



Hearing Conservation: Engineering and Administrative Solutions

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By 1985, 1970's Engineering Controls will Accomplish:

% of Workers Exposed		
Noise Level	90 dB Limit	85 dB Limit
<80	47.0	47.0
80-85	18.5	49.4
85-90	33.9	3.0
90-95	0.2	0.2
95-100	0.2	0.2
100-105	0.2	0.2
>105	Nil	nil

From Bolt, Beranek and Newman Economic Impact Analysis, Rpt No. 3246, April 21, 1976

What's the Big Deal Anyway?

- Projected percent of workforce with noise-induced hearing loss after working 8 hours a day for 20 years at the respective exposure level.

	90 dBA	85 dBA	80 dBA
ISO	21%	10%	0%
EPA	22%	12%	5%
NIOSH	29%	15%	3%

What is Noise-Induced Hearing Loss?

- Sensorineural Injury
 - Traumatic
 - Insidious
- Characteristics
 - Usually bilateral
 - Notch at 3-6 KHz deepens and widens
- Assessment
 - Audiometric test at various frequencies
 - Evaluation of speech understanding

What Sounds Damage Hearing?

- Intensity and duration – dose
 - Sufficient energy for long enough time
- Rules of thumb
 - Invade one's personal space to be heard
 - TINNITUS after leaving area
 - Muffled sounds after leaving area

Exposures that Affect NIHL

- Aminoglycocides
- Arsenic
- Carbon disulfide
- Carbon monoxide*
- Cyanide
- Lead & derivatives*
- Manganese
- Mercury & derivatives
- n-Hexane
- Stoddard solvent
- Toluene*
- Trichloroethylene*
- Xylene*

* High Priority ototoxins per NIOSH

Implications of Hearing Loss

- Physiological
 - Irreversible
 - Hair Cells Damaged Beyond Repair
 - Fatigue
 - Continuing Research

Healthy Cochlea



Cochlea Destroyed by Excessive Noise



Implications of Hearing Loss

- Psychological
 - Anxiety
 - Stigma
 - Depression
 - Withdrawal



Implications of Hearing Loss

➤ Social

➤ Background Interference

➤ Communication

- Spouse

- Family

- Friends

- Speech Intelligibility

➤ Quality of Life

Implications of Hearing Loss

➤ Safety

➤ Sense of Danger

➤ Directions

- Shipyard Safety

- Role of ambient noise and hearing ability in accident investigation

- Target Finding in Military

➤ Warnings

- Localization

What Can Be Done to Prevent NIHL?

- Eliminate the Noise
 - Purchase quiet equipment
 - Quiet noisy equipment
 - Maintain controls on quiet equipment
- Training
 - Behavior of superiors
 - Protection
 - Personal entertainment systems

Prevent NIHL (and lower WC costs)

- Establish a process/system for Hearing Loss Prevention/Noise Control
- Gain management/labor buy-in/commitment/support for your initiative
- Explain the process to those whose assistance you will need, e.g., engineers, doctors, nurses, supervisors

The Process

- Identify the employees who are exposed to 85 dBA or greater
 - **Intermittent noise is underestimated by 5dB doubling**
 - Mobile jobs
 - Rotating jobs
 - Place them in a Hearing Conservation Program

The Process

- Identify the employees who are exposed to 90 dBA or greater
 - Evaluate their jobs to determine if engineering controls are technologically feasible and economically justifiable at a first cut.

Hearing Conservation Program

- Yearly audiometric testing
- Notify employee of results
- If necessary, provide hearing protection based on worksite exposure
 - Here's where an opportunity presents itself
- Training
- Recordkeeping
- Audiometric Analysis

Engineering Program

- Buy it Quiet
 - 95% of opportunity to reduce noise
- Make it Quiet
 - 5% of opportunity to reduce noise by retrofitting
- Keep it Quiet
 - Maintenance

Buy it Quiet

- Sometimes all you have to do is ask.
- Often added expense will zero out over time with fewer employees in HCP, less medical costs, less workers' comp, reduced cost of administering hearing protection program.
- Insist that new equipment meet certain noise requirements and test to see that it does before bringing it into the facility.

