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# Occupational Noise Exposure During Aircraft Engine Run-up Task in Aviation Maintenance

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## ABSTRACT

Hearing loss risk is influenced by factors such as aging, trauma, infection, and prolonged noise exposure. Aviation maintenance personnel operate in high-noise environments, particularly during aircraft engine run-up procedures, where sound levels can reach up to 140 dBA. This study evaluates noise exposure during engine run-up tasks and compares results to the ACGIH Threshold Limit Value (TLV) for an 8-hour time-weighted average (TWA). Noise exposure was measured using two dosimeters during engine run-up tasks lasting approximately 10 minutes. Equivalent personal exposure (Leq) and peak noise levels were recorded and extrapolated to an 8-hour workday. Measured Leq values ranged from 64 to 127 dBA, exceeding recommended limits in several cases. Peak noise levels averaged 144 dBA, exceeding the 140 dBA threshold. Single hearing protection was insufficient to reduce exposure to safe levels. Aviation maintenance personnel are at significant risk of hearing loss during engine run-up operations. Observed noise levels exceeded ACGIH limits, particularly due to extreme peak exposures. Double hearing protection is necessary in these conditions, along with implementation of additional engineering controls to reduce noise at the source.

**Keywords:** Noise exposure, Aircraft engine run-up, Aviation maintenance

## INTRODUCTION

Hearing loss is a multifactorial condition associated with aging, trauma, infections, and prolonged exposure to high-intensity noise. Among these factors, occupational noise exposure remains one of the leading causes of preventable hearing impairment worldwide, particularly in high-risk industries such as aviation (Zhou et al., 2024). Aviation maintenance personnel operate in acoustically challenging environments where exposure to noise from powered tools, auxiliary systems, and aircraft operations is routine. However, the most significant exposure occurs during aircraft engine run-up procedures, where sound pressure levels can exceed 140 dBA, posing substantial risks to auditory health.

Noise-induced hearing loss (NIHL) is irreversible and often progressive, resulting from cumulative damage to the auditory system. In aviation settings, continuous and intermittent exposure to high-intensity noise has been identified as a major occupational hazard affecting maintenance personnel and other aviation workers (Orikpete et al., 2024). Empirical studies have

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demonstrated that workers exposed to aircraft noise exhibit elevated high-frequency hearing thresholds and increased susceptibility to long-term hearing impairment (Kuo et al., 2021). In addition to auditory damage, excessive noise exposure has been linked to non-auditory effects such as fatigue, stress, and reduced cognitive performance, which can negatively impact safety-critical maintenance tasks (Basner et al., 2014).

The American Conference of Governmental Industrial Hygienists (ACGIH) recommends an exposure limit of 85 dBA as an 8-hour time-weighted average (TWA), with strict limits on peak exposures exceeding 140 dBA (ACGIH, 2022). However, aviation maintenance activities frequently exceed these thresholds, highlighting the need for task-specific exposure assessment and improved hearing conservation strategies.

This study aims to quantify noise exposure during aircraft engine run-up procedures and compare measured levels with ACGIH TLVs. The findings will support the development of targeted engineering and administrative controls to reduce occupational noise exposure and protect the hearing health of aviation maintenance personnel.

## METHODOLOGY

The study was conducted at an aviation college located in the Daytona Beach, Florida area within an engine test cell facility used for line maintenance training. Noise exposure measurements were collected during aircraft engine run-up procedures performed on a Lycoming IO-360-B1E engine following standard maintenance protocols. The run-up procedure consisted of four main stages: pre-start inspection, engine start, operational run-up, and engine shutdown. Pre-start inspection included verification of fuel levels, engine oil (6–8 quarts), and equipment security, along with implementation of safety controls such as wheel chocks, tie-downs, propeller guards, and fire extinguishing readiness. The engine was then started and stabilized at approximately 1,000 rpm prior to conducting functional checks.

During the run-up phase, the engine was operated at multiple power settings, including idle, 1,700 rpm for magneto checks, and full throttle for maximum performance verification. These procedures are consistent with standard aviation maintenance practices used to ensure engine reliability and operational safety following maintenance activities (Federal Aviation Administration, 2021). The average duration of each run-up ranged between 6 and 9 minutes. Two trials were conducted, lasting approximately 9 minutes and 5 minutes, respectively.

