ASSESSING FORMALDEHYDE EXPOSURE IN YOUR GROSS LAB

OCCUPATIONAL EXPOSURE LIMITS & BEST PRACTICES

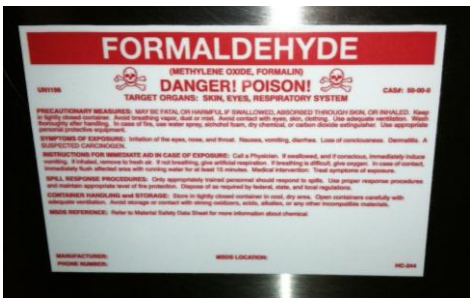
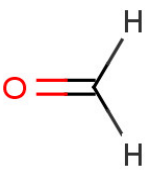


Photo by: Frank Demer

Julia Rosen, MS, CIH
Health and Safety Officer
University of Arizona
Risk Management Services

OSHA Formaldehyde Standard

29 CFR 1910.1048



Permissible Exposure Limits
Exposure Monitoring
Training
Labels, MSDS, signs
Engineering Controls
Respiratory Protection
Medical Surveillance

Health Effects

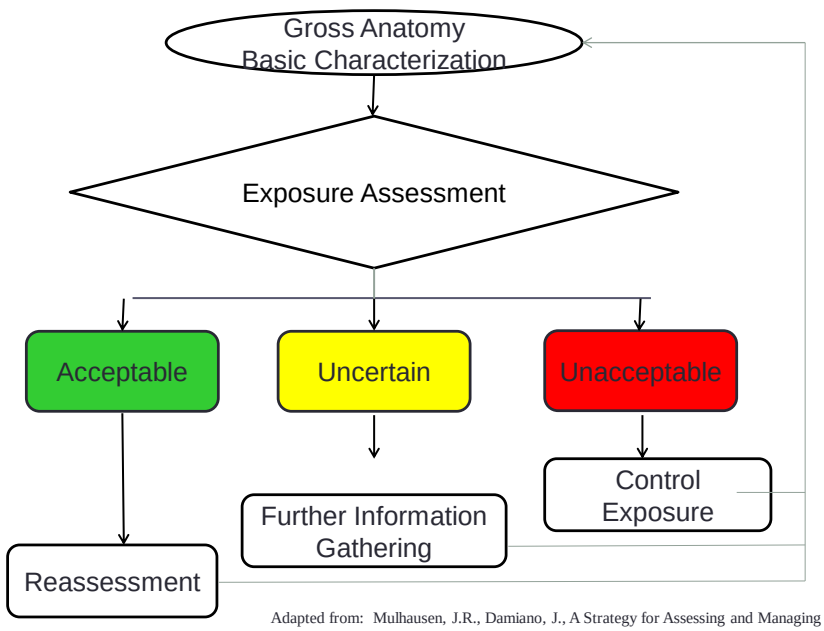
Heath Hazard

- Known Carcinogen
  - Animal & Human
- Respiratory Sensitizer
- Reproductive Hazards
  - limited studies

Corrosive

- Skin Corrosion/ burns
- Eye Damage

- Skin Sensitizer
- Respiratory Tract Irritant
- Eye Irritant



Adapted from: Mulhausen, J.R., Damiano, J., A Strategy for Assessing and Managing Occupational Exposures, Second Edition, AIHA Press, 1998

Formaldehyde Air Sampling Methods

Contact your institution's Environmental Health & Safety Department
to request industrial hygiene assistance

