

Beyond Hearing Loss

The Hidden Health Effects of Noise Exposure

Noise, Ototoxicants, and the Risks We May Be Missing

Kristy Thornton, MS, COH | Forensic Analytical Consulting Services

Noise Is More Than a Hearing Hazard



HEARING

- Permanent threshold shift
- Tinnitus
- Communication interference

WHOLE-BODY

- Stress response
- Cardiovascular effects
- Fatigue / sleep disruption

COMBINED EXPOSURES

- Ototoxic chemicals
- Multiple exposure routes
- Noise + chemical interaction

What We're Going to Challenge Today

01

UNDERSTAND NOISE

How noise damages hearing — and affects more than the ear.

02

SPOT OTOTOXINS

What ototoxic chemicals are, where they occur, and why noise matters.

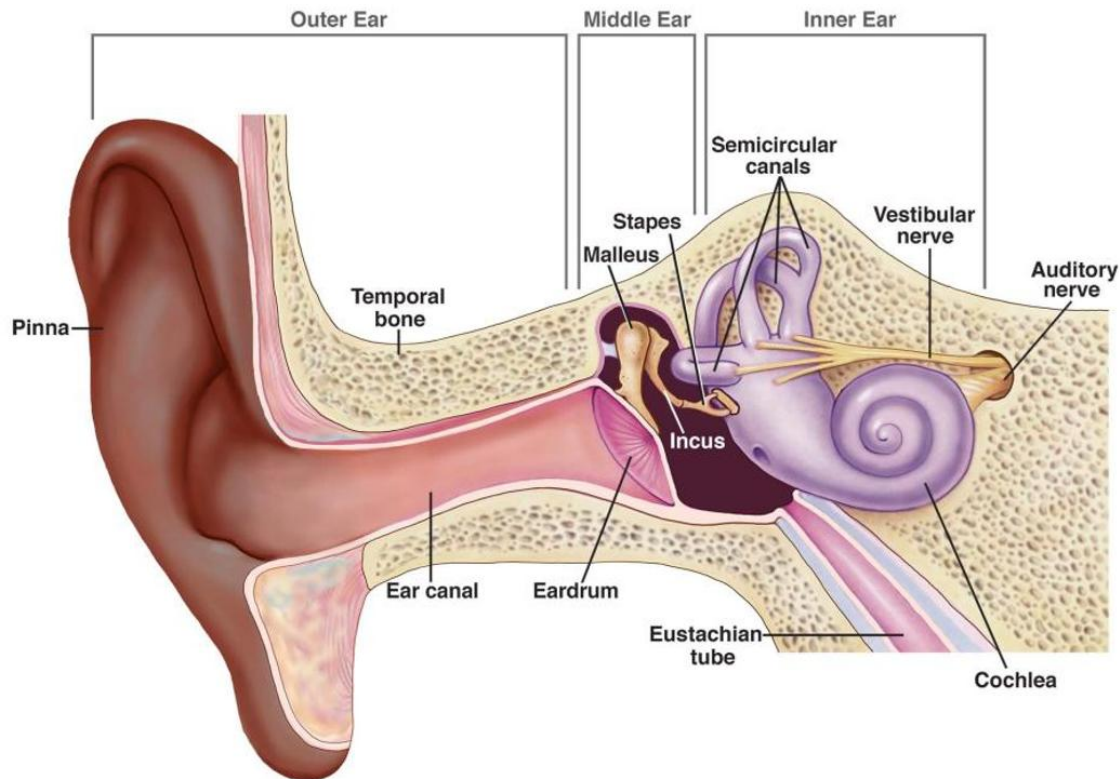
03

KNOW WHAT TO DO

Simple questions safety professionals can ask during routine work.

You do not need to be an industrial hygienist to recognize the warning signs.

How We Hear



OUTER EAR

Collects and funnels sound.

MIDDLE EAR

Transmits and amplifies vibration.

INNER EAR

Cochlear hair cells convert vibration to neural signals.

Cochlear Damage



NOISE DAMAGES SENSORY HAIR CELLS

Painless

Progressive

Permanent

The damage does not “grow back.”

Noise Dose: Level × Time



Quantifying Noise Exposure

A dosimeter helps quantify noise exposure over the workday. The result is important — but it may not describe every factor affecting hearing risk.

