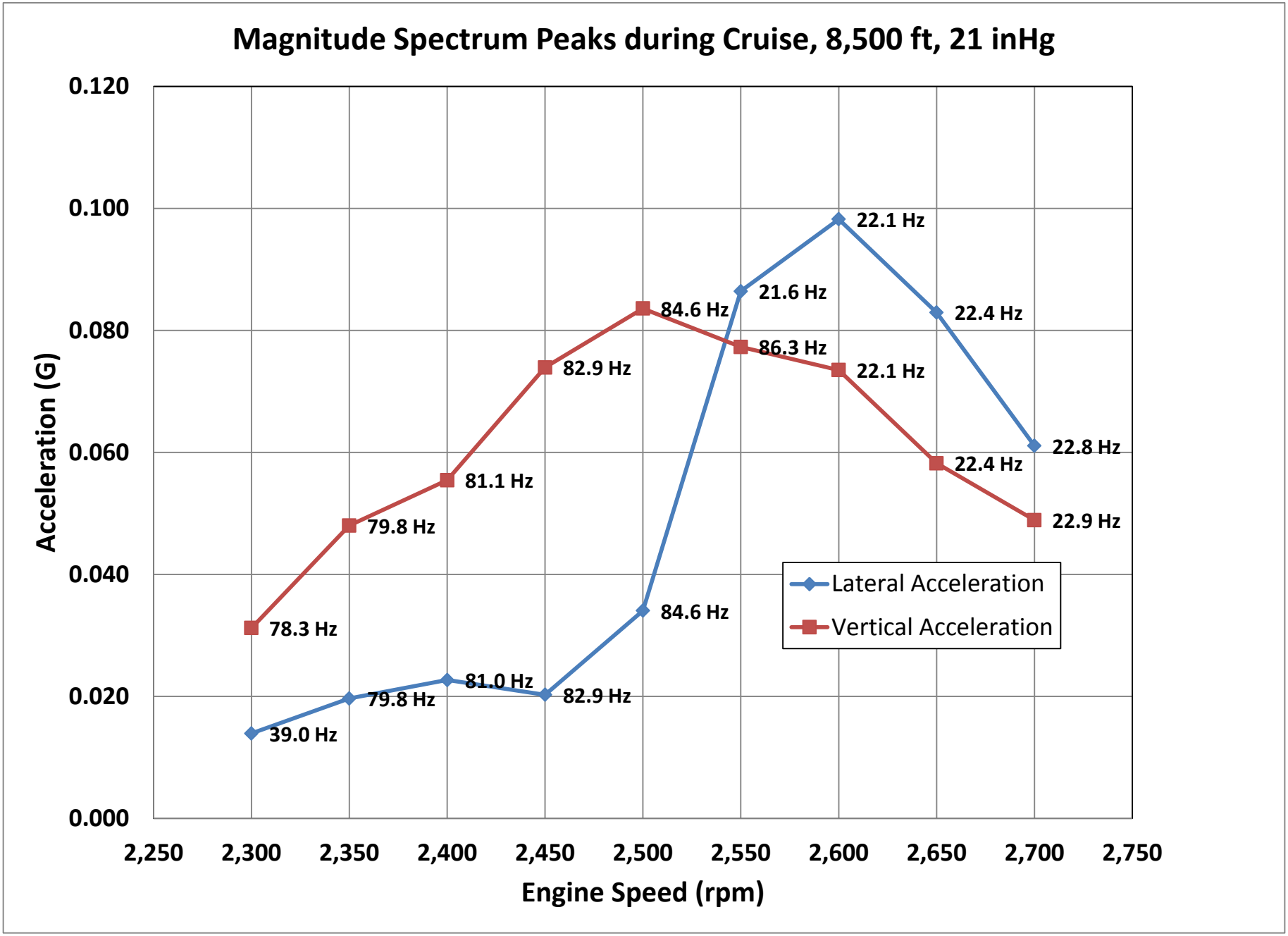
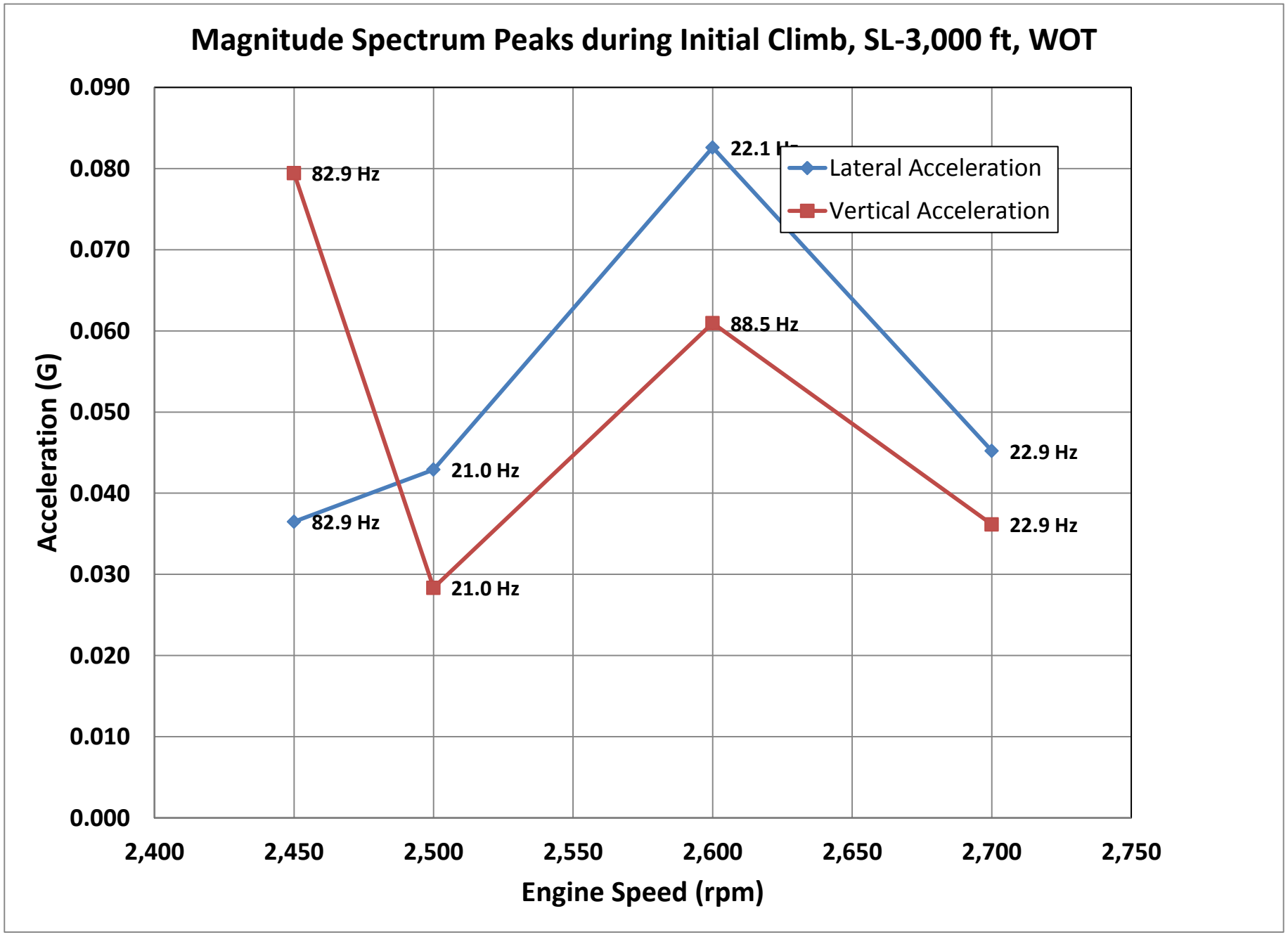
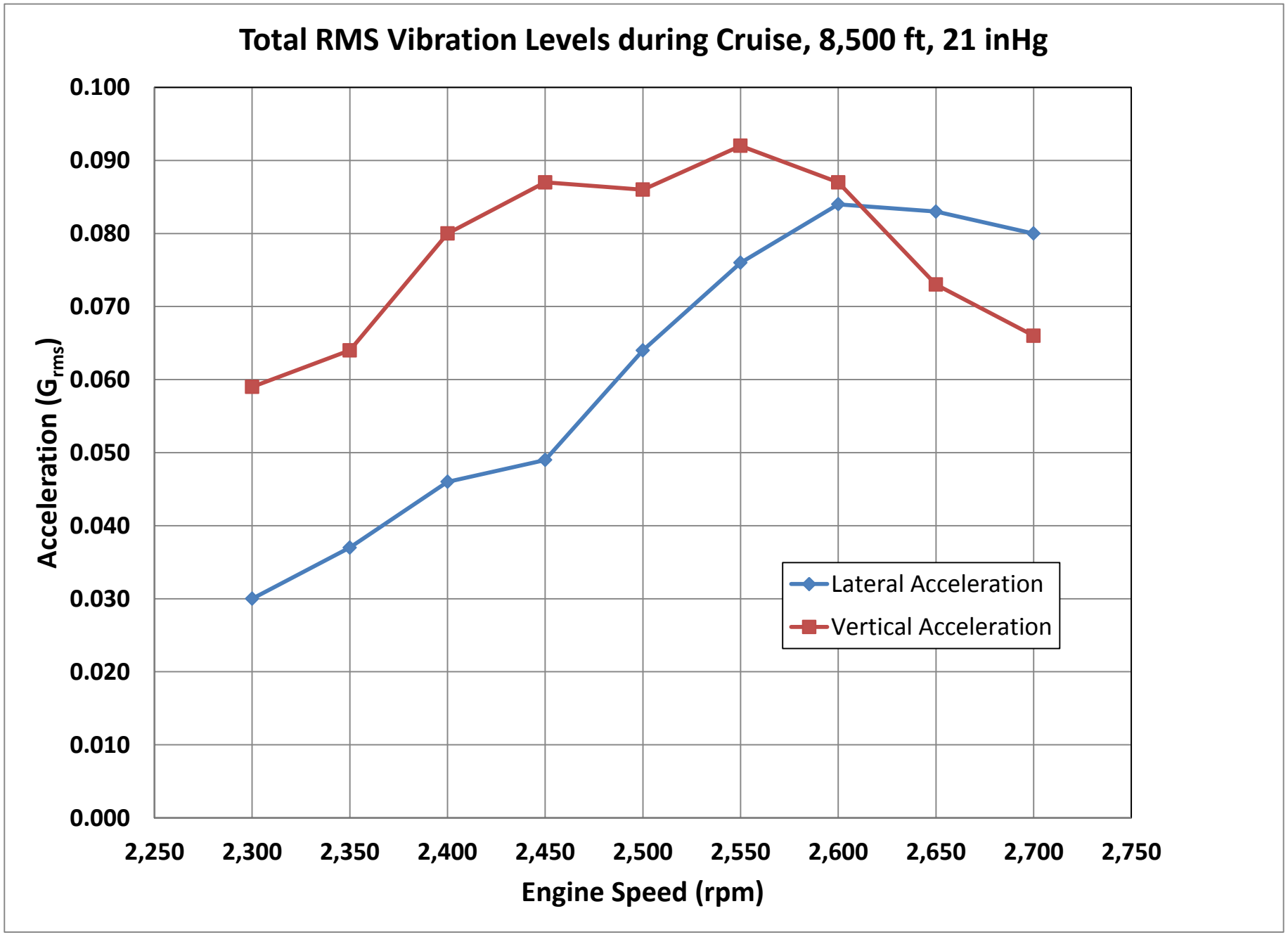
Lancair 360, N91CZ In-Flight Vibration Summary