Colorimetric

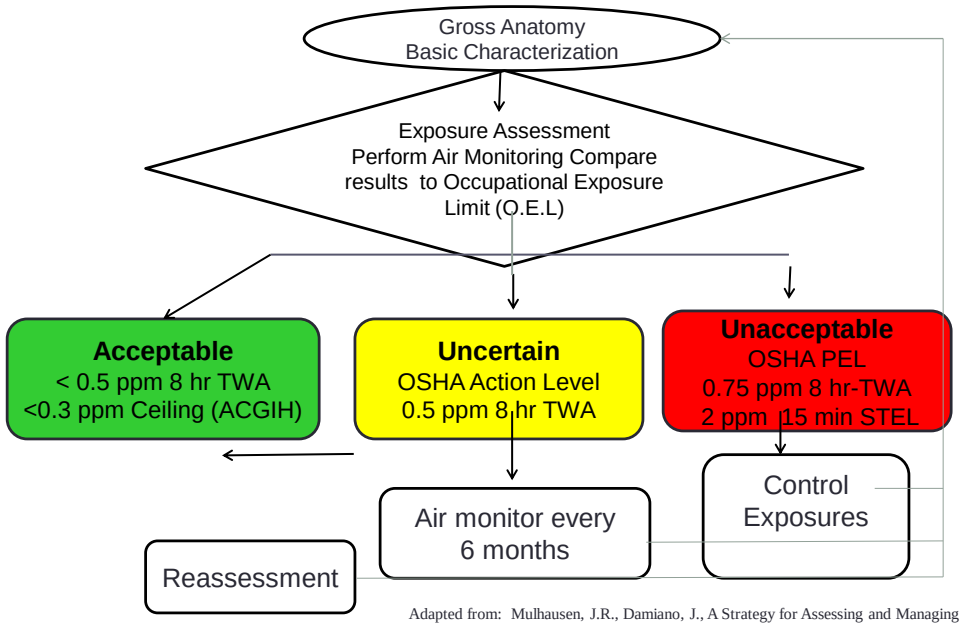
Passive Samplers

Active Sampling

Direct Read

Please note mention of commercial brands in following slides
is for illustration purposes only, and does not imply recommendation

Formaldehyde Air Sampling Methods	COST	TWA	STEL	Lab Analysis	Notes Interferences
Colorimetric Tubes **Diffusion Dosimeters**	$ $	X X	X		
Passive Badges (DPNH method) U.S.A. OSHA 1007 U.K. HSE MDHS 78	$$	X	X	stable derivative HPLC, UV	Diffusion sampling rate may differ in gross labs with formalin, as opposed to other sources of formaldehdye. Test side-by-side with active sampler. Negative interferences: ozone > 0.5 ppm, relative humidity < 10%; acetone, other carbonyls
Active Pump + DPNH silica gel U.S.A. NIOSH 2016 U.K. HSE MDHS 102 (older method) OSHA 52	$$$ T	 X X X	 X X X	Stable derivative HPLC, UV GC	Negative interferences: If ozone > 0.5 ppm (use potassium iodide scrubber) Acetone, other ketones and aldehydes, but separated by chromatography, can be quantified
Direct- Reading Instruments Infra Red Spectrophotometer PID Photoionization	$$$$$ $$$$	X	X		Dataloggers record exposure "movie" Specific, non-destructive Non-specific, measures volatile organics 11.7 eV bulb, 0.1-0.2 ppm resolution
Electrochemical (Formaldemeter htVr) Photoelectric + Colorimetric	$$$ $$$	X			1 ppm – max range precludes STEL



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Colorimetric Tubes

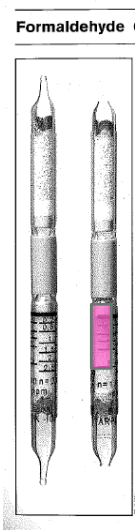
Hand bellows pump
"Grab Sample" 2-3 min

10 strokes 20 strokes
0.5 – 5 ppm 0.2– 2.5 ppm

Direct read color change
white to pink

Instant results
no lab analysis
$ cost

STEL – 1 sample
TWA – multiple



Source: Draeger
others include Gastec, Matheson, MSA, Supelco

Diffusion Tubes

Diffusion tube

(Photo: Gastec, SKC supplier

Passive, direct read TWA

Formaldehyde Air Sampling

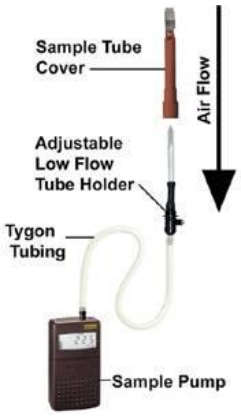
2,4,dintrophenylhydrazine coated silica gel film tube + formaldehyde → stable DNPH derivative

