SPECIFICATIONS AND OPERATING CONDITIONS

Jeff G. Schmitt, P.E., ViAcoustics

With acknowledgment to my colleagues
Beth Cooper – NASA Glenn Research Center (retired)
David Nelson – Nelson Acoustics

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What does a consultant to acoustic laboratory and test engineers know about purchase specifications and operating conditions?

…as it turns out, quite a lot

Most acoustic data result correlation, comparison and data usability issues are the result of poor acoustic and/or operating condition specifications

...not calibration, test method or other technical issues

A LARGE AMOUNT OF TIME IS USED TO DEBUG CORRELATION ISSUES AND DATA USAGE ISSUES THAT TURN OUT TO BE RELATED TO:

- Poor specification of what is to be tested, or was tested….sound power level, sound pressure at a distance, what test code or standard?
- Inadequate information on how the device is to be operated, or was operated during testing…… no load, full load, representative load?

Typical Specification

The equipment shall not exceed 85 dB

- A-weighted?
- Sound Power Level or Sound Pressure Level at Specified Position?
- When tested per Standard or Test Code?

OR

- When operated and mounted as follows:
  - No load?
  - Operation under typical use load?
  - Mounting?

Key Element of Buy Quiet Purchase Specification

- Purchase of quiet products lowers the "cost of noise"
- Good purchase specifications lead to quiet product purchases
- Purchase Specifications need to cover level requirements
- Purcchase Specification need to cover test standards, test codes or test methods to be used
- Purchase Specifications need to cover operating and mounting conditions

Purpose of Noise Emission Declaration Data

- Used for determining the quietest equipment or machinery
- Used for forecasting of noise exposure

Therefore, specified operating conditions should be representative of how the machine or equipment will be used

Buy Quiet Roadmap

BUYQUIET Roadmap

EDUCATIONAL TOOLS AND RESOURCES
THAT ENERGIZE THE PRACTICE OF HEARING CONSERVATION

- http://buyquietroadmap.com/

- 1. Plan Your Procurement
  - When to Hire an Acoustical Consultant
- 2. Research Available Products
  - Online Noise Databases
  - External Specifications and Regulations
- 3. Select Noise Emission Criterion
  - Select Baseline Criterion
    - Simplified EU Machinery Directive Table
  - Adjust the Criterion
    - Raising the Criterion
    - Lowering the Criterion in Special Cases
  - Community Noise Check for Outdoor Equipment

- 4. Determine Procurement Strategy
  - Micropurchase (Commercial Purchase Card)
  - GSA Schedule Purchase
  - Lowest Price Technically Acceptable
  - Tradeoff Process
    - Tradeoff Analysis
- 5. Build Specification
- 6. Verify Noise Emission
  - Equipment Test Standards
  - Shop Verification
  - Field Verification

- Forms & Worksheets
  - Economic Benefit of Noise Control Worksheet
  - NASA Noise Emission Specification Template
  - Community Noise Check Worksheet
  - Convert Sound Power to/from Sound Pressure
    - Simplified Conversion Method Worksheet
    - Room Acoustics Method Worksheet
  - Simplest Procurement Strategy Worksheet
  - NASA Form 1707 (NF 1707)
  - Tradeoff Analysis Workbook
  - Criterion Adjustment Authorization Form
  - Sound Data Verification Form
  - Submittal Data Waiver Form
  - Shop Verification Authorization Form
  - Field Verification Authorization Form

Buy Quiet Noise Emission Specification Template

NASA Noise Emission Specification Template

Noise Emission Criterion

Unless specified otherwise in this document, the A-weighted noise emission shall not exceed:

Choose one of the following:

[insert sound level criterion here] dB(A) A-weighted sound level at *[insert location (e.g., operator position) or distance (e.g., 1 meter) here]*

OR

[insert sound power level criterion here] dB(A) sound power level

Always include the following:

during all operational states of the machine, in accordance with *[insert test standard here]*.

Operational Conditions

- Operational states from Test Codes developed by industry working groups
- Unloaded conditions – No always quietest…or loudest
- Loaded conditions – Standardized loads
- Typical Usage Conditions – as used or in-situ

Operating conditions need to be achievable, duplicateable and result in reliable measurements.