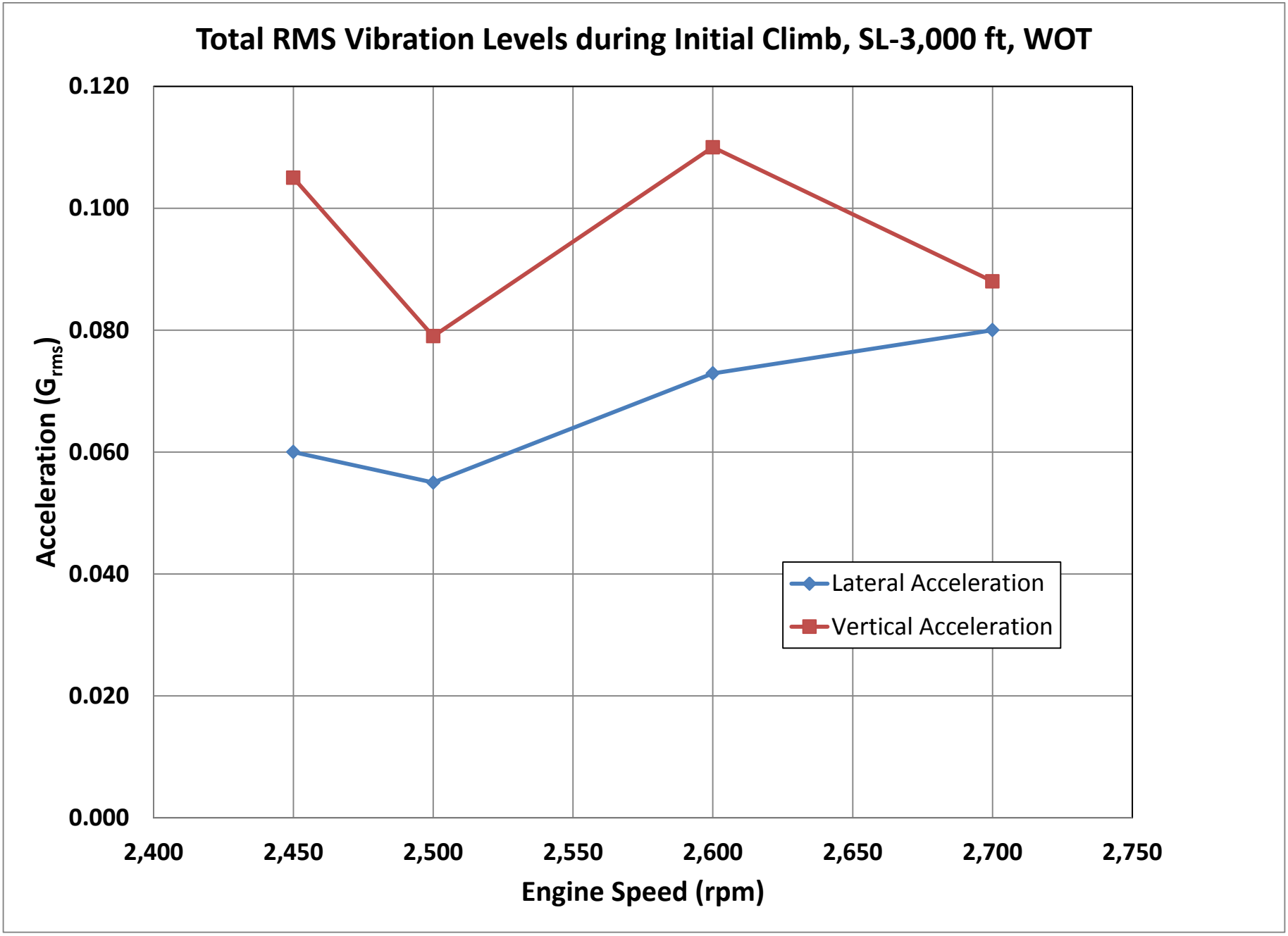
- Acceleration measurements taken on a centrally located accessory bulkhead supporting the battery and hydraulic pump.
- Lateral and Vertical accelerations were recorded
- Data recorded at 1kHz
- Propeller Dynamic Balance at 2,450 rpm was 0.02 ips
- Two Flight Phases recorded
  - Initial Climb, WOT, four different engine speeds
  - Cruise, 8500', 21" MP (~1"Hg below WOT), nine different engine speeds

