A FIELD STUDY: MEASUREMENT AND EVALUATION OF WHOLE BODY VIBRATION FOR MH-60S PILOTS

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Introduction

Pilots of the MH-60S helicopter are exposed to continuous whole body vibration (WBV). Pilot fatigue is a growing operational concern due to the increased frequency of extended durations of missions (6-8+hours) in support of Operations Iraqi Freedom and Enduring Freedom. Endurance aspects of the currently used rotary wing seating systems were not optimized for the longer missions and wide range of pilot anthropometric measurements, which is now typical of naval aviation. The current seating systems were designed primarily to meet crashworthiness requirements, not for the wide range of pilot anthropometry or to mitigate WBV. Albeit, an issue, pilot fatigue and reduced mission effectiveness are also critical concerns.

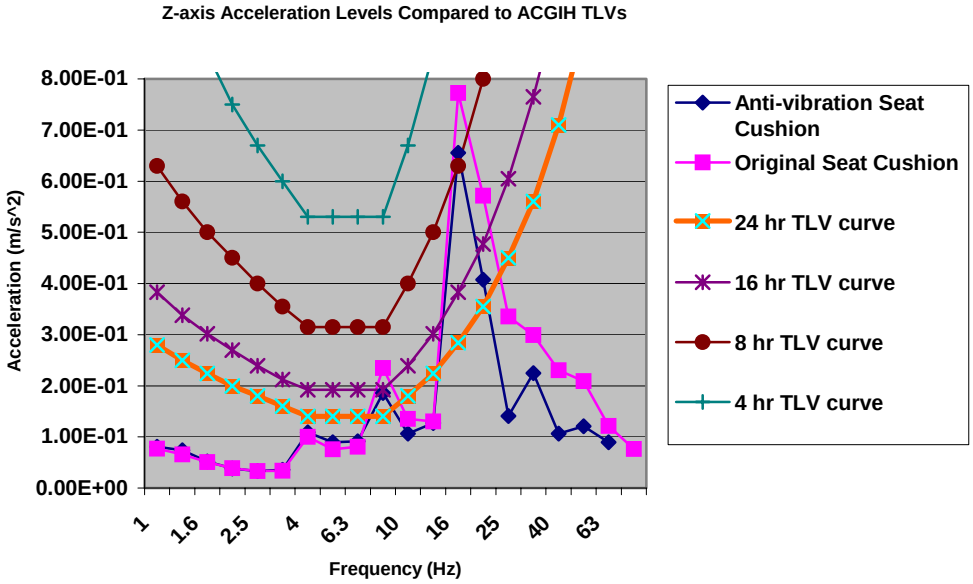
Current Hazard Reports indicated that pain in pilots' legs and backs begin two to four hours into the flight and increase with time. Mission readiness also decreases with an increase in flight duration due to the constant distraction of pilots shifting in their seats while trying to get comfortable. Froom, et al [2] reported a dose-response relationship between the length of military helicopter flights and back discomfort. He also concluded that this pain is typically dull, over the lower back, and its prevalence and intensity are dependent on the total flight hours of exposure.

Methods

This study evaluated WBV produced in the pilot seating systems onboard the MH-60S. The purpose of the study was to test and compare the effectiveness of two different seat cushions, the current seat cushion versus an anti-vibration seat cushion. Both seat cushions were measured for acceleration levels averaged over five-minute intervals using a triaxial seat pad accelerometer. The recordings were completed for a 3-hour straight and level flight. A frequency analysis from 0-80 hertz (Hz) was conducted on all acceleration measurements to determine the dominant axis and frequency of the pilots' vibration exposure. The results were then compared to the applicable Threshold Limit Values (TLVs) established by the American Conference of Governmental Industrial Hygienists (ACGIH) [1] and the International Organization for Standardization (ISO) 2631.1 [3] to determine the MH-60S pilots' permissible exposure time for both seat cushions.

Results

The results of the study showed that for both seat cushions the vibration levels of the z-axis at 16 Hz had the shortest allowable exposure duration, according to the ACGIH TLVs. In the z-axis at 16 Hz, the MH-60S's current seat cushion's acceleration levels indicated an exposure time limit of approximately 6 hours, while the anti-vibration seat cushion's acceleration levels pierced the 8-hour exposure time limit curve. This is shown in the graph below.



When compared to the ISO standard, the acceleration levels are 0.86 m/s^2 and 0.73 m/s^2 for the current and anti-vibration seat cushions, respectively.

Discussion

While the anti-vibration seat cushion's acceleration levels were slightly lower than the current seat cushion's levels, the helicopter pilots are still overexposed to WBV. Since the average flight during a deployment or mission could last up to 8 hours, the current exposure places the pilots at an unacceptable risk of injury, lack of mission readiness, and possible equipment damage. In the future, helicopters will be outfitted with auxiliary fuel tanks, enabling even longer flights.

Additional research should be conducted to include a larger sample size, evaluate specific flight profiles other than straight and level flights, and perform transmissibility studies aboard the MH-60S targeting specific portions of the human body. Additionally, extensive follow-up epidemiological studies should be performed for Navy helicopter pilots to evaluate the incidence rates of back injury and their relationship to whole body vibration exposure.

References

1. American Conference of Governmental Industrial Hygienists (2005). Whole-body vibration. In: Threshold limit values, TLVs and biological exposure indices for 2005, pp. 126-133. ACGIH, Cincinnati, Ohio.
2. Froom, .P, Hanegbi, R., Ribak, J., Gross, M. (1987). Low back pain in a AH-1 Cobra helicopter. *Aviation Space Environmental Medicine* 58: 315-8.
3. International Organization for Standardization (1997). Mechanical Vibration and shock – Evaluation of human exposure to whole-body vibration – Part 1: General requirements. ISO 2631-1. International Organization for Standardization, Geneva.