85 dBA: A Line, Not a Wall

85 dBA

A Regulatory Threshold — Not a Biological Wall

PROGRAM TRIGGER



OSHA Standard

For OSHA general industry, an 8-hour TWA of 85 dBA triggers mandatory hearing-conservation requirements.

BIOLOGICAL REALITY



Continuous Spectrum

85 dBA is not a biological switch that turns hearing risk on at 85 and off at 84. Risk increases continuously.



Critical Takeaway

That distinction matters when other hearing hazards are present.

OSHA vs. NIOSH / ACGIH

OSHA

Legal requirements

- 90 dBA PEL
- 85 dBA hearing-conservation trigger
- 5-dB exchange rate

NIOSH

Recommended exposure limit

- 85 dBA
- 3-dB exchange rate

ACGIH

Health-based guidance

- 85 dBA TLV
- 3-dB exchange rate



Safety Takeaway

The standards are tools for managing risk — they are not all identical.

Beyond Hearing Loss

PERFORMANCE



- Communication interference
- Reduced concentration
- Increased error potential

PHYSIOLOGY



- Stress response
- Blood pressure
- Cardiovascular concern

WELLBEING



- Fatigue
- Annoyance / irritability
- Sleep disturbance



Key Takeaway

Noise exposure impacts far more than hearing capacity—it introduces workplace safety hazards and systemic health risks.

Your Body Hears Noise Too

NOISE IS A SAFETY HAZARD TOO

Alarms • verbal warnings • situational awareness • fatigue



The Risk We Often Miss

NOISE

**CHEMICAL
EXPOSURE**

**HEARING / BALANCE
RISK**

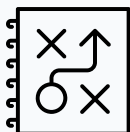
What Is an Ototoxicant?

OTOTOXIC = “TOXIC TO THE EAR”

Some chemicals can damage the parts of the body we use to hear and maintain balance. These chemicals are called **ototoxicants**.

Routes of Entry

They can enter the body through **breathing**, **skin contact**, or **ingestion**.



Direct Effect

Some chemicals can affect hearing and balance system functions entirely **on their own**.

