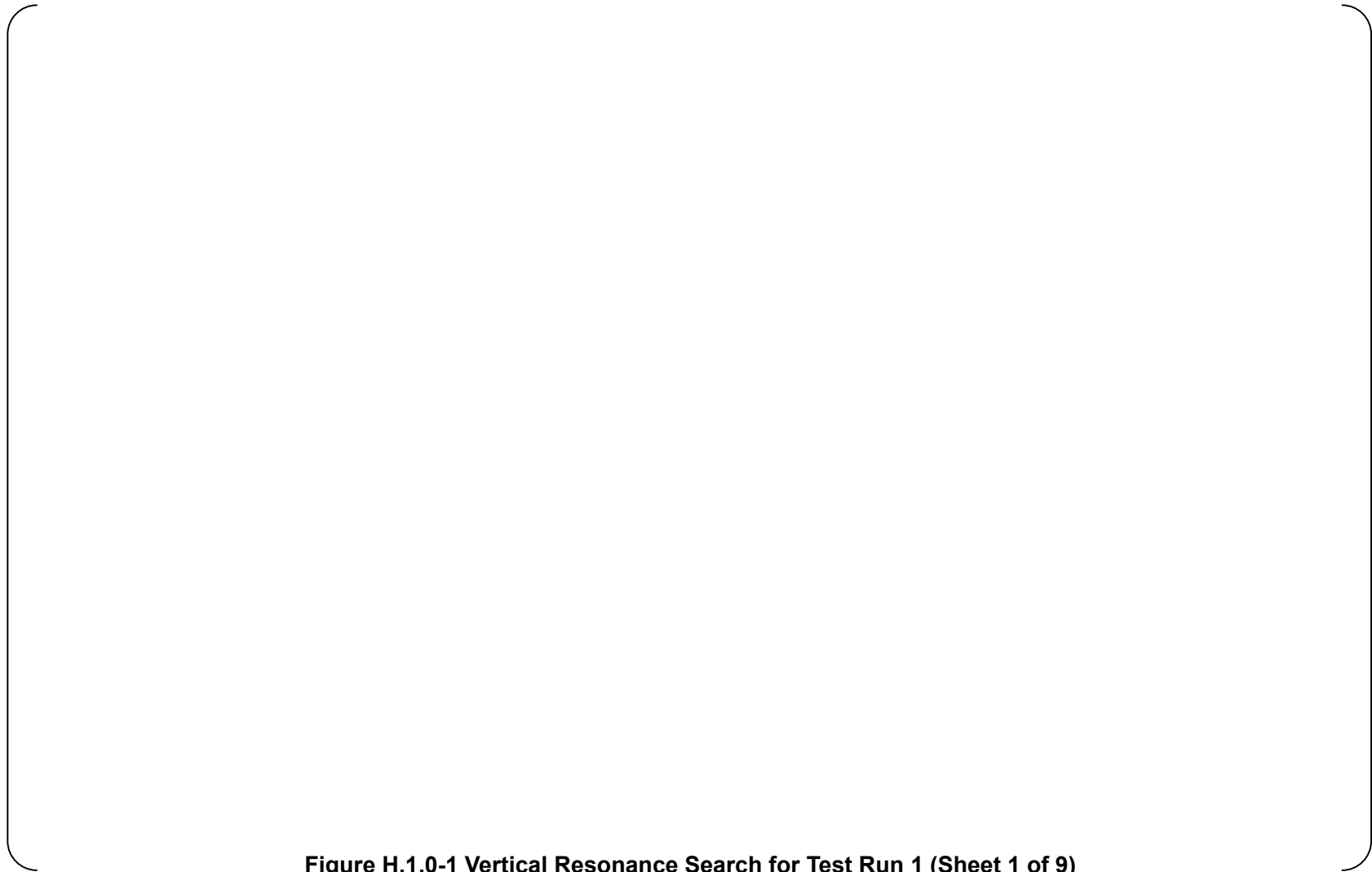


Figure H.1.0-1 Vertical Resonance Search for Test Run 1 (Sheet 1 of 9)



Figure H.1.0-1 Vertical Resonance Search for Test Run 1 (Sheet 2 of 9)



Figure H.1.0-1 Vertical Resonance Search for Test Run 1 (Sheet 3 of 9)

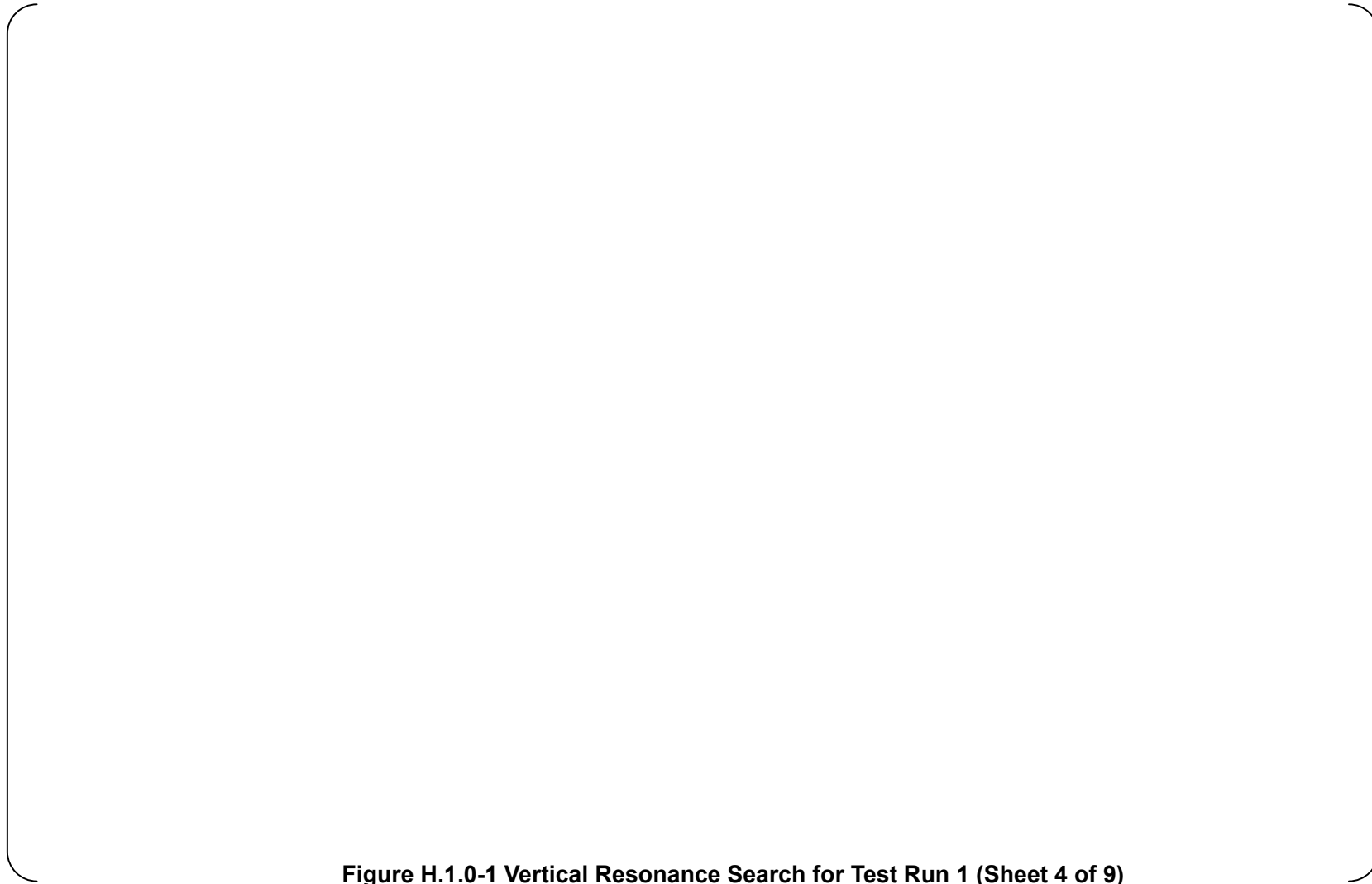


Figure H.1.0-1 Vertical Resonance Search for Test Run 1 (Sheet 4 of 9)

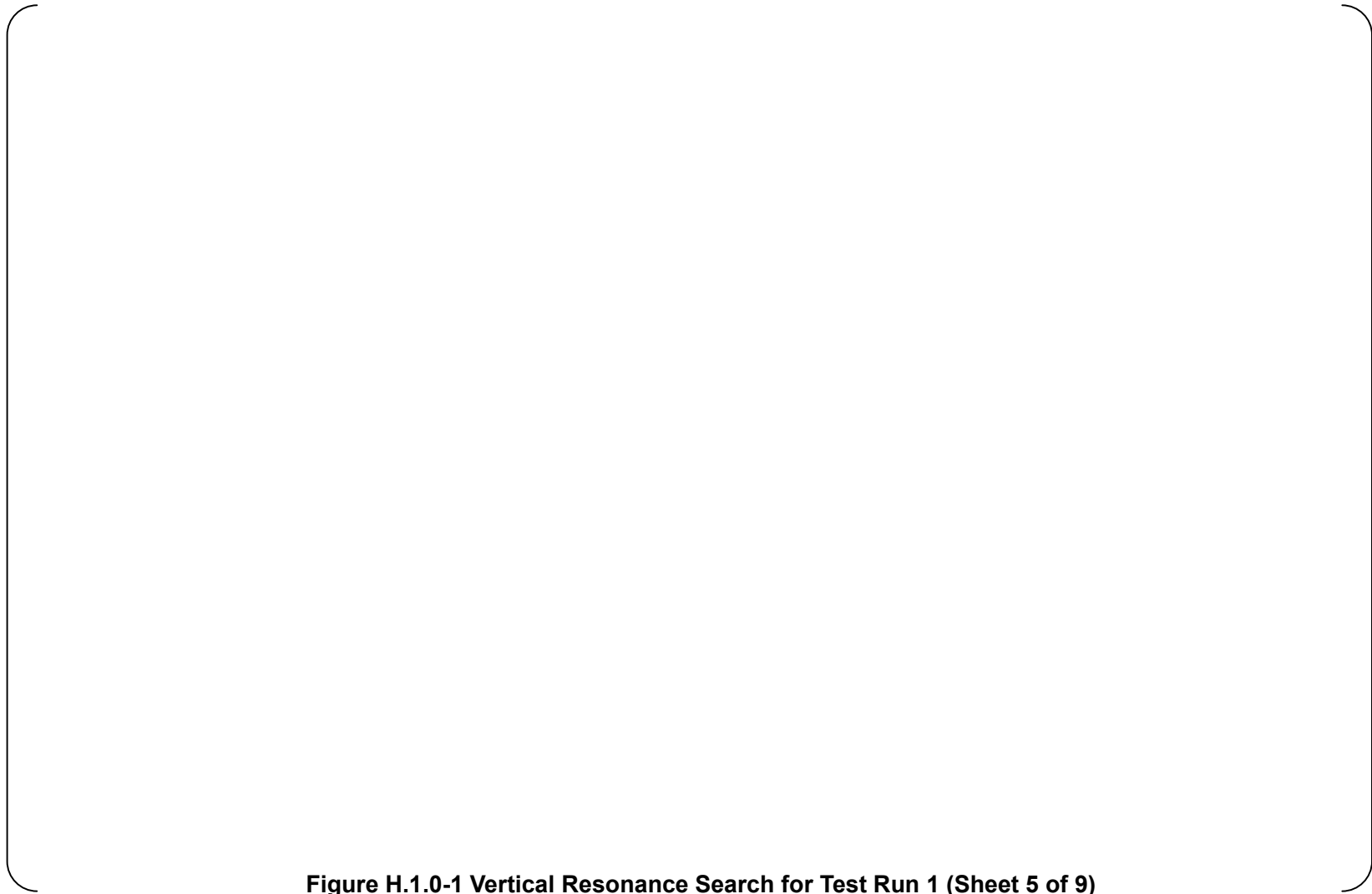


Figure H.1.0-1 Vertical Resonance Search for Test Run 1 (Sheet 5 of 9)



Figure H.1.0-1 Vertical Resonance Search for Test Run 1 (Sheet 7 of 9)



Figure H.1.0-1 Vertical Resonance Search for Test Run 1 (Sheet 8 of 9)



Figure H.1.0-1 Vertical Resonance Search for Test Run 1 (Sheet 9 of 9)



Figure H.1.0-2 Horizontal Resonance Search for Test Run 2 (Sheet 1 of 9)



Figure H.1.0-2 Horizontal Resonance Search for Test Run 2 (Sheet 2 of 9)

Figure H.1.0-2 Horizontal Resonance Search for Test Run 2 (Sheet 3 of 9)

Figure H.1.0-2 Horizontal Resonance Search for Test Run 2 (Sheet 4 of 9)



Figure H.1.0-2 Horizontal Resonance Search for Test Run 2 (Sheet 5 of 9)



Figure H.1.0-2 Horizontal Resonance Search for Test Run 2 (Sheet 6 of 9)



Figure H.1.0-2 Horizontal Resonance Search for Test Run 2 (Sheet 7 of 9)





Figure H.1.0-2 Horizontal Resonance Search for Test Run 2 (Sheet 9 of 9)



Figure H.1.0-3 Radom Multifrequency Test for Test Run 3 (Sheet 1 of 2)



Figure H.1.0-3 Radom Multifrequency Test for Test Run 3 (Sheet 2 of 2)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 1 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 2 of 40)

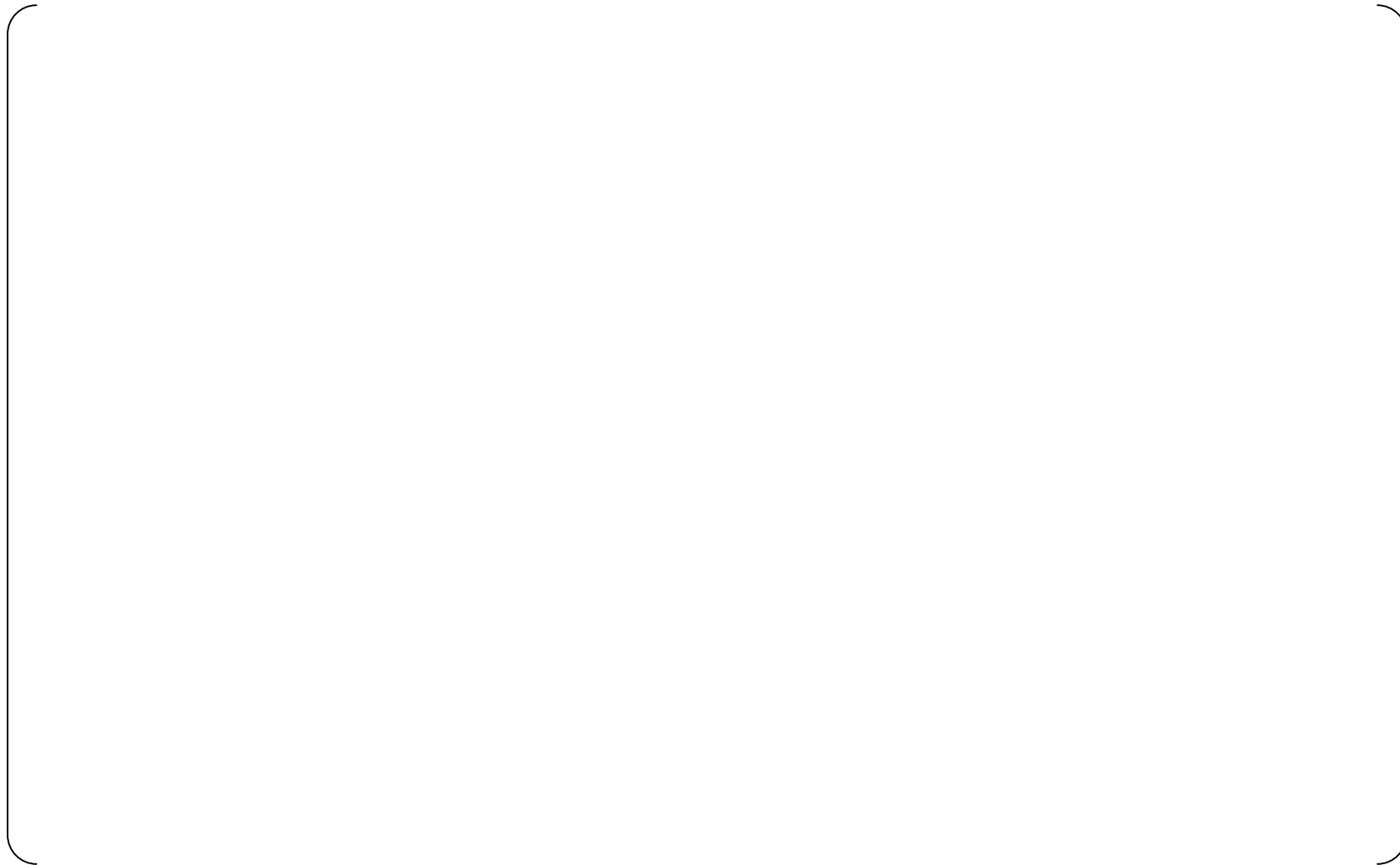


Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 3 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 4 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 5 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 6 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 7 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 8 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 9 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 10 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 11 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 12 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 13 of 40)

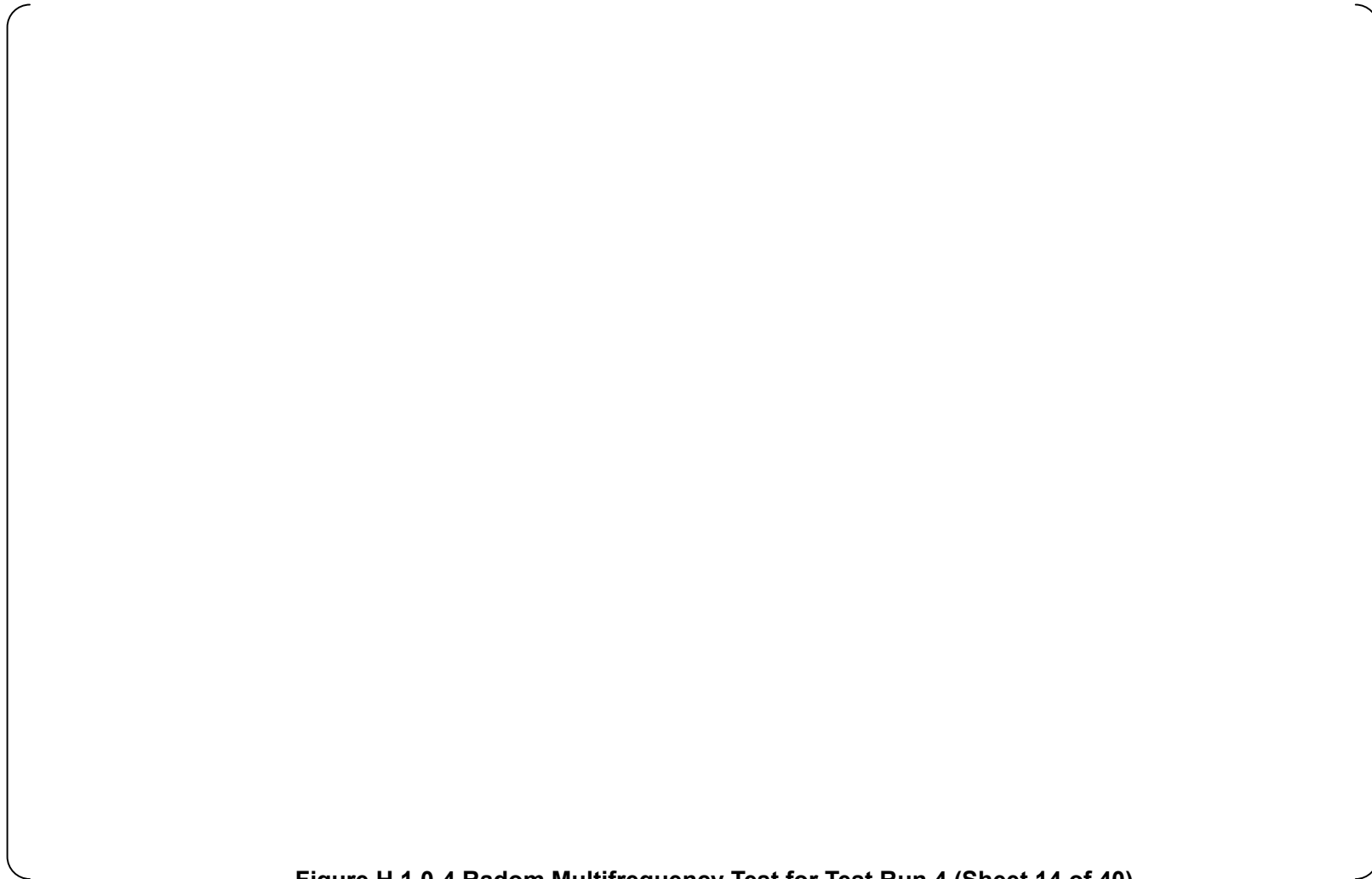


Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 14 of 40)

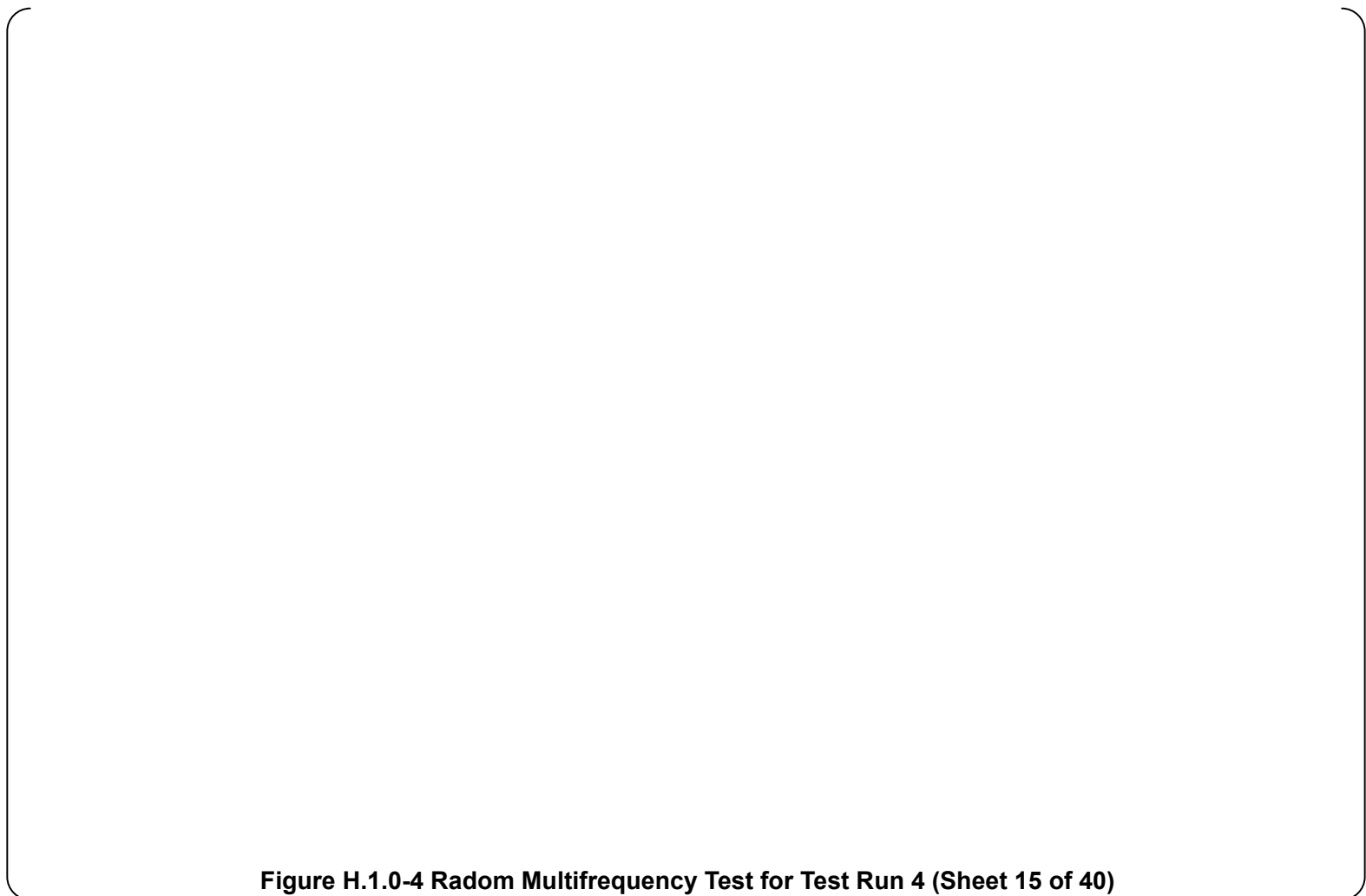


Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 15 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 16 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 17 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 18 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 19 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 20 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 21 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 22 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 23 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 24 of 40)

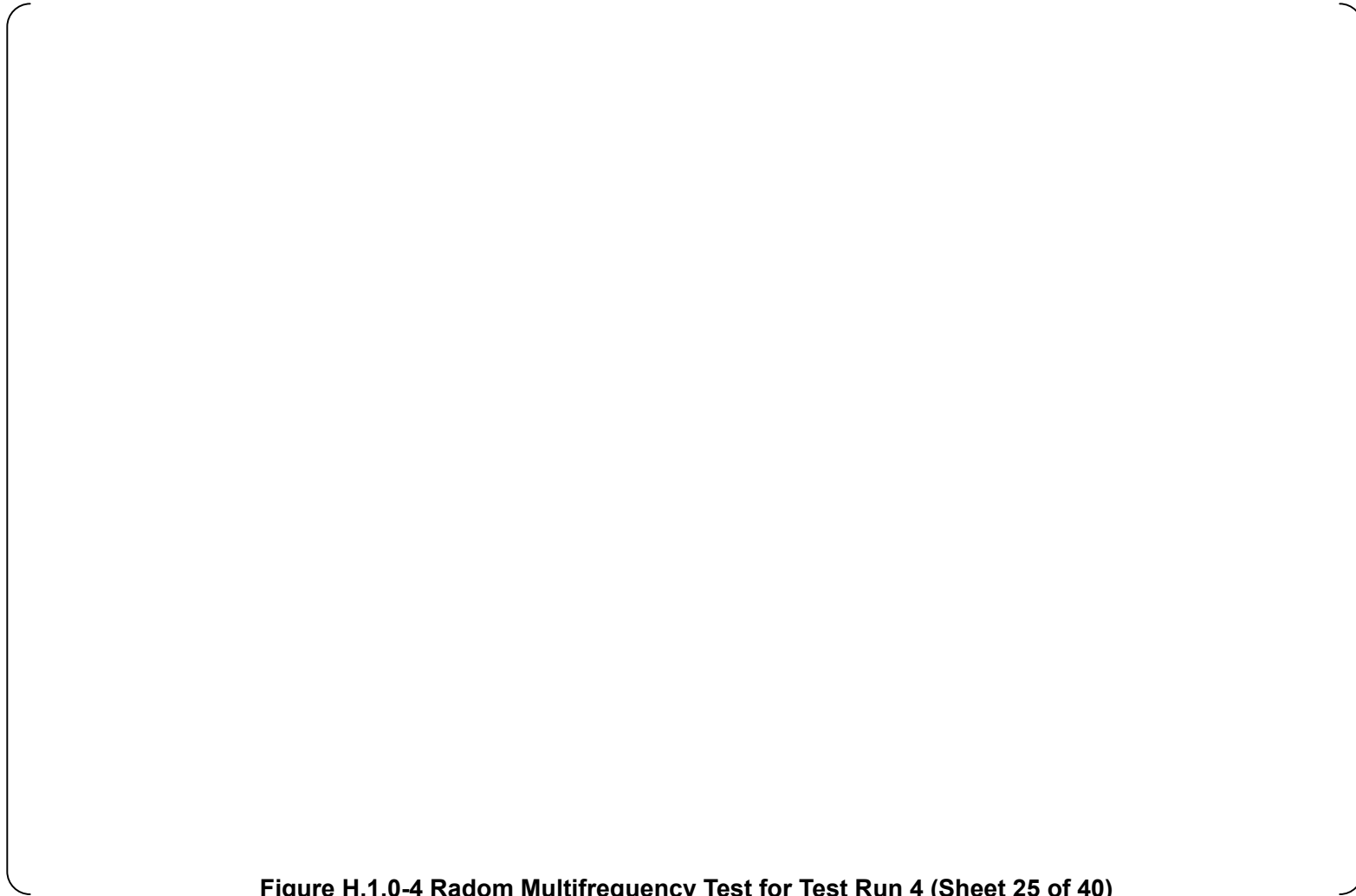


Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 25 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 26 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 27 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 28 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 29 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 30 of 40)

