

# Welcome to Vibrationdata

Acoustics • Shock • Vibration • Signal Processing

May 2003 Newsletter

## Memorial Day 2003

Recently, my family and I had the opportunity to visit Arlington National Cemetery, near Washington D.C.

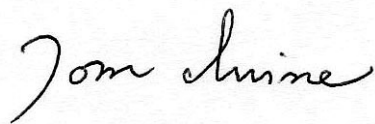
The gravesite of President John F. Kennedy and his wife Jacqueline Kennedy Onassis are a prominent part of this cemetery. A plaque at this site gave President Kennedy's Inaugural Address from January 20, 1961. Two paragraphs gave these inspired declarations:

Let every nation know  
Whether it wishes us well or ill  
That we shall pay any price - bear any burden  
Meet any hardship - support any friend  
Oppose any foe to assure the survival  
And the success of liberty

And so my fellow Americans  
Ask not what your country can do for you  
Ask what you can do for your country

This month's newsletter pays tribute to President Kennedy by recalling the unique rendition of Taps at his funeral.

Sincerely,



Tom Irvine  
Email: tomirvine@aol.com

## Feature Articles



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## Vibrationdata Announces

## Shock & Vibration Response Spectra & Software Training Course

### Course Benefits

This training will benefit engineers who must analyze test data, derive test specifications, and design isolation systems, with respect to shock and vibration environments.

Engineers in the aerospace, automotive, medical, petroleum and semiconductor industries can apply the course materials to solve real-world vibration problems.

### Course Description

- The course includes PowerPoint slide presentations as well as hands-on software training
- Each student will receive a licensed copy of MIT's EasyPlot software
- Each student will receive software programs which perform the following calculations:  
Power Spectral Density (PSD), Fast Fourier Transforms (FFT), Shock Response Spectrum (SRS), and digital filtering
- Students will receive data samples so that they can practice using the software programs
- Students are also welcome to bring their own data samples

### Dates for upcoming 2003 Courses

July 9-11

September 17-19

November 5-7

### Location

Dynamic Labs  
1720 W. Parkside Lane  
Phoenix, Arizona 85027

Students may also arrange for onsite training.

### For Further Information Please Contact

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<http://www.vibrationdata.com/>

## The Sounding of Taps at President Kennedy's Funeral

by Tom Irvine



### John F. Kennedy's Presidency

John Fitzgerald Kennedy (1917-1963) was the 35th president of the United States of America. He was the youngest man ever elected to the presidency. He is remembered for his stirring speeches.

President Kennedy proclaimed in his inaugural address, "Ask not what your country can do for you -- ask what you can do for your country."

He gave a speech to congress on May 25, 1961 in which he set forth the nation's goal of manned spaceflight to the Moon:

First I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth.

He continued this message in a speech at Rice University on September 12, 1962:

We choose to go to the Moon. We choose to go to the Moon in this decade and do the other things, not because they are easy, but because

they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too.

Furthermore, President Kennedy gave a speech in West Berlin on June 26, 1963, expressing America's unity with West Berlin:

Two thousand years ago the proudest boast was "*civis Romanus sum*." Today, in the world of freedom, the proudest boast is "*Ich bin ein Berliner*."

Note that both the nation of Germany and the city of Berlin were divided into East and West sections during the cold war, from 1945 to 1989.

Tragically, President Kennedy was assassinated on November 22, 1963, while riding in a motorcade in Dallas, Texas.

### President Kennedy's Funeral

President Kennedy's funeral was held on November 25, 1963. He was buried at Arlington National Cemetery.

President Kennedy was given full military honors at the graveside ceremony. Three volleys were fired followed by the sounding of Taps, the folding of the flag, and its presentation to the widow, Jacqueline Kennedy.



Sergeant Keith Clark

### Broken Note

Sergeant Keith Clark of the U.S. Army Band was chosen to play Taps on his B-flat bugle for the graveside ceremony.

Note that the US Army Band chose this key to match the sound of B-flat trumpets, which are used at ceremonies at Arlington National Cemetery when a bugle is not available. Also, the thought may have been that the trumpet sound would carry farther.