Buy it Quiet

➤ Hand tools

➤ NIOSH has tested and published noise levels, manufacturer and model of the following:

➤ belt sander, circular saw, drill, framing saw, grinder, hammer drill, jig saw, impact wrench, miter saw, orbital sander, reciprocating saw, screwdriver

➤ <http://www.cdc.gov/>

➤ >hazards & exposures>noise>At-Work Solutions for Noise>Power Tools Database

Make it Quiet

- Go for the low hanging fruit
- Air leaks
 - Reduce air pressure
 - Control air blowoffs
 - Install air nozzles on blowoffs (noise is not necessary to do job)
 - Eliminate the use of compressed air where possible (may lower foreign object in eye visits)
- Air is expensive
 - A plant saved \$1,400,000 in a year with a leak tag program

Make it Quiet

- Metal to Metal Contact
 - Reduce dropping height
 - Increase rigidity of containers or conveyor belts receiving impact
 - Damp containers or conveyor belts with damping material
 - Use soft rubber or plastic to receive hard impacts

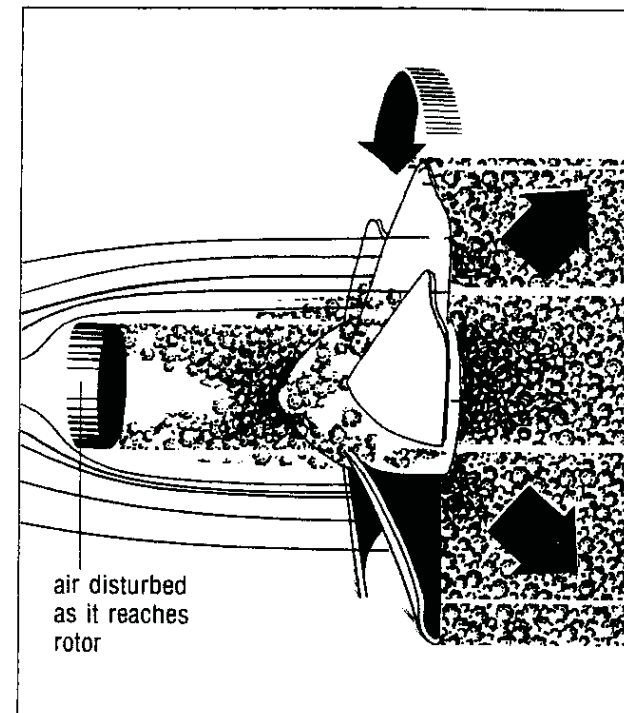
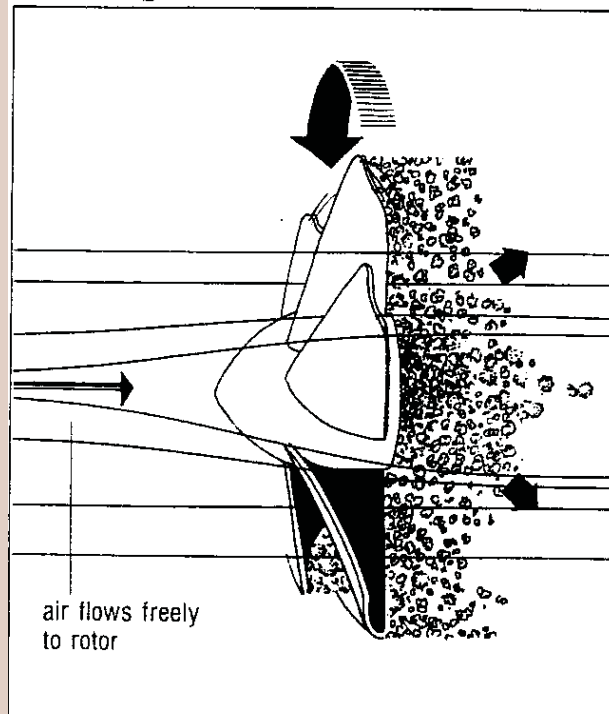
Make It Quiet

Fans make less noise if placed in smooth, undisturbed flow streams

A fan produces turbulence in air, which causes noise. If turbulence is already present in the incoming air, the sound will be more intense. The

same principle applies, for example, to propellers in water.