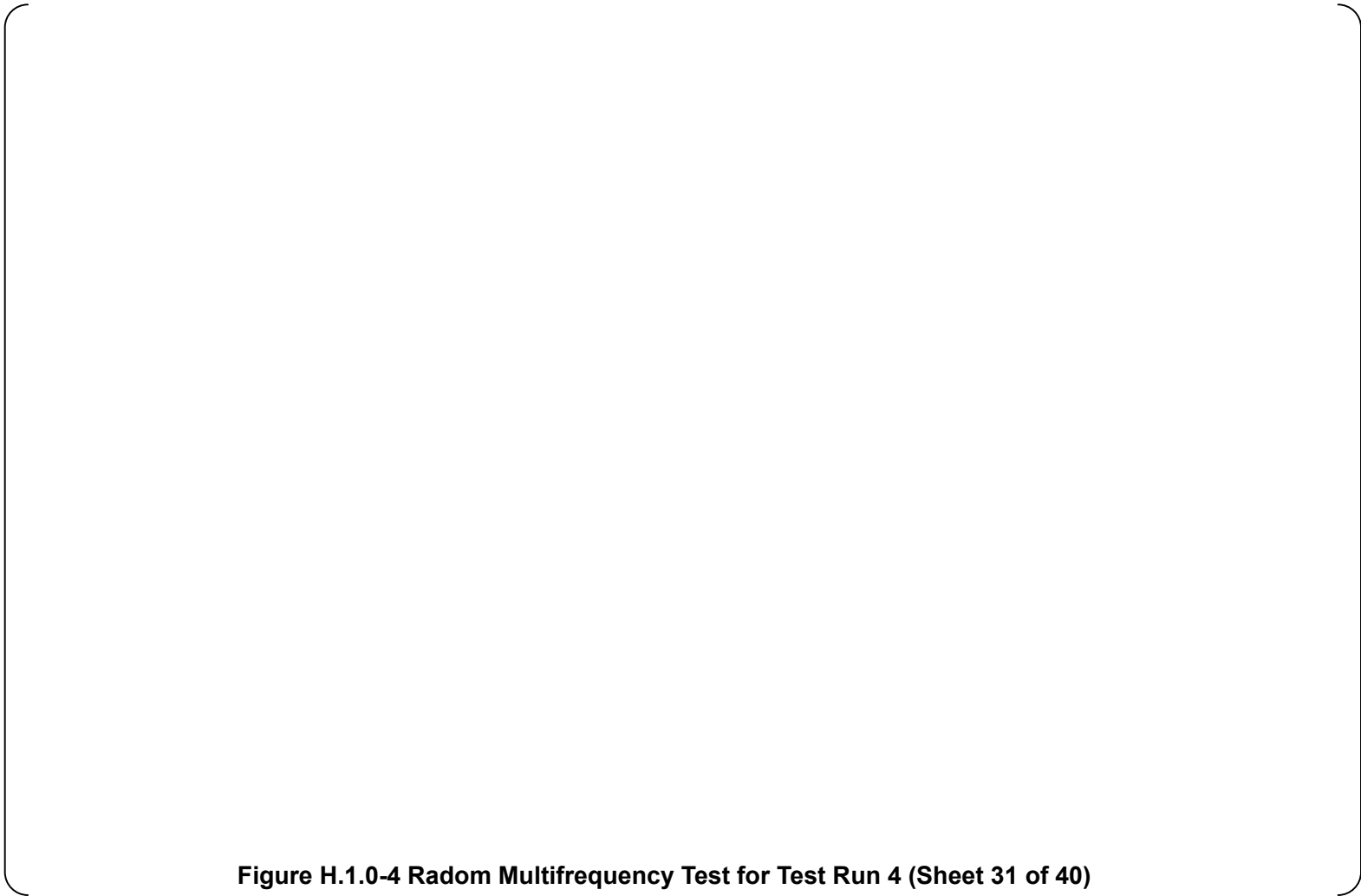




Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 32 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 33 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 34 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 35 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 36 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 37 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 38 of 40)

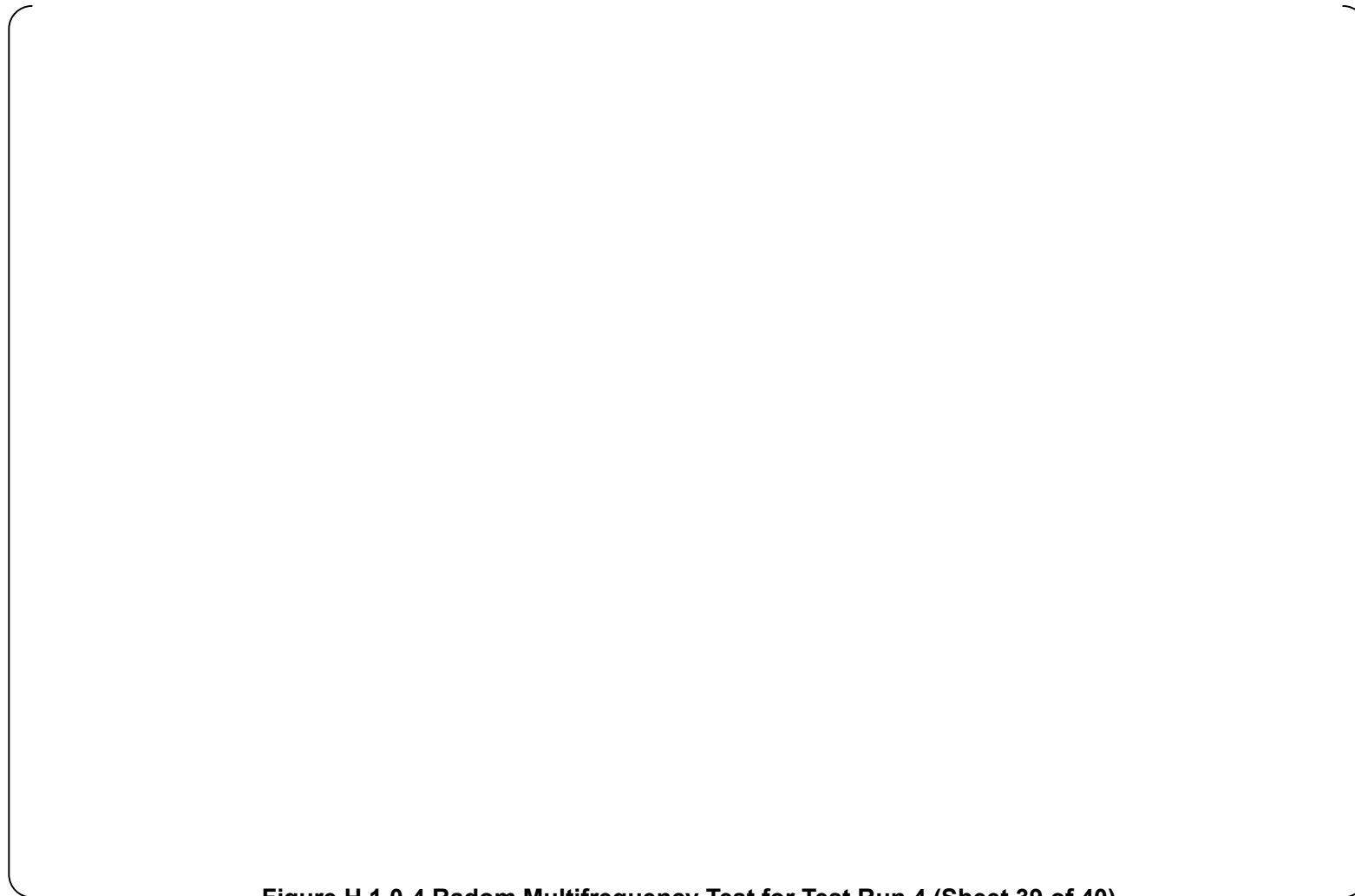


Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 39 of 40)



Figure H.1.0-4 Radom Multifrequency Test for Test Run 4 (Sheet 40 of 40)

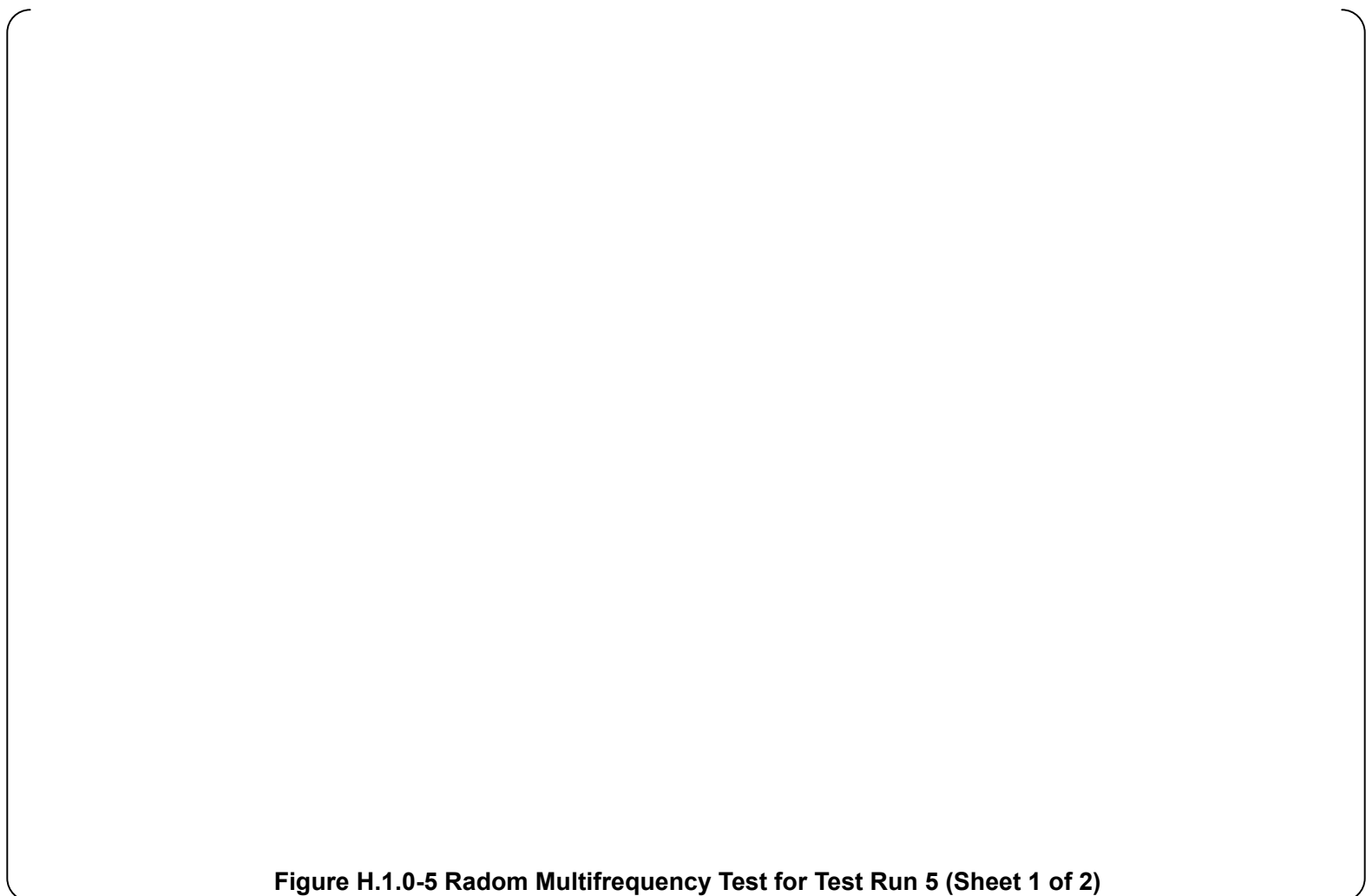


Figure H.1.0-5 Radom Multifrequency Test for Test Run 5 (Sheet 1 of 2)

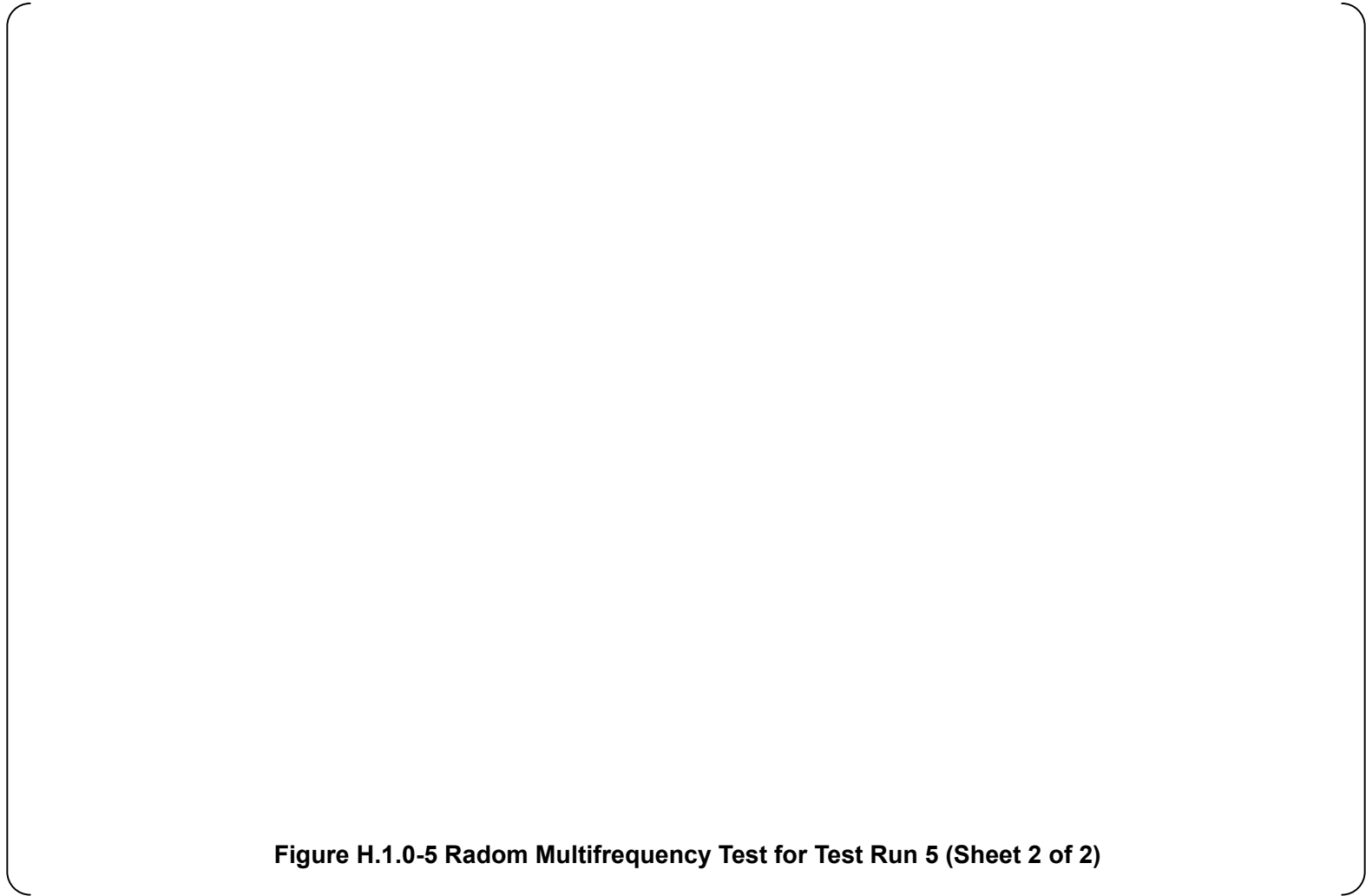


Figure H.1.0-5 Radom Multifrequency Test for Test Run 5 (Sheet 2 of 2)

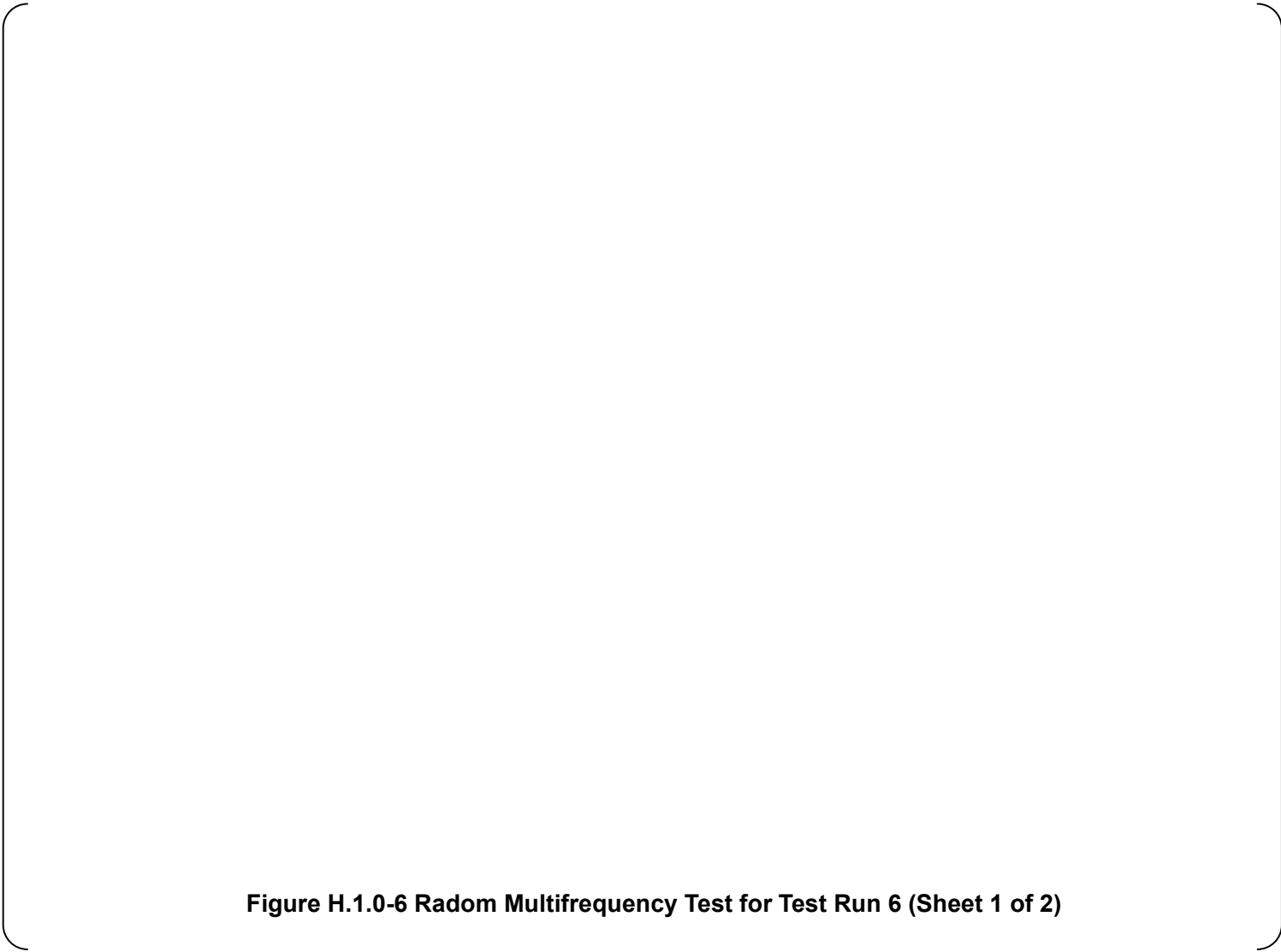


Figure H.1.0-6 Radom Multifrequency Test for Test Run 6 (Sheet 1 of 2)

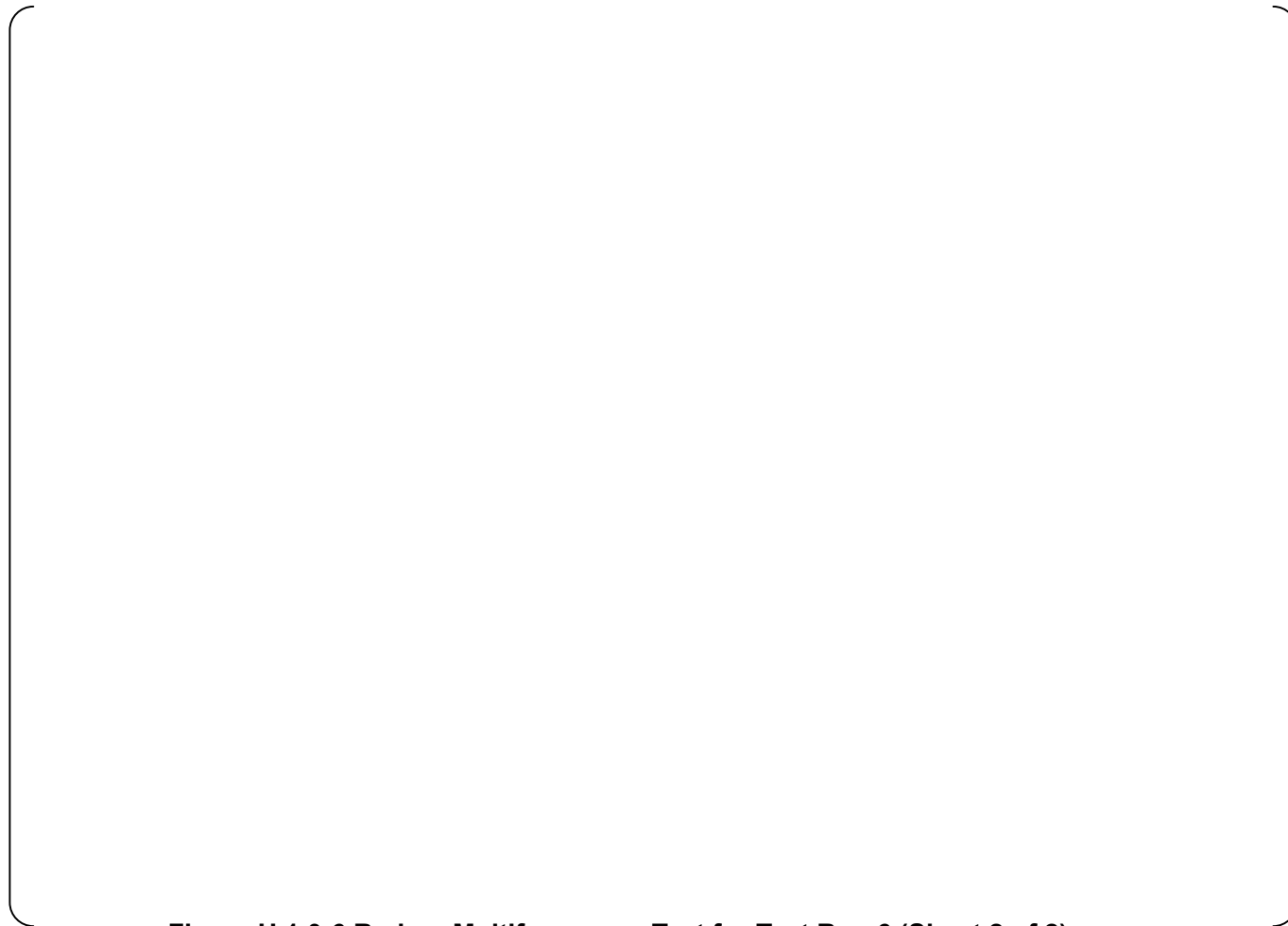


Figure H.1.0-6 Radom Multifrequency Test for Test Run 6 (Sheet 2 of 2)



Figure H.1.0-7 Radom Multifrequency Test for Test Run 7 (Sheet 1 of 2)



Figure H.1.0-7 Radom Multifrequency Test for Test Run 7 (Sheet 2 of 2)

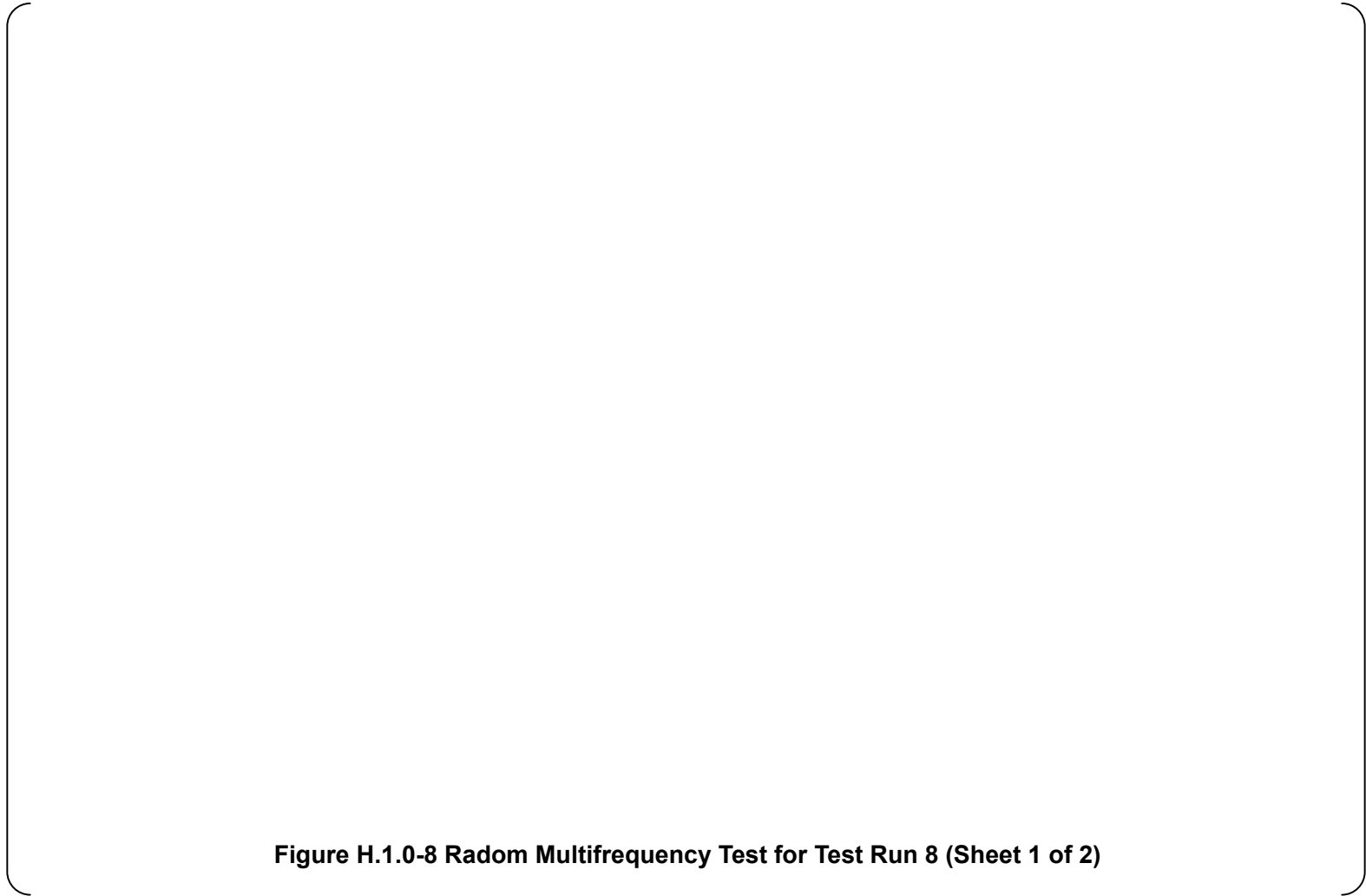


Figure H.1.0-8 Radom Multifrequency Test for Test Run 8 (Sheet 1 of 2)