Millions of people around the world listened on TV and radio as Sergeant Clark played the famous 24 notes of Taps. Clark, however, cracked the sixth note. The note was off-key and truncated.

Reporters and commentators assumed that Sergeant Clark intentionally broke the note.

A Newsweek magazine article called the note a "tear."

Author William Manchester described the note as being "like a catch in your voice, or a swiftly stifled sob" in the 1967 book "The Death of a President."

Sergeant Clark's broken note was apparently unintentional. He had been given little time for warming up. Furthermore, Clark was momentarily rendered deaf by the three volleys, which were fired five yards from his position.

Clark later wrote:

I feel the thought behind the playing and feeling used in the performance are the most important parts of each sounding of Taps.

Regardless, the imperfect note clearly enhanced the rendition of Taps, adding a depth of sorrowful emotion.

### Acoustic Analysis

The Taps sound file from President Kennedy's funeral is available at

<http://www.vibrationdata.com/taps.wav>

The sixth note from this file is shown in time history format in Figure 1. A segment of this note is shown in Figure 2. The Fourier transform of the complete sixth note is given in Figure 3. The accompanying table identifies the prominent frequencies.

SIXTH NOTE OF TAPS AT PRESIDENT KENNEDY'S FUNERAL  
BROKEN NOTE

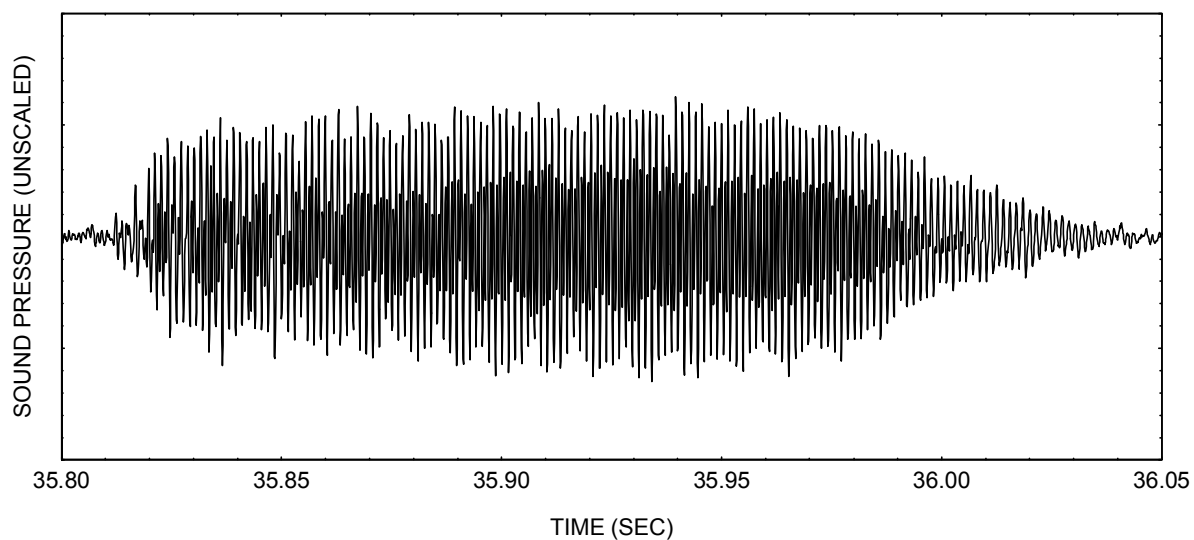


Figure 1. Full Time History of Sixth Note

SIXTH NOTE OF TAPS AT PRESIDENT KENNEDY'S FUNERAL  
BROKEN NOTE

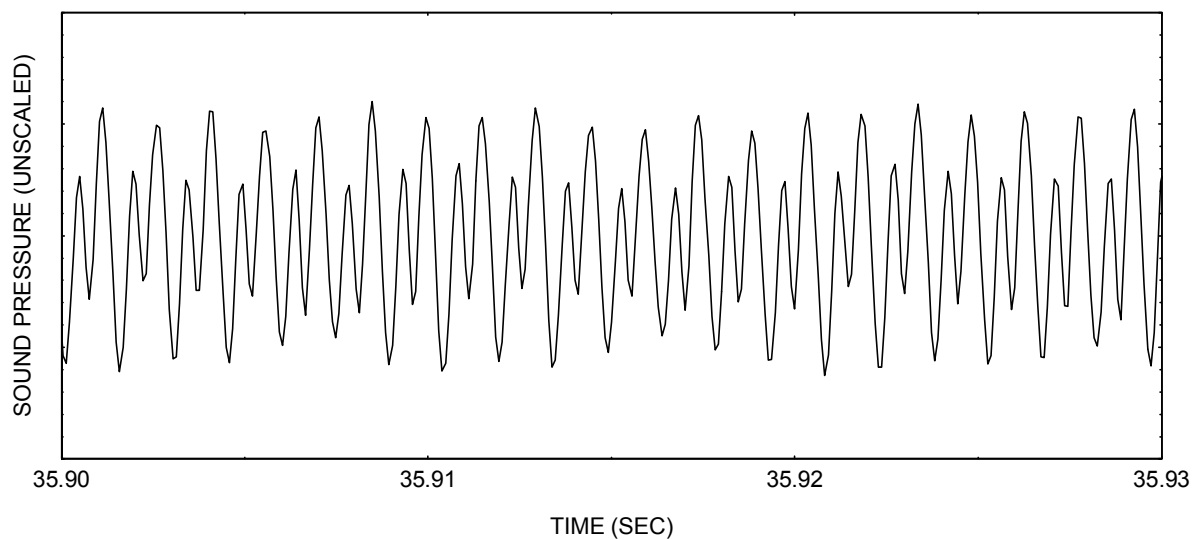