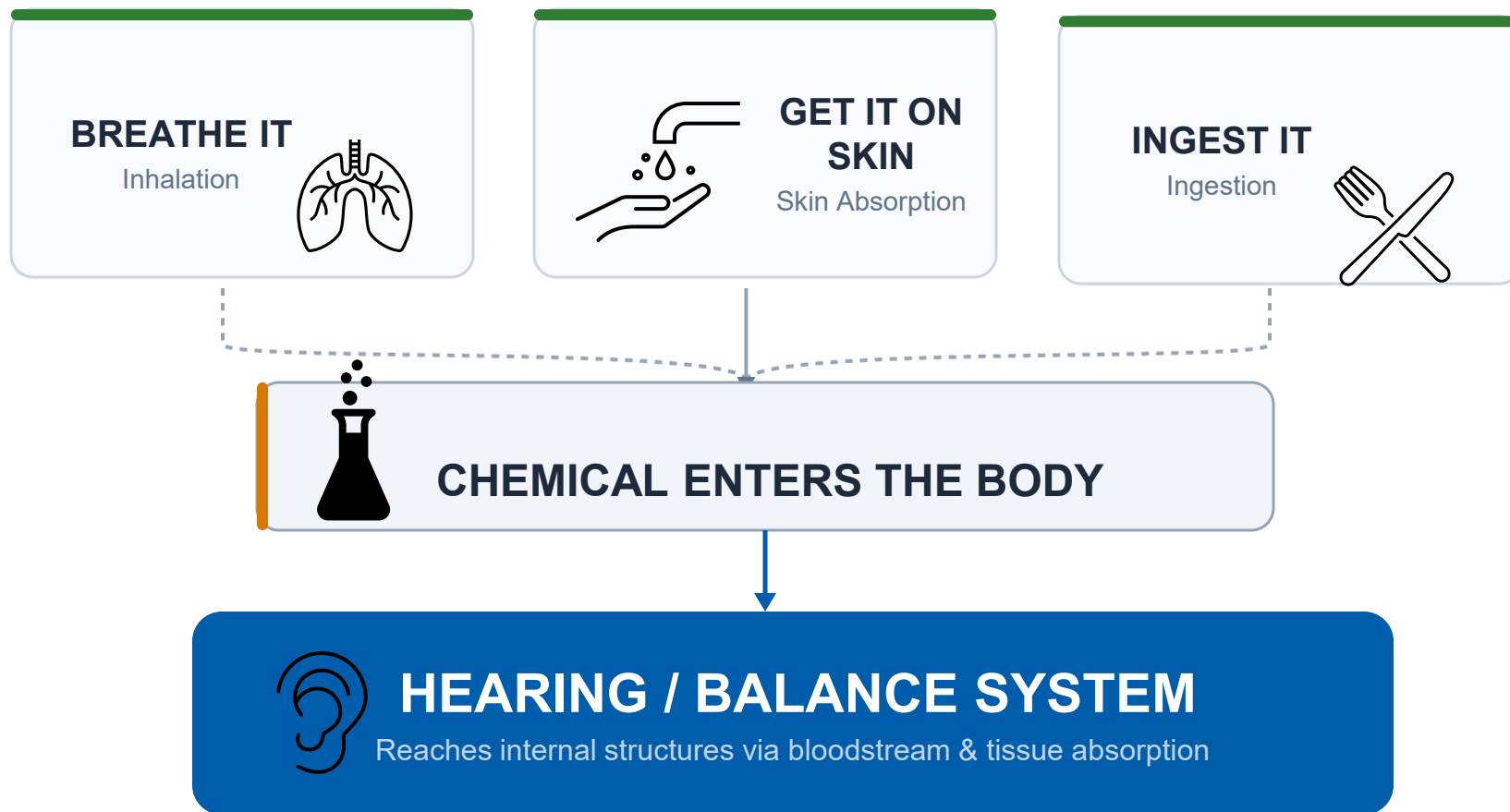


Combined Risk

Some become especially dangerous when the worker is also **exposed to noise**.



How Ototoxicants Reach the Ear



Hearing Is Only Part of the Story

HEARING



- Threshold changes
- Difficulty understanding speech
- Tinnitus

BALANCE



- Dizziness
- Unsteadiness
- Spatial-orientation problems

CRITICAL SAFETY IMPLICATION

Balance effects can become an immediate safety issue around ladders, roofs, platforms, vehicles, or moving equipment.

Ototoxicants Are More Common Than You Think

SUBSTANCE CLASS	CHEMICALS
Pharmaceuticals	Aminoglycoside antibiotics; selected other antibiotics; loop diuretics; certain analgesics/antipyretics; selected antineoplastic agents
Solvents	Carbon disulfide; n-hexane; toluene; p-xylene; ethylbenzene; n-propylbenzene; styrene / methylstyrene; trichloroethylene
Asphyxiants	Carbon monoxide; hydrogen cyanide and salts; tobacco smoke
Nitriles	3-butenenitrile; cis-2-pentenitrile; acrylonitrile; cis-crotonitrile; 3,3'-iminodipropionitrile
Metals / compounds	Mercury compounds; germanium dioxide; organic tin compounds; lead

Source framework: OSHA/NIOSH ototoxicant guidance; cross-check current ACGIH TLVs/notations for substances in your workplace.

Don't memorize the list — recognize the categories and a few common names.

Solvents: A Familiar Workplace Exposure

PAINT / COAT

Toluene • Xylene •
Ethylbenzene



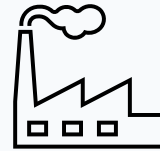
DEGREASE / CLEAN

Solvents may be present



MANUFACTURE

Styrene and other
solvents



MAINTAIN / REPAIR

Solvents + equipment
noise may overlap



Key Safety Question

“Is the worker using a solvent while also working in noise?”

Asphyxiants: A Different Pathway to the Same Target



CARBON MONOXIDE (CO)

- Combustion
- Engines / exhaust
- Fire response
- Enclosed or poorly ventilated areas



HYDROGEN CYANIDE (HCN)

- Fire / smoke environments
- Certain industrial processes
- Combustion of nitrogen-containing materials

Key Safety Awareness

“The hearing hazard may not be the first thing you think about when you see these exposures.”

Metals and Other Agents

LEAD

May coexist with noise in construction, manufacturing, maintenance and other industrial work.



MERCURY

Certain mercury compounds are identified as ototoxicants.