Figure H.1.0-8 Radom Multifrequency Test for Test Run 8 (Sheet 2 of 2)

Figure H.1.0-9 Radom Multifrequency Test for Test Run 9 (Sheet 1 of 2)

Figure H.1.0-9 Radom Multifrequency Test for Test Run 9 (Sheet 2 of 2)

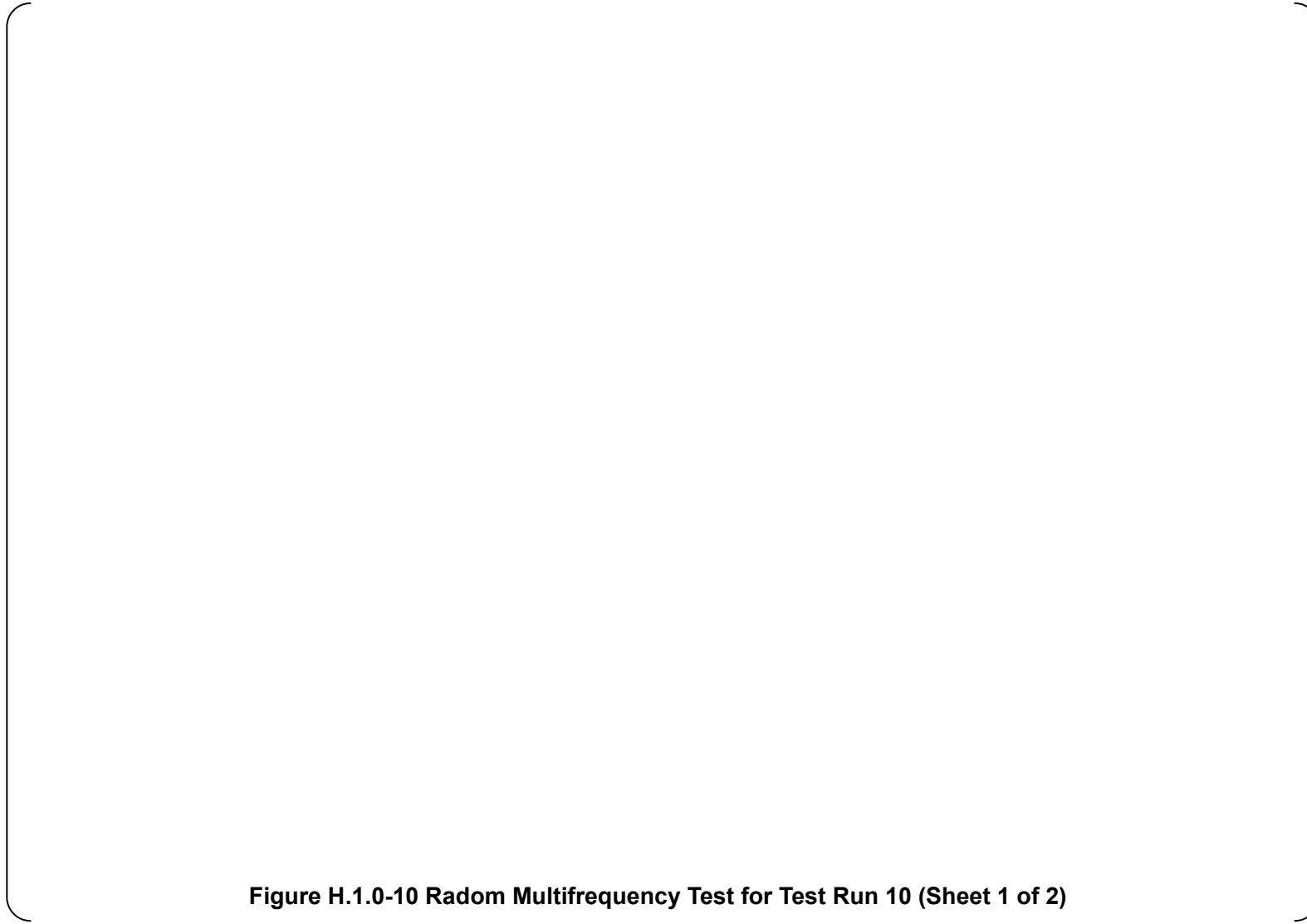


Figure H.1.0-10 Radom Multifrequency Test for Test Run 10 (Sheet 1 of 2)

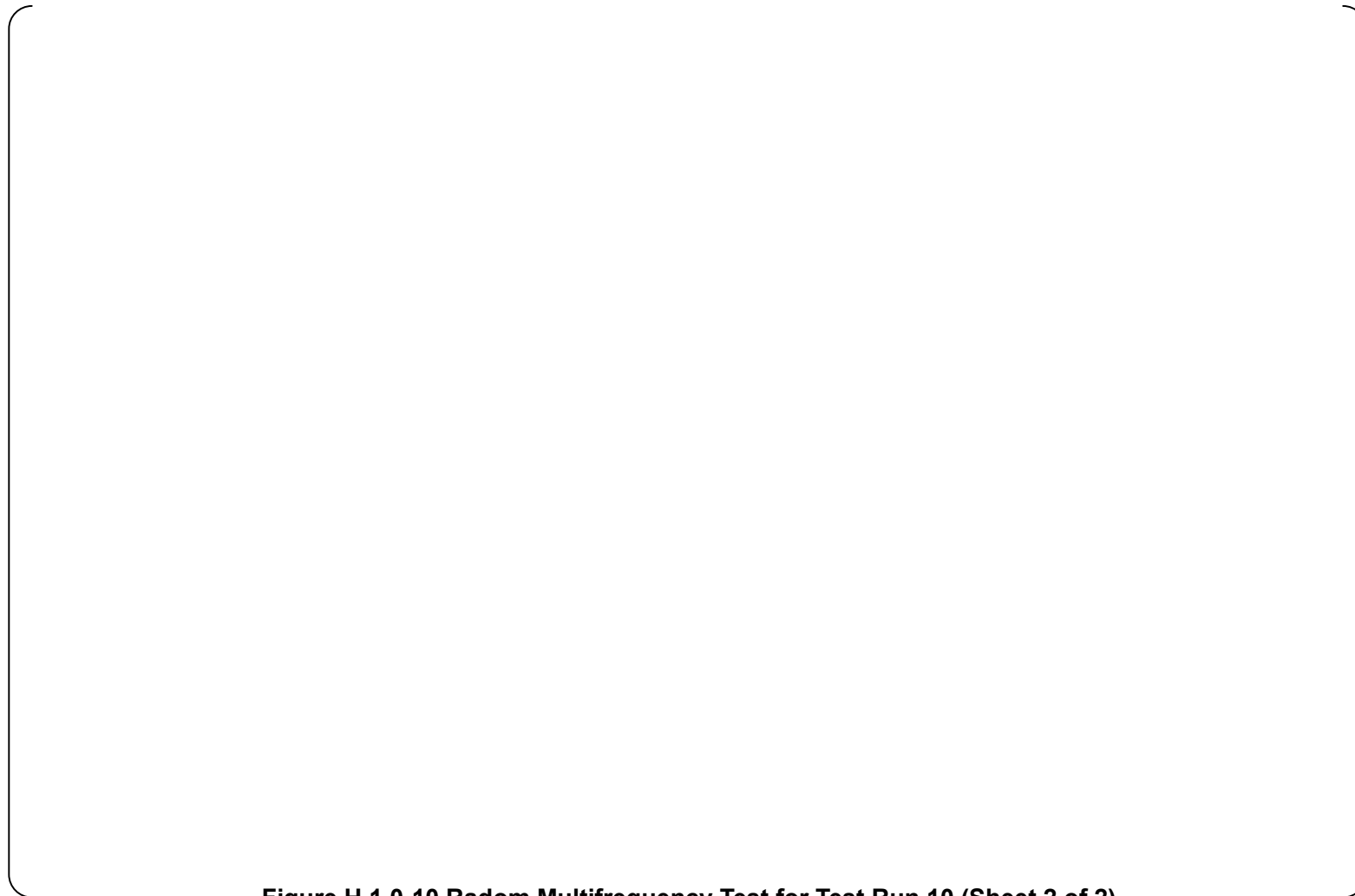


Figure H.1.0-10 Radom Multifrequency Test for Test Run 10 (Sheet 2 of 2)

Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 1 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 2 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 3 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 4 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 5 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 6 of 43)

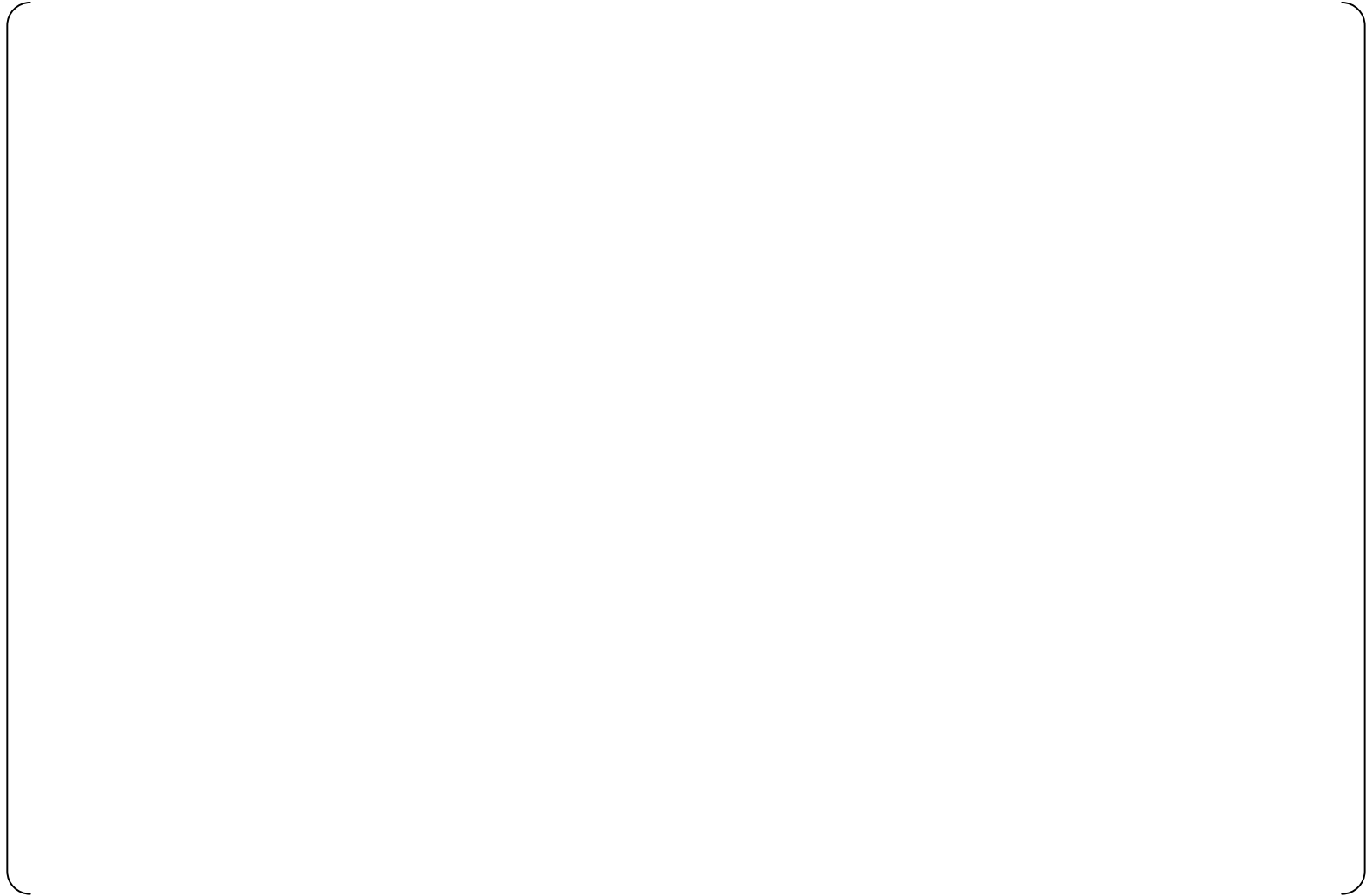


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 7 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 8 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 9 of 43)

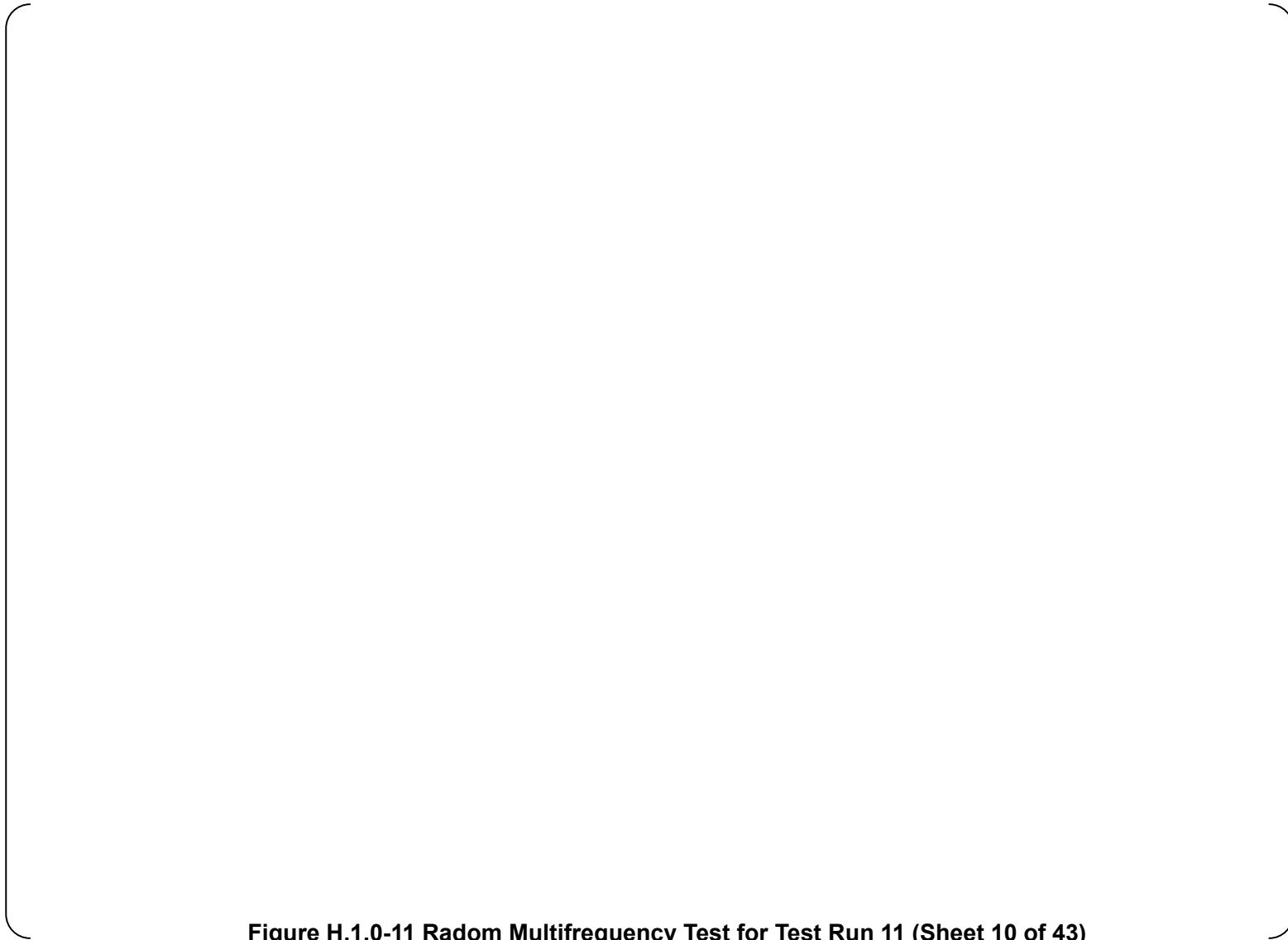


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 10 of 43)

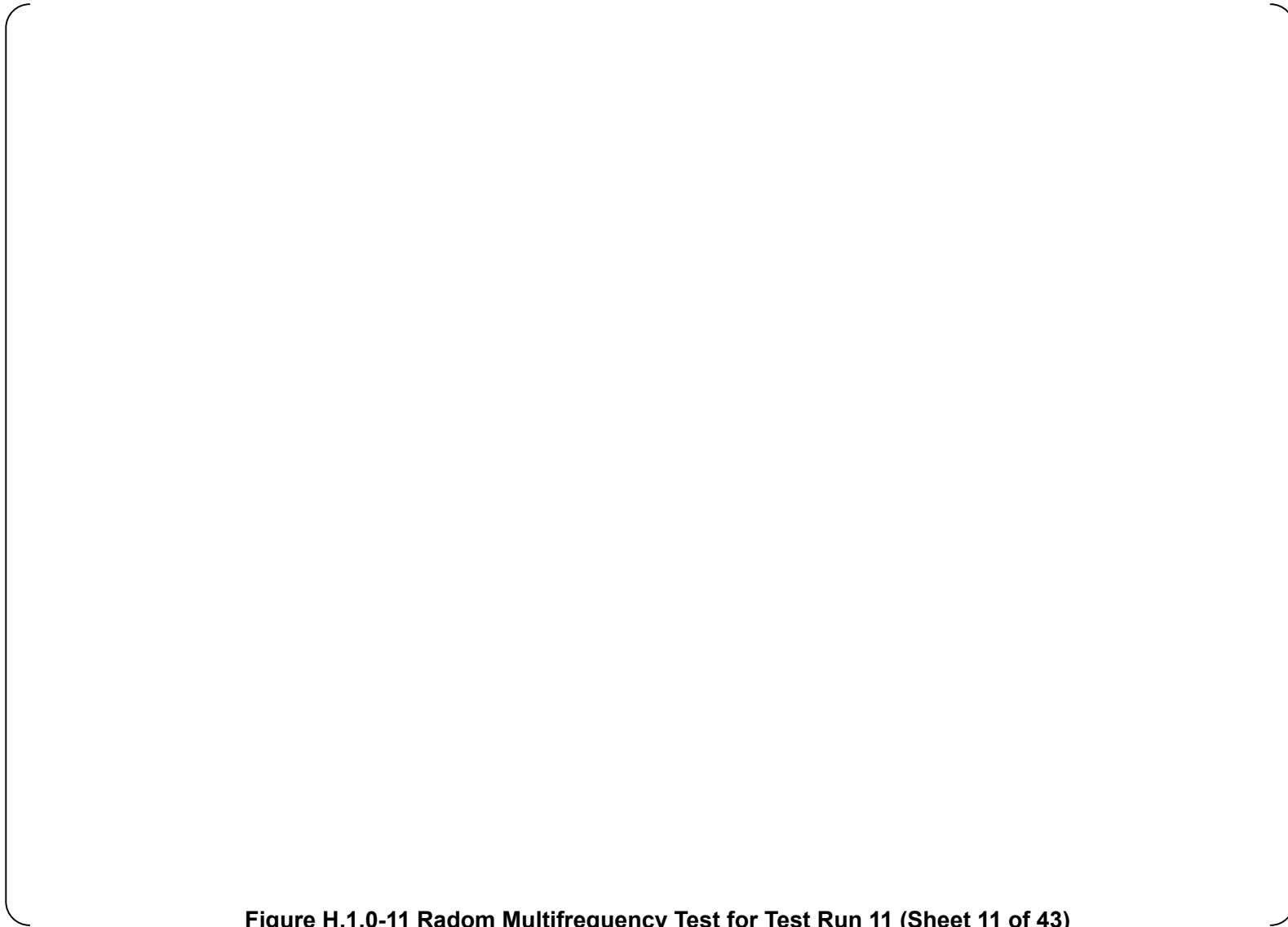


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 11 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 12 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 13 of 43)

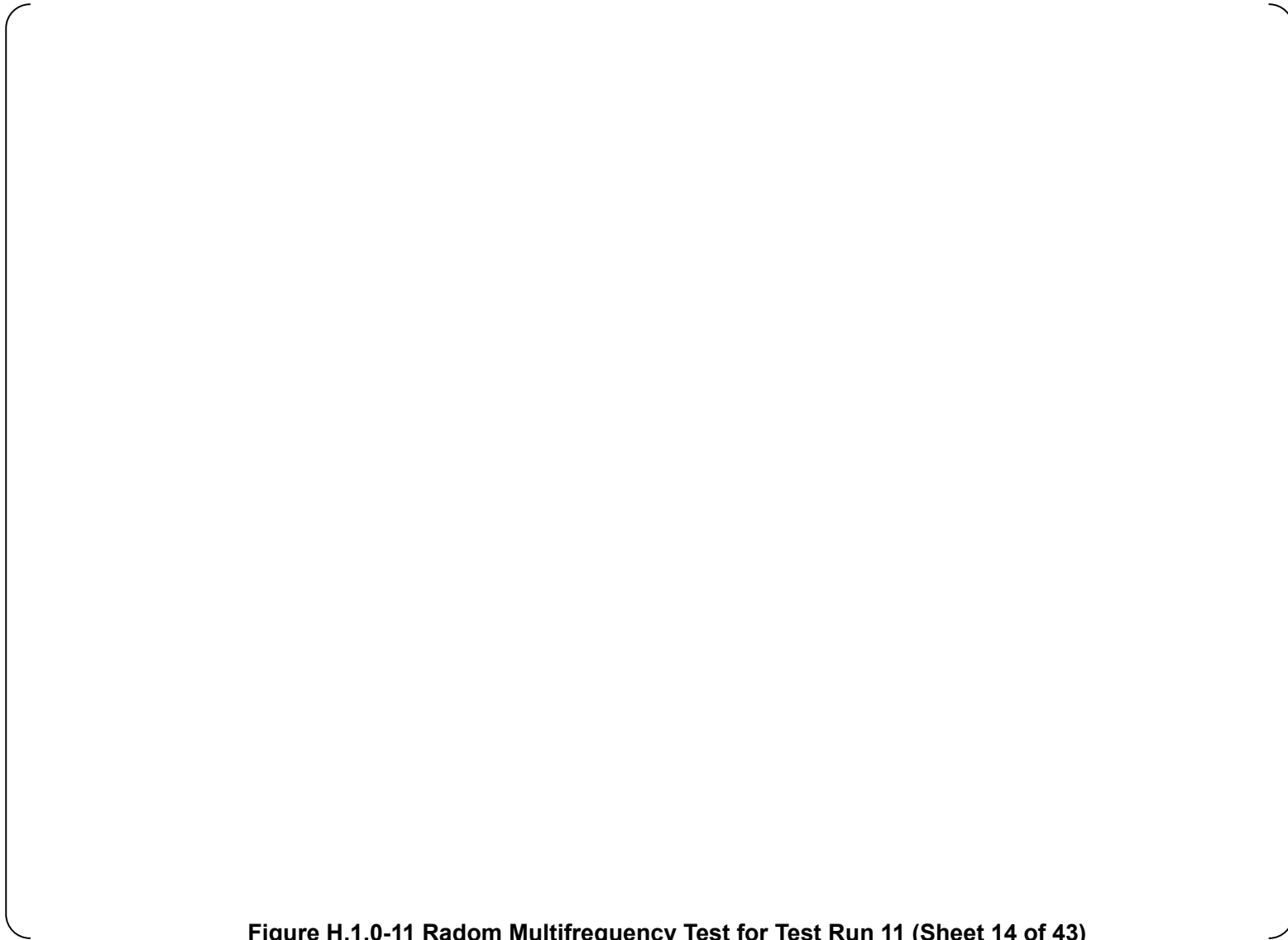


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 14 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 15 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 16 of 43)

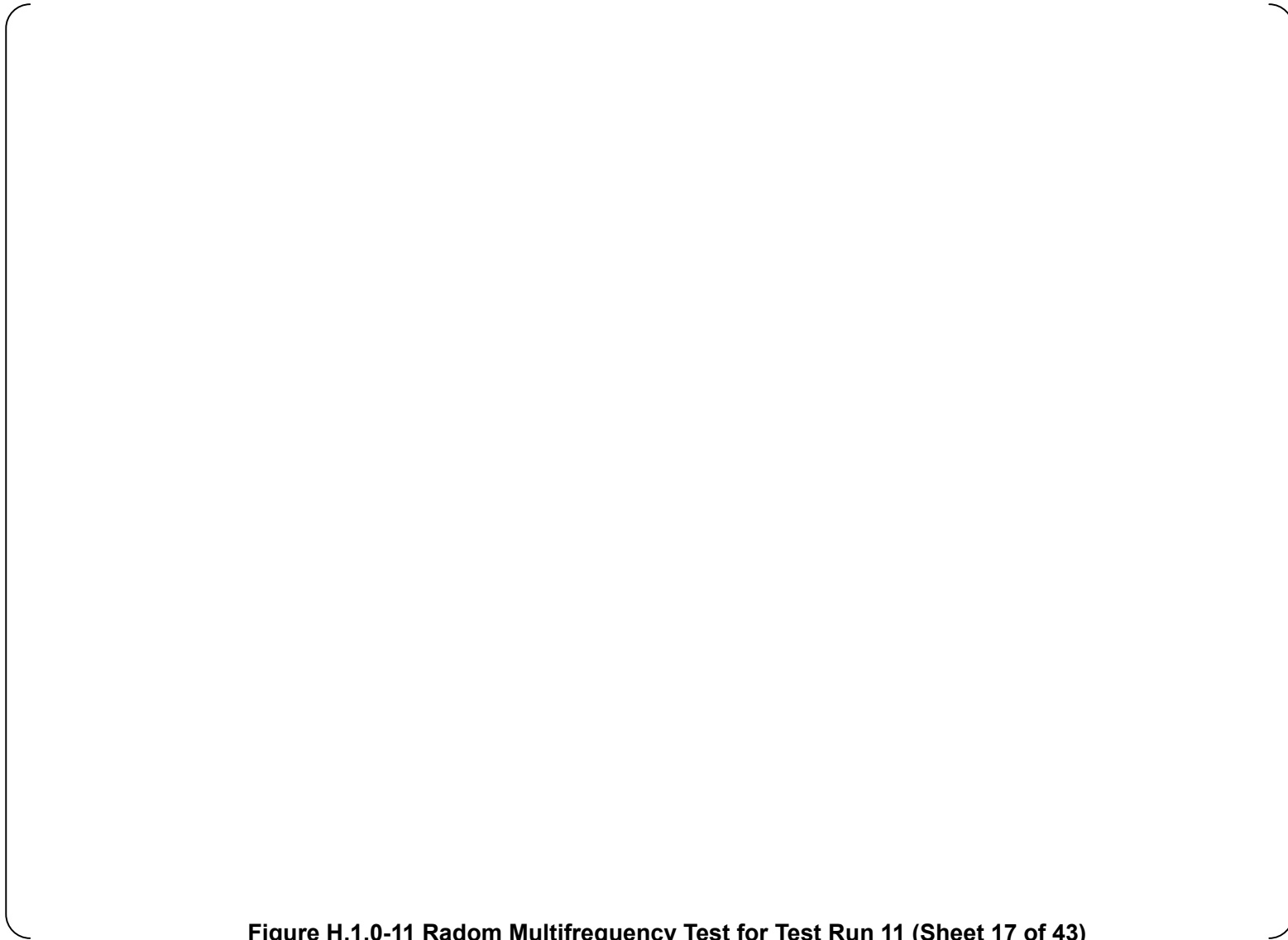


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 17 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 18 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 19 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 20 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 21 of 43)

