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A GENERAL DYNAMICS COMPANY

MEMORANDUM

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Action	X
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Reply Requested	

Date: June 25, 2015

To: James White

cc: Steve Forman, Michele Nierenberg, John Maxon, Paul Conti, Scott Kendall, Michael Clune, Alex Cameron, Justin Janzen PJC

From: Charles Roberts, II

Job #AC-15-076
A/V-15-077

Subject: **A/C 1085 Cabin Vibration Investigation**

Attachments: High Speed Vibration and Cabin Noise Data

Introduction

The owner of GIV s/n 1085 has been experiencing high levels of low frequency vibration during the climb and cruise phase of flight. The customer scheduled a "drop in" visit to the GAC Brunswick Service Center on 06/19/2015 to perform a maintenance flight to identify the source of the vibration.

Summary

Accelerometers were placed on the pilot inboard seat track, the copilot inboard seat track, the Window 2 left outboard seat track, and the Window 2 right outboard seat track. A microphone was placed at the Window 2 center position. Engine vibration data was acquired from the left and right broadband outputs located in the forward left and right radio racks. A normal taxi and take-off was executed. Data was recorded during a normal climb up to 45000 feet.

Results

Analysis of the recorded data showed a ½ harmonic on the left engine's N1 spool during climb through 36000 feet. The frequency of the ½ harmonic was 61.7 Hz with a vibration level of 0.16 in/s and a sound pressure level of 71.9 dB (Figures 1 & 2). The vibration was also measured on the Window 2 left and right outboard seat tracks (Figure 3). When the left engine was decelerated to idle, the ½ N1 harmonic went away. During climb, the left engine's N1 vibration levels were as high as 0.14 in/s and the right engine's N1 vibration levels were as high as 0.20 in/s.

Recommendation

To mitigate the felt vibration during climb to 45000 feet, it is recommended to perform a 180º clocking of the left engine fan followed by a fan trim-balance on both engines. The fan trim-balance should achieve N1 vibration levels no greater than 0.10 in/s from MCT to idle on both engines.

NOTE: Performing Vibration Surveys and Fan Trim Balancing in windy conditions can produce inaccurate vibration measurements that may lead to erroneous balancing solutions. If these actions must be performed in windy conditions, then the aircraft should be pointed nose-into-the-wind to minimize the effects.

Data Acquisition

The engine vibration was recorded using the EVM broadband B-n-C outputs located in the upper left and right radio racks. Engine vibration was measured with the primary and secondary accelerometers located on the engine's fan case. The primary and secondary accelerometers were oriented in the in-service position in the radial direction.

The engine accelerometers measure acceleration, which is integrated by the on-board signal conditioning unit, to obtain velocity. Thus, the measured output form the maintenance port is velocity, not acceleration.

Data Reduction

The recorded data was processed using the ArtemiS Clasic software package which was developed by Head Acoustics. This software package provides a spectrogram and a peak hold spectrum plot of the acoustic and vibration data.