Figure 2. Time History Segment of Sixth Note

FOURIER MAGNITUDE  
SIXTH NOTE OF TAPS AT KENNEDY FUNERAL

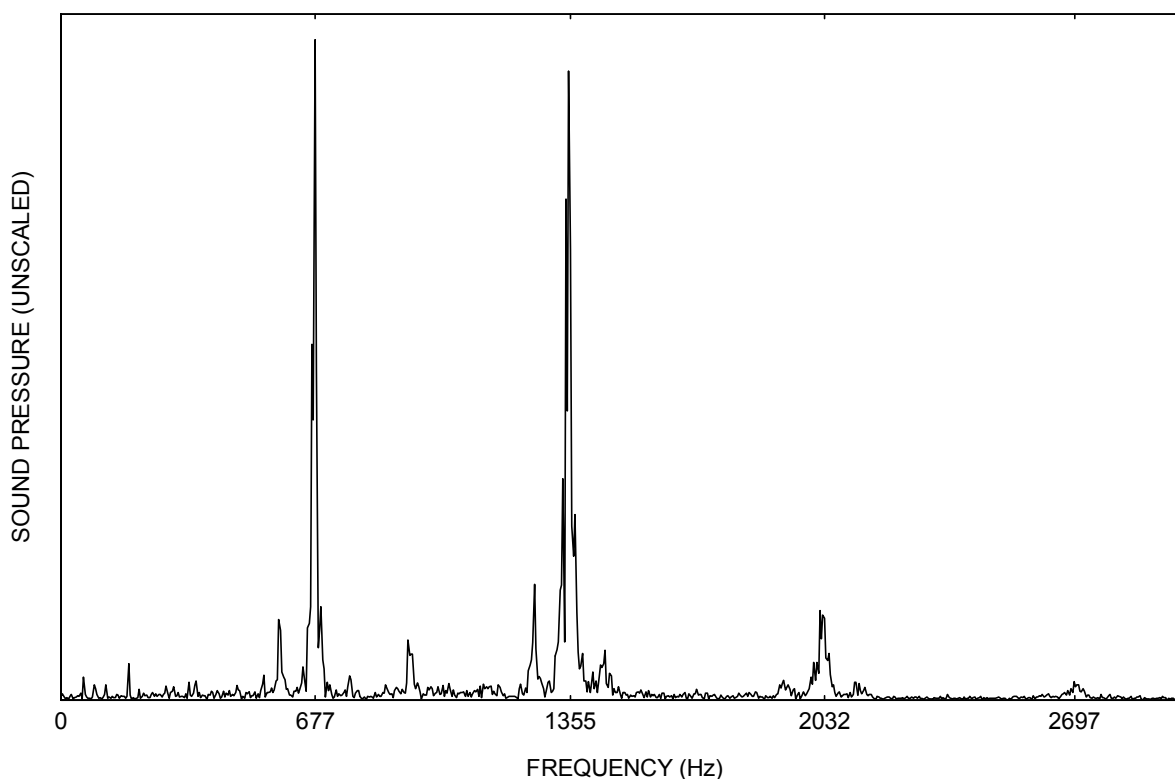


Figure 3. Fourier Transform of Sixth Note

Sixth Note of Taps Played Off-Key		
Measured Frequency (Hz)	Note	Description
677	Between E5 & F5	Fundamental
1355	Between E6 & F6	2X harmonic
2032	Between B6 & C7	3X harmonic
2697	Between E7 & F7	4X harmonic

The sixth note should have been a distinct D5 with a fundamental frequency of 587 Hz. There is in fact a small spectral peak at 587 Hz, immediately to the left of the peak at 677 Hz. Nevertheless, the dominant frequency is at 677 Hz with a harmonic at 1355 Hz.

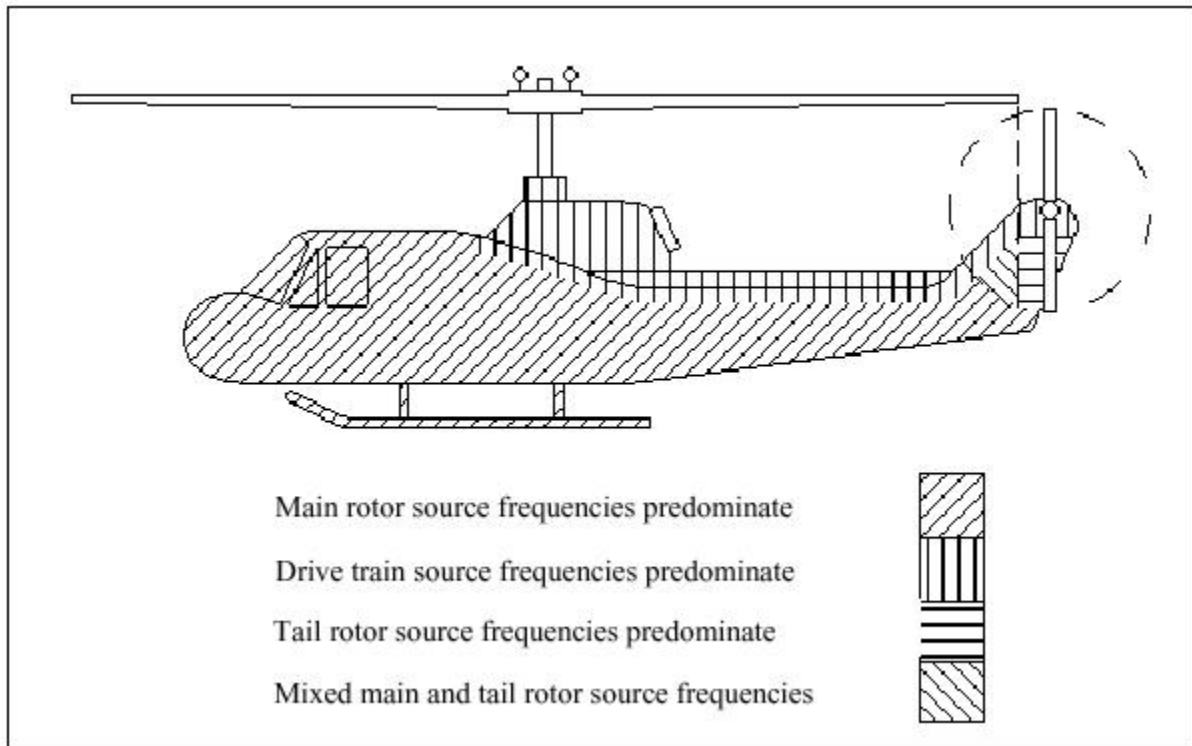
The D5 note is the sixth note from the Taps score transposed to the key of F for a B-flat bugle, as shown on the next page.

