Motorcycle Noise Levels at Rest and in Riding Conditions

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PURPOSE AND ABSTRACT

The purpose of this investigational study was to examine the static and dynamic noise output levels of motorcycles with varying engine size and exhaust pipes in order to investigate the possible correlating risks to hearing.

This study examined the amount of noise motorcycle riders are exposed to while in static and dynamic (riding) conditions. Sound levels were measured at exhaust level and ear level, and then analyzed with regard to multiple variables including the brand of the motorcycle; size of engine, exhaust system, driving speed, and helmet versus no helmet use. The noise measured from the motorcycles ranged from 70 dBA to 128.2 dBA in the static position and from 90 dBA to approximately 128 dBA while in a dynamic position with recorded speeds ranging from 45 mph to 65 mph.

INTRODUCTION

According to the U.S. Department of Transportation, more than 5 million Americans are registered motorcycle owners. Of the 28 million Americans who have some degree of hearing loss, about one-third can attribute their hearing loss to excessive noise exposure. While noise induced hearing loss is permanent, it is also completely preventable. In order to prevent hearing loss, one must know the level at which this can happen and the approximate level of noise being produced during the preferred activity.

Unfortunately, there have been no scientific studies conducted thus far which measure the noise levels of motorcycles while in motion. If consumers look online for information regarding noise levels, they will find data with a 20 to 25 dB range. This is not reliable data for riders. This study was conducted to provide such data. In order for consumers to make informed decisions about hearing protection while riding, there must be more readily available information regarding motorcycle noise levels.

In a previous informal survey of 33 motorcycles' noise levels, we found nearly half produced sounds above 100 decibels when throttled up -- equivalent in intensity to a loud rock concert or a chainsaw. These measures were taken at exhaust level and at ear level while the motorcycle was in a static position. It was recognized then that further studies needed to be conducted with the motorcycles at cruising speed to account for wind noise.

MATERIALS AND METHODS

Sound levels were measured with a Quest Technologies Q-300 noise dosimeter. Initially, sound levels were recorded at exhaust pipe level (6 inches behind the pipe) and at ear level in a static position with the engine at idle and revved up to approximately 4000 rpm.

Sound levels were also taken at ear level with and without a helmet at speeds of 45, 55, and 65 mph. Variables taken into consideration included the make, model and year of the motorcycle, size of engine, exhaust system, any modifications made to the bike, windshield versus no windshield, driving speed, and helmet versus no helmet use

Subject Demographics

Subject Number	1	2	3	4	5	6
Age	25	58	47	45	26	41
Gender	Female	Male	Male	Female	Male	Male
Motorcycle Brand	Honda	BMW	Honda	Kawasaki	Harley Davidson	Harley Davidson
Model	Shadow	R 80 R	VFR 800A	Vulcan	V-ROD	Road King Custom
Engine Size	750 cc	800 cc	800 cc	800 cc	1130 cc	1600 cc
Year	2004	1984	2004	1995	2006	2007
Type of Exhaust Pipes	Stock	Stock	OEM	Stock	Stock	Vance & Hines
Helmet brand and size	Shoei Full face	3/4 size	Shoei Full face (back vent open)	Fulmer 3/4	HJC Full face	Half (no coverage on ears)
Any modifications to bike	No	No	K & N Air filter	No	No	Yes (straight pipes)
Windshield (y/n)	Yes	Yes	Yes	No	No	No

RESULTS

Maximum sound level at 65mph (no helmet)		Maximum allowable safe exposure time	
Subject	Level	Subject	Time
1	105 dB A	1	4 min 43 sec
2	99 dB A	2	18 min 59 sec
3	99 dB A	3	18 min 59 sec
4	128.2 dB A	4	1 sec
5	101.8 dB A	5	9 min 27 sec
6	106.7 dB A	6	2 min 59 sec

Maximum sound level at 65mph (with helmet)		Maximum allowable safe exposure time	
Subject	Level	Subject	Time
1	98.4 dB A	1	23 min 49 sec
2	99.3 dB A	2	18 min 59 sec
3	100 dB A	3	15 min
4	109.7 dB A	4	1 min 29 sec
5	95 dB A	5	47 min 37 sec
6	111.9 dB A	6	56 sec

Subjects one (ADP) and five (wearing full face helmets with face-shield and all vents closed) experienced the most noise reduction while wearing a helmet. However, the reduction in noise level is not enough for the maximum allowable safe exposure time to reach an hour at 65 mph.

Subject three wore a full face helmet as well, but the back vent was open. The noise level actually increased with helmet use, presumably due to air flow within the helmet.

Subject two (JWH) wore a 3/4 size helmet which does not have a face shield but does cover the ears. Results show no significance difference in noise levels between wearing a helmet and not wearing one. This subject also had the largest windshield and a fairing, a feature that may be the main contributor to reduction in wind noise.

Subject four, with a 3/4 helmet, showed some decrease in noise at 65mph but not to a safe exposure level.

CONCLUSIONS

All motorcycles measured in this study reached and exceeded "action-level noise"; the level at which employers are required by law to provide hearing protection to employees exposed to this noise level. The loudest bike measured was 128.2 dB A at 65 mph in the "no helmet" condition. This noise level is only safe for exactly one second, after which, damage to hearing can and will occur. The lowest measurement at 65 mph was 95 dB A in the "with helmet" condition. The maximum allowable safe exposure time of this bike is 47 minutes and 37 seconds. With even the quietest bike (the BMW) or the most attenuating helmet (HJC 3/4) in this study, a rider would still need to wear ear protection to ride at any time longer than 48 minutes.

If the riders were to wear EARsoft earplugs, they would be afforded an NRR of up to 33dB. This is the highest NRR available among disposable earplugs. While wearing both EARsoft earplugs and their helmets, each rider in this study would reduce their noise levels to below dangerous exposure levels and could ride for any amount of time without causing damage to their hearing.

Further investigation of motorcycle sound levels is warranted, to include a wider variety of motorcycles and riding conditions (e.g., rider versus passenger and rider position in a group) and helmet designs. Our data suggest that helmet design should include noise reduction features.