OTHER AGENTS

Evidence varies by chemical. Use recognized IH resources rather than assuming all chemicals behave the same.

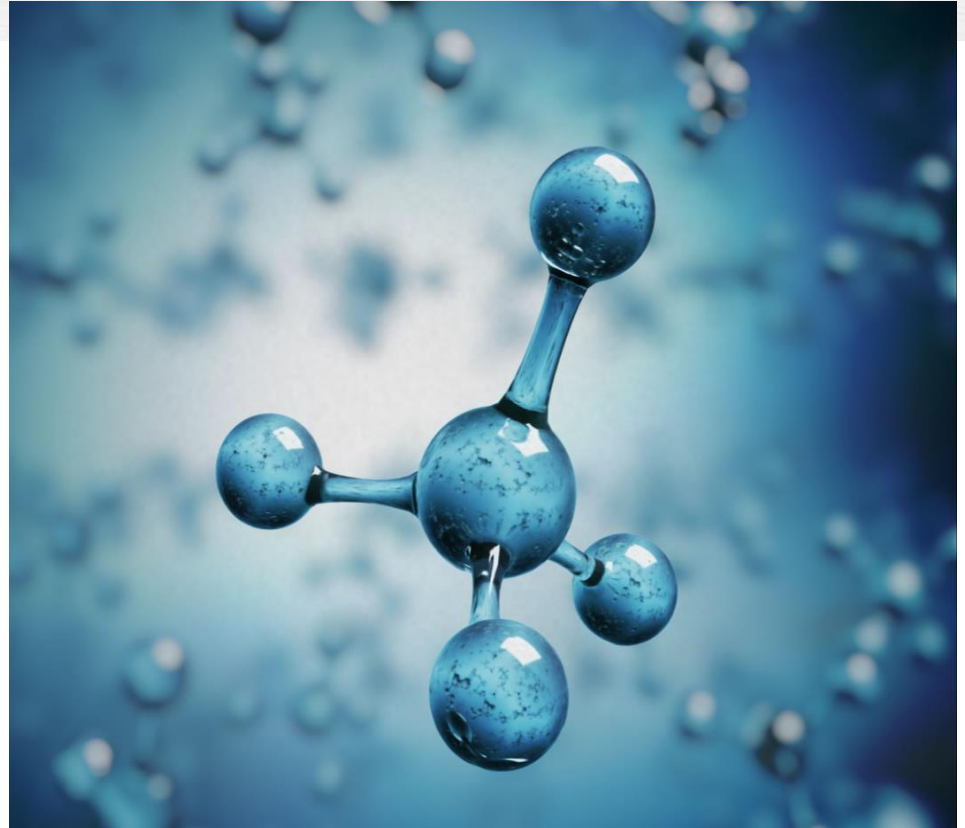


Key Takeaway

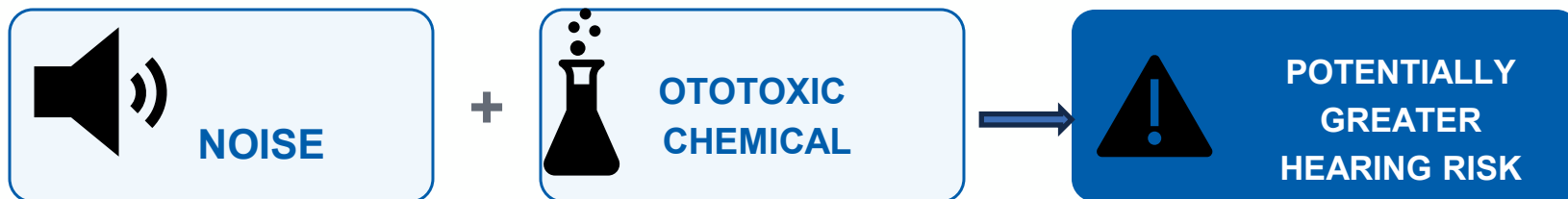
“You do not need to determine the toxicology yourself — you need to know when to ask the question.”

Where Might We Find Combined Exposures?

- Mining
- Manufacturing
- Utilities
- Construction
- Agriculture
- Firefighting
- Pest control
- Printing



When Noise Meets Chemicals



ACGIH identifies an OTO notation for selected substances where ototoxicity is an important consideration.