Left Engine Vibration During Climb Up To 45000 feet

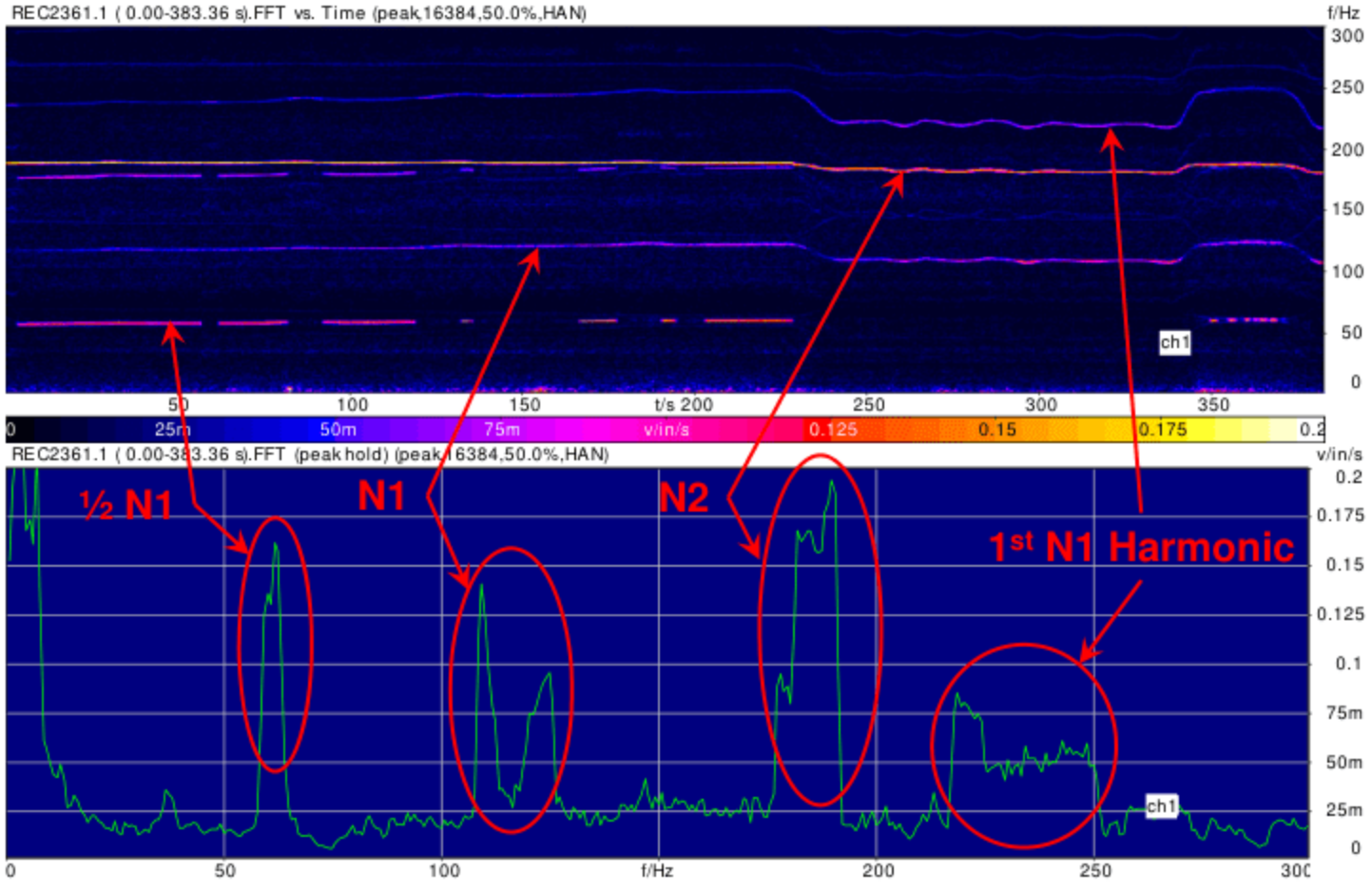

Figure 1

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Sound Pressure Level at Window 2 Center

