


National Institute for Occupational Safety and Health



Comparison of Gas-Powered vs. Battery-Powered Equipment for Landscape Maintenance – Hedge Trimming Operations

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Overview

**Purpose:** Compare noise levels of battery-powered vs. gas-powered landscaping equipment to assist in making purchasing decisions

- Visited a resort hotel facility
- Performed area sound level measurements and dosimetry for two different hedge-trimming crews
  - One using **battery**-powered equipment
  - The other using **gasoline**-powered equipment
- Discussed noise exposure and other concerns with management



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Methods



**Grounds maintenance crew:**

- Two workers operating hedge-trimmers
- One worker operating a blower
- One worker occasionally collecting the trimmings

*Two workers with gas-powered trimmers*

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### Methods - Dosimetry

- Estimate noise dose accumulated over a work shift
  - Dosimeters (Larson Davis Spark model 706RC) collected data with both OSHA (90/5) and NIOSH (85/3) exchange rates
  - Calibration before and after use.
- In each group of workers, a dosimeter was worn by the operator of a blower and the operator of a hedge-trimmer.
- Short sample from a gas-powered riding mower



*Worker with gas-powered blower*

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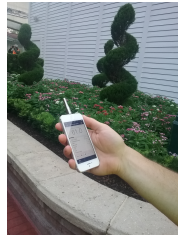
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### Methods – Sound Level Meter Measurements

SLM measurements were taken to estimate the levels experienced by both workers and bystanders

- Apple iPhone 5S with a Mic-W Lightning Microphone and NIOSH SLM app
- Larson Davis 831
- Leica Disto E7400X Laser Distance Meter - used to determine distances from the SLM to the noise source



*iPhone with mic and NIOSH SLM app*

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### Methods – Feedback from Management

- Discussed evaluation criteria for new equipment purchase, particular advantages and disadvantages of various models
- Workers also weighed-in on their equipment preferences




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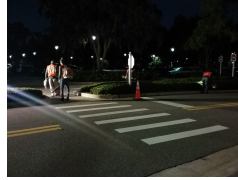
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### Results - Dosimetry

- Dosimeters ran for about 5 hours
- A typical shift is 8 hours, including:
  - set-up at the start of the shift
  - clean-up at the end of the shift
  - lunch break
  - bathroom or water breaks
  - quiet periods when workers were changing locations, or using manual tools (rake or shovel)
- Other noise sources:
  - gas-powered generator powering lights - near the crew using gasoline-powered equipment
  - another crew of workers mowing in the vicinity
  - light vehicle traffic



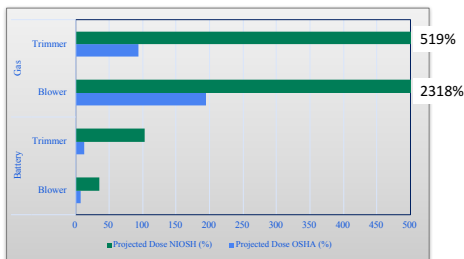
Gas-powered crew

### Dosimetry Results

Power Source	Tool	OSHA Criteria (90/5)				NIOSH Criteria (85/3)			
		Dose (%)	TWA (dBA)	Projected Dose (%)	8-hour TWA (dBA)	Dose (%)	TWA (dBA)	Projected Dose (%)	8-hour TWA (dBA)
Battery	Blower	5	72	8	69	30	81	35	79
	Trimmer	8	76	13	72	66	85	103	83
Gas	Blower	121	95	194	91	1449	99	2318	97
	Trimmer	60	90	94	86	330	92	519	90

- Gas-powered riding mower – Leq of 99 dBA for a 5-minute sample
- Note: these are protected exposures, workers were all wearing hearing protection

### Projected Dose (%) – NIOSH and OSHA Criteria



**SLM Results**

Noise Source	Position	SLM	L <sub>Aeq</sub> (dBA)
Battery-powered trimmer A	Hearing zone	NIOSH App	82
Battery-powered trimmer B	Hearing zone	NIOSH App	79
Battery-powered blower	Hearing zone	NIOSH App	85
Battery-powered blower	5-15 feet away	NIOSH App	83
Battery-powered trimmers (A & B)	About 30-38 feet away	NIOSH App	70
Gas-powered trimmer	38 feet away	NIOSH App	78
Gas-Powered trimmers and blower	15 - 20 feet away	NIOSH App	83
Gas-powered generator for lights	2 feet away	LD831	91

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**Feedback from workers and management – Safety**

- Management would like to reduce noise levels enough to eliminate need for hearing conservation program
- Battery-powered trimmers can improve ergonomics - workers find battery-powered hedge-trimmers much lighter (11.4 lbs. vs. 15.4 lbs + fuel, according to manufacturer website)
- Battery-powered equipment doesn't produce exhaust which improves comfort, and potentially health



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**Feedback from workers and management – Quality of Grounds**



- Battery-powered blowers work at least as well as their gasoline-powered counterparts
- Battery-powered trimmers work as well as gas-powered, except when the hedges have thick-diameter foliage

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### Feedback from workers and management – Economic Feasibility

- Battery life needs to last for an entire work shift
- Battery-powered equipment would need last as long as gas-powered equipment before needing replacement (about 18 months) – still TBD
- Cost of maintenance is an issue - battery-powered trimmers fail more frequently than gas-powered versions




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### How Reliable/Consistent are the data?

- That day only
- Not a whole shift (cut short for logistical reasons)
- Sound Level Measurements don't have statistical significance
  - We wish we'd taken more of these!
- Occasional background noise (gasoline powered-generator)
- Data are not sufficient to determine dose or to meet any OSHA requirements




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### So What are the Data Good For?

- Along with other factors, incredibly useful for making a **low-stakes power-tool purchasing decision**
- Noise – just one factor among many in decision making for company
- No/Low risk for results being imprecise
  - Worst case scenario if they are wrong/change.
- The supervisor could have made sound level measurements very easily




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### Recommendations to the Company

1. Keep up the good work in considering noise levels when purchasing equipment
  - SAE Standard AS6228 – “Safety Requirements for Procurement, Maintenance and Use of Hand-held Powered Tools” (SAE International, 2018)
2. Consider evaluating other hazards
  - Ototoxins (gasoline, exhaust fumes)
  - Noise > other health outcomes (Cardiovascular health, depression, tinnitus, etc.)
3. Consider applying for the Safe-in-Sound Excellence in Hearing Loss Prevention Awards™




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### Broad Picture Takeaways

1. Buy-Quiet has a problem that on-site user-friendly sound level measurements can fix
2. The resulting data should be sufficient to make low-risk purchasing decisions
3. Must be careful to not improperly use the data
  1. Not adequate for dose
  2. Not adequate for correctly choosing hearing protection




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### Next Steps for NIOSH

1. Develop and promote SLM field-testing ‘best practices’
  - Maybe based on ANSI 12.15, “Standard for Acoustics-Portable Electric Power Tools, Stationary and Fixed Electric Power Tools, and Gardening Appliances – Measurement of Sound Emitted”
2. Research to show viability/practicality of routinely using standardized field-testing ‘best practices’
3. Research on the viability/practicality of instituting Buy-Quiet programs based resulting data
4. Ultimate dissemination plan: NIOSH Science Blog, social media campaign to raise awareness, best practices, industry publications




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THANK YOU!!

***Questions/Discussion as time permits***

For more information, contact CDC  
1-800-CDC-INFO (232-4636)  
TTY: 1-888-232-6348 [www.cdc.gov](http://www.cdc.gov)

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