Passive (diffusion)

Source: Radiello Aldehdye Sampler

Source: SKC UMEX 100

Active



Source: SKC

Laboratory Analysis

Acetonitrile extraction
High Performance Liquid Chromatography, UV Detector
Quantify 2.4-dintrophenylhydrazone of formaldehyde

Real Time Instruments

Photo: Miran SapphIRe:

Portable InfraRed Spectrophotometer

Specific, Sensitive & Quantitative
for formaldehdye detection datalogging

Too large for personnel wearing
Can be held in breathing zone by operator

Photo: Raesystms ppbRAE 3000

PID Photoionization Detector

Non-specific responds to ionizable volatile organics present quantitatively, datalogging exposure "movie"

11.7 eV bulb required with 0.1 – 0.2 ppm resolution to detect formaldehyde and methanol at relevant levels.

Standard 10.6 eV bulb – will detect ethanol as surrogate agent, but not formaldehyde

Choosing a laboratory

The American Industrial Hygiene Association (AIHA) offers industrial hygiene lab accreditation services

Lab locations:	U.S., Brazil, Canada, China, Chili, Spain
Lab types:	Private, Governmental, University

Check with your national occupational hygiene society for accreditation services

Additional Factors:	Cost & Service Technical assistance Some provide passive badges, sorbent tubes, loaner pumps

Let your lab know about other chemicals present at time of sampling, such as acetone, methanol, phenol, glutaraldehyde, so analyst can assist with data interpretation

Formaldehyde Air Sampling Plans

Do Collect Personal breathing zone samples
Published studies show formaldehyde levels 2 – 3 higher than area samples

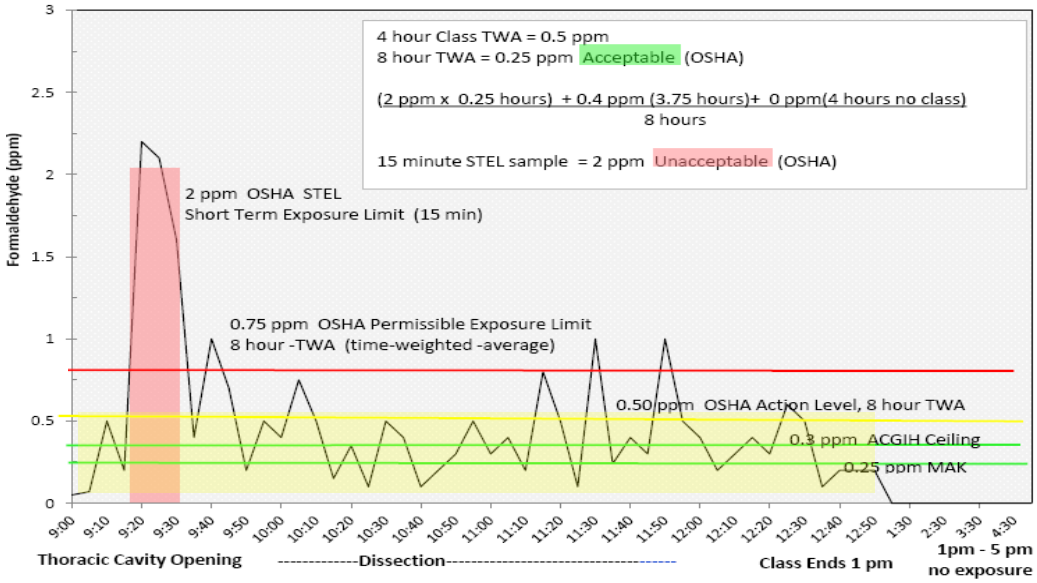
Do include 15 minute STEL samples for worst case tasks
opening thoracic cavities, abdomen and cranium

Do Observe sampling most effective:
note activities, work practices, time spent in close proximity to dissection