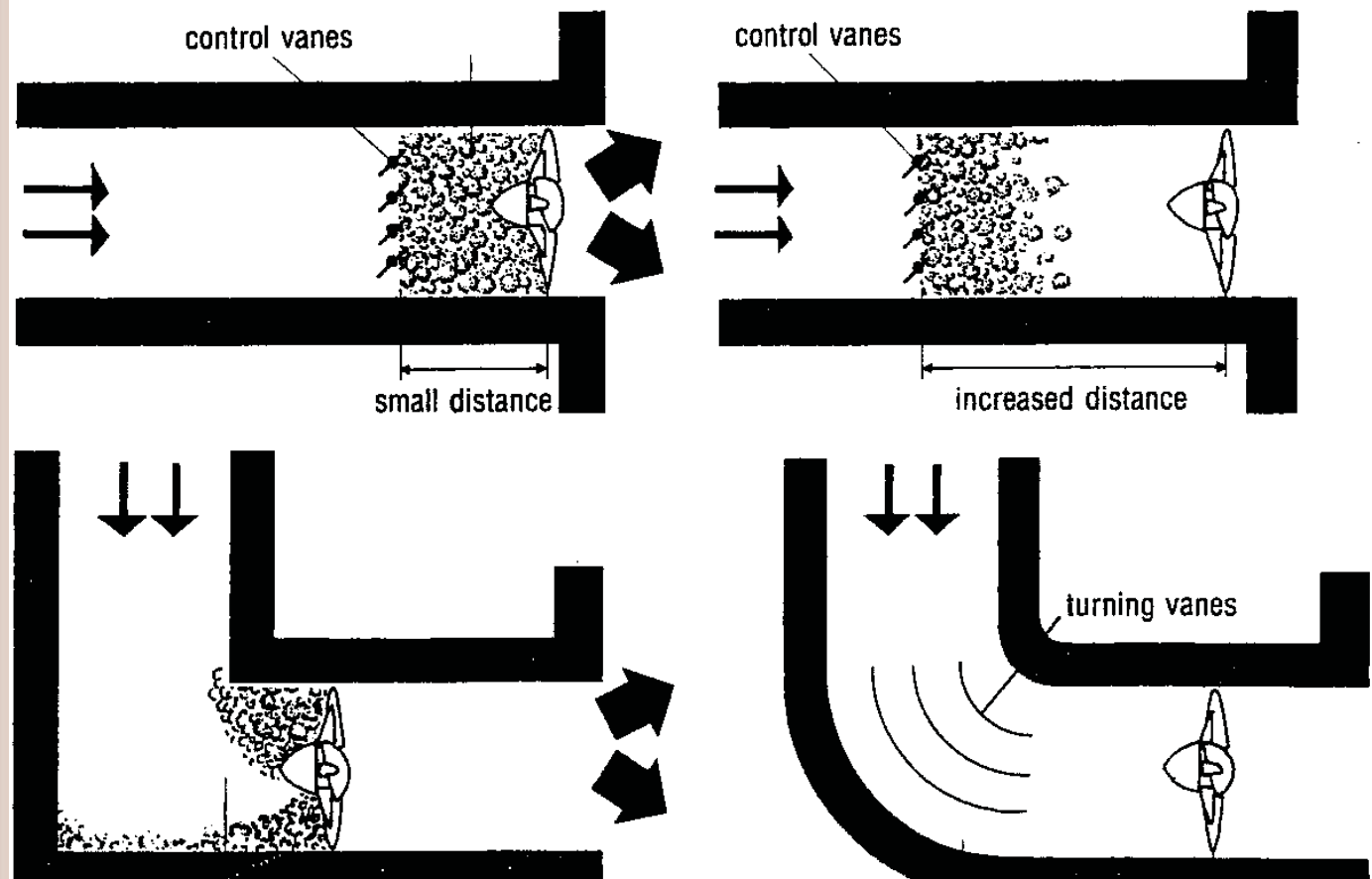
Principle



Make It Quiet

barrier, and in the other case too close to a sharp bend. The flow is disturbed and the noise at the outlet is intense.

fan so that the turbulence has time to die down. In the other case, the bend is made smoother, and the fan is moved away