Test Code Examples

- ISO 7779 – Information Technology Equipment
- IEC 60704 Series – Appliances (dishwashers, washers, refrigeration, etc.)
- ISO 6395/6396 – Earth Moving Machinery Sound Pressure Level/Sound Power
- ISO 2151 – Compressors and Vaccum Pumps
- ISO 1680 – Rotating Machines
- ARI 270 - Outdoor HVAC units
- ANSI S12.15 – Power Tools
- ISO 10302 – Fans

Buy Quiet Noise Emission Verification

Shop Verification

Noise emission verification testing shall be performed at vendor's facility in accordance with *[insert test standard here]*.

The offeror's proposal shall provide the detailed sound measurement test procedure that complies with or is equivalent to the test standard cited. Any alternate proposed sound measurement test procedures shall be subject to review and approval by NASA.

If actual loading is not possible, loading shall be accomplished by simulation. Details of the load simulating device and loading techniques shall be subject to review and approval by NASA.

NASA shall be notified at least 10 days in advance to witness any specified tests.

Neither acceptance of the equipment after shop verification nor shipment of the equipment releases the supplier from its responsibility to meet the specified criterion upon installation.

Field Verification Testing

Noise emission verification testing shall be conducted after the equipment is installed and prior to contract closeout in accordance with *[insert test standard here]*.

The offeror's proposal shall provide the detailed sound measurement test procedure that complies with or is equivalent to the test standard cited. Any alternate proposed sound measurement test procedures shall be subject to review and approval by NASA.

NASA shall be notified at least 5 days in advance to witness any specified tests.