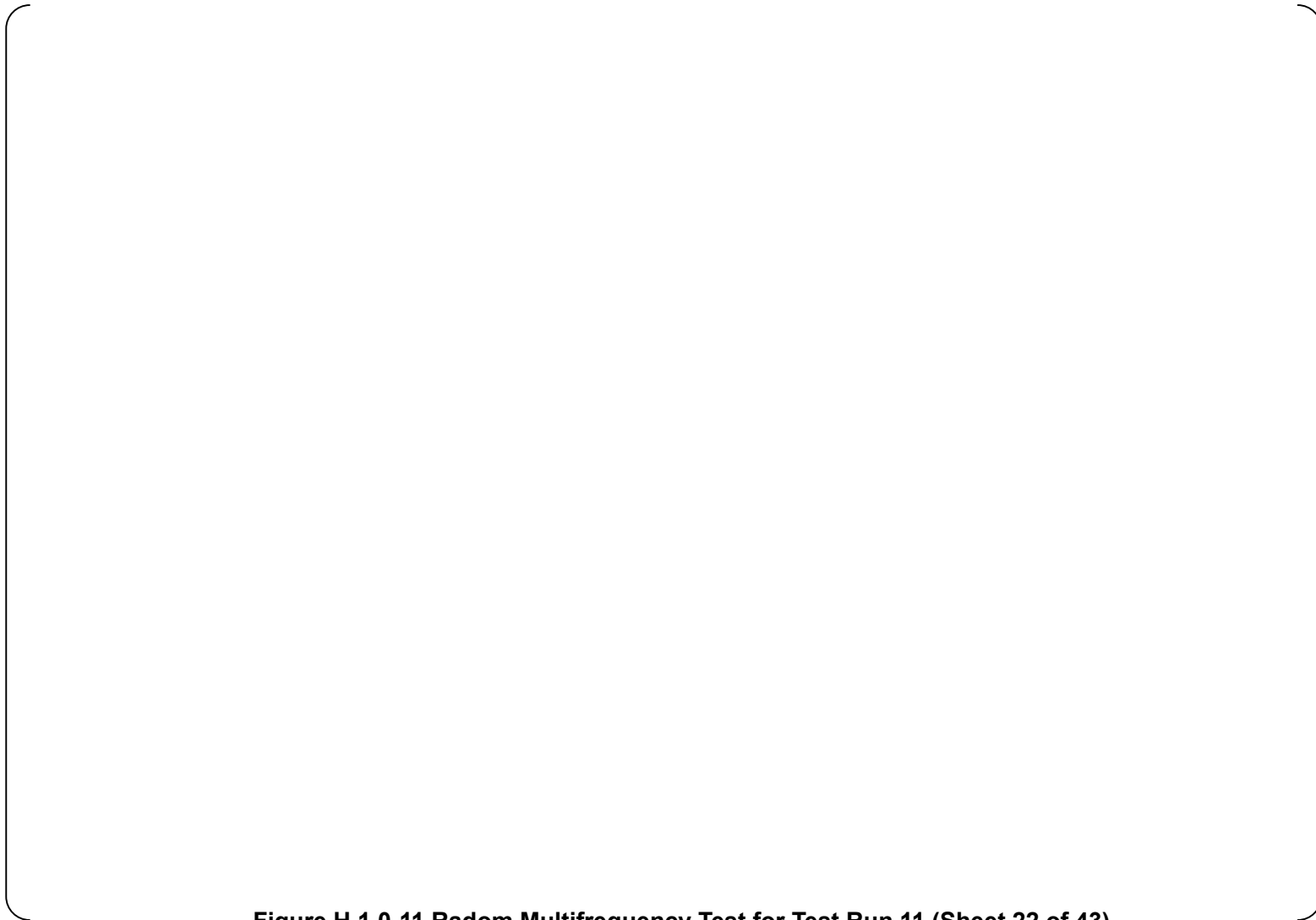


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 22 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 23 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 24 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 25 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 26 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 27 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 28 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 29 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 30 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 31 of 43)

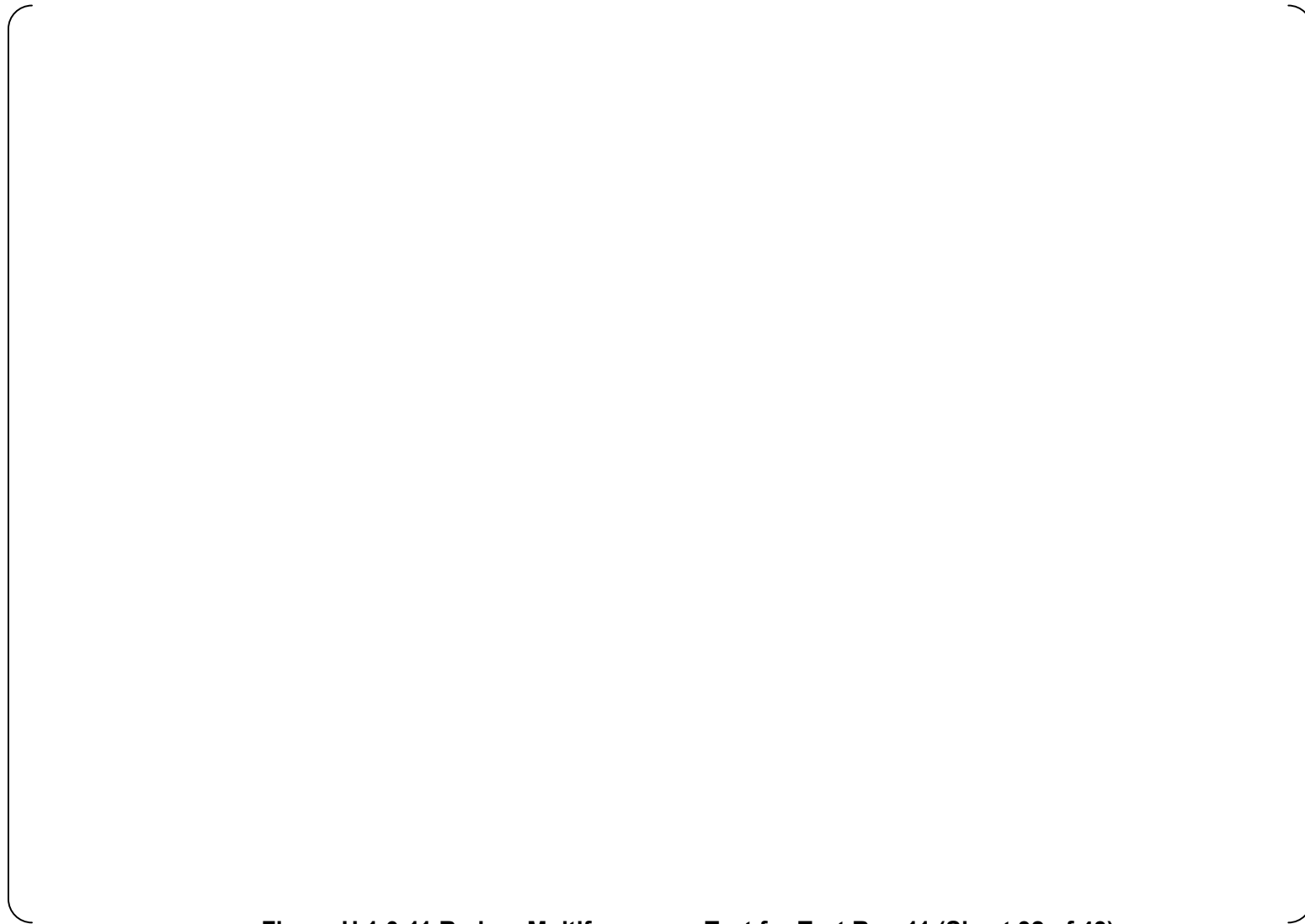


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 32 of 43)

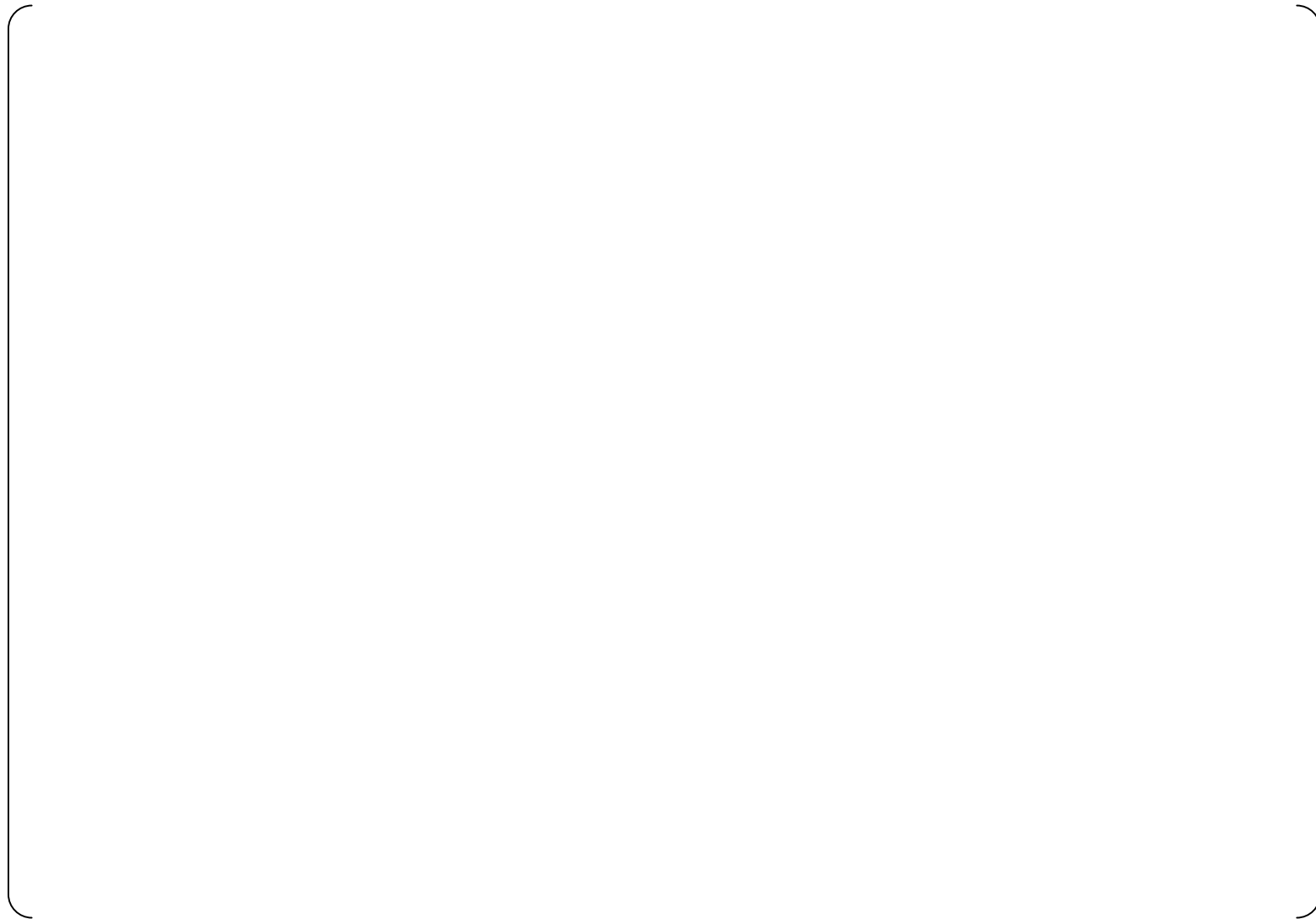


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 33 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 34 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 35 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 36 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 37 of 43)

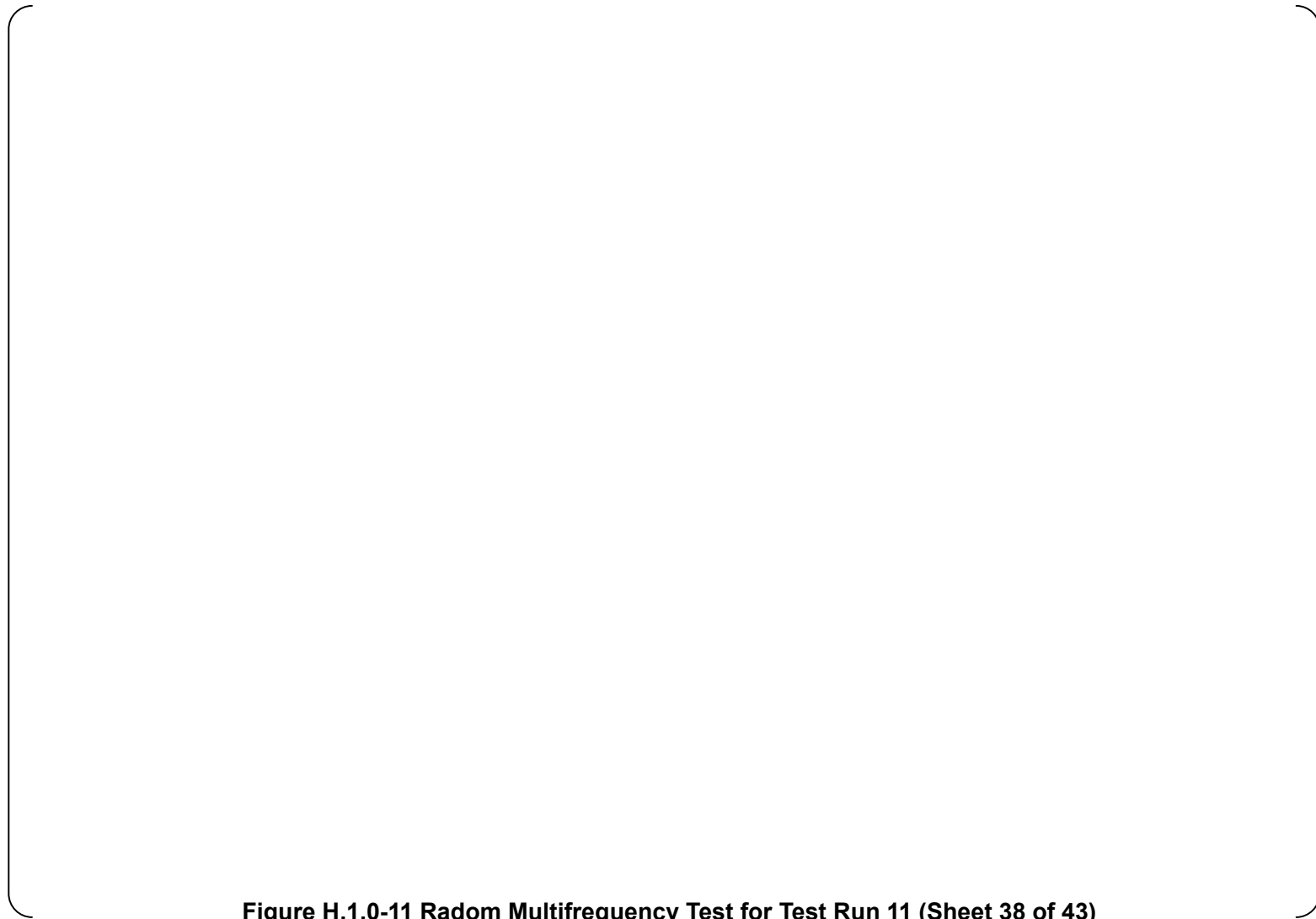


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 38 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 39 of 43)

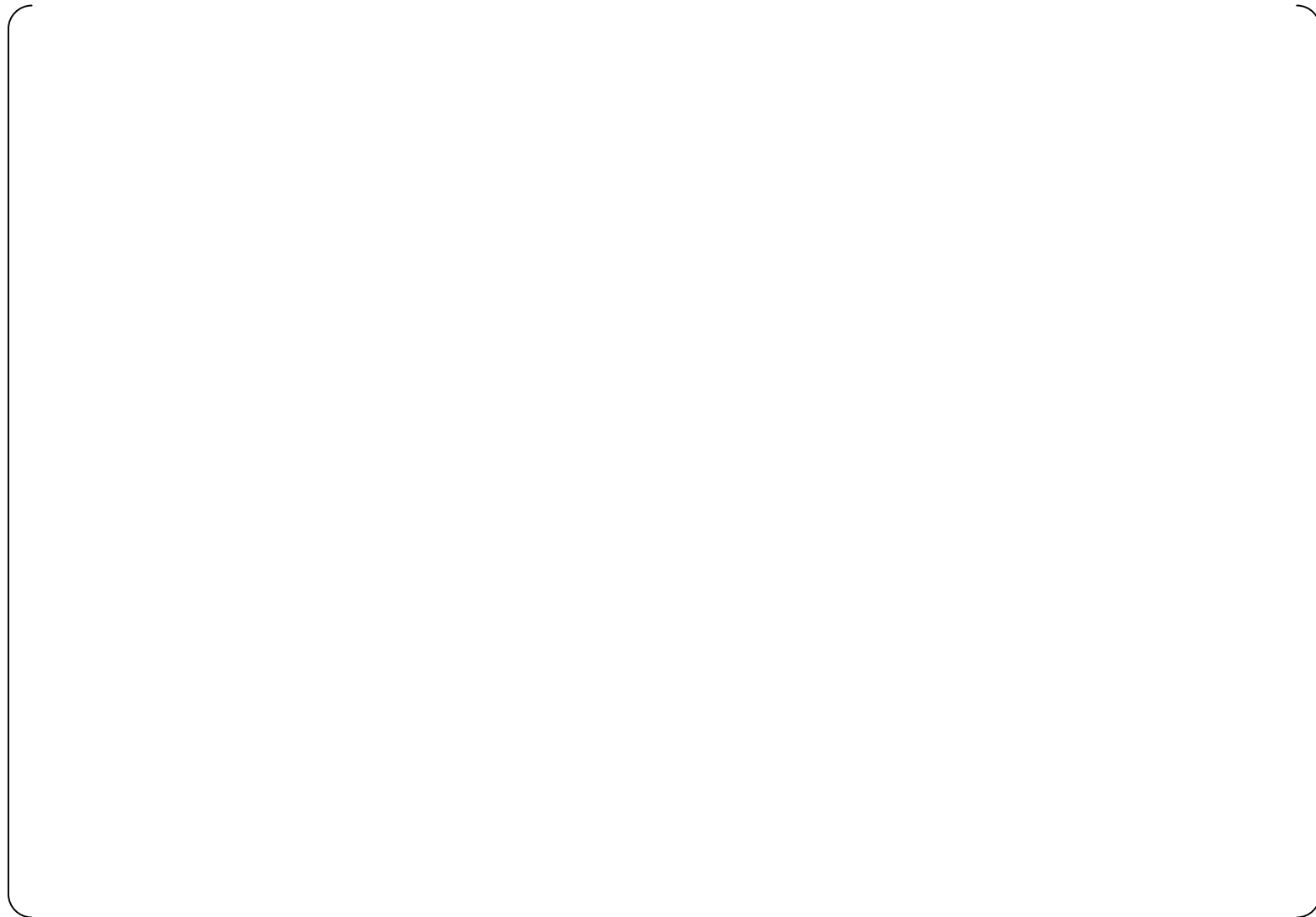


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 40 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 41 of 43)



Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 42 of 43)

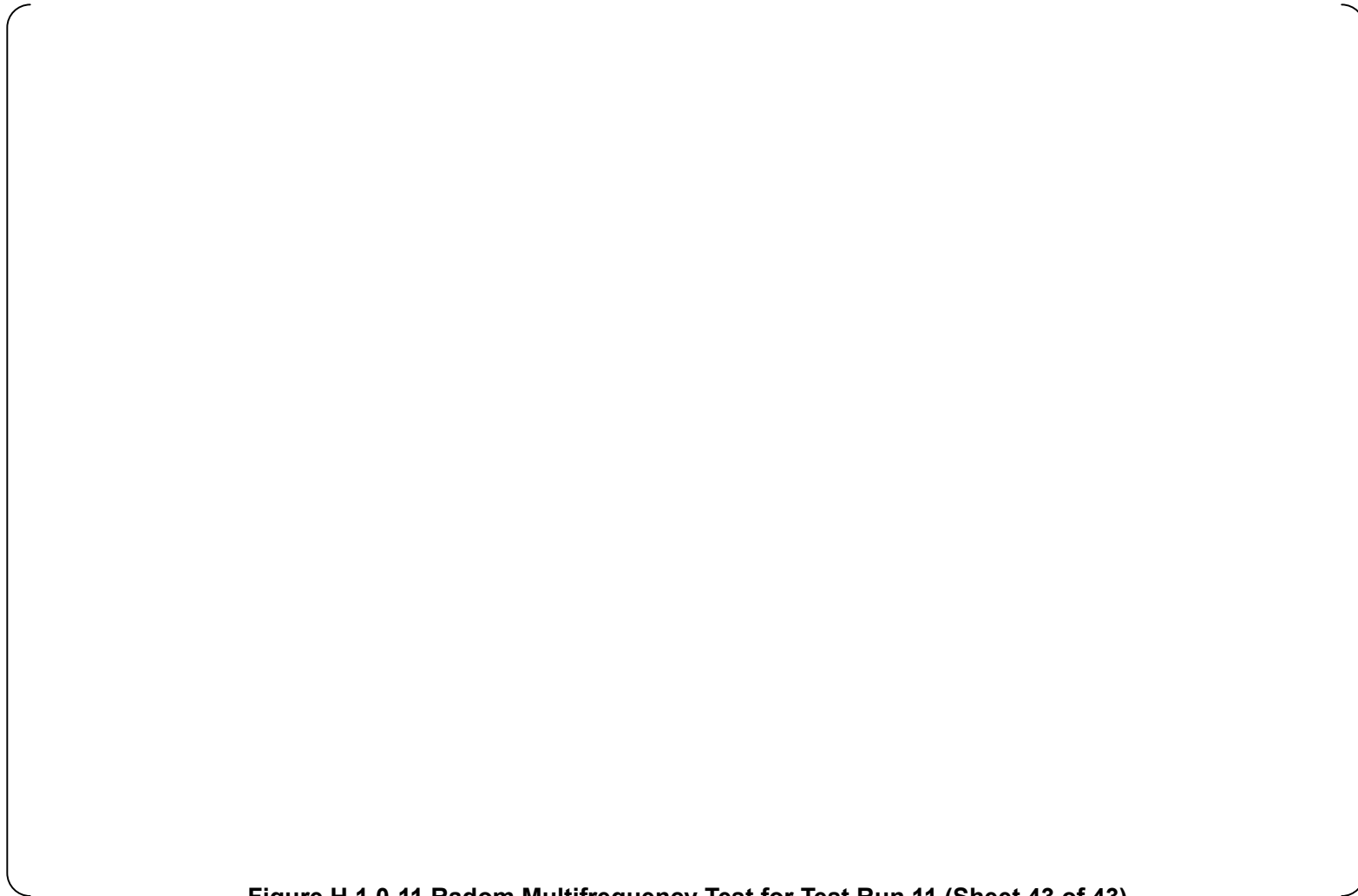


Figure H.1.0-11 Radom Multifrequency Test for Test Run 11 (Sheet 43 of 43)



Figure H.1.0-12 Horizontal Resonance Search for Test Run 12 (Sheet 1 of 9)

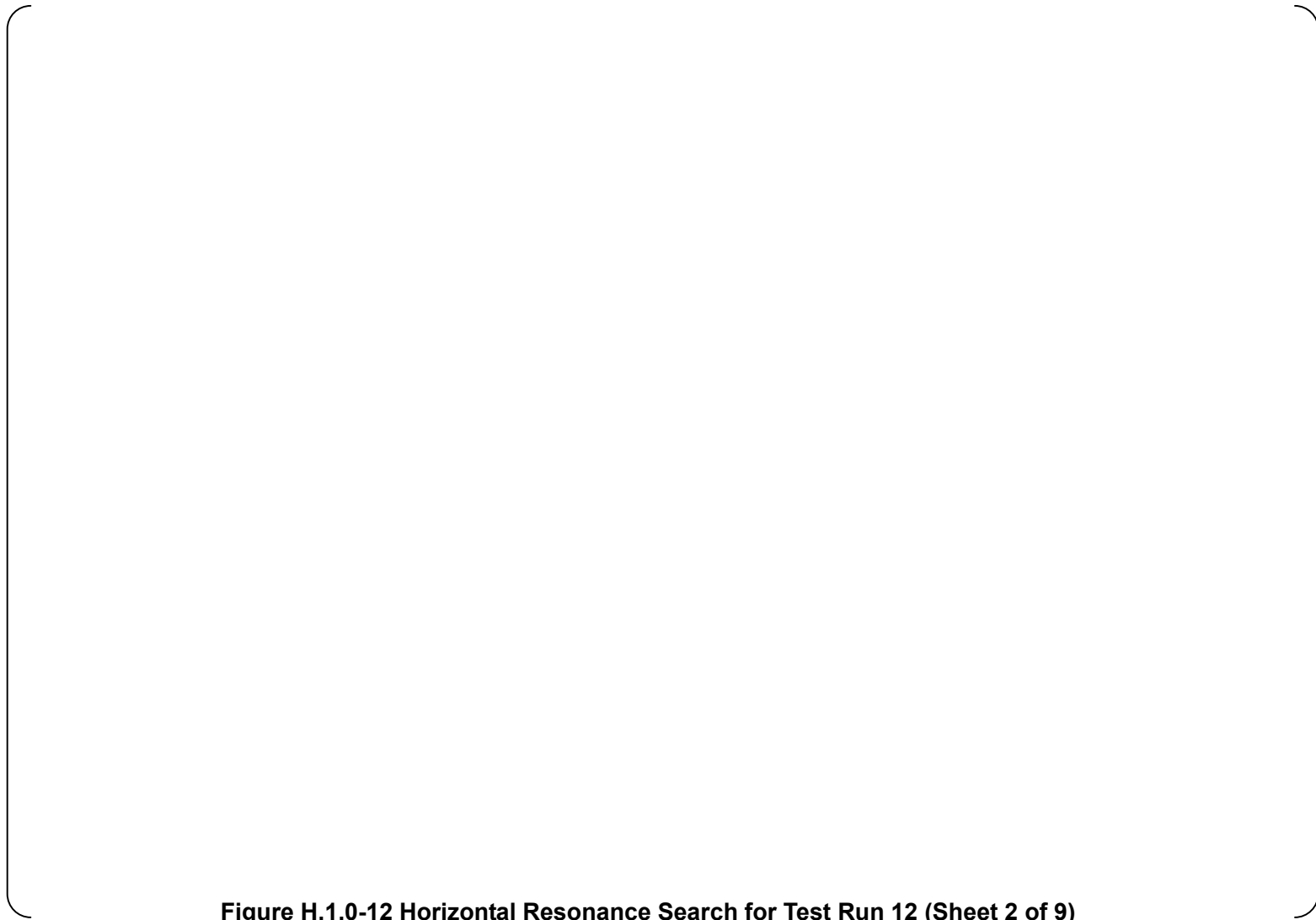


Figure H.1.0-12 Horizontal Resonance Search for Test Run 12 (Sheet 2 of 9)



Figure H.1.0-12 Horizontal Resonance Search for Test Run 12 (Sheet 3 of 9)

Figure H.1.0-12 Horizontal Resonance Search for Test Run 12 (Sheet 4 of 9)