from the bend. Turning vanes could also be used.



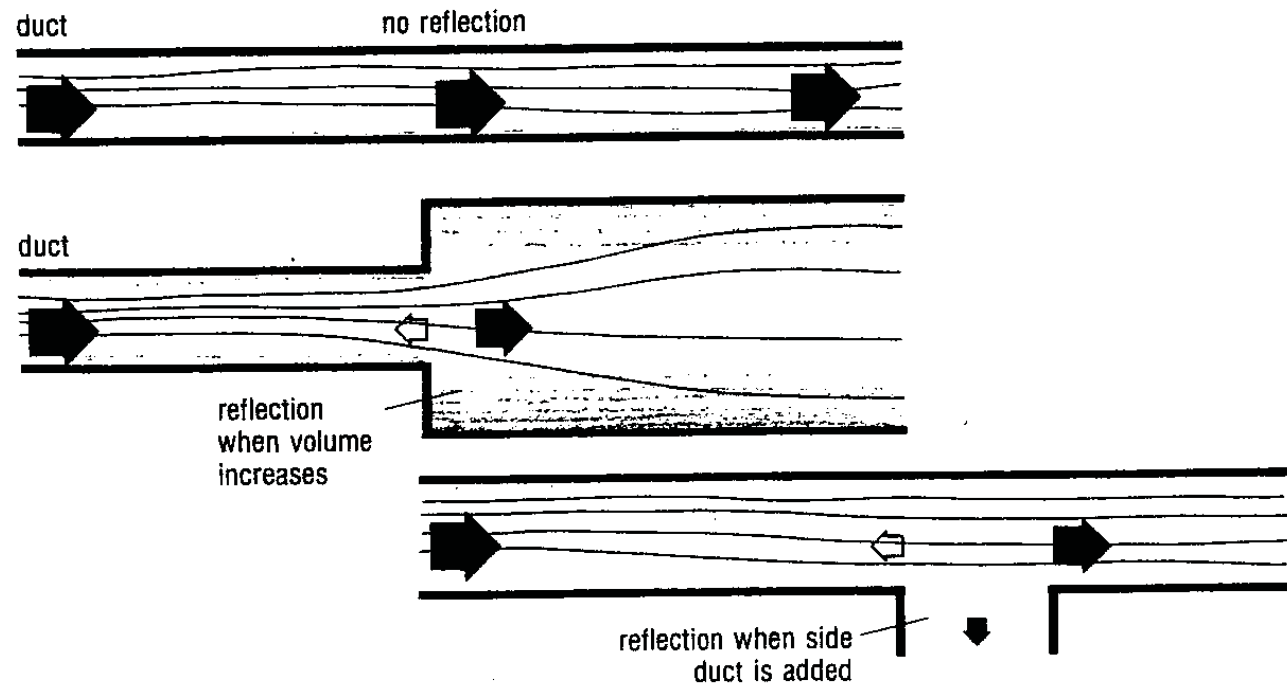
Make It Quiet

All duct changes reduce sound transmission

With all changes in pathway, some sound energy is reflected back. In a duct this may apply to

bends, branches, and changes in volume, shape, or wall materials.