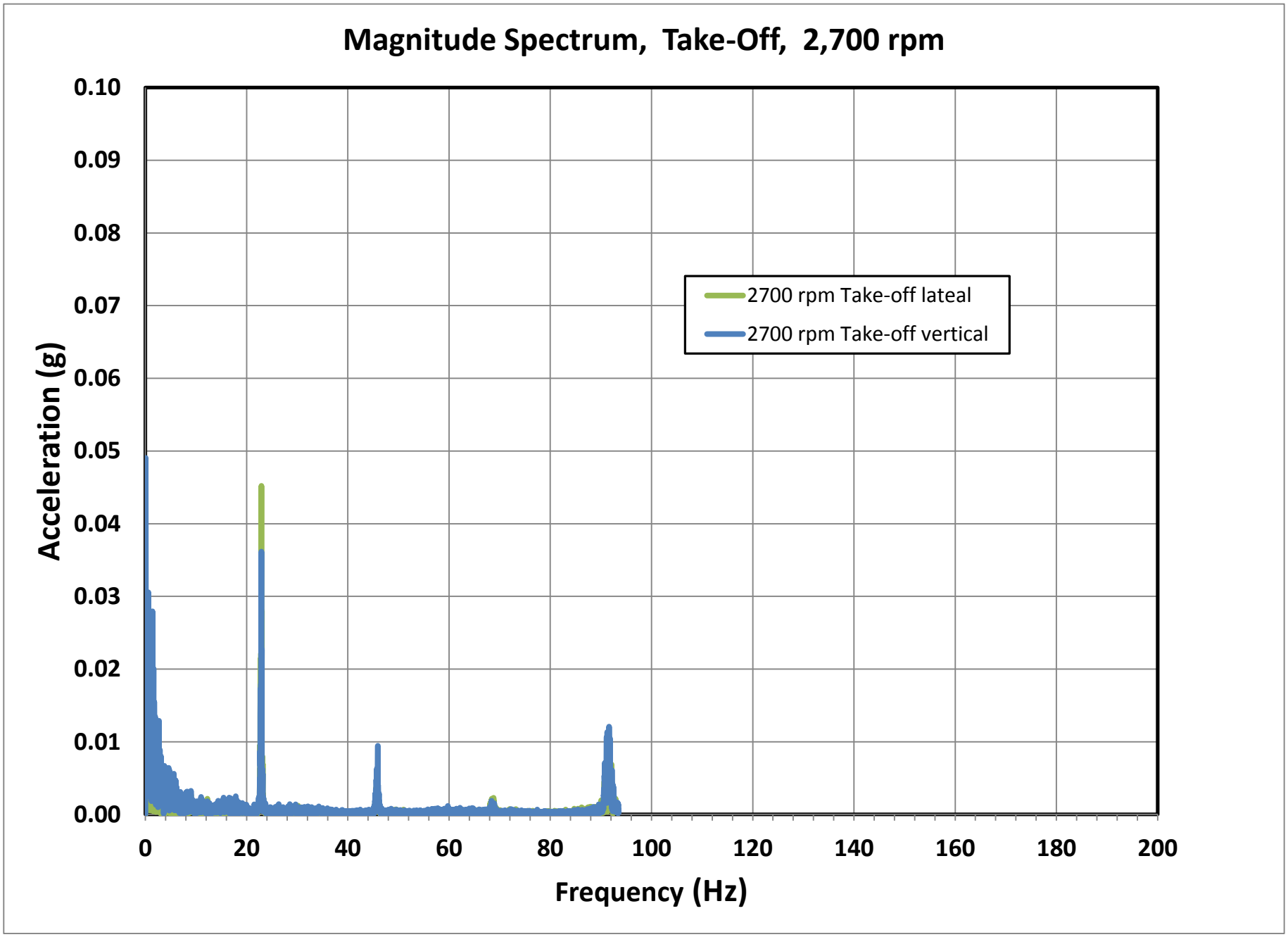
- Plots
  - Peak G-levels and frequencies from all cruise points
  - Peak G-levels and frequencies from all climb points
  - Total RMS values for all cruise points
  - Total RMS for all climb points
  - Magnitude spectrum for Climb @ 2,700 rpm (was turbulent)
  - Magnitude Spectrum for Cruise @ 2,300 rpm (smoothest cruise)
  - Magnitude Spectrum for Cruise @ 2,500 rpm (~roughest cruise)
  - Power Spectrum for Climb @ 2,700 rpm
  - Power Spectrum for Cruise @ 2,300 rpm (smoothest cruise)
  - Power Spectrum for Cruise @ 2,500 rpm (~roughest cruise)
  - Aero Commander 690B twin turboprop PSD comparison charts (2)
  - Sample raw data (3)