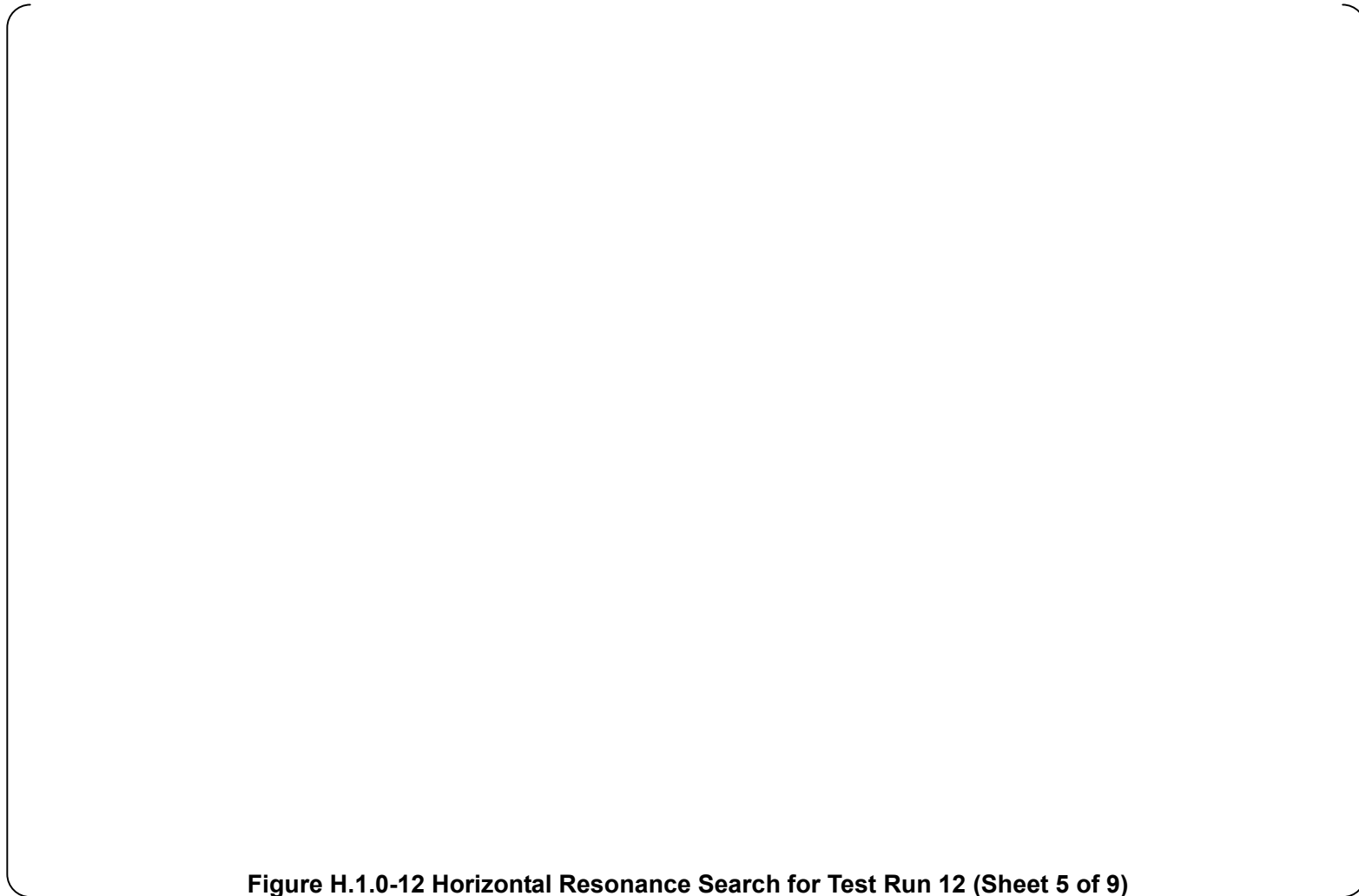


Figure H.1.0-12 Horizontal Resonance Search for Test Run 12 (Sheet 6 of 9)



Figure H.1.0-12 Horizontal Resonance Search for Test Run 12 (Sheet 7 of 9)



Figure H.1.0-12 Horizontal Resonance Search for Test Run 12 (Sheet 8 of 9)



Figure H.1.0-12 Horizontal Resonance Search for Test Run 12 (Sheet 9 of 9)



Figure H.1.0-13 Horizontal Resonance Search for Test Run 13 (Sheet 1 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 2 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 3 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 4 of 40)

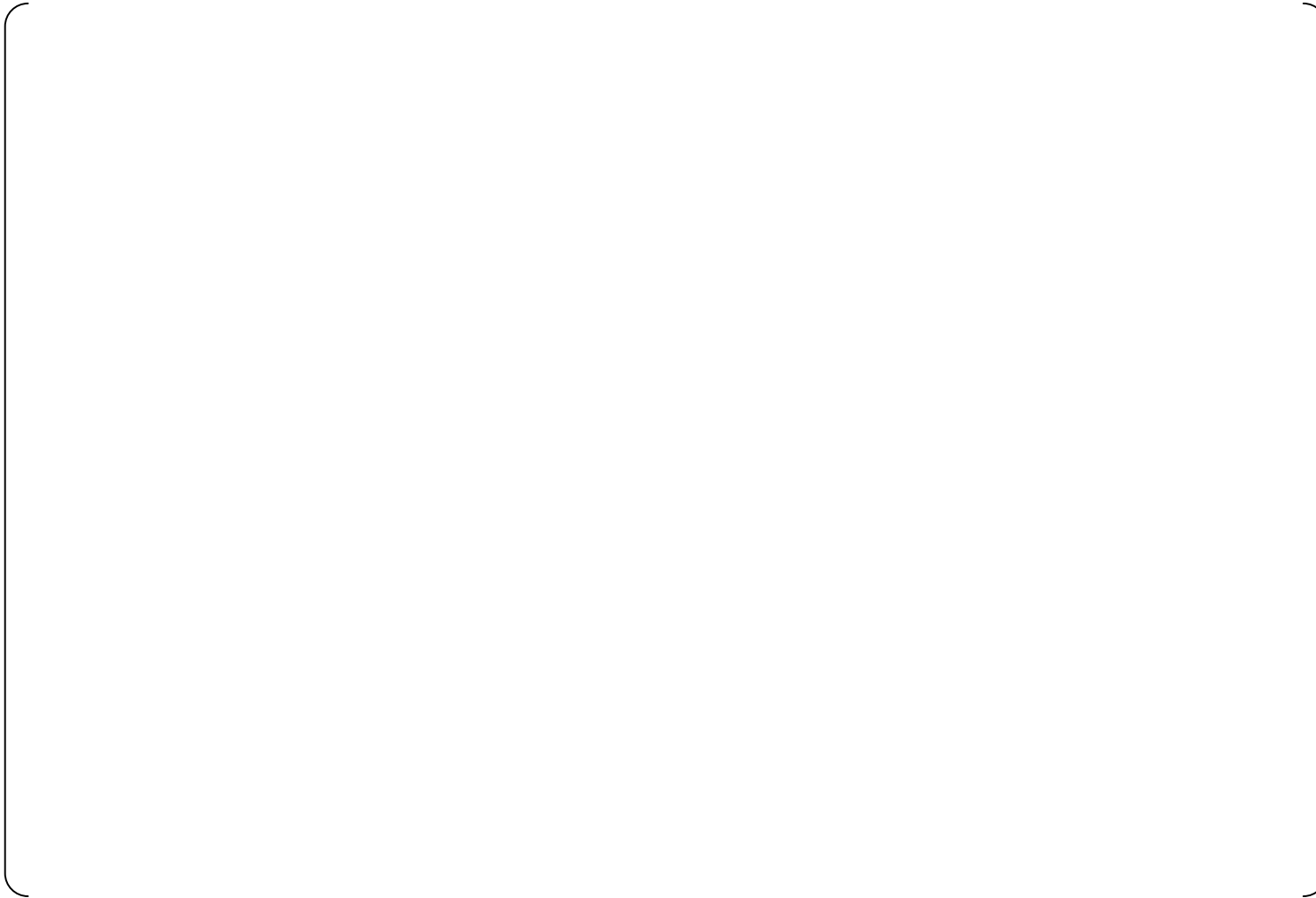


Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 5 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 6 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 7 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 8 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 9 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 10 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 11 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 12 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 13 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 14 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 15 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 16 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 17 of 40)

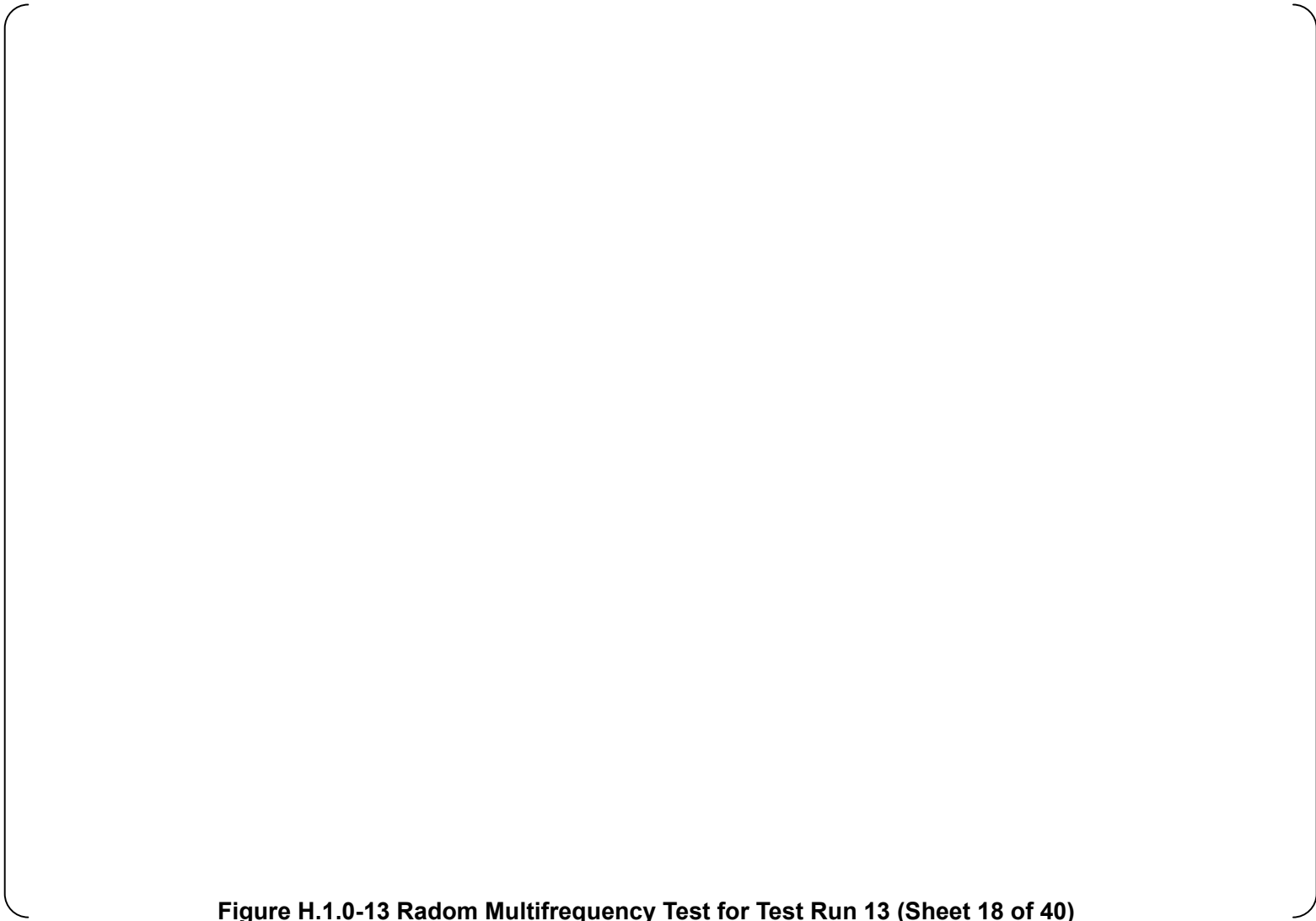




Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 19 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 20 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 21 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 22 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 23 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 24 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 25 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 26 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 27 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 28 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 29 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 30 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 31 of 40)

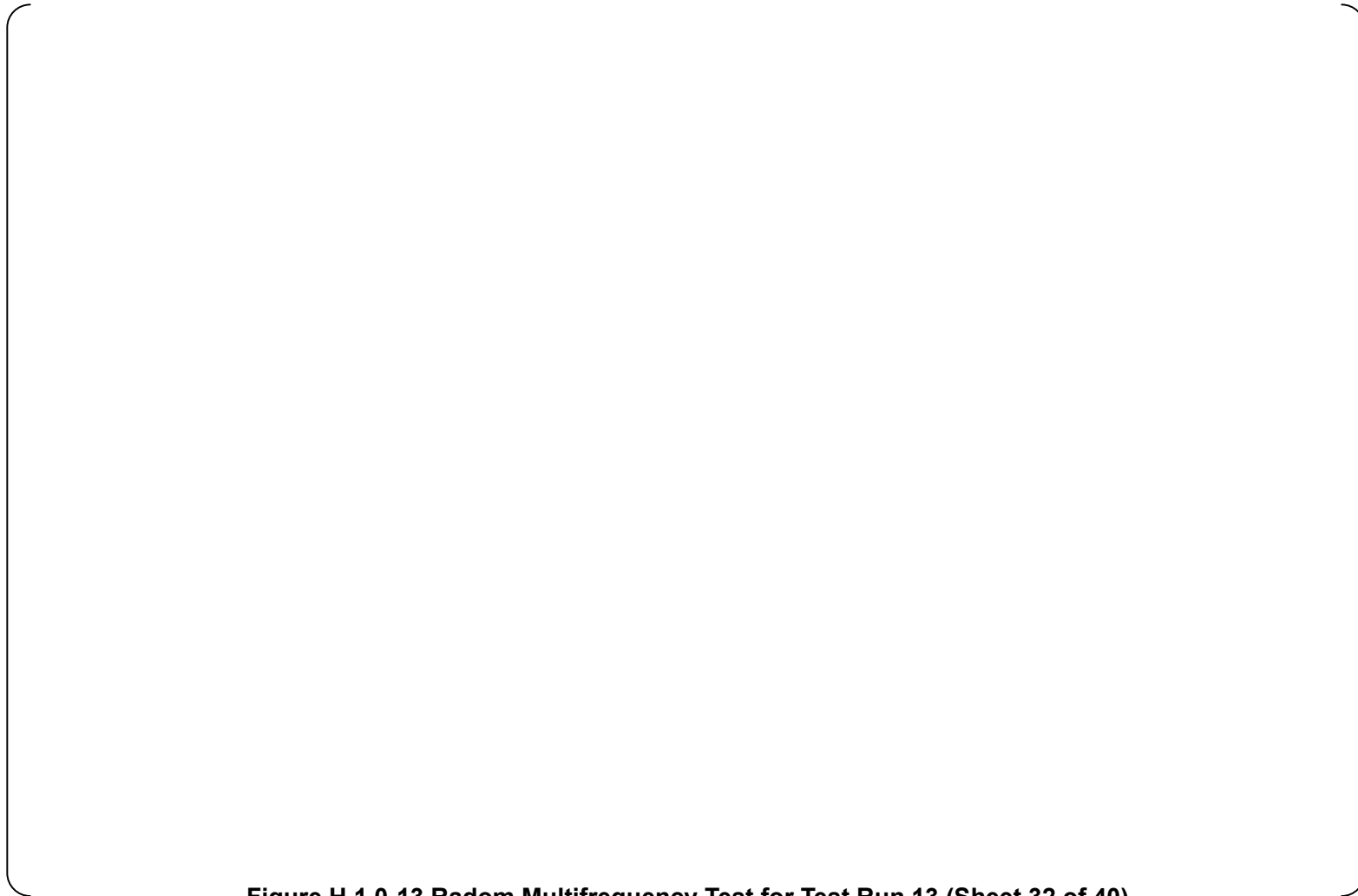


Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 32 of 40)

Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 33 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 34 of 40)

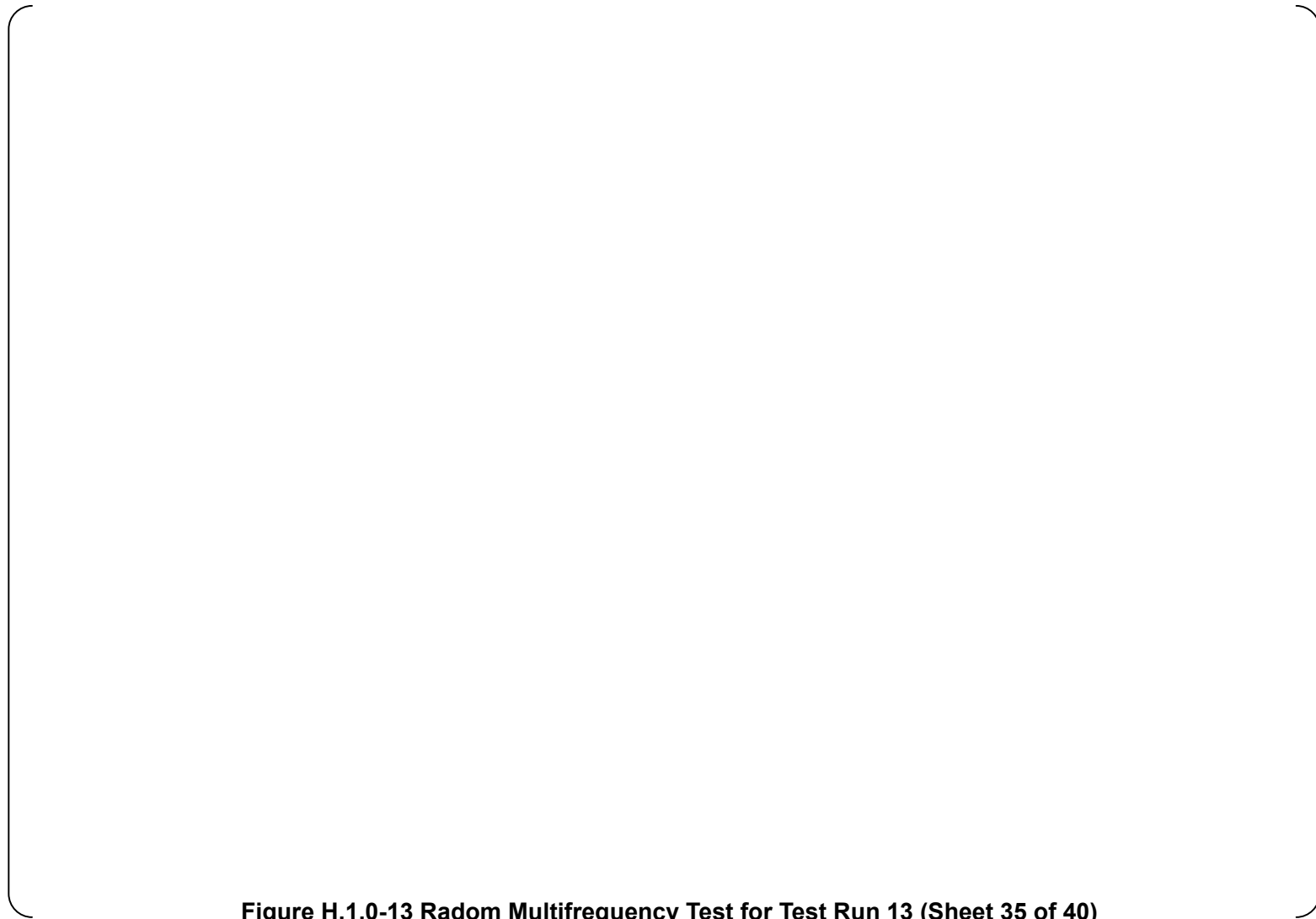


Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 35 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 36 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 37 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 38 of 40)

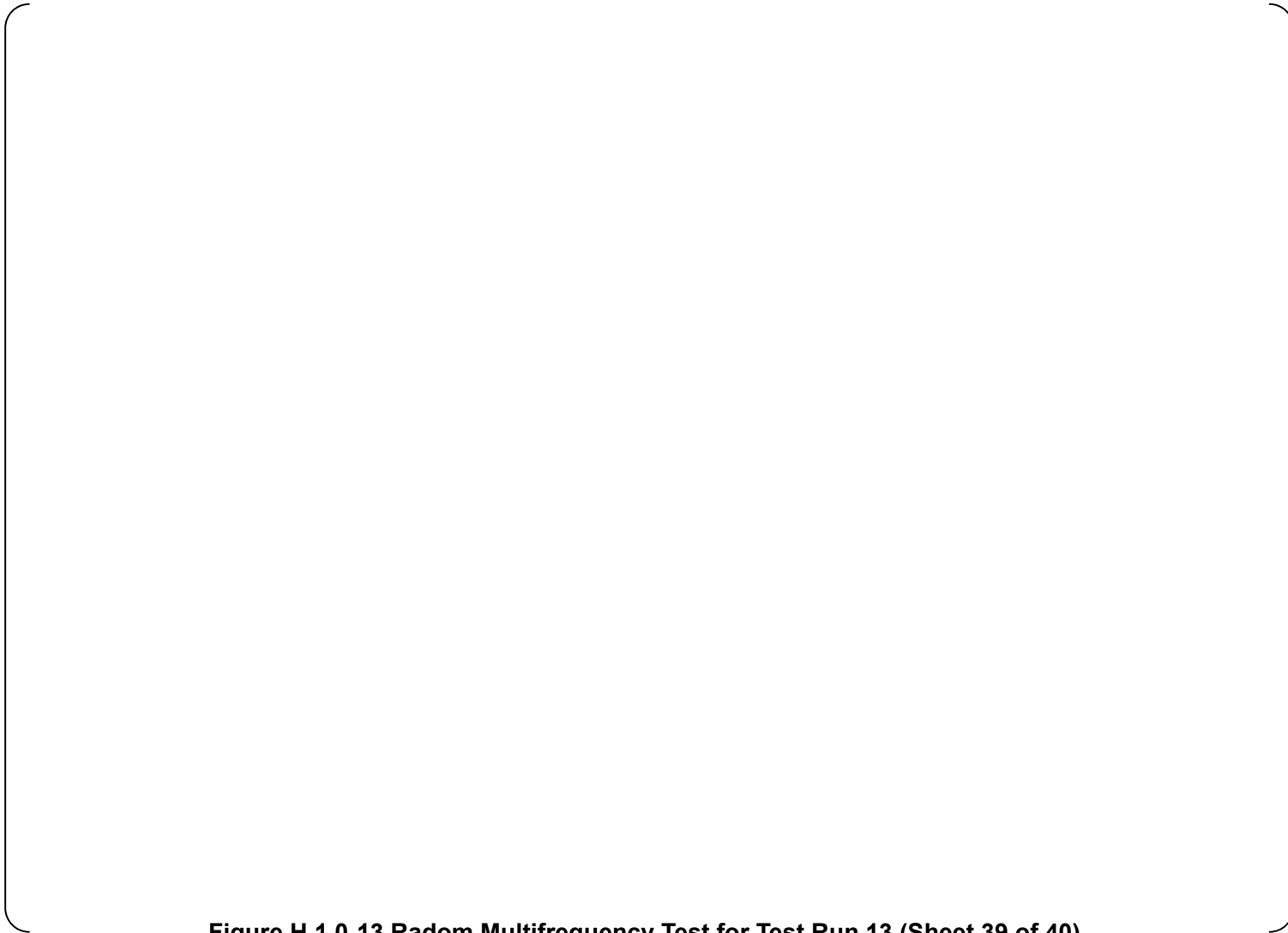


Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 39 of 40)



Figure H.1.0-13 Radom Multifrequency Test for Test Run 13 (Sheet 40 of 40)



Figure H.1.0-14 Radom Multifrequency Test for Test Run 14 (Sheet 1 of 2)

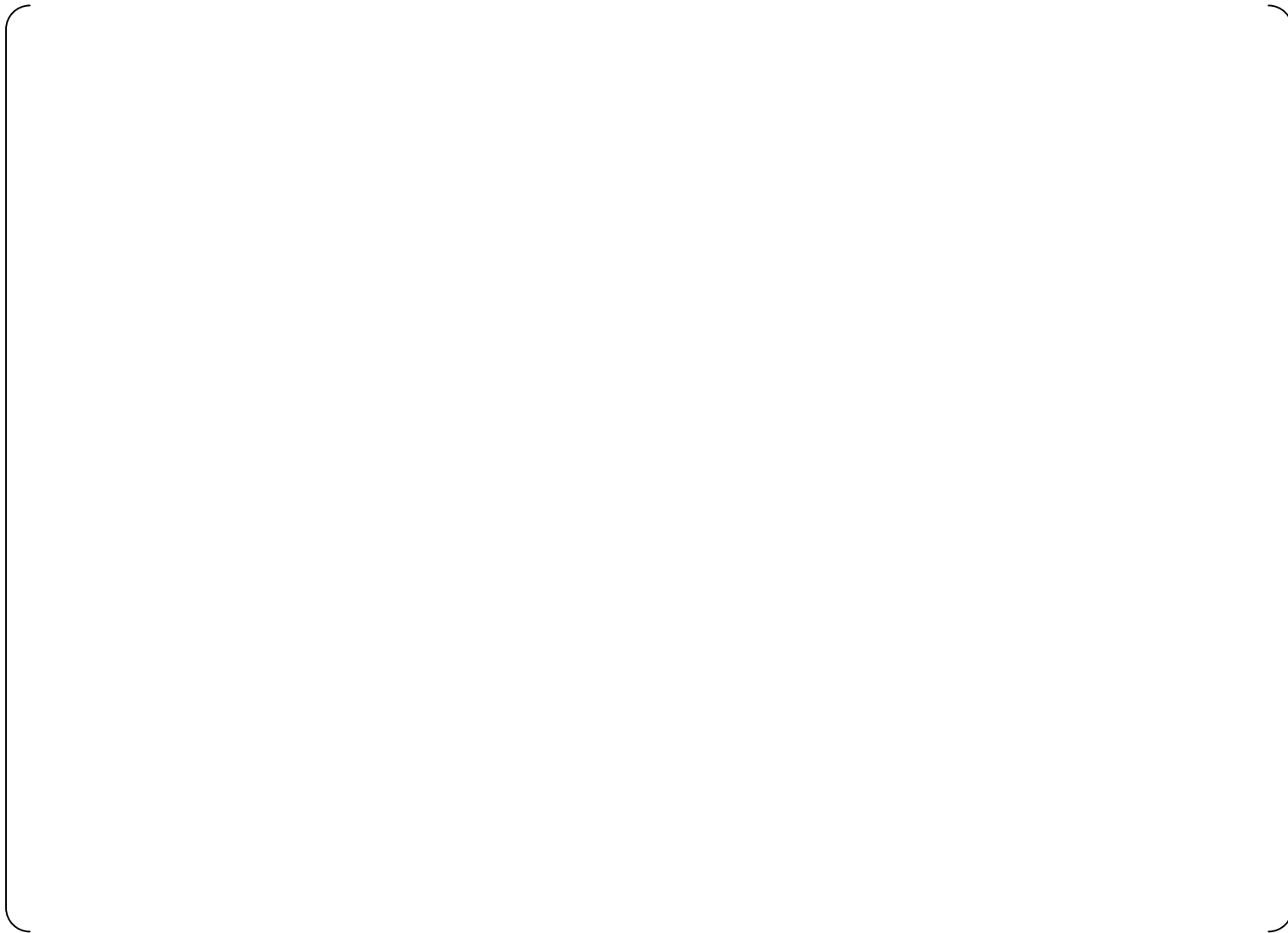


Figure H.1.0-14 Radom Multifrequency Test for Test Run 14 (Sheet 2 of 2)



Figure H.1.0-15 Radom Multifrequency Test for Test Run 15 (Sheet 1 of 2)



Figure H.1.0-15 Radom Multifrequency Test for Test Run 15 (Sheet 2 of 2)



Figure H.1.0-16 Radom Multifrequency Test for Test Run 16 (Sheet 1 of 2)



Figure H.1.0-16 Radom Multifrequency Test for Test Run 16 (Sheet 2 of 2)



Figure H.1.0-17 Radom Multifrequency Test for Test Run 17 (Sheet 1 of 2)



Figure H.1.0-17 Radom Multifrequency Test for Test Run 17 (Sheet 2 of 2)



Figure H.1.0-18 Radom Multifrequency Test for Test Run 18 (Sheet 1 of 2)



Figure H.1.0-18 Radom Multifrequency Test for Test Run 18 (Sheet 2 of 2)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 1 of 45)