Taps Transposed to Key of F for the B-flat Bugle

By Jan Irvine



**Helicopter Vibration per MIL-STD-810F, Method 514.5** by Tom Irvine



MIL-STD-810F, Figure 514.5C-11. Helicopter vibration zones

MIL-STD-810F, Method 514.5, paragraphs 2.2.6 and 2.3.3 are concerned with the vibration levels that helicopter components and cargo must withstand.

The helicopter vibration environment is a combination of many sinusoidal components due to the main rotor, tail rotor, gearbox, and engine. In addition, there is low-level random due to aerodynamic flow. The April 2003 Vibration Newsletter featured an article on Apache Noise that described these sources in some detail.

The following tables show the main rotor and tail rotor frequencies of typical military helicopters. Sinusoidal vibration occurs at these frequencies, as well as at the blade passing frequencies.

The blade passing frequency is the rotor speed multiplied by the number of blades. Both the main rotor and the tail rotor produce blade passing frequencies.

Furthermore, harmonics occur at integer multiples of the blade passing frequencies. MIL-STD-810F specifies component and cargo vibration test levels based on these rotational frequencies.

Note that the frequencies in the following tables are nominal values. MIL-STD-810F, Method 514.5, paragraph 2.3.3, subparagraph b states:

The dominant sinusoids are generated by rotating components of the helicopter, primarily the main rotor(s), but also tail rotor, engine(s), drive shafts, and gear meshing. The normal operating speeds of these components are generally constant, varying less than five percent. However, recent designs have taken advantage of variable rotor speed control that generates a pseudo steady state rotor speed at values between 95 and 110 per cent of the nominal rotor speed.





**AH-1 Super Cobra**  
Attack and Reconnaissance  
Helicopter

Main Rotor  
Speed = 5.40 Hz  
2 Blades

Tail Rotor  
Speed = 27.2 Hz  
2 Blades



**AH-64 Apache**  
Attack Helicopter

Main Rotor  
Speed = 4.82 Hz (early version)  
Speed = 4.86 Hz (late version)  
4 Blades

Tail Rotor  
Speed = 23.4 Hz (early version)  
Speed = 23.6 Hz (late version)  
4 Blades



**Little Bird**

AH-6J – Armed Variant  
MH-6H – Utility Variant

Main Rotor  
Speed = 7.80 Hz  
5 Blades

Tail Rotor  
Speed = 47.5 Hz  
2 Blades



**CH-47D Chinook**

Heavy Lift and Transport  
Helicopter

Main Rotor  
Speed = 3.75 Hz  
3 Blades

(Two main rotors, but no tail rotor)



**OH-6A Cayuse**

Light Observation Helicopter

Main Rotor  
Speed = 8.10 Hz  
4 Blades

Tail Rotor  
Speed = 27.2 Hz  
2 Blades



**OH-58A/C Kiowa**

Light Observation Helicopter

Main Rotor  
Speed = 5.90 Hz  
2 Blades

Tail Rotor  
Speed = 43.8 Hz  
2 Blades



**OH-58D Kiowa Warrior**  
Light Observation Helicopter

Main Rotor  
Speed = 6.60 Hz  
4 Blades

Tail Rotor  
Speed = 39.7 Hz  
2 Blades



**Huey UH-1**  
Utility Helicopter

Main Rotor  
Speed = 5.40 Hz  
2 Blades

Tail Rotor  
Speed = 27.7 Hz  
2 Blades



**UH-60 Blackhawk**  
Multi-mission Helicopter

Main Rotor  
Speed = 4.30 Hz  
4 Blades

Tail Rotor  
Speed = 19.8 Hz  
4 Blades