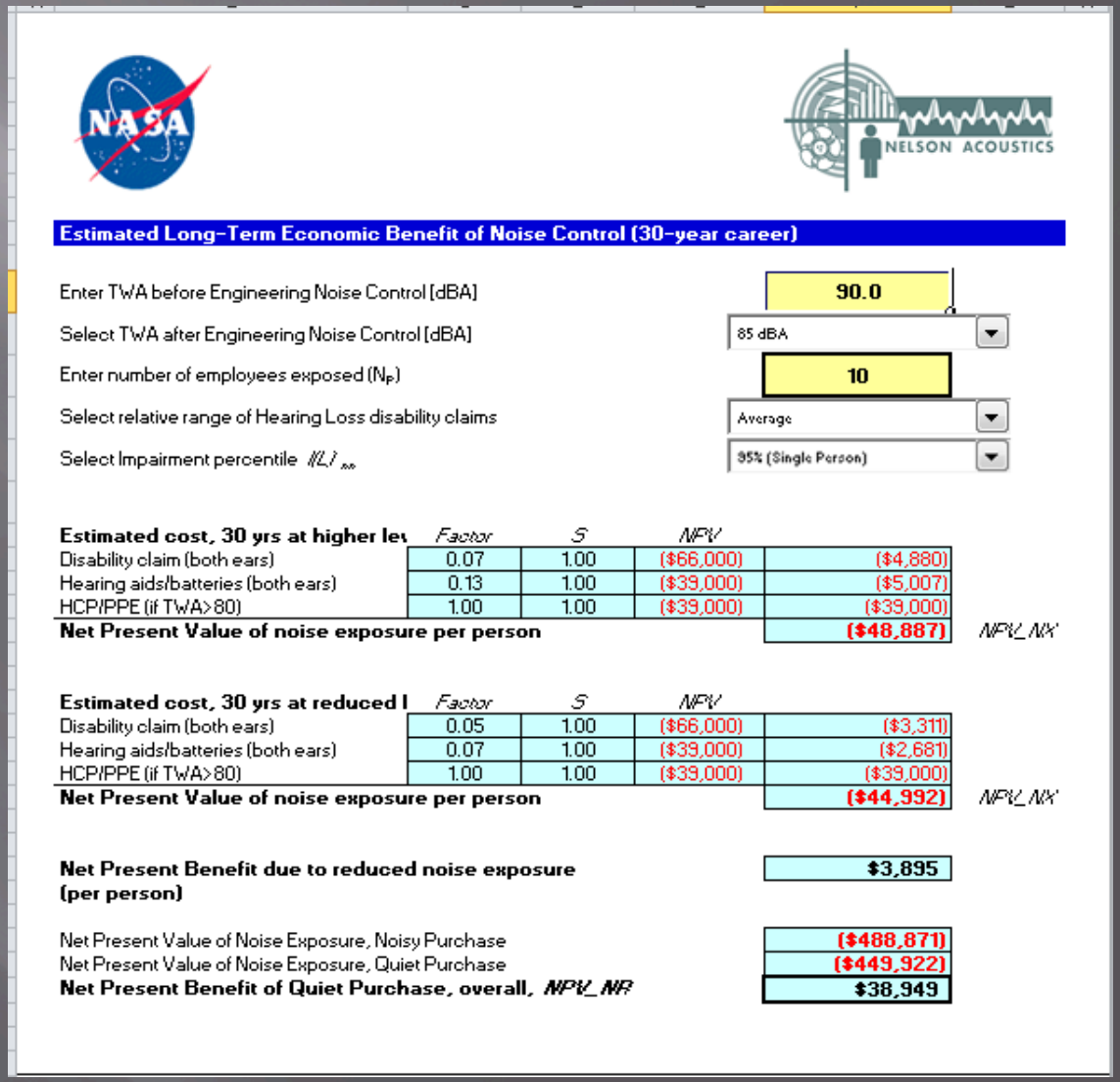
Cost of Buy Quiet vs. Cost of Noise

- Justification for Buy Quiet Procurement is based on the "Cost of Noise"
- Disabilities and associated costs
- Costs related to Hearing Aids
- Costs Related to Maintaining Hearing Conservation Programs
- Costs Related to Productivity, Recruitment and Legal

Economic Benefits of Noise Control/Buy Quiet

Economic Benefit of Noise Control Worksheet from the Buy Quiet Website

Provides method for calculating the net present value of Quiet Purchases



Estimated Long-Term Economic Benefit of Noise Control (30-year career)

Enter TWA before Engineering Noise Control [dBA]	90.0
Select TWA after Engineering Noise Control [dBA]	85 dBA
Enter number of employees exposed (N_P)	10
Select relative range of Hearing Loss disability claims	Average
Select Impairment percentile *IL/ ...*	95% (Single Person)

Estimated cost, 30 yrs at higher le	*Factor*	*S*	*NPV*	
Disability claim (both ears)	0.07	1.00	($66,000)	($4,880)
Hearing aids/batteries (both ears)	0.13	1.00	($39,000)	($5,007)
HCP/PPE (if TWA>80)	1.00	1.00	($39,000)	($39,000)
Net Present Value of noise exposure per person				**($48,887)** *NPV_NX'*