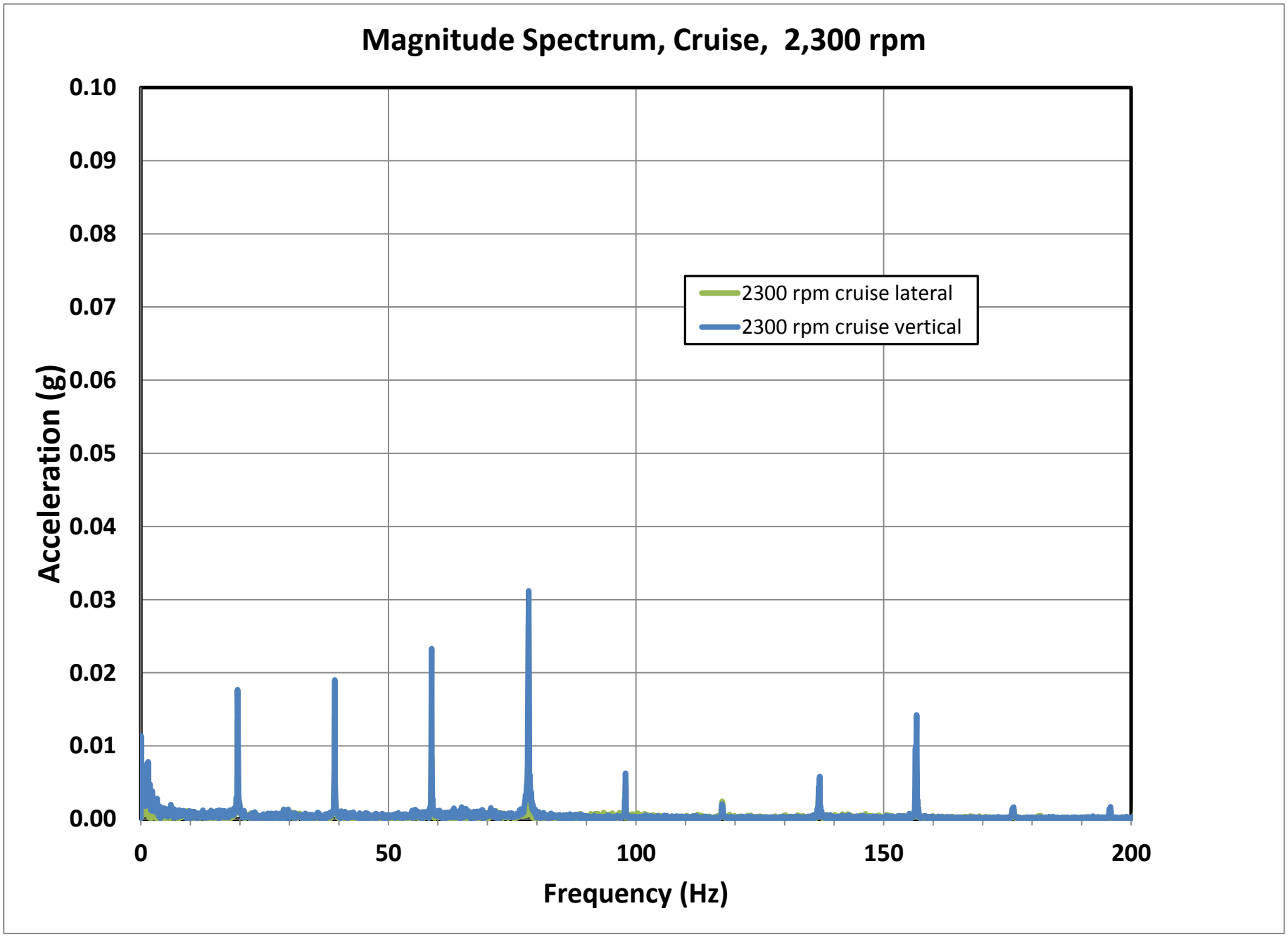

Magnitude Spectrum Peaks during Cruise, 8,500 ft, 21 inHg
Acceleration (G)
0.120
0.100
0.080
0.060
0.040
0.020
0.000
2,250
2,300
2,350
2,400
2,450
2,500
2,550
2,600
2,650
2,700
2,750
Engine Speed (rpm)
Lateral Acceleration
Vertical Acceleration
78.3 Hz
79.8 Hz
81.1 Hz
82.9 Hz
84.6 Hz
86.3 Hz
22.1 Hz
22.4 Hz
22.9 Hz
39.0 Hz
79.8 Hz
81.0 Hz
82.9 Hz
84.6 Hz
21.6 Hz
22.1 Hz
22.4 Hz
22.8 Hz

