

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA24FA371

SOUND SPECTRUM

Specialist's Factual Report

January 16, 2026

A. ACCIDENT

Location: Vergennes, VT
Date: September 8, 2024
Time: 1225 Eastern Daylight Time (EDT)
1625 Coordinated Universal Time (UTC)
Airplane: Piper PA-28R-180, Private, N3757T

B. SOUND SPECTRUM SPECIALIST

Specialist Kyle Garner
Sr. Aerospace Engineer – Recorder Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A sound spectrum study group was not convened. The NTSB received a video file (IMG_9634.mov) from a witness who observed the accident aircraft during its takeoff roll at Basin Harbor Airport (B06) in Vergennes, Vermont.

Metadata associated with the file indicated that it was recorded at 12:24:20 EDT on September 8, 2024. The video was captured at a resolution of 1920 × 1080 pixels, with a frame rate of 30 frames per second and audio recorded at a sampling rate of 44.1 kHz. The total duration of the recording was approximately 12 seconds. The video showed the aircraft moving from left to right across the frame during its takeoff roll; however, it ended before the airplane became airborne.

Figure 1 is a Google Earth image that shows the witness's location, the approximate start and end points of the video, and the aircraft's direction of travel. Note that the weather and lighting conditions depicted in the image may not accurately reflect those present at the time of the accident.

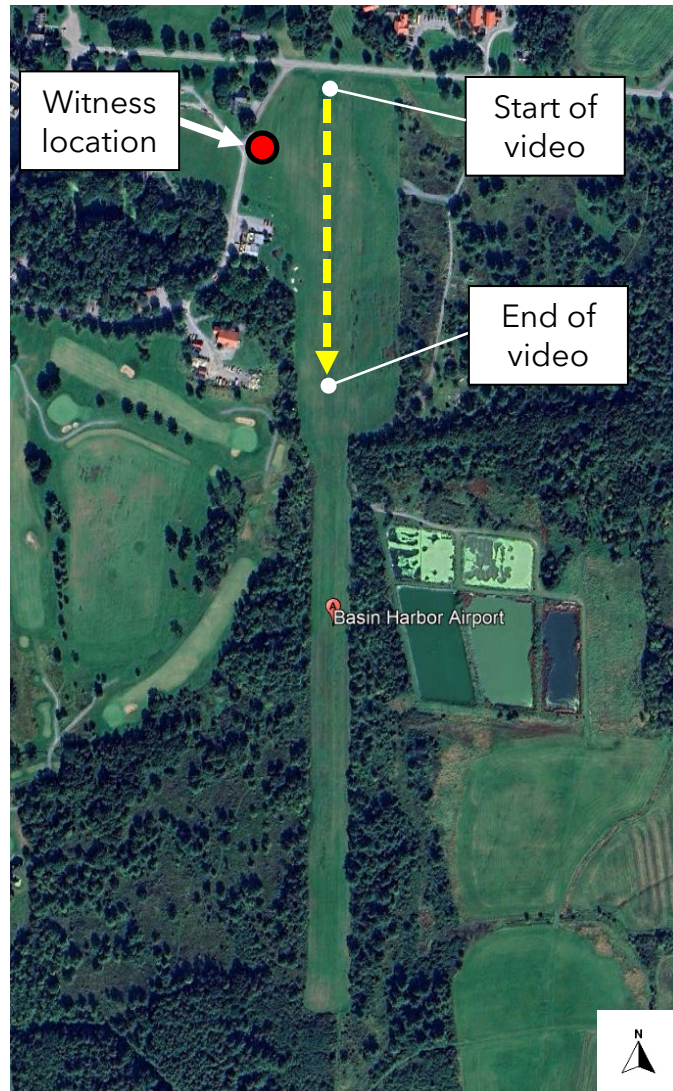


Figure 1. Google Earth image showing the location of the witness, the approximate start and end locations of the video, and the direction of travel of the aircraft.

1.0 Sound Spectrum Study

Audio from the video was analyzed to assess the operating speed of the aircraft's engine during the takeoff roll. The accident aircraft was equipped with a Lycoming IO-360-B1E four-cylinder direct-drive engine and a Hartzell two-bladed propeller. For this configuration, the strongest tonal component in the recorded sound is typically the fundamental blade passage frequency (BPF).¹ For a two-bladed propeller, the relationship between engine speed and BPF is given in equation 1:

$$RPM = \frac{BPF}{\text{number of blades}} \times 60 \quad \text{eq. 1}$$

¹ Smith, M. (1989). "Aircraft Noise." Cambridge University Press.

According to the airplane owner's manual, the engine's normal maximum rated continuous power setting is 2700 RPM, which corresponds to a fundamental BPF of approximately 90 Hz.²

Figure 2 shows a spectrogram of the audio for the duration of the video. The horizontal axis represents time in seconds, the vertical axis represents frequency in hertz, and brighter colors indicate higher spectral amplitude.

The fundamental BPF and its harmonics are visible throughout the spectrogram. The gradual downward slope of these lines indicates the presence of Doppler shift as the aircraft accelerated and moved farther from the witness.