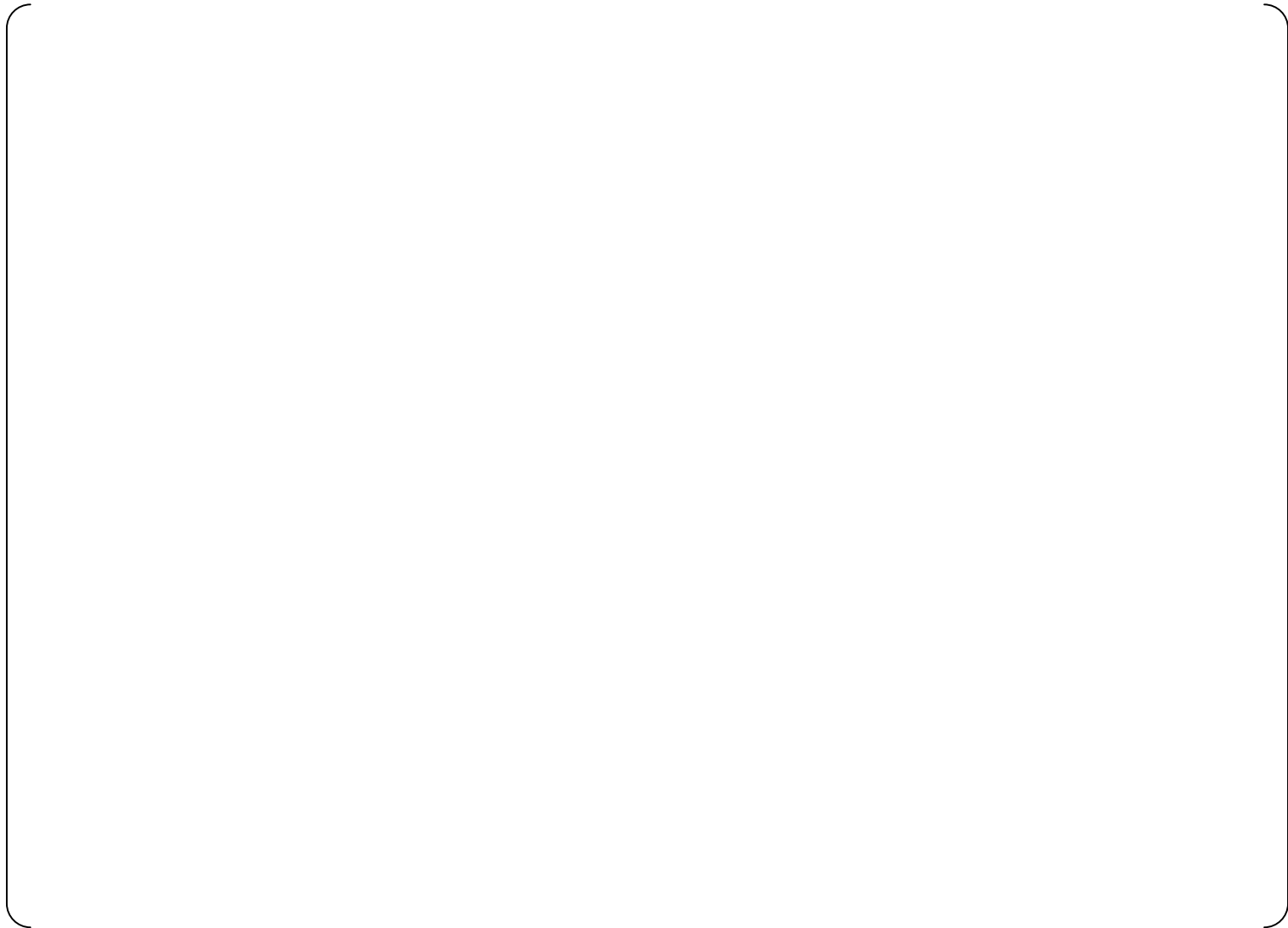


Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 2 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 3 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 4 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 5 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 6 of 45)

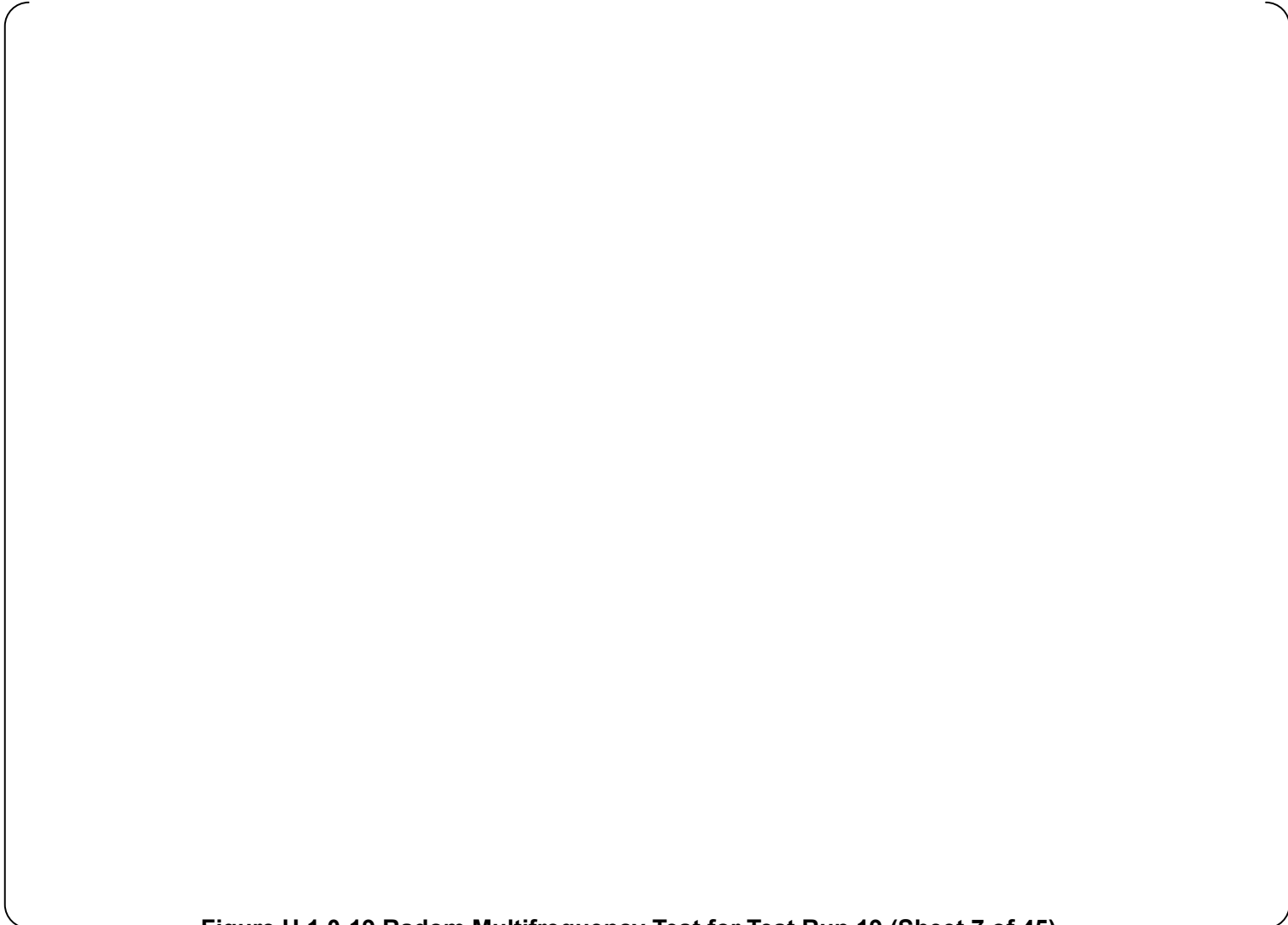


Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 7 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 8 of 45)

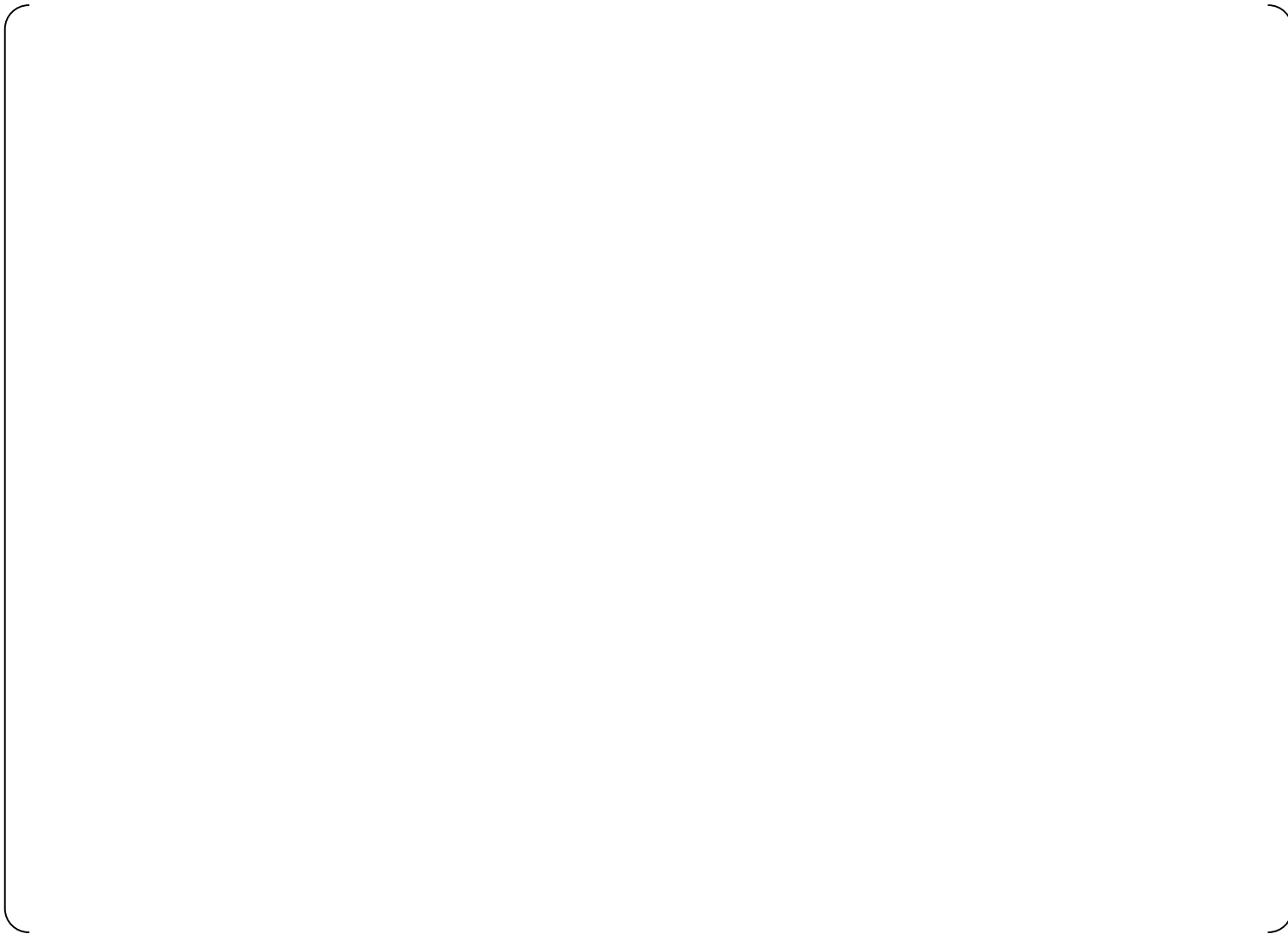


Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 9 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 10 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 11 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 12 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 13 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 14 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 15 of 45)





Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 17 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 18 of 45)

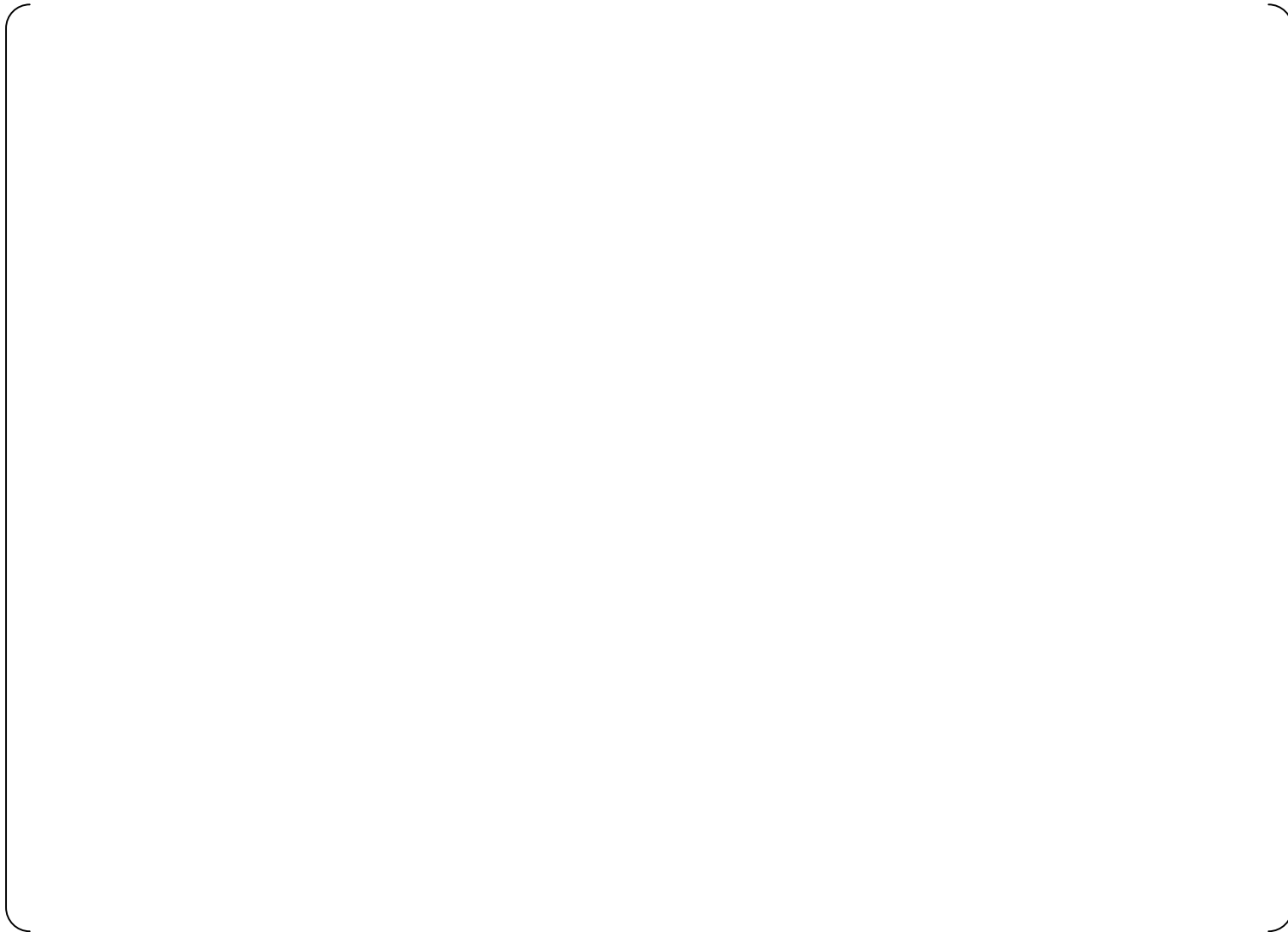


Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 19 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 20 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 21 of 45)





Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 23 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 24 of 45)

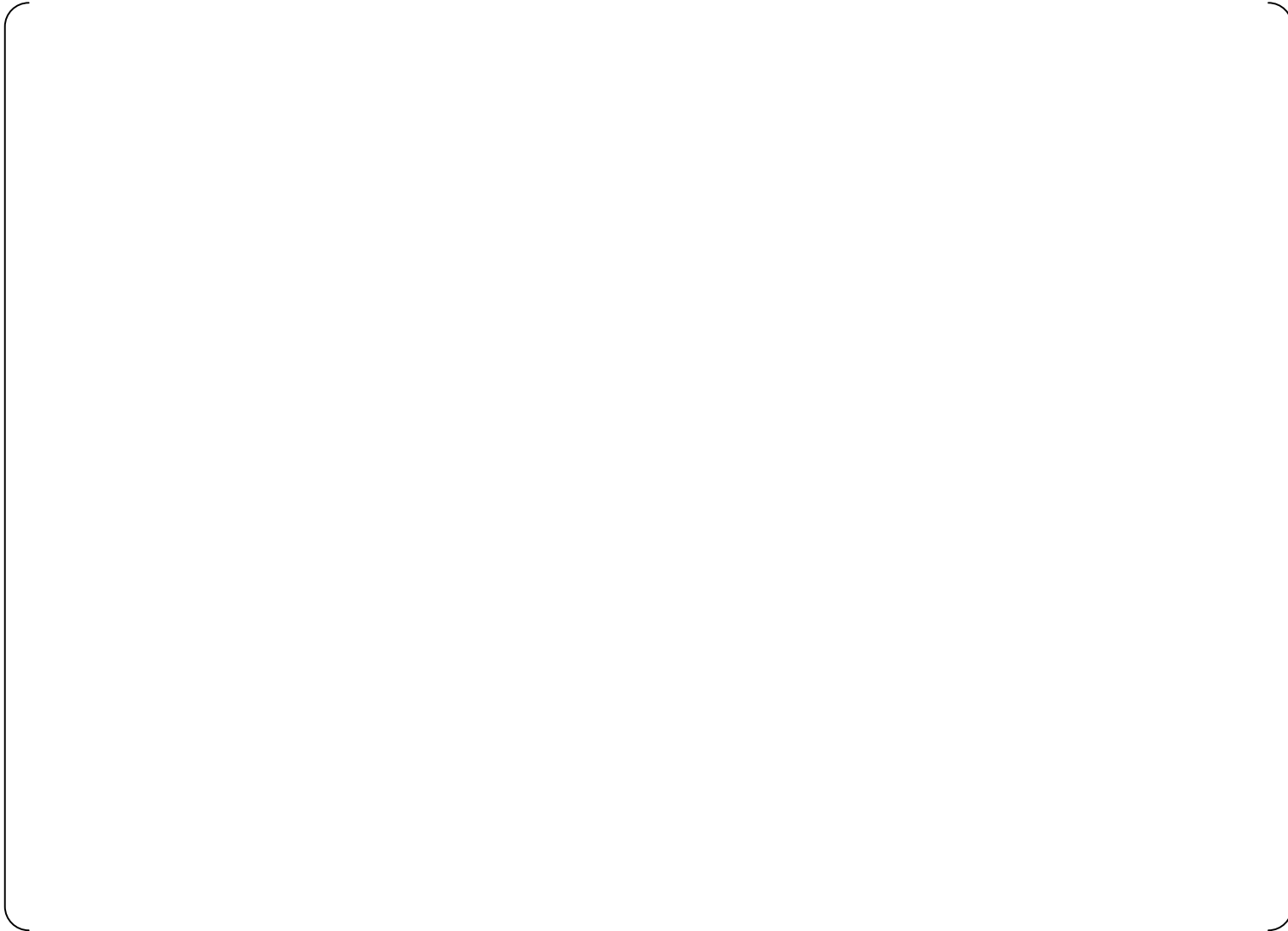


Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 25 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 26 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 27 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 28 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 29 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 30 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 31 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 32 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 33 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 34 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 35 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 36 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 37 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 38 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 39 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 40 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 41 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 42 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 43 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 44 of 45)



Figure H.1.0-19 Radom Multifrequency Test for Test Run 19 (Sheet 45 of 45)

Appendix I Result of seismic test for Generator Bearing Lubrication Oil System

Table I.1.0-1 North-South RRS for Generator Bearing Lubrication Oil System

(Sheet 1 of 2)

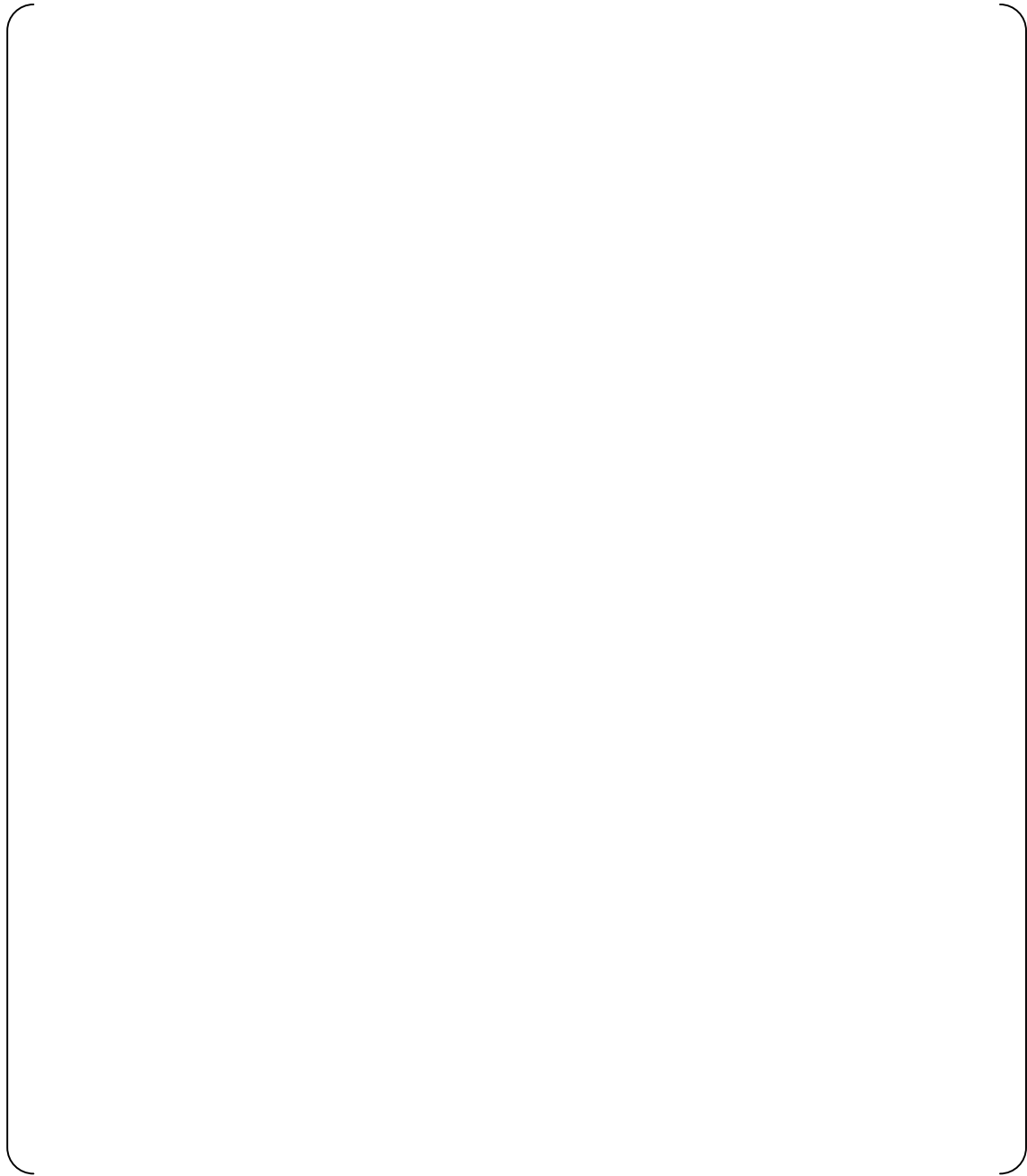


Table I.1.0-1 North-South RRS for Generator Bearing Lubrication Oil System
(Sheet 2 of 2)

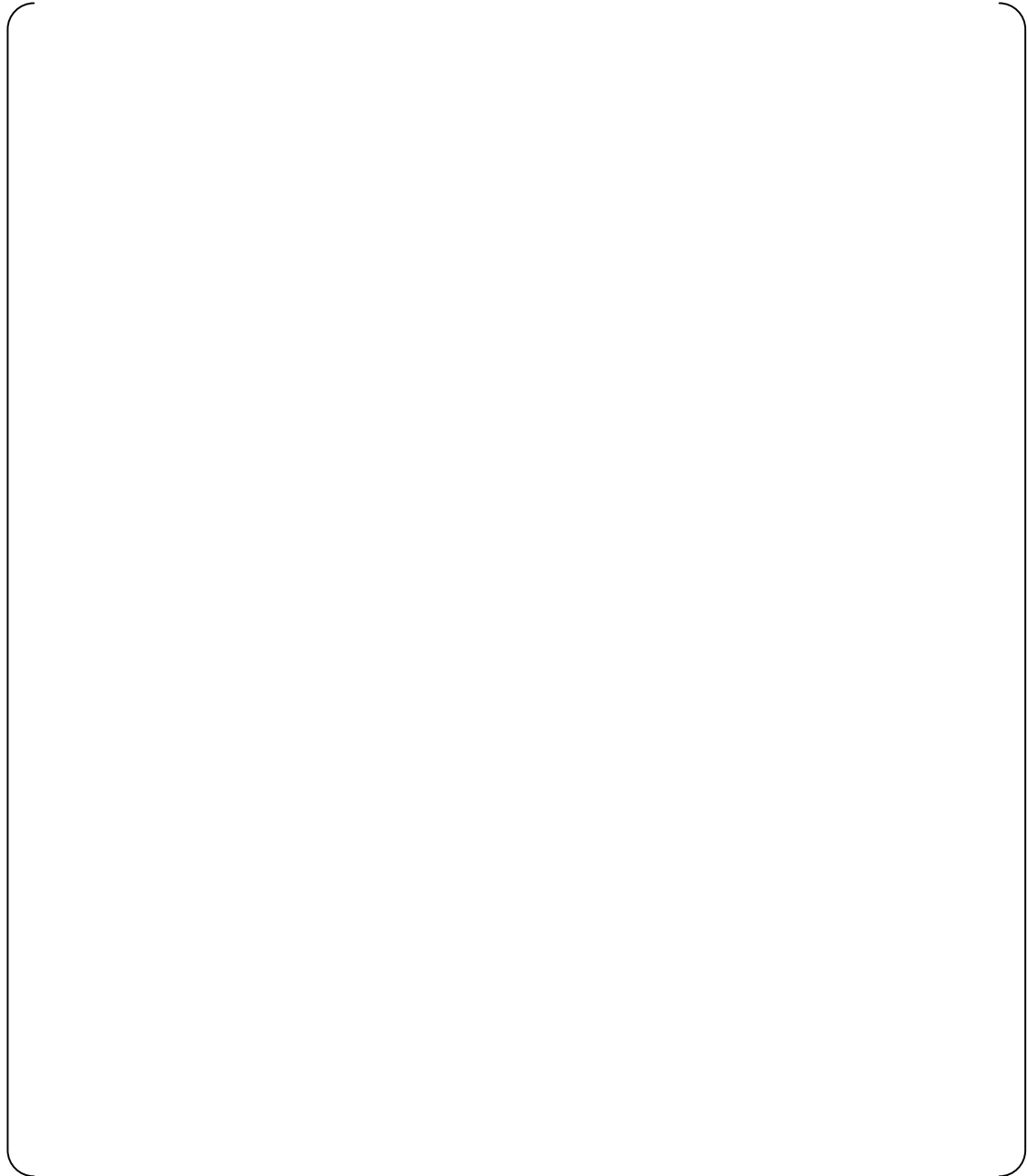
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Table I.1.0-2 East-West RRS for Generator Bearing Lubrication Oil System
(Sheet 1 of 2)