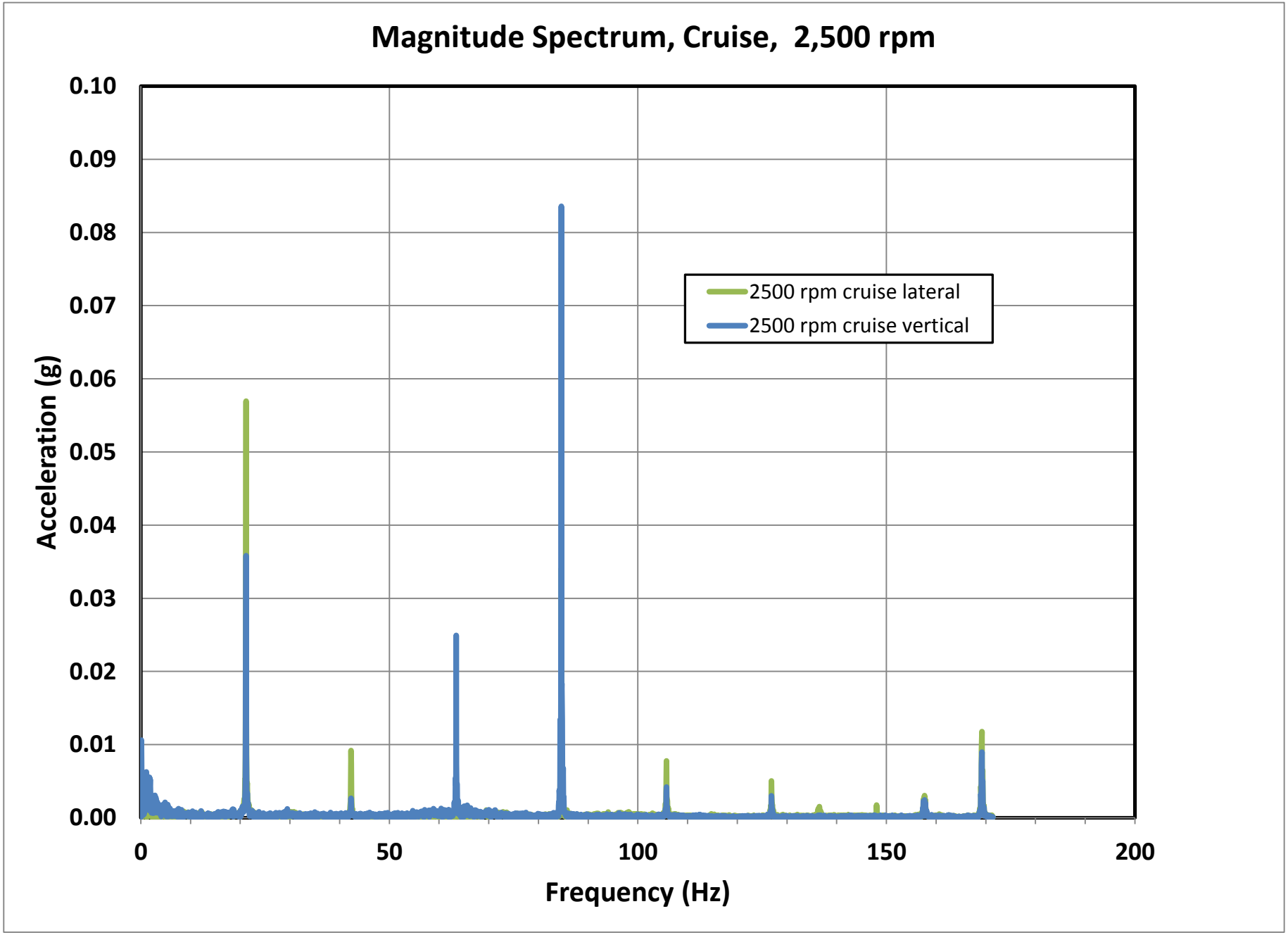

Magnitude Spectrum Peaks during Initial Climb, SL-3,000 ft, WOT
Acceleration (G)
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2,400
2,450
2,500
2,550
2,600
2,650
2,700
2,750
Engine Speed (rpm)
Lateral Acceleration
Vertical Acceleration
82.9 Hz
22.1 Hz
88.5 Hz
21.0 Hz
82.9 Hz
21.0 Hz
22.9 Hz
22.9 Hz