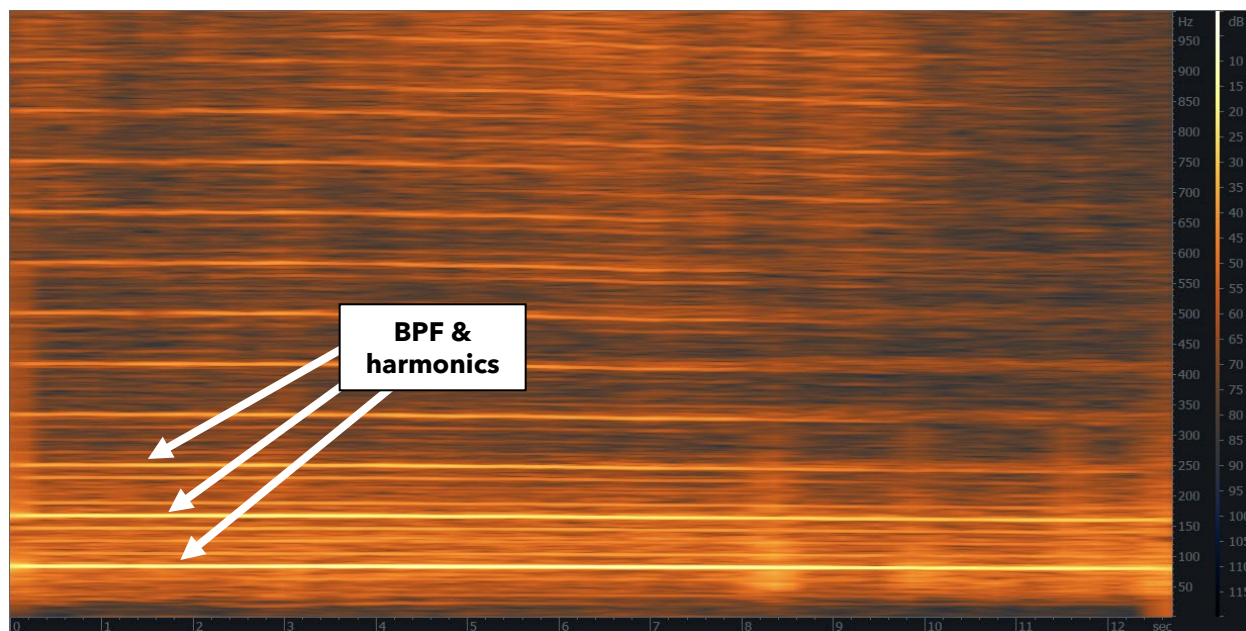


Figure 2. Spectrogram of audio for the duration of the video.

Between 0 and 2 seconds elapsed time of the video, the aircraft's propeller was approximately perpendicular to the witness, allowing the Doppler effect to be neglected. Additionally, because the witness was in close proximity to the aircraft, the time required for sound to reach the recording device was considered negligible and was not accounted for.

A Fast Fourier Transform (FFT) of the audio over this interval, Figure 3, shows a fundamental BPF of 83.5 Hz, corresponding to an engine speed of approximately 2500 RPM. Because the aircraft's groundspeed during the takeoff roll was not independently known, Doppler-based RPM corrections were not performed.³ The

² Piper Cherokee Arrow Owners Handbook, Piper Aircraft Corporation, January 1987.

³ The Doppler effect states that, for a source with constant emitted frequency, the measured frequency is higher than the emitted frequency as the source approaches the observer, identical as the source passes perpendicular to the observer, and lower as the source moves away from the observer.

continuity and stability of the fundamental BPF and its harmonics throughout the recording were consistent with steady engine operation.

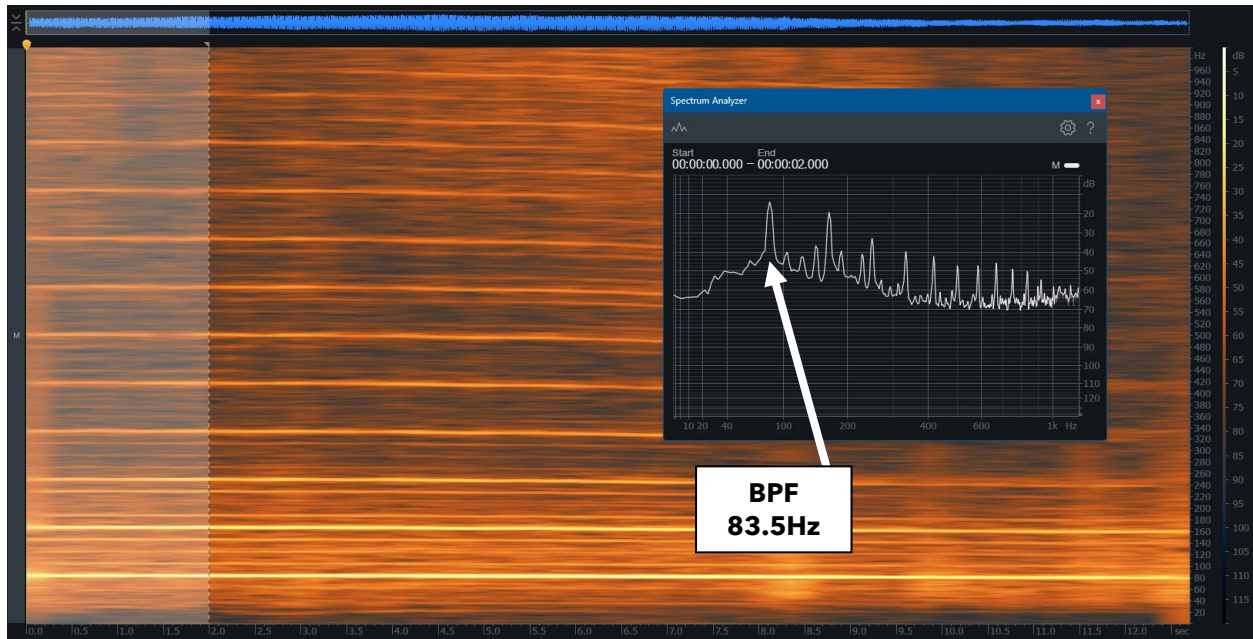


Figure 3. FFT of audio from 0 to 2 seconds of video elapsed time.

Submitted by:

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