Unusual Jobs Require Unusual Methods for Noise Exposure Measurement

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Abstract: U.S. Department of Labor compliance officers use employee-worn noise dosimeters almost exclusively to document alleged violations of the occupational noise standards. However, employers and consultants may use any method that properly identifies those employees who need to be included in a hearing conservation program and that relates the noise exposure with the risk of occupational hearing loss and the effectiveness of hearing protection devices. Some environmental and operational problems that affect noise measurement are temperature, humidity, rain, wind, radio, magnetic and microwave interference, intrinsic safety, and the presence of hazardous materials. To illustrate effective handling of these measurement problems, some specialized methods will be discussed to measure occupational noise exposure in several work sites.

INTRODUCTION

Unusual jobs may require unusual methods for noise exposure measurement. With the diversity of the American workplace, the one size fits all approach can not accommodate every occupational noise exposure measurement. This is precisely why ANSI Standard S12.19-1996, Measurement of Occupational Noise Exposure, permits different measurement criteria and a variety of instrumentation and methodologies. Occupational noise measurements were performed in several challenging work environments; namely, a metropolitan fire department, water department positions, a poultry processing plant, and a glass plant.

THE FIRE SERVICE

From an industrial hygiene standpoint, the fire service presents every conceivable problem possible in the measurement of occupational noise exposure. There is no typical daily exposure. Each tour of duty is unique and different. The sacred 8-hour day is never worked. Shifts are 10, 14, or 24 hours long and a lot of overtime occurs. The possibilities of temperature extremes, high humidity, intense radio interference (RF), radiation, magnetic fields, vibration, wind, mechanical shock, explosive environments, chemical and biological exposure, privacy rights, water and pressure are possible on every response.

Due to a rising trend in hearing loss claims, it was imperative that a department of 2400 firefighters and paramedics be evaluated for occupational noise exposure as soon as possible. An additional limitation was the necessity to use only instrumentation currently in inventory, all of which were 10 to 25 years old and far removed from being state of the art equipment. An extensive literature review summarized by Tubbs (1) indicated that small, medium, and large fire departments all presented daily noise exposure significantly below that allowed by the Occupational Safety and Health Administration (OSHA). Even the OSHA time-weighted action level of 85 dBA was rarely reached or exceeded in the published studies. However, the paradoxical situation of hearing loss was present in every department studied by the National Institute for Occupational Safety and Health (NIOSH). Given, a large exposed population, few instruments, a short time frame to complete the study, and an anticipation for daily noise exposure far below OSHA-permitted levels, a worst first sampling strategy was selected. If the busiest companies demonstrated low daily noise doses, then average and slow companies would be even lower. On each sampled shift an entire company and the investigator were sampled for the whole day or night shift even if it ran into overtime. The investigator was issued turnout gear and participated in each run or event in the shift. A detailed log was produced on each shift to facilitate data interpretation.

Since it is neither practical nor safe to perform time and motion studies with a sound level meter in the fire service, noise dosimeters were the instruments of choice. Two models were available: the Quest Micro 15 and the Dupont MK-2. Preliminary trials indicated that the MK-2's were more prone to RF interference than the Micro 15's. Also, the Micro 15 allowed simultaneous evaluation of daily noise exposure using the OSHA 5 dB exchange rate as well as the international 3 dB exchange rate. Since the fire department studied does not come under OSHA jurisdiction, 3 dB noise exchange is not permitted.
dose information would be useful. To document individual sources of noise and to validate the noise dosimetry, an IVIE Model IE-30A precision sound level meter and real time analyzer was used on each run. Some runs were tape recorded using a B & K 213H sound level meter and modified SONY TC-150 cassette recorder. The A-weighted tapes were played through a graphic level recorder to analyze time-history information. To preserve privacy rights, the audio tapes were destroyed after graphic time-history analysis. All measurement microphones were covered by polyurethane windscreens for wind, chemical, and mechanical shock protection.

Data were analyzed by job position and company, e.g. engine officer, paramedic, ladder firefighter etc. Thus each position could be represented by a mean dose, standard deviation, and sample size. This controlled for the atypical daily exposure and facilitated risk analysis. Since 8-hours days are not found in the fire service, time-weighted averages were also computed to facilitate comparison of fire service daily noise dose with conventional occupations studied by NIOSH and OSHA. Handling of RF interference was the most difficult measurement error factor. The presence of RF interference inflated both the 5 and 3 dB data; however, the effects on 3 dB data were more dramatic. Table 1 demonstrates the effect. On the 4 hour longer night watch with this company wherein there were two runs, the largest 3 dB dose was only 48%. The true equivalent sound level was less than 75 dBA for each watch.

### TABLE 1. Engine Company 71, Day Watch, 24 September 1994, No Runs, In Station

<table>
<thead>
<tr>
<th>Position</th>
<th>Percent Noise Dose</th>
<th>A-weighted Equivalent Sound Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 dB</td>
<td>3 dB</td>
</tr>
<tr>
<td>Driver</td>
<td>29.8</td>
<td>401.5</td>
</tr>
<tr>
<td>Officer</td>
<td>16.8</td>
<td>54.8</td>
</tr>
<tr>
<td>Investigator</td>
<td>34.8</td>
<td>333.6</td>
</tr>
<tr>
<td>Firefighter 1</td>
<td>11.6</td>
<td>161.6</td>
</tr>
<tr>
<td>Firefighter 2</td>
<td>28.0</td>
<td>292.6</td>
</tr>
</tbody>
</table>

### SOME OTHER WORK SITES

Water department employees often work in confined spaces and locations presenting explosion hazards. While the Micro 15 dosimeters are intrinsically safe for methane atmospheres, they are not certified for Class A or B hazards such as acetylene used in welding operations. Very few dosimeters can be safely used when there is an acetylene presence. In food processing such as poultry plants and at HAZMAT sites, dosimeters and sound level meters need to be bagged to facilitate decontamination.

Evaluation of noise dosimetry in a glass blowing operation demonstrated the importance of keeping the measurement microphone in the OSHA defined hearing zone. Use of a hand-held sound level meter at this site produced data up to 12 dB lower than worker-worn dosimetry due to microphone placement. The worker was exposed in the acoustic near field while the meter microphone was much farther than the hearing zone due to safety limitations.

### REFERENCE