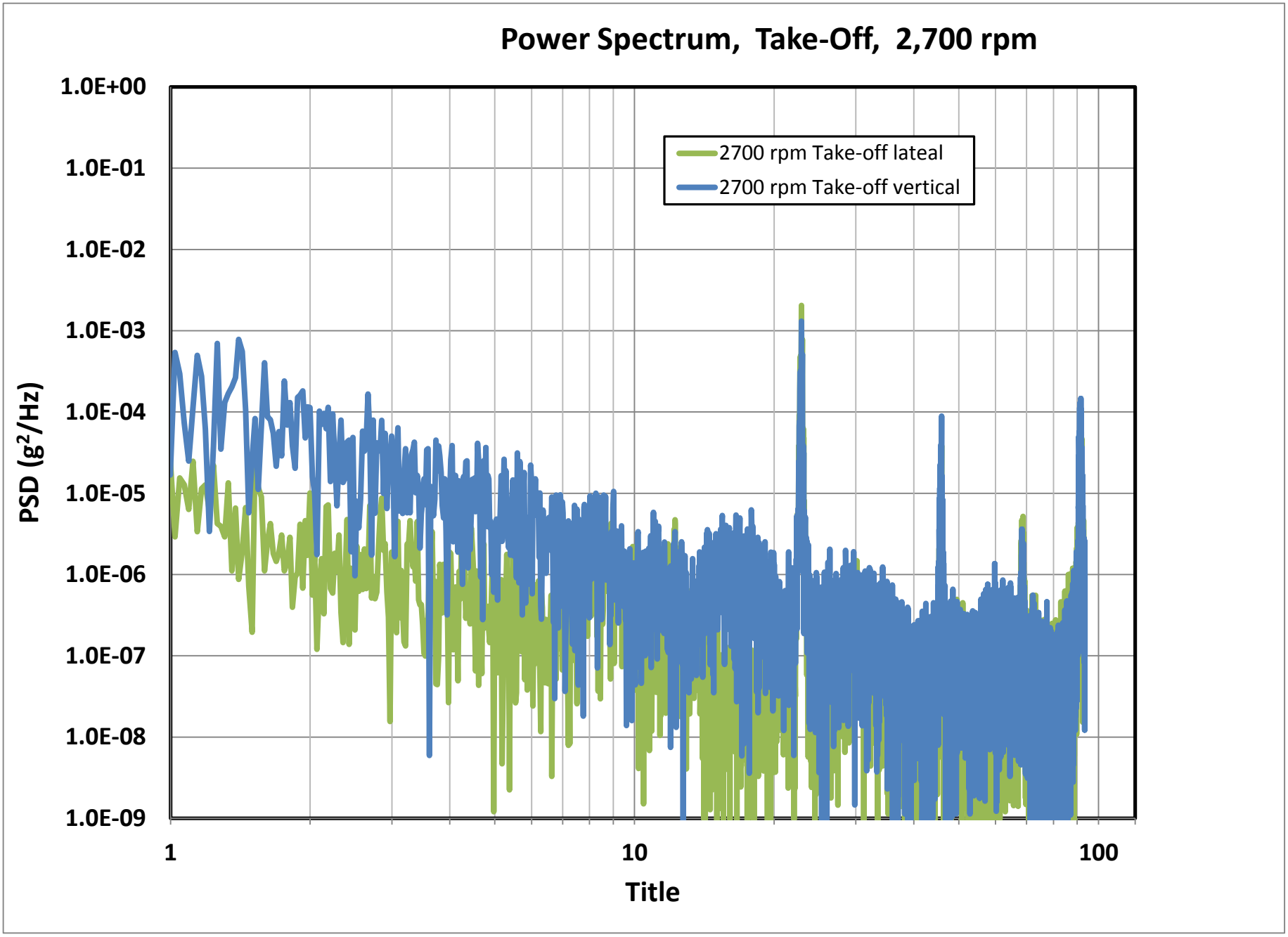

Total RMS Vibration Levels during Cruise, 8,500 ft, 21 inHg
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Acceleration (Grms)
2,250
2,300
2,350
2,400
2,450
2,500
2,550
2,600
2,650
2,700
2,750
Engine Speed (rpm)
Lateral Acceleration
Vertical Acceleration

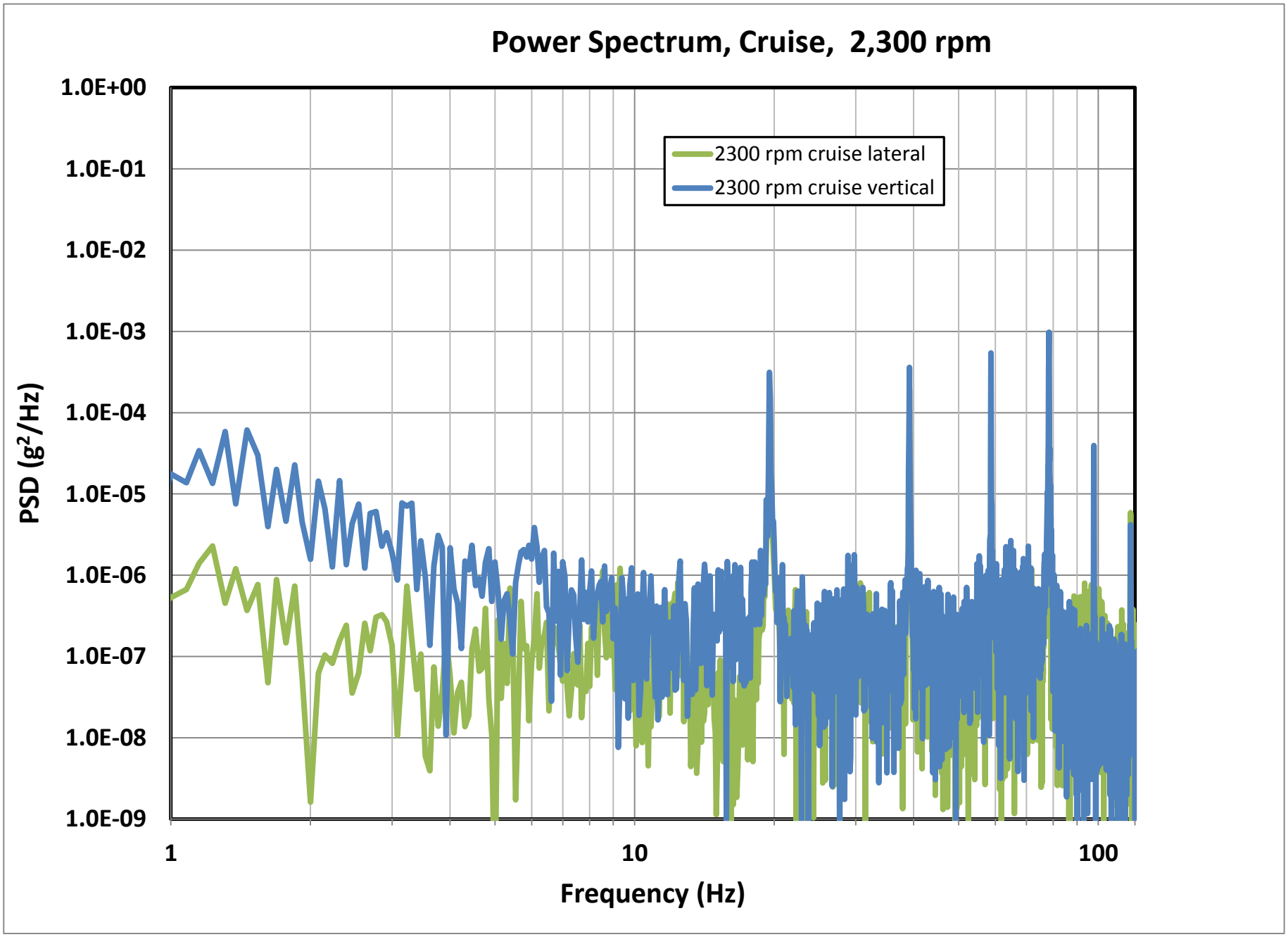

Total RMS Vibration Levels during Initial Climb, SL-3,000 ft, WOT
0.120
0.100
0.080
0.060
0.040
0.020
0.000
Acceleration (Grms)
2,400
2,450
2,500
2,550
2,600
2,650
2,700
2,750
Engine Speed (rpm)
Lateral Acceleration
Vertical Acceleration