Ethylbenzene
(OTO)



Styrene
(OTO)



Toluene
(OTO)



Xylene
(OTO)

Source: ACGIH TLV

Case Study: The 82-dBA Worker

MEET MICHELLE



ROLE / POSITION

Maintenance Technician

NOISE MONITORING RESULT

82 dBA TWA (Below 85 dBA Action Level)

CHEMICAL EXPOSURE

Uses a toluene-containing solvent during routine work

PROGRAM STATUS

Not in Hearing Conservation Program (based on noise alone)

EXPOSURE ANALYSIS

82 dBA

Occupational Noise Exposure



TOLUENE

Ototoxic Chemical Solvent



ARE WE FINISHED?

Does noise evaluation alone protect workers against combined ototoxic risk?

What Would You Do?

WHAT WOULD YOU CHECK NEXT?

1



What chemical is being used?

2



How often and how much?

3



Could skin exposure occur?

4



Is noise present during the same task?

5



Do we need IH / occupational-health input?

The SDS Problem

START WITH WHAT YOU ALREADY HAVE

SDS



Look for words such as ototoxic, auditory, hearing, vestibular or neurotoxic.



**CHEMICAL
INVENTORY**

Flag common solvents, CO/HCN, lead/mercury compounds and other known agents.



**TASK /
JOB REVIEW**

Ask whether chemical exposure and noise happen at the same time.



If you see both hazards, that is the point to involve IH / occupational health as needed.

A Simple Safety-Professional Screen

1

IS THERE NOISE?

Dosimeter, SLM, noisy task or obvious noise source

2

IS THERE AN OTOTOXICANT?

SDS, inventory, process knowledge

3

DO THEY OVERLAP?

Same worker? Same task? Same shift?

4

WHO NEEDS TO HELP?

Safety + IH + occupational health



If the answer to #1 and #2 is YES, do not automatically evaluate them in separate silos.

Hearing Protection Isn't Chemical Protection

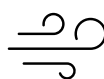
EARPLUGS / EARMUFFS

REDUCE NOISE AT THE EAR



OTOTOXIC CHEMICALS

BODY ENTRY PATHWAYS



Lungs (Inhalation)



Skin (Absorption)



Ingestion (Swallowing)



Earplugs do not stop a solvent from entering the body.

Control the Whole Exposure

SOURCE



- Eliminate / substitute
- Quieter equipment
- Less ototoxic chemical

PATH

Isolation

Enclosure

Ventilation

Distance

WORKER



- Work practices
- Exposure time
- Appropriate PPE
- Hearing protection



Control BOTH the noise and the chemical exposure.

Rethinking Hearing Conservation

Why ACGIH says this matters

*“...to focus attention, not only on engineering controls,
administrative
controls and PPE needed to reduce airborne concentrations,
but
also on other means of preventing excessive combined
exposures
with noise to prevent hearing disorders.”*

PLAIN ENGLISH:

— ACGIH TLV documentation

**Don't manage the chemical and the noise as if they have
nothing to do with each other.**

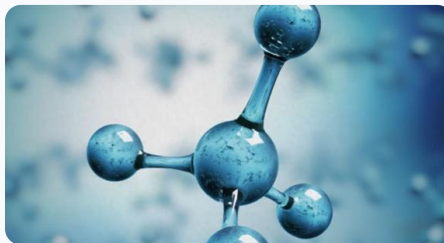
Three Things to Do Monday

SEE NOISE?



ACTION REQUIRED
ASK ABOUT
CHEMICALS

SEE SOLVENTS / CO / METALS?

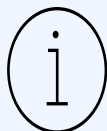


ACTION REQUIRED
ASK ABOUT NOISE

SEE BOTH?



ACTION REQUIRED
CONNECT SAFETY + IH
+ OCC HEALTH



A noise measurement tells you about noise exposure. It may not tell you the worker's total hearing risk.

Selected References & Resources

- OSHA / NIOSH (2018). Preventing Hearing Loss Caused by Chemical (Ototoxicity) and Noise Exposure.
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- Shaw E. The Ear Poisons: An Introduction to Ototoxins. The Synergist.

Thank You!

Forensic Analytical Consulting Services, Inc.

Right
People.

Right
Perspective.

Right
Now.