Principle



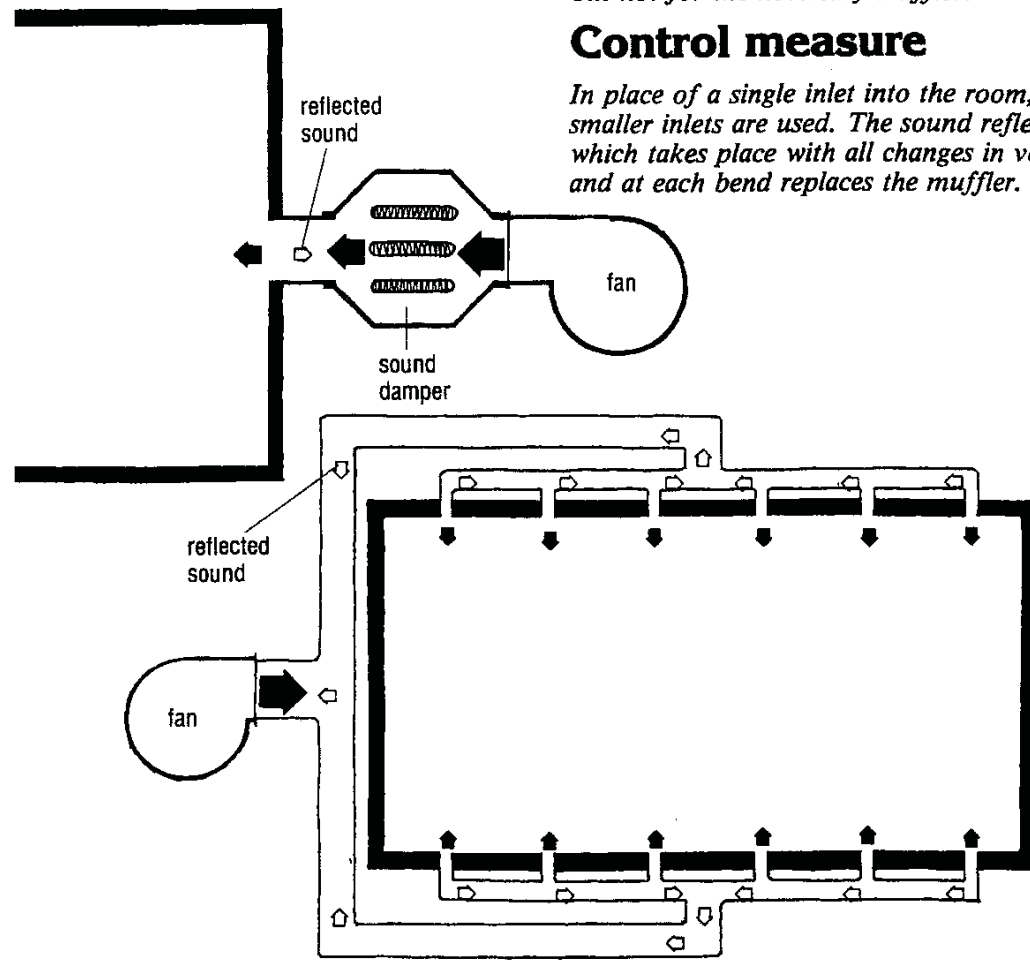
Make It Quiet

Example

An area is to be provided with mechanical ventilation. There is sufficient space for the fan, but not for the necessary muffler.

Control measure

In place of a single inlet into the room, several smaller inlets are used. The sound reflection which takes place with all changes in volume and at each bend replaces the muffler.



Make it Quiet

➤ Industrial Noise Control Manual

➤ <http://www.cdc.gov/Niosh/79-117pd.html>

➤ Practical Guide

➤ Preventing Occupational Hearing Loss: A Practical Guide

- DHHS (NIOSH) Publication No. 96-110
- 1-800-35NIOSH

➤ NIOSH Criteria Document

➤ <http://www.cdc.gov/niosh/noise2a.html>



Thank you for your attention

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