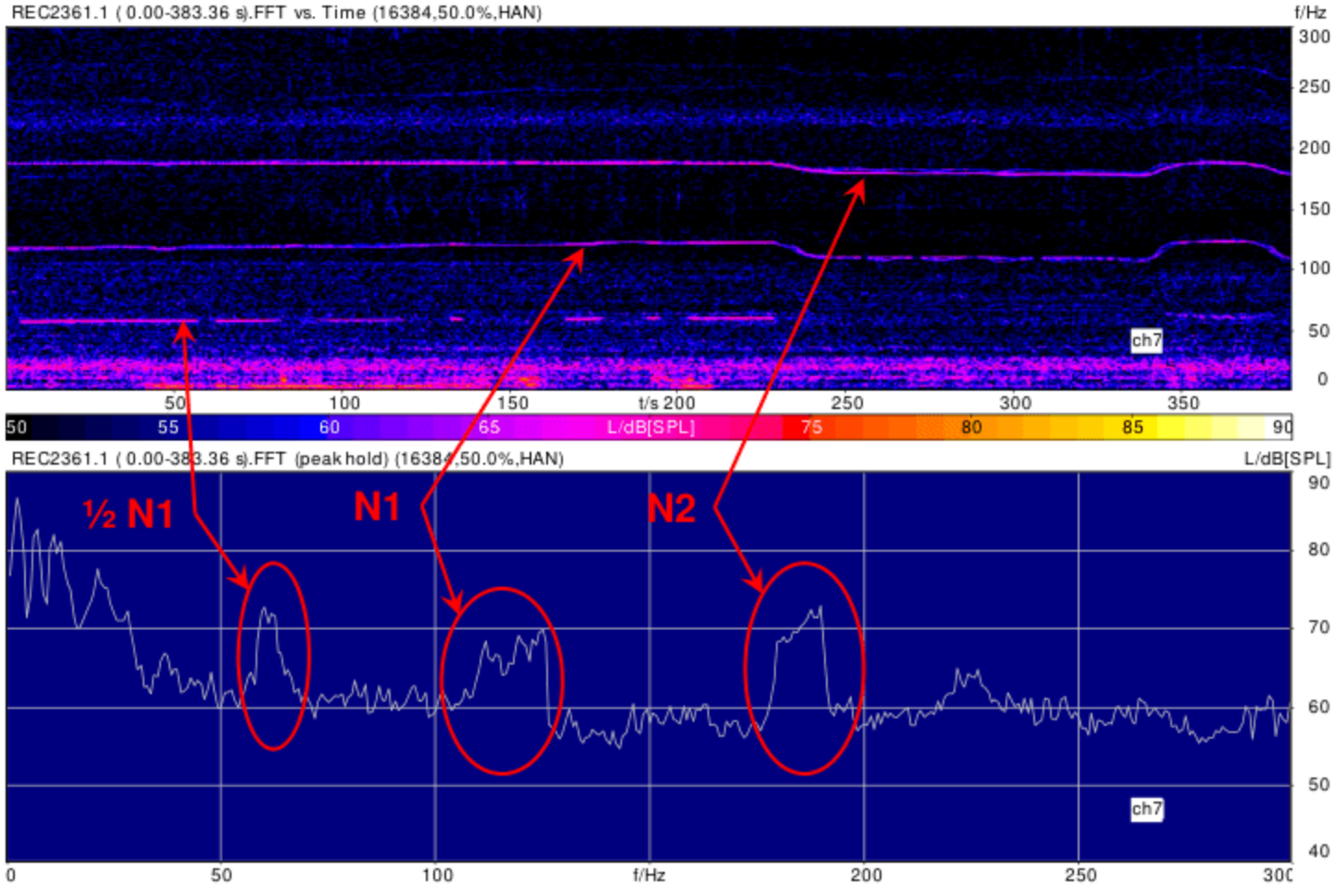

Figure 2

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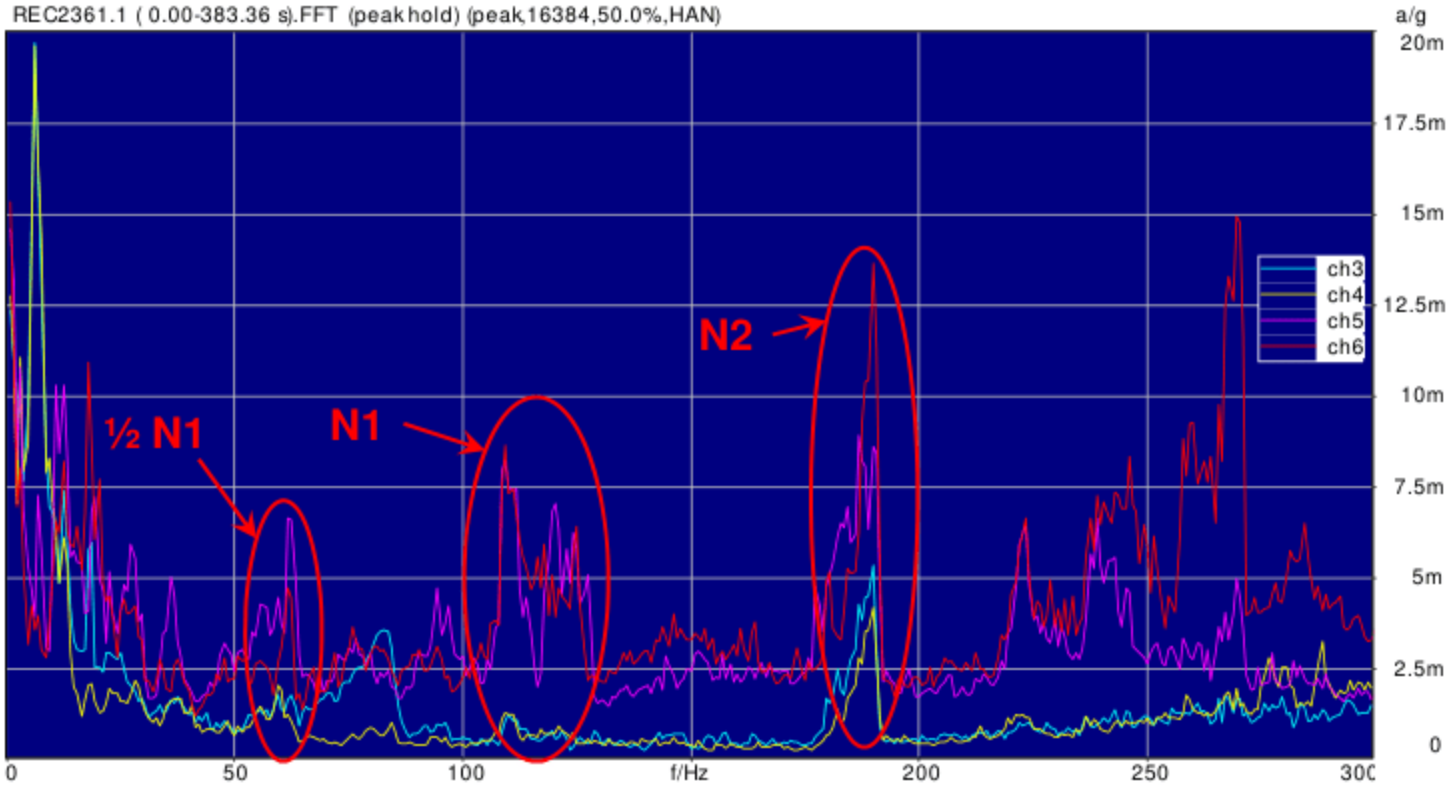
Vibration Measured on Seat Tracks



Ch 3 Pilot Inboard Seat Track
Ch 4 Co-Pilot Inboard Seat Track
Ch 5 Window 2 Left Outboard Seat Track
Ch 6 Window 2 Right Outboard Seat Track

Figure 3

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