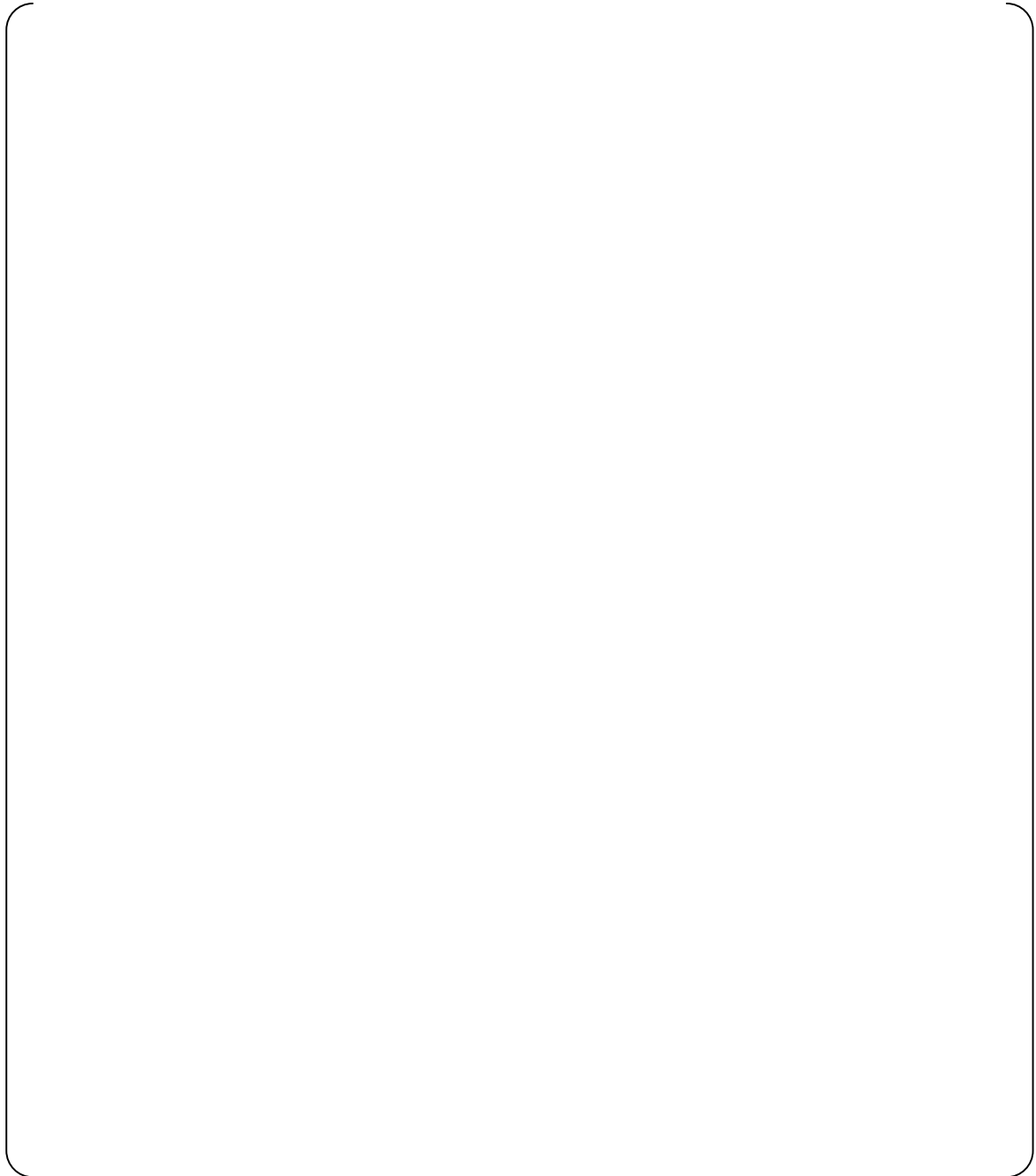


Table I.1.0-2 East-West RRS for Generator Bearing Lubrication Oil System
(Sheet 2 of 2)

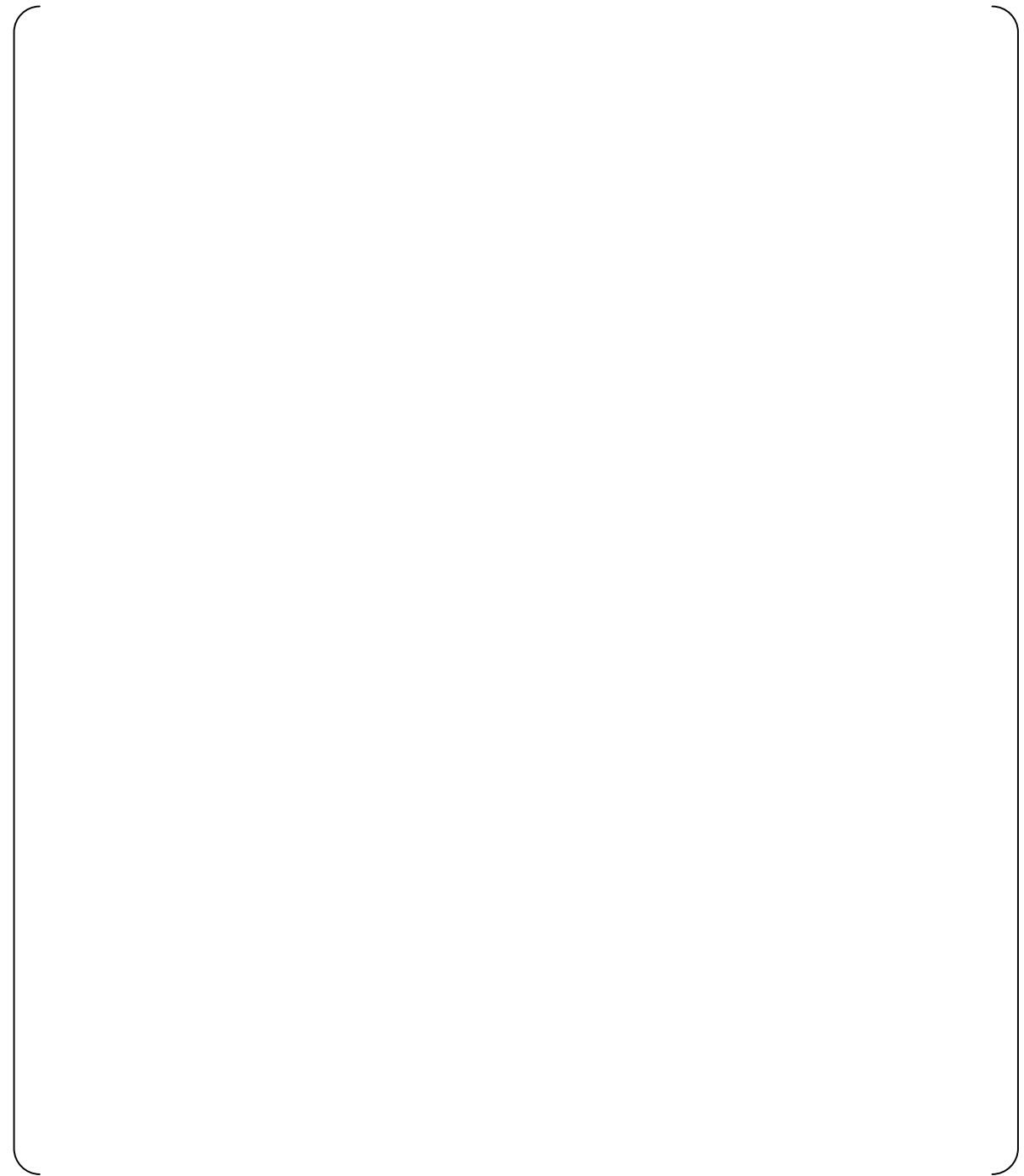


Table I.1.0-3 Vertical RRS for Generator Bearing Lubrication Oil System
(Sheet 1 of 2)

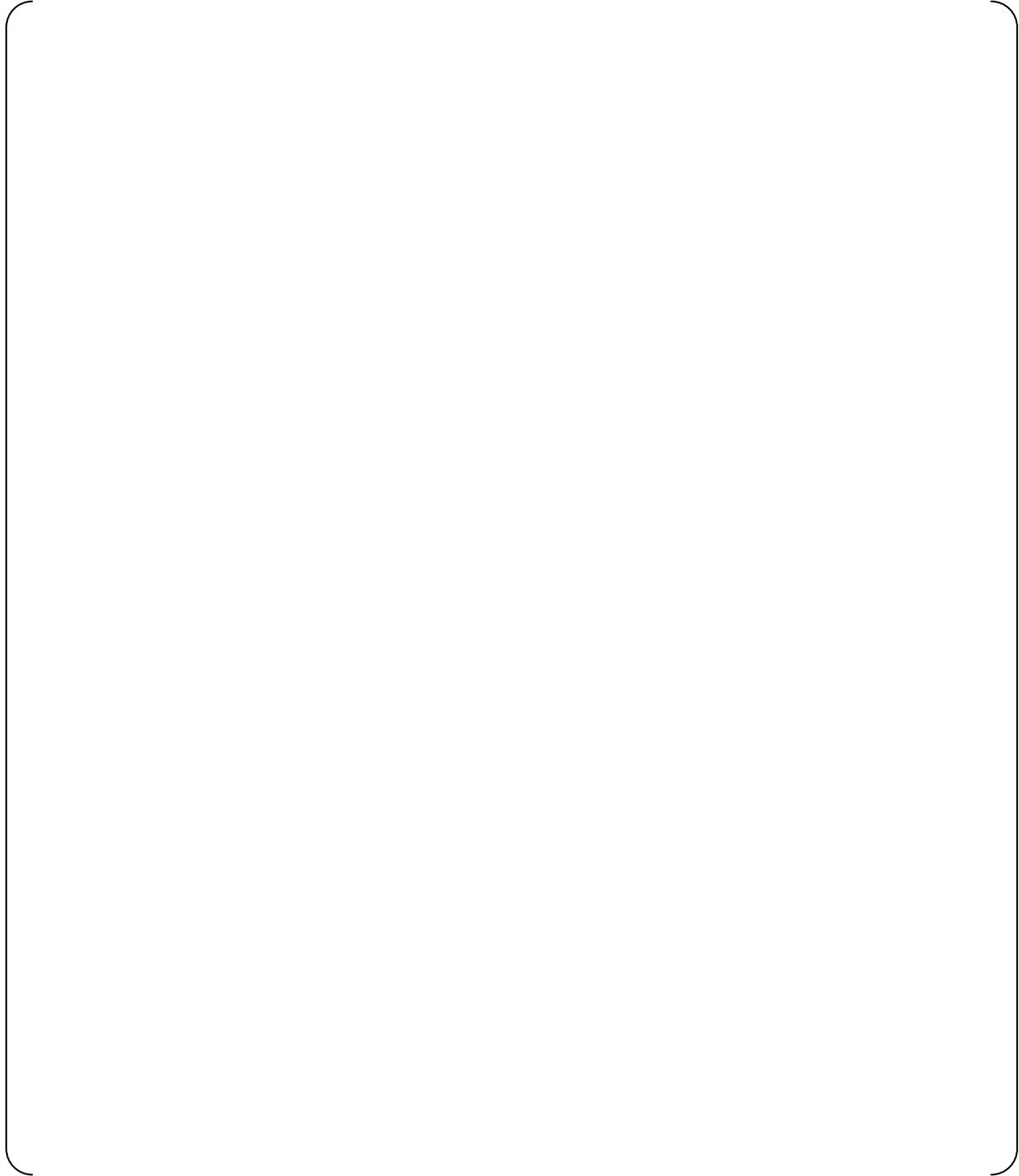


Table I.1.0-3 Vertical RRS for Generator Bearing Lubrication Oil System
(Sheet 2 of 2)

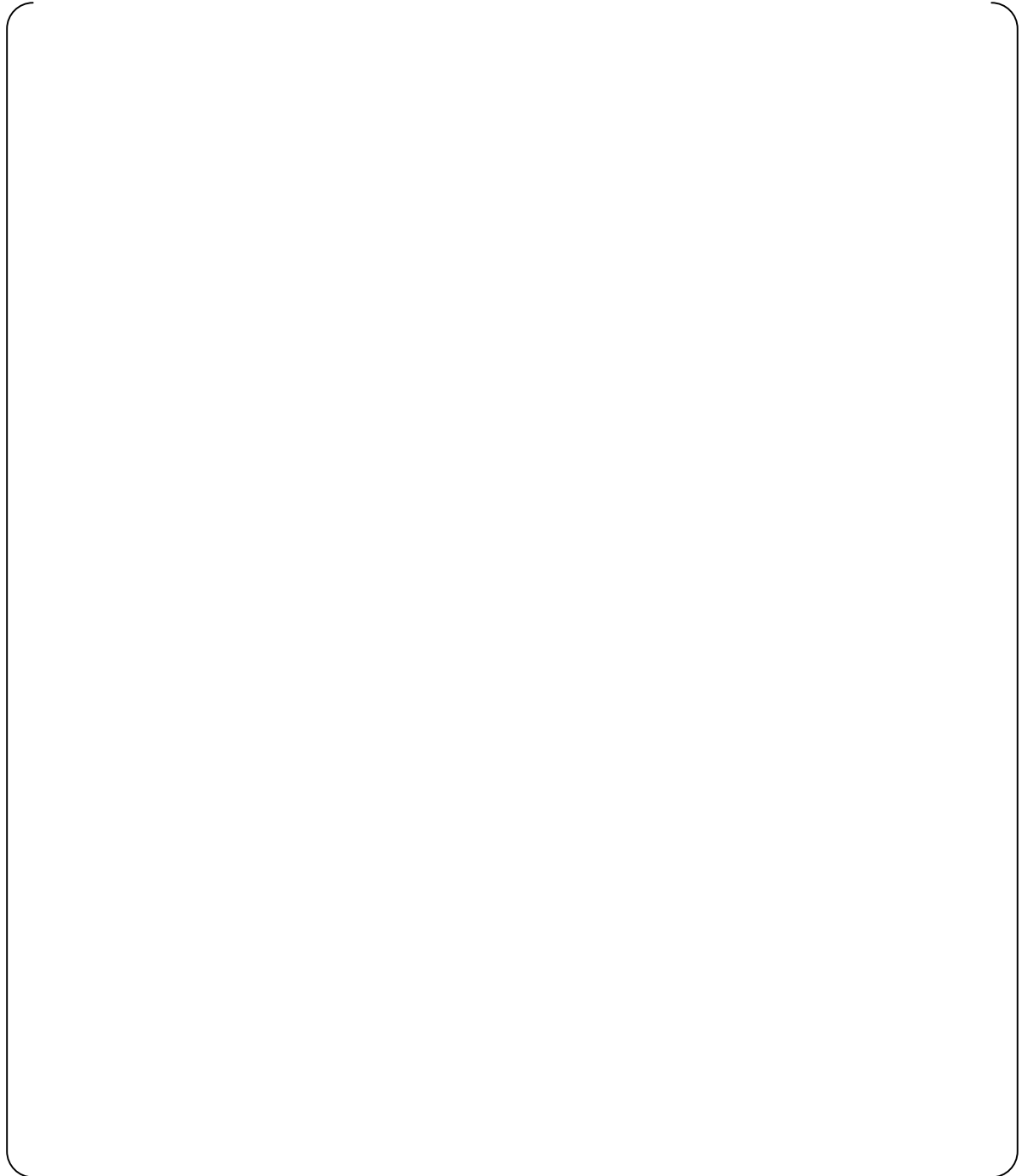




Figure I.1.0-1 OBE 1 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure I.1.0-1 OBE 1 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure I.1.0-1 OBE 1 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure I.1.0-2 OBE 2 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure I.1.0-2 OBE 2 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure I.1.0-2 OBE 2 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure I.1.0-3 OBE 3 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure I.1.0-3 OBE 3 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure I.1.0-3 OBE 3 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)





Figure I.1.0-4 OBE 4 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure I.1.0-4 OBE 4 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure I.1.0-5 OBE 5 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure I.1.0-5 OBE 5 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure I.1.0-5 OBE 5 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure I.1.0-6 SSE 1 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure I.1.0-6 SSE 1 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure I.1.0-6 SSE 1 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure I.1.0-7 OBE 1 Correlation Plots



Figure I.1.0-8 OBE 1 Stationarity Plots



Figure I.1.0-9 SSE 1 Correlation Plots



Figure I.1.0-10 SSE 1 Stationarity Plots

Appendix J Result of seismic test for Lube Oil Cooler Fan Assembly

Table J.1.0-1 North-South RRS for Lube Oil Cooler Fan Assembly (Sheet 1 of 2)

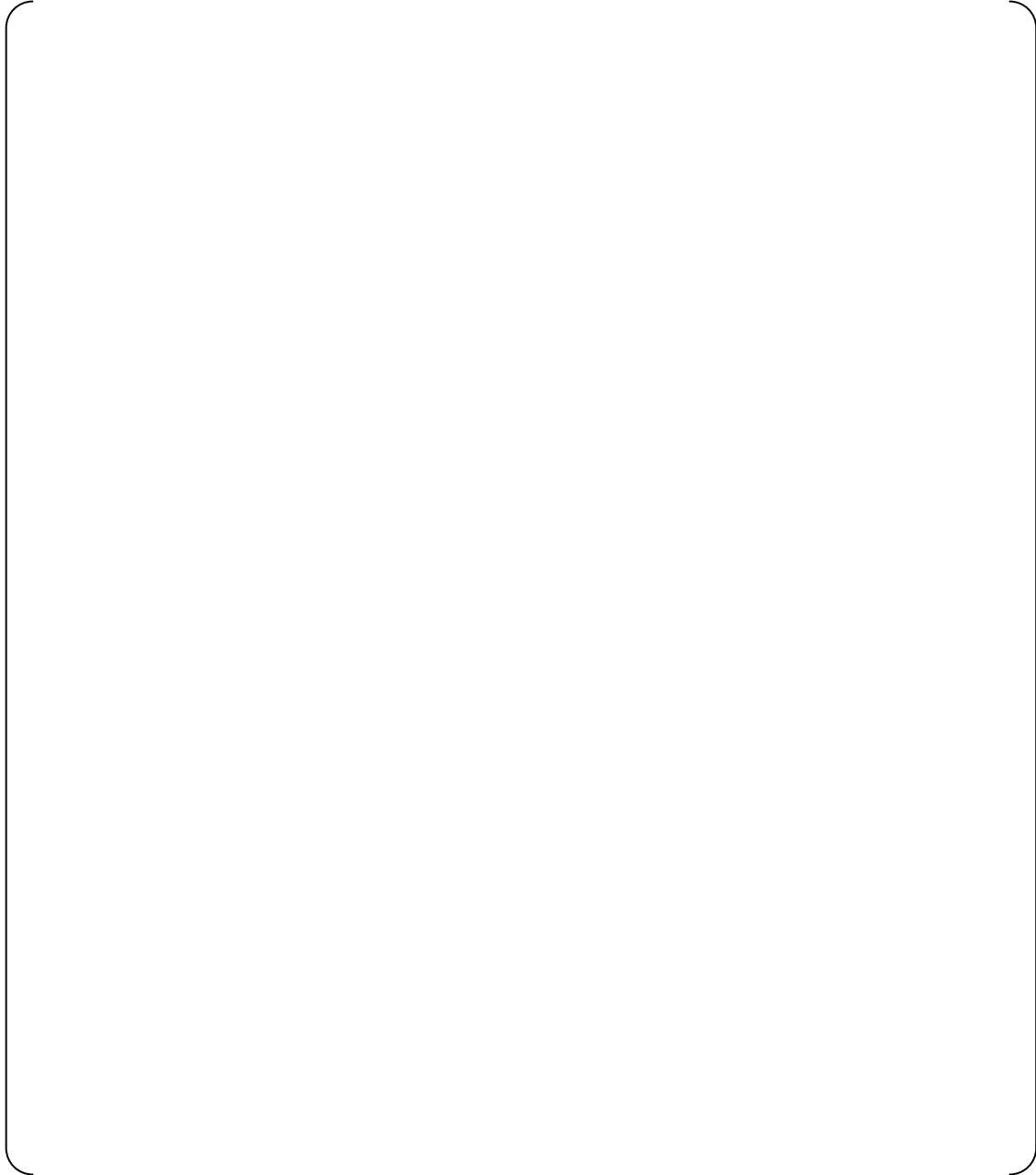


Table J.1.0-1 North-South RRS for Lube Oil Cooler Fan Assembly (Sheet 2 of 2)



Table J.1.0-2 East-West RRS for Lube Oil Cooler Fan Assembly (Sheet 1 of 2)

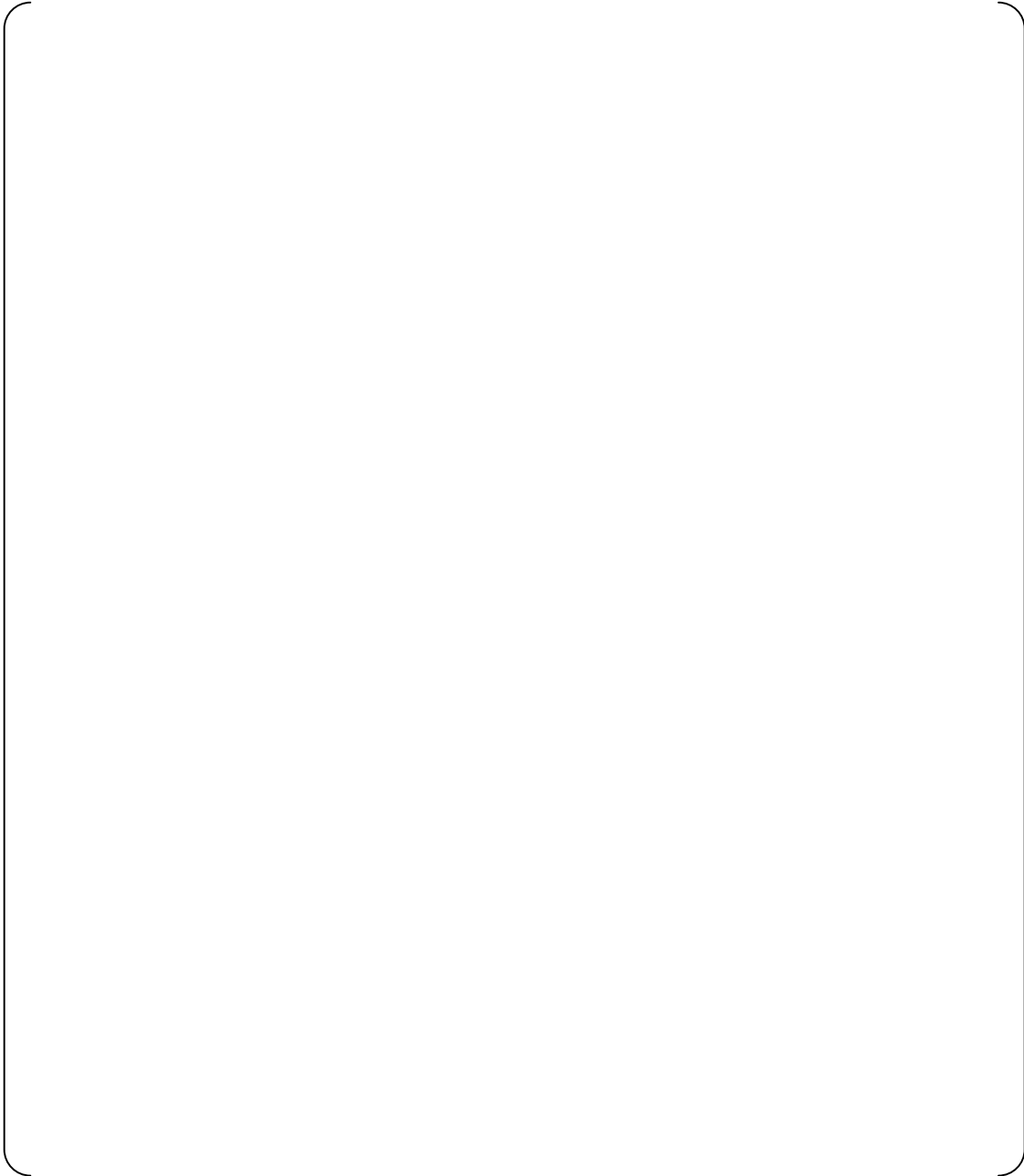


Table J.1.0-2 East-West RRS for Lube Oil Cooler Fan Assembly (Sheet 2 of 2)

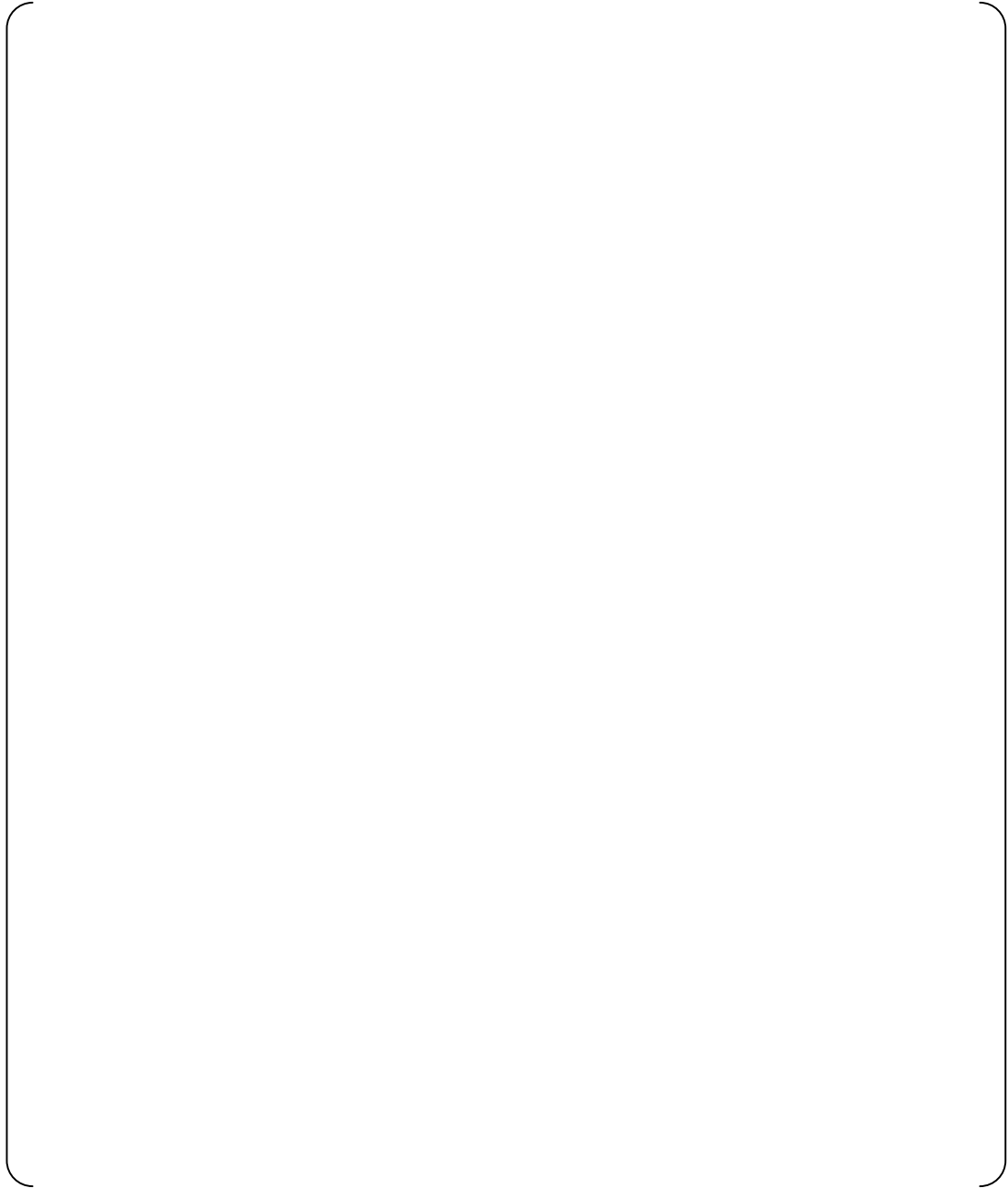


Table J.1.0-3 Vertical RRS for Lube Oil Cooler Fan Assembly (Sheet 1 of 2)