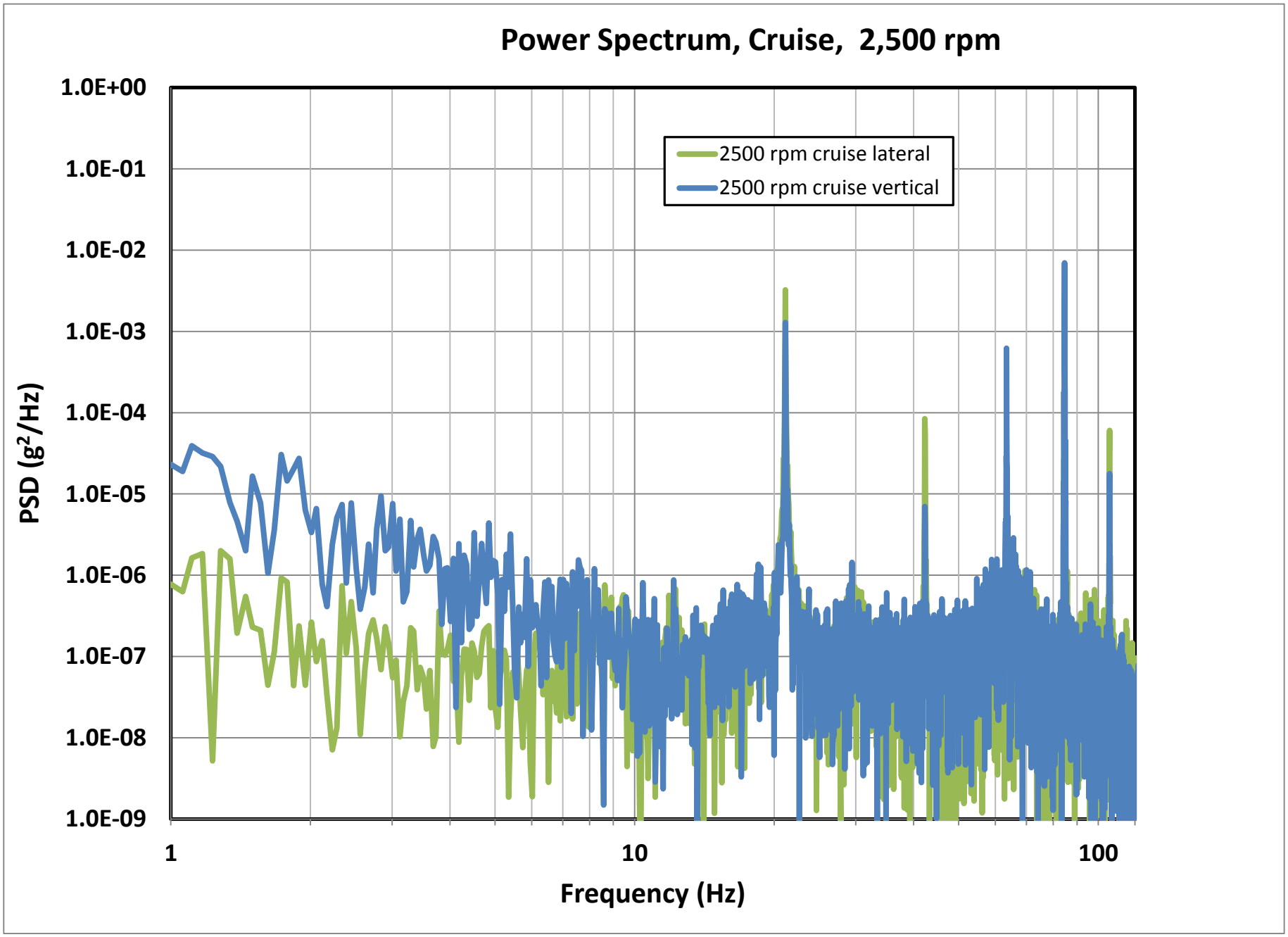

Magnitude Spectrum, Take-Off, 2,700 rpm
Acceleration (g)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
2700 rpm Take-off lateal
2700 rpm Take-off vertical


Magnitude Spectrum, Cruise, 2,300 rpm
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Acceleration (g)
2300 rpm cruise lateral
2300 rpm cruise vertical
0
50
100
150
200
Frequency (Hz)


Magnitude Spectrum, Cruise, 2,500 rpm
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Acceleration (g)
0
50
100
150
200
Frequency (Hz)
2500 rpm cruise lateral
2500 rpm cruise vertical