Noise exposure was measured using two personal noise dosimeters (Casella Airwave, UK). One dosimeter was positioned on the operator at approximately zero distance from the engine control point, while the second was placed approximately 6 feet behind the engine to assess spatial variation in exposure. Equivalent continuous sound levels (Leq) and peak noise levels were recorded and compared to ACGIH Threshold Limit Values to evaluate occupational risk (ACGIH, 2022).

## RESULTS

Noise exposure measurements obtained during aircraft engine run-up procedures demonstrated consistently elevated sound pressure levels across all trials. The equivalent continuous sound level (Leq) ranged from 105.8 to 109.6 dBA, with an overall mean of 107.7 dBA. Maximum recorded levels exceeded 126 dBA in all samples, indicating sustained exposure to high-intensity noise during engine operation. Peak sound pressure levels were notably high, averaging 143.4 dBA across all measurements.

Each run-up event lasted approximately 5 to 10 minutes, representing short-duration, high-intensity exposure conditions. Measurements were collected using two personal noise dosimeters positioned at the operator location and approximately 6 feet behind the engine, capturing spatial variation in exposure. Despite differences in duration and position, noise levels remained consistently elevated across all trials.

When compared with ACGIH Threshold Limit Values (TLVs), the measured Leq values substantially exceeded the recommended 8-hour time-weighted average limit of 85 dBA. Furthermore, recorded peak levels exceeded the ACGIH ceiling limit of 140 dBA for impulse noise (ACGIH, 2022).

## DISCUSSION

The findings indicate that aircraft engine run-up procedures expose aviation maintenance personnel to hazardous noise levels that exceed ACGIH Threshold Limit Values (TLVs), particularly due to elevated equivalent sound levels and peak exposures above 140 dBA. Such exposure conditions present a significant risk for noise-induced hearing loss (NIHL), especially given the combination of high-intensity impulse noise and repeated task exposure. The short duration of run-up events does not eliminate risk, as peak sound pressure levels are sufficient to cause immediate auditory damage if not properly controlled.

The use of single hearing protection devices is inadequate under these conditions, as attenuation limits may be exceeded in environments with extreme peak noise levels. Therefore, double hearing protection, consisting of earplugs combined with earmuffs, is necessary to achieve sufficient noise reduction and maintain exposure within acceptable limits (ACGIH, 2022). Proper fit, training, and consistent use are critical to ensure the effectiveness of this control measure.

In addition to personal protective equipment, engineering controls are essential for reducing noise at the source and along the transmission path. Effective strategies include the use of engine test cells with acoustic insulation, installation of sound-absorbing barriers or enclosures, and implementation of exhaust mufflers or silencers to reduce noise emissions. Increasing distance from the noise source and optimizing facility layout can further reduce exposure levels. Collectively, these measures are necessary to minimize occupational risk and enhance hearing conservation in aviation maintenance environments.

## CONCLUSION

This study evaluated occupational noise exposure during aircraft engine run-up procedures and demonstrated that aviation maintenance personnel are subjected to sound levels that exceed ACGIH Threshold Limit Values. The measured equivalent continuous noise levels and peak exposures indicate a high-risk environment for the development of noise-induced hearing loss (NIHL), particularly due to the presence of impulse noise exceeding recommended limits. These findings highlight the critical need for effective noise control strategies in aviation maintenance operations.

The results confirm that reliance on single hearing protection is insufficient under extreme noise conditions. The implementation of double hearing protection is essential to achieve adequate attenuation and reduce exposure to safer levels. However, personal protective equipment alone cannot fully mitigate the hazard. Engineering controls, such as acoustic enclosures, sound-absorbing materials, and noise isolation within engine test environments, are necessary to reduce noise at the source and along its transmission path.

From a human factors and ergonomics perspective, reducing occupational noise exposure is vital not only for protecting worker hearing but also for maintaining cognitive performance, minimizing fatigue, and reducing the likelihood of human error in safety-critical aviation tasks. Future research should focus on optimizing engineering control designs and evaluating their effectiveness in real-world maintenance settings. Continuous monitoring and integration of comprehensive hearing conservation programs are essential to ensure long-term worker health and operational safety (ACGIH, 2022).

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