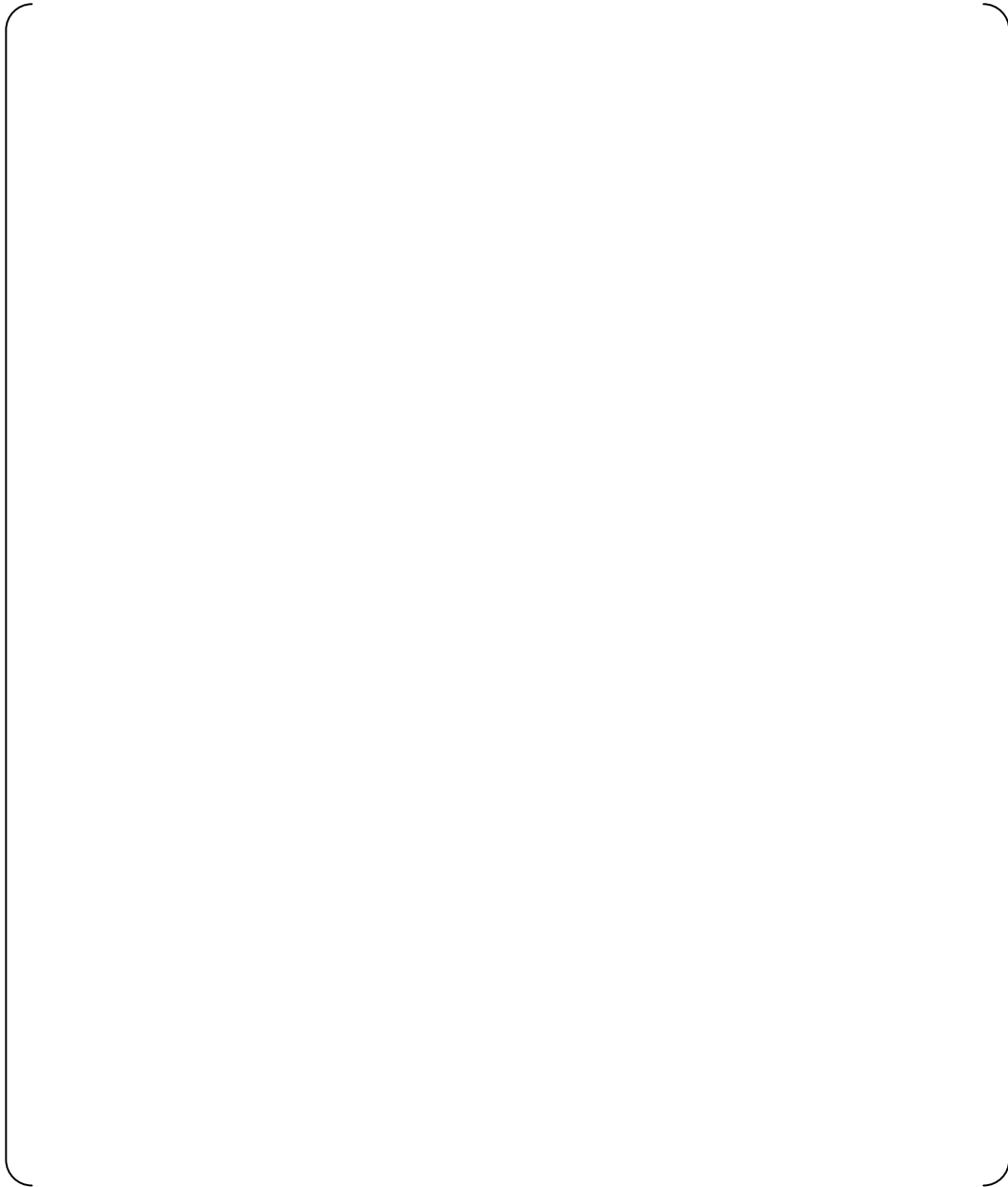


Table J.1.0-3 Vertical RRS for Lube Oil Cooler Fan Assembly (Sheet 2 of 2)

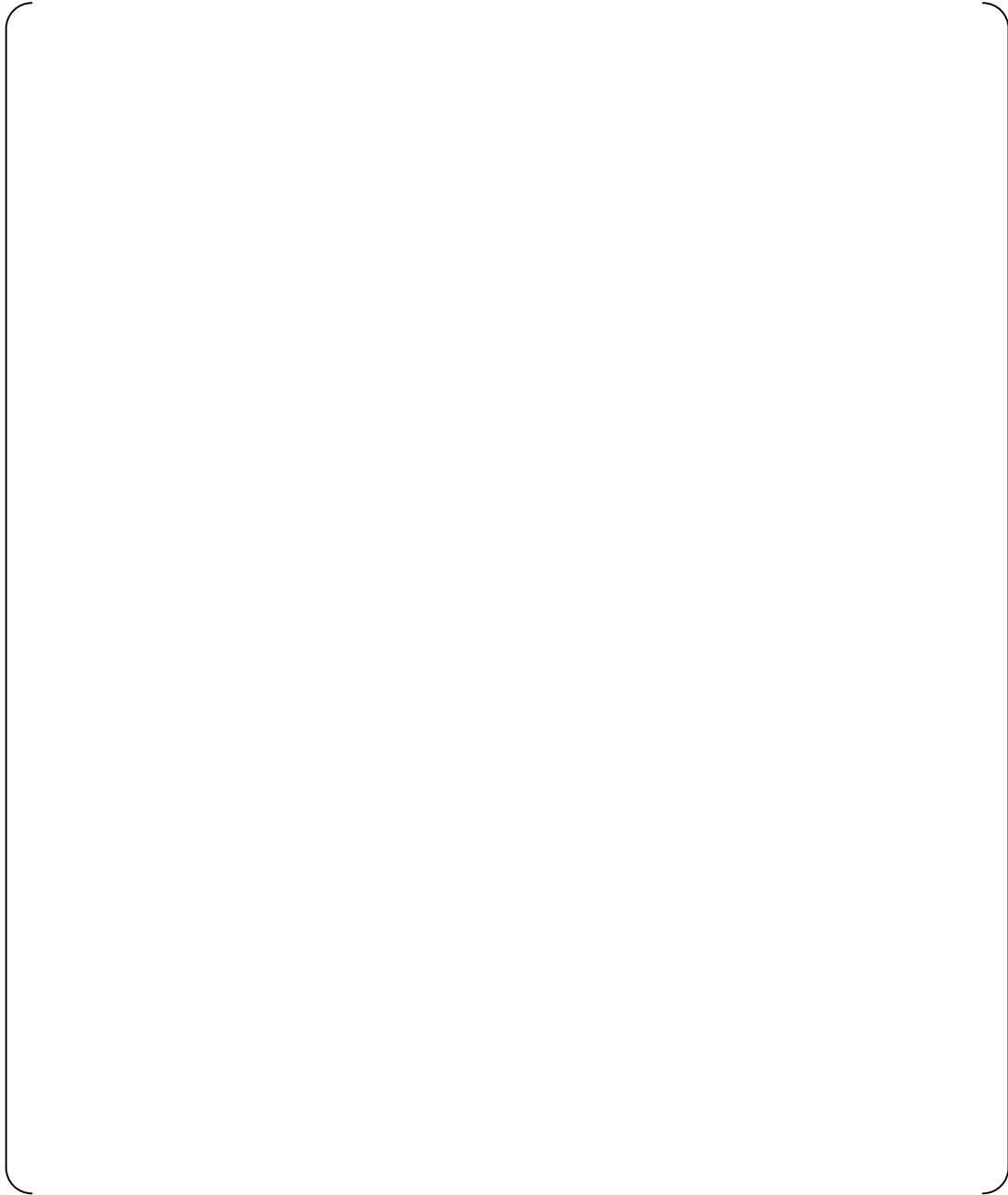




Figure J.1.0-1 OBE 1 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)

Figure J.1.0-1 OBE 1 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)

Figure J.1.0-1 OBE 1 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure J.1.0-2 OBE 2 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure J.1.0-2 OBE 2 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure J.1.0-2 OBE 2 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)

Figure J.1.0-3 OBE 3 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure J.1.0-3 OBE 3 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure J.1.0-3 OBE 3 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure J.1.0-4 OBE 4 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure J.1.0-4 OBE 4 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure J.1.0-4 OBE 4 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure J.1.0-5 OBE 5 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure J.1.0-5 OBE 5 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)



Figure J.1.0-5 OBE 5 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure J.1.0-6 SSE 1 Test Response Spectra Plots and Time History Plots (Sheet 1 of 3)



Figure J.1.0-6 SSE 1 Test Response Spectra Plots and Time History Plots (Sheet 2 of 3)

Figure J.1.0-6 SSE 1 Test Response Spectra Plots and Time History Plots (Sheet 3 of 3)



Figure J.1.0-7 OBE 1 Correlation Plots

Figure J.1.0-8 OBE 1 Stationarity Plots

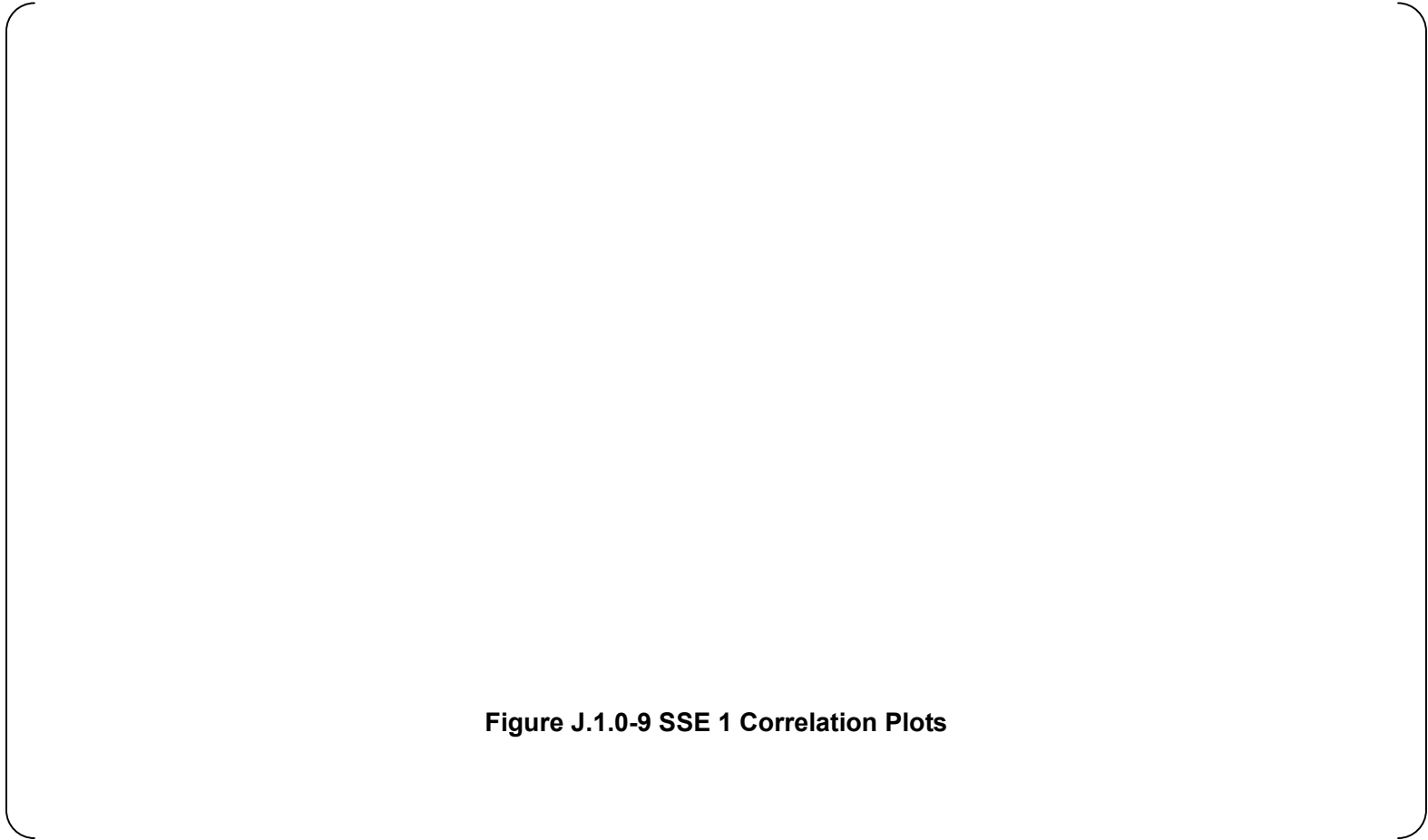
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Figure J.1.0-9 SSE 1 Correlation Plots



Figure J.1.0-8 SSE 1 Stationarity Plots

Appendix K Fuel Nozzle Maintenance

K.1.0 Basis of 50 Start Maintenance Interval

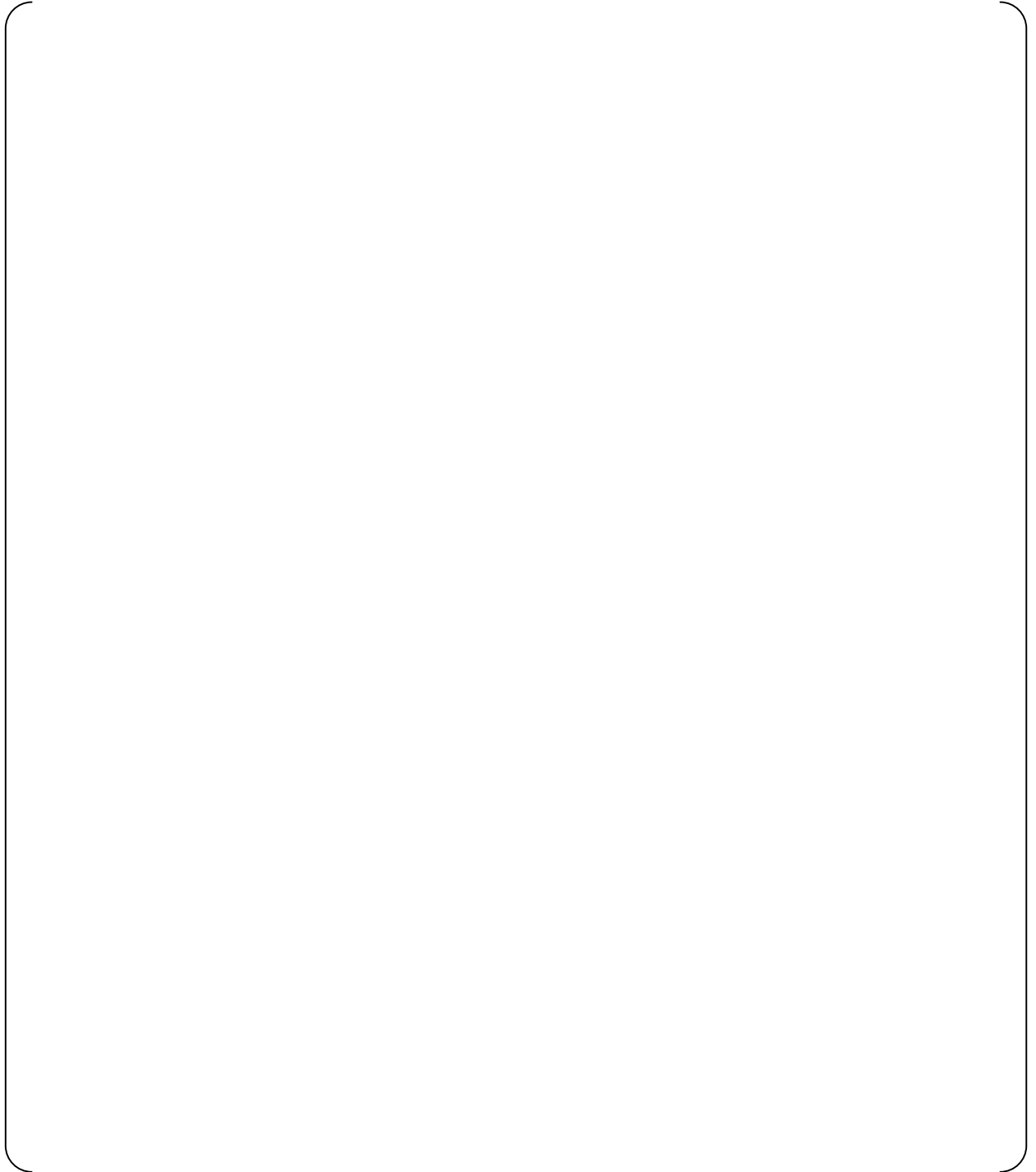
This maintenance activity is one of several recommended by the engine manufacturer, Kawasaki Heavy Industries (KHI). The intent is to prevent the buildup of gums and other insoluble materials, including carbon within the nozzle and the nozzle tip. This is commonly referred to as fuel nozzle "coking." The effect of severe coking is a reduction in ignition and running performance. The engine manufacturer recommends the fuel nozzle maintenance (cleaning) for all users, and routinely performs cleaning as part of its preventive maintenance program. According to the engine manufacturer, cleaning the fuel nozzle every 50 starts is conservative, based on the engine manufacturer's field experience for GTGs of its type.

The impact of not cleaning the fuel nozzles, as with any preventive maintenance activity, will affect performance over time. In the case of gas turbine engines, not cleaning the fuel nozzles will ultimately lead to a buildup of gums and other insoluble materials, including carbon that will delay the GTG start time and load capability. Although the engine manufacturer recommends fuel nozzle cleaning after every 50 engine starts based on their typical industrial experience, this cleaning activity cannot be defined as essential to the successful completion of the 150 start and load acceptance tests for the US-APWR application. This is because the quality of fuel for nuclear applications, such as the US-APWR, is better than the quality of other typical industrial applications which is the engine manufacturer's basis for their maintenance procedure. However, because fuel nozzle cleaning is the engine manufacturer's recommended maintenance item required during the series of tests; it was included in the test sequence. The engine manufacturer strongly recommends fuel nozzle cleaning after every 50 engine starts.

K.2.0 "As found" Fuel Nozzle Condition

During each fuel nozzle cleaning, there was some slight surface discoloration found on the portions of the nozzles that were exposed to the high temperatures within the combustion chamber. Port or fuel passageway clogging was not evident or observed. The surface discoloration is the result of gum like deposits from the fuel that plated out on the fuel nozzle as the fuel vaporized while in contact with the nozzle or condensed on the cooler parts of the nozzle during starting. The discoloration was not excessive and was typical of that observed for the quality of the fuel being used. The quality of the fuel oil used in a nuclear power plant is better than in other industrial applications and that used during the testing. Fuel quality is usually No. 2 diesel fuel, or better.

K.3.0 An Expression of the Engine Manufacturer's View on Fuel Nozzle Maintenance



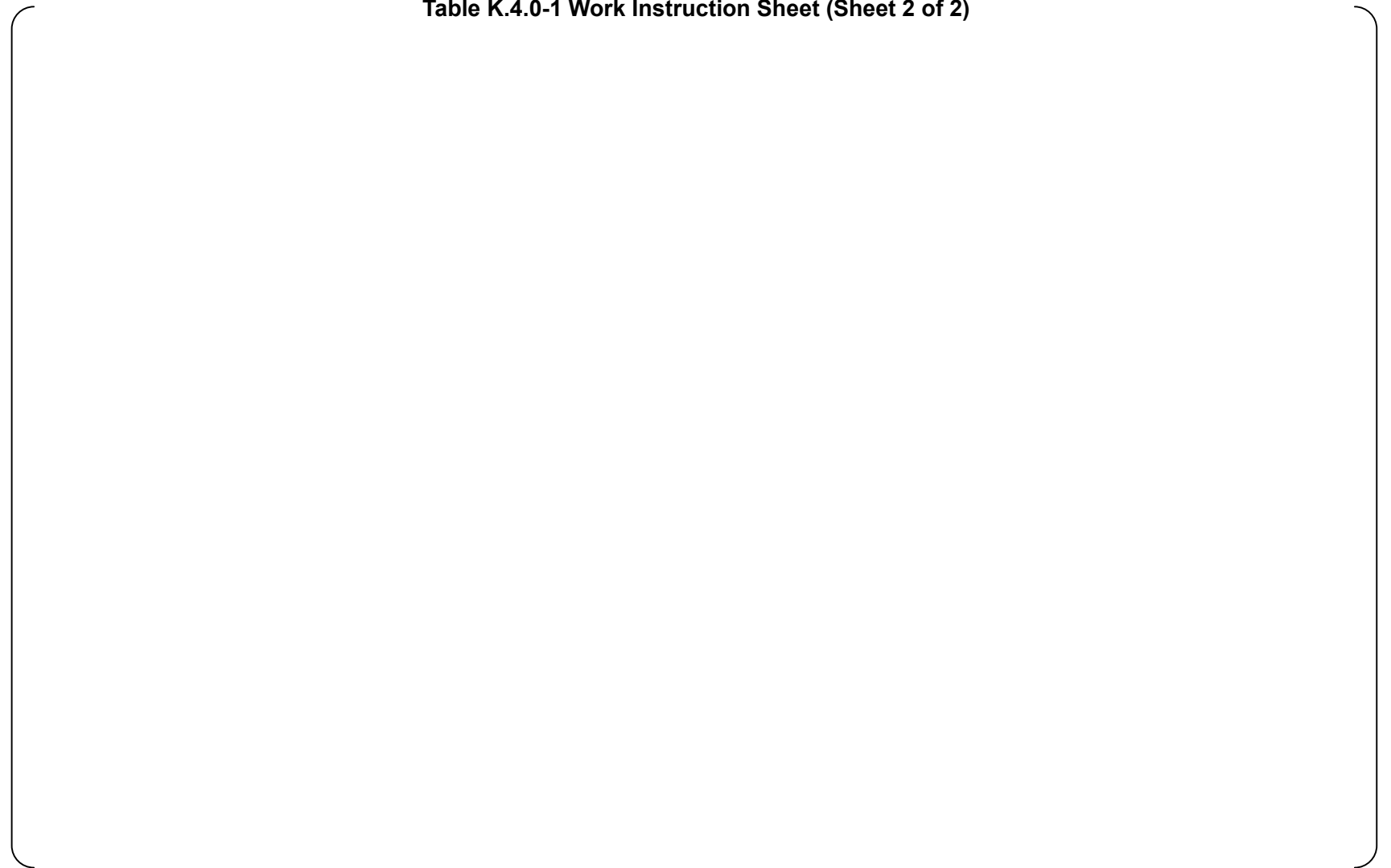
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K.4.0 Fuel Nozzle Cleaning Procedure

Manufacturer's maintenance procedure approved by MHI is shown in Table K.4.0-1.

Table K.4.0-1 Work Instruction Sheet (Sheet 1 of 2)

Table K.4.0-1 Work Instruction Sheet (Sheet 2 of 2)



Appendix L Load Bank Failure

L.1.0 Description of the Event

During Start and Load Acceptance Test Number 128, the load bank failed. This resulted in a sudden unplanned reactive load addition on the GTG. The load bank failure occurred approximately 15 minutes into Test No. 128, after the GTG had successfully started and accepted the test load; however, before the machine temperature stabilized within 10°F of normal operating temperature. Consequently, the third acceptance criterion was not achieved and test 128 was classified as “Disregarded” per IEEE Std 387-1995 Section 6.2.2.e).5).

The load bank failure caused an approximately 200- 300% overload of the GTG, which tripped on “under frequency”. The GTG responded to the load bank failure as expected and in accordance with the protection scheme established for the test.

After the under-frequency shutdown of the GTG, the Qualification Vendor investigated the load bank facility. It was discovered that a major electrical fault had occurred in one of the reactive load banks. The load bank facility includes individual cabinets, each containing 375 KVAR inductive loads. The actual load available at the time of the GTG testing was 4,729 KVAR. One of the load banks had significant burn marks, sheet metal burnout, and loss of 3-phase bus work. A large sheet metal cover was found 8-10 feet away from the unit, having been explosively burned and dislodged from its normal position.

Subsequent to a visual inspection by the Qualification Vendor, MHI, and the GT engine manufacturer’s representatives, the machine was barred over (purged) three times and then started. The GTG successfully started, accepted load and reached stable operating temperatures. The parameters were closely monitored and were determined to be within normal expected values. Therefore, the Start and Load Acceptance testing was allowed to continue.

Start and Load Acceptance testing was resumed by repeating Test No. 128. The GTG successfully started and accepted load. During the load run, a whistling noise that had not been present during previous test runs was noticed coming from the enclosure that had not been present during previous test runs. The GTG parameters were stable and within normal values, therefore Test No. 128 was allowed to continue to completion. During the subsequent investigation into the source of the noise, deformation of the combustion air duct was noticed. During further investigation and removal of the deformed duct, it was discovered that the Foreign Object Debris (FOD) screen had been damaged and a sound insulation component was found inside the intake air plenum. The component had been displaced from its location in the ceiling of the GTG enclosure.

According to the engine manufacturer’s technical representative, the overload from the load bank failure had created a pressure pulse within the intake air ducting that dislodged the sound insulating component. In addition to the displaced component, two other similar components were found loose but not displaced. The component that was dislodged from the ceiling consisted of an outer steel welded box, insulating material, and a perforated cover that was riveted to the box. The enclosure manufacturer failed to appropriately weld the assembly in place. During the load bank failure, the assembly became displaced from its location and fell through the FOD screen, lodging in the GT engine intake air plenum. The failure to weld these sound insulating components into the enclosure frame was classified as a manufacturing defect.

L.1.1 Probable Cause of the Load Bank Failure

Due to normal load bank maintenance, the Qualification Vendor had, over time, replaced many of the control contactors that were originally supplied with the equipment. The original contactors included rigid copper connectors that provided physical support for the 3-phase control bus. However as the years progressed, the original style contactors became obsolete. The newer contactors were available only with flexible conductors which provide no support to the control bus work. This had the effect of leaving the bus work susceptible to movement when energized. The Qualification Vendor believes the lack of adequate support at the end of the copper bus work allowed two phases to contact each other creating an explosive phase to phase to ground fault. The cause of load bank failure cannot be attributed to the GTG. The GTG was stable and operating well within nominal values for all parameters when the load bank failure occurred.

L.2.0 Potential for Similar Occurrence in Operating Plants

The potential effects fall into two distinct classes; electrical damage to the generator or exciter, and mechanical damage to the turbine engine.

L2.1 Potential for Electrical Damage

With regard to potential electrical damage, the load bank failure is highly similar to a sudden overload (200 to 300%) or a ground fault. In the absence of a second failure within the generator protection scheme the GTG would isolate itself. Within an actual nuclear plant application, the protection scheme is designed to protect the generator from electrical failures to avoid permanent damage to the critical components, (e.g., rotor and stator windings, prime mover, etc.). A methodology of selective fault protection is employed to trip the circuit breaker closest to the fault. In such a situation, the GTG would continue to supply the remaining non faulted safety related loads without interruption. The electrical protection scheme is also designed to isolate the GTG versus tripping the machine. Once the electrical problem is cleared, the GTG could be safely restarted, if necessary, and realigned to supply the loads.

The load characteristics within a plant power distribution system are different from a test load bank. Pure inductive loads rarely exist within a plant. Typical loads are mixed as in a motor for example. A typical squirrel cage induction motor has inductive as well as resistive components, however, they are not distinct and separable. In a test load bank the resistors and inductors are separate and configurable to a range of real and imaginary loads with different lagging power factor. A fault on a typical plant load would be isolated by the protective scheme. A load bank does not have a similar protection scheme. The protection is designed to allow for quick sudden changes in the load characteristics for testing and to protect the test specimen. Although, a sudden load increase many occur within a plant it would not be in the range of 200% of the machine rating. There is no single load that large connected to the safety bus in the US-APWR.

L.2.2 Potential for Mechanical Damage

The manufacturing defect (loose parts in the air flow path) potentially could result in ingesting foreign objects into the turbine engine. The combustion air intake plenum is designed with a 90° turn at the bottom to preclude large and potentially damaging objects from reaching the moving parts. In such an event, the components that were not correctly attached are too large to enter the engine and potentially come into contact with moving parts. Light weight soft fibrous objects such as the sound insulation that may have been pulled into the turbine engine should pass through without damage, as they did in this case.

The most significant potential is the entry of a hard metal object small enough to be entrained in the combustion air, yet large and hard enough to physically damage (chip) the compressor turbine blades. The plenum and ducting are designed with a sufficiently large cross sectional area to keep air velocities below what would be necessary to entrain such objects.

The successful post maintenance run after the load bank failure, the successful Start and Load Acceptance Test No. 128 (repeat) indicated that the enclosure manufacturing defect did not impact the performance of the GTG. During these two test runs and the remaining testing, detectable changes in the performance of the GTG were not observed.