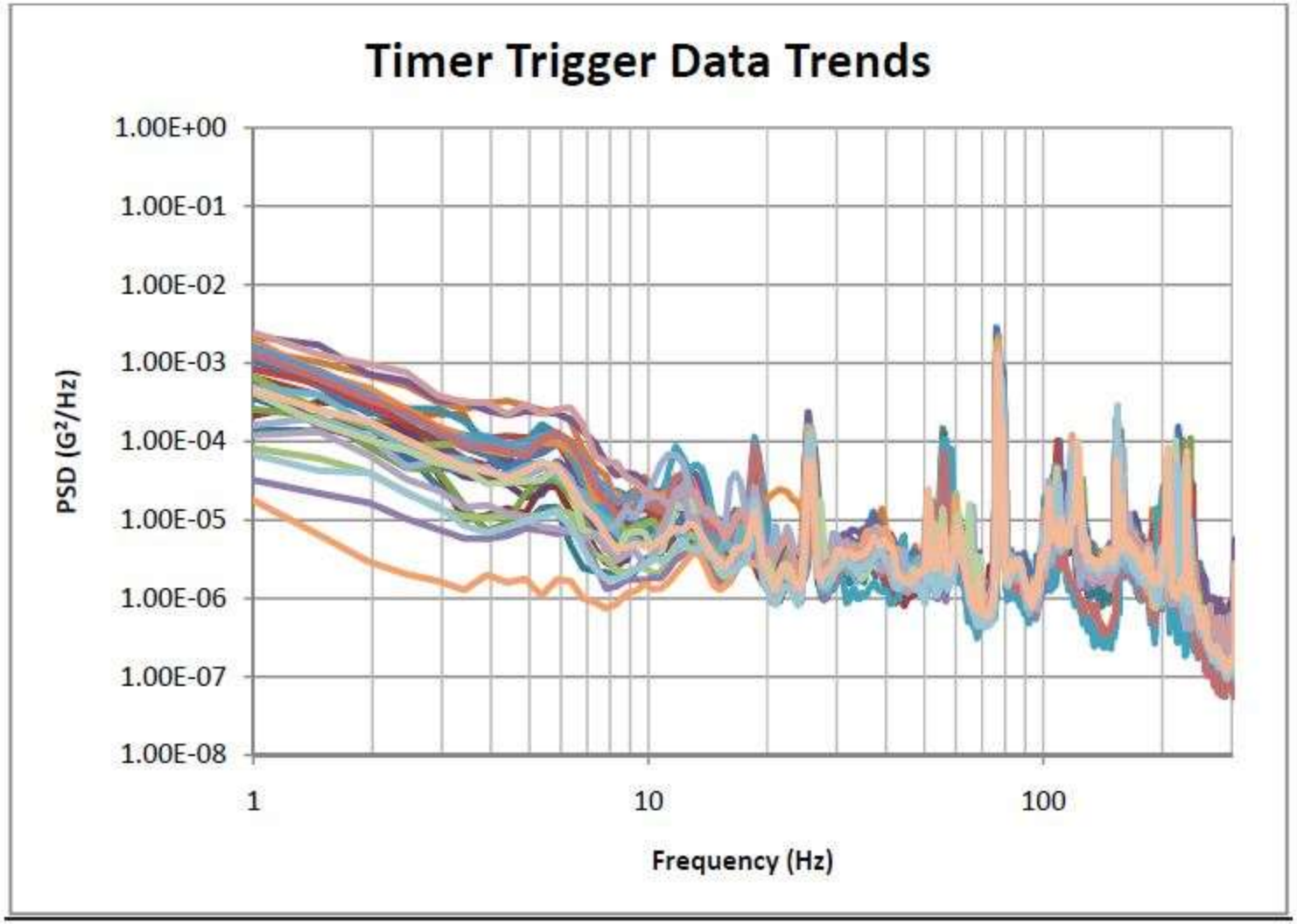

Power Spectrum, Take-Off, 2,700 rpm
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
PSD (g²/Hz)
1
10
100
Title
2700 rpm Take-off lateal
2700 rpm Take-off vertical


Power Spectrum, Cruise, 2,300 rpm
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
PSD (g²/Hz)
1
10
100
Frequency (Hz)
2300 rpm cruise lateral
2300 rpm cruise vertical


Power Spectrum, Cruise, 2,500 rpm
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
PSD (g²/Hz)
1
10
100
Frequency (Hz)
2500 rpm cruise lateral
2500 rpm cruise vertical

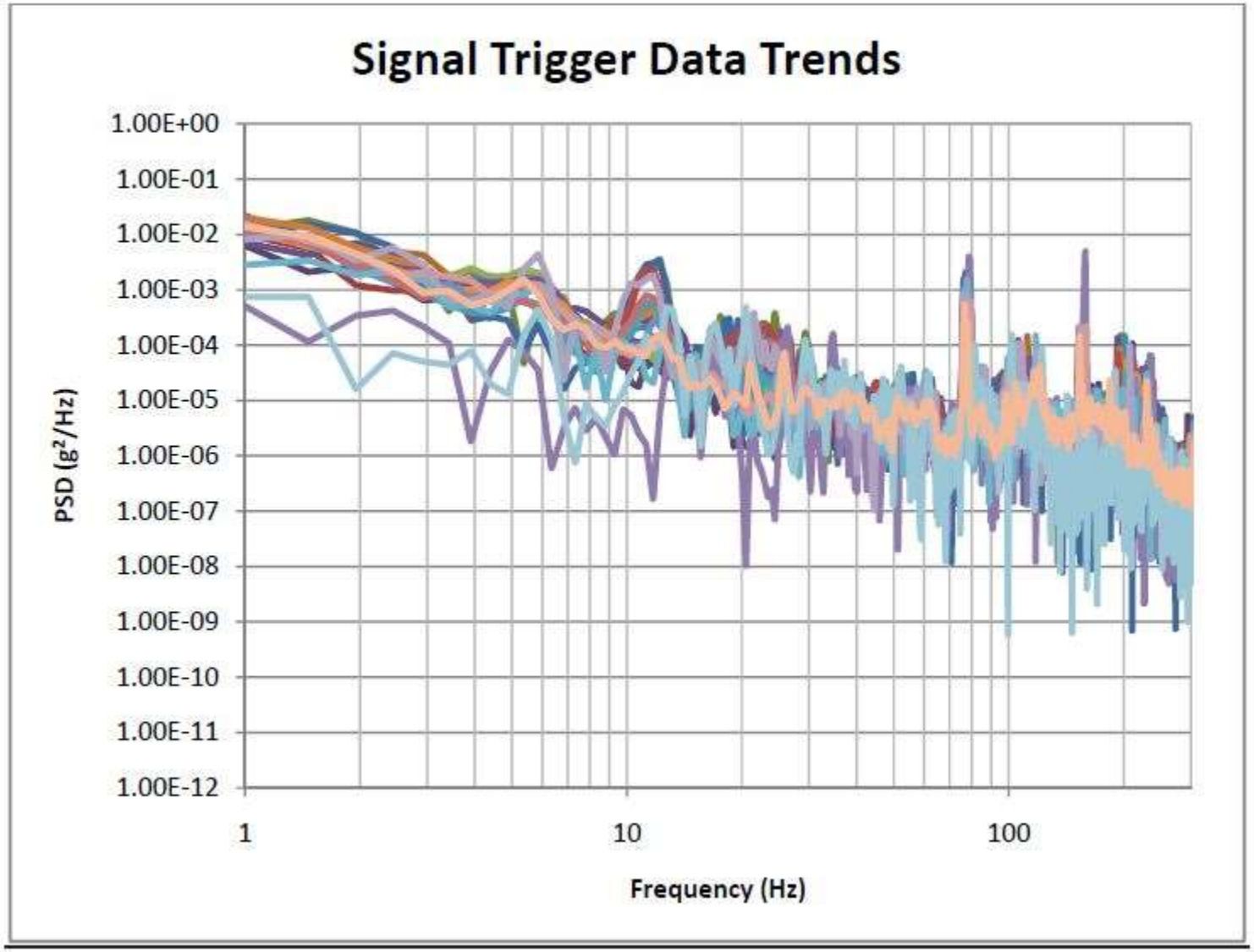
Comparison: Rockwell Turbocommander 690B AC90
Timer Trigger: Every 30 seconds recording starts for a 2 second sample at 1kHz
K. Dunno, 2008

Timer Trigger Data Trends – Thirty Flights



Comparison: Rockwell Turbocommander 690B AC90
Signal Trigger: any 0.5 G input triggers recording for a 2 second sample at 1kHz
K. Dunno, 2008

Signal Trigger Data Trends – Thirty Flights



Sample Data: 2,300 rpm Cruise