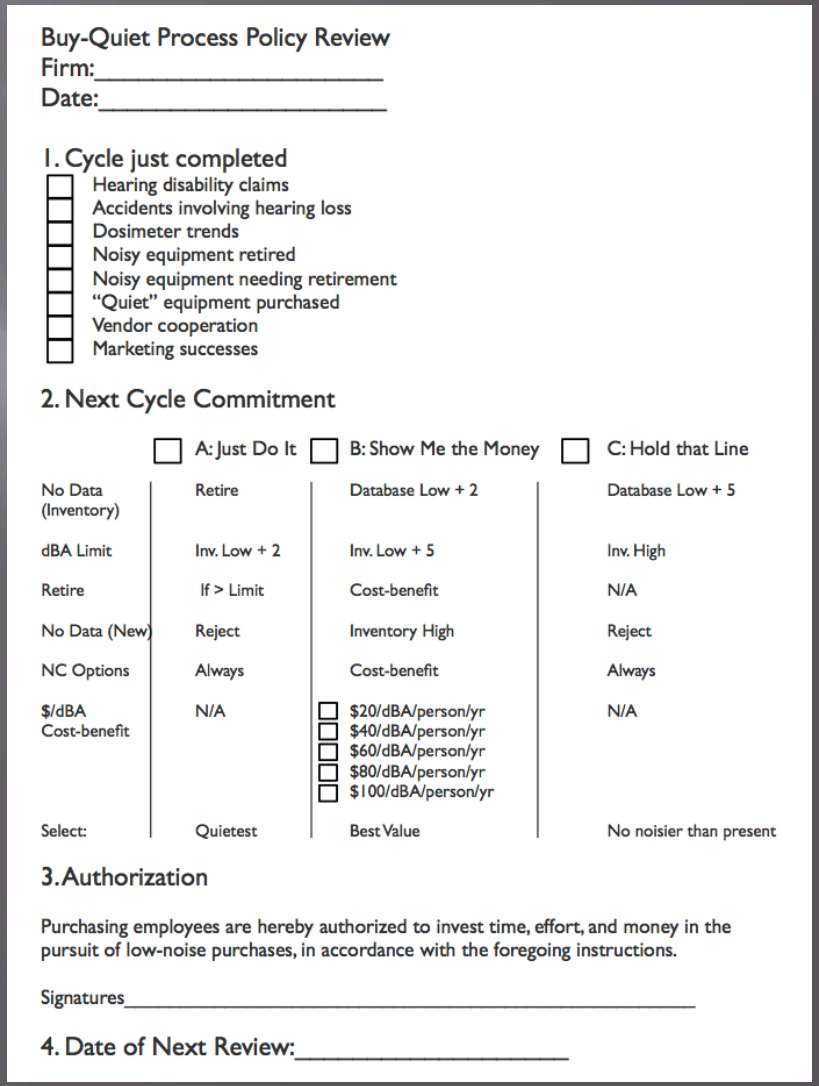
Estimated cost, 30 yrs at reduced l	*Factor*	*S*	*NPV*	
Disability claim (both ears)	0.05	1.00	($66,000)	($3,311)
Hearing aids/batteries (both ears)	0.07	1.00	($39,000)	($2,681)
HCP/PPE (if TWA>80)	1.00	1.00	($39,000)	($39,000)
Net Present Value of noise exposure per person				**($44,992)** *NPV_NX'*

Net Present Benefit due to reduced noise exposure (per person)	**$3,895**
Net Present Value of Noise Exposure, Noisy Purchase	($488,871)
Net Present Value of Noise Exposure, Quiet Purchase	($449,922)
Net Present Benefit of Quiet Purchase, overall, *NPV_NP*	**$38,949**

Buy Quiet Process Policy Review

Economic Benefit of Noise Control Worksheet from the Buy Quiet Website

Provides method for calculating the net present value of Quiet Purchases



Buy-Quiet Process Policy Review
Firm:_____
Date:_____

1. Cycle just completed

- ☐ Hearing disability claims
- ☐ Accidents involving hearing loss
- ☐ Dosimeter trends
- ☐ Noisy equipment retired
- ☐ Noisy equipment needing retirement
- ☐ "Quiet" equipment purchased
- ☐ Vendor cooperation
- ☐ Marketing successes

2. Next Cycle Commitment

	☐ A: Just Do It	☐ B: Show Me the Money	☐ C: Hold that Line
No Data (Inventory)	Retire	Database Low + 2	Database Low + 5
dBA Limit	Inv. Low + 2	Inv. Low + 5	Inv. High
Retire	If > Limit	Cost-benefit	N/A
No Data (New)	Reject	Inventory High	Reject
NC Options	Always	Cost-benefit	Always
$/dBA Cost-benefit	N/A	☐ $20/dBA/person/yr ☐ $40/dBA/person/yr ☐ $60/dBA/person/yr ☐ $80/dBA/person/yr ☐ $100/dBA/person/yr	N/A
Select:	Quietest	Best Value	No noisier than present

3. Authorization

Purchasing employees are hereby authorized to invest time, effort, and money in the pursuit of low-noise purchases, in accordance with the foregoing instructions.

Signatures_____

4. Date of Next Review:_____

Buy Quiet Specification and Operating Condition Review

- Buy Quiet Procurements require good purchase specifications
- Purchase specifications need to cover
  - Levels
  - Test Methods
  - Operating Conditions
  - Mounting Conditions
- Good Purchase Specifications Lead to Quieter Equipment
- Quieter Equipment Lowers the “Cost of Noise”

Specfication and Operating Conditions – A Test Engineers Perspective

Projects with well defined specification and operating conditions:

- Facilitate product testing without numerous questions and discussion
- Creates more time for testing and analysis of data
- Frees up engineers to focus on why the equipment makes noise
- Leads to Quieter Products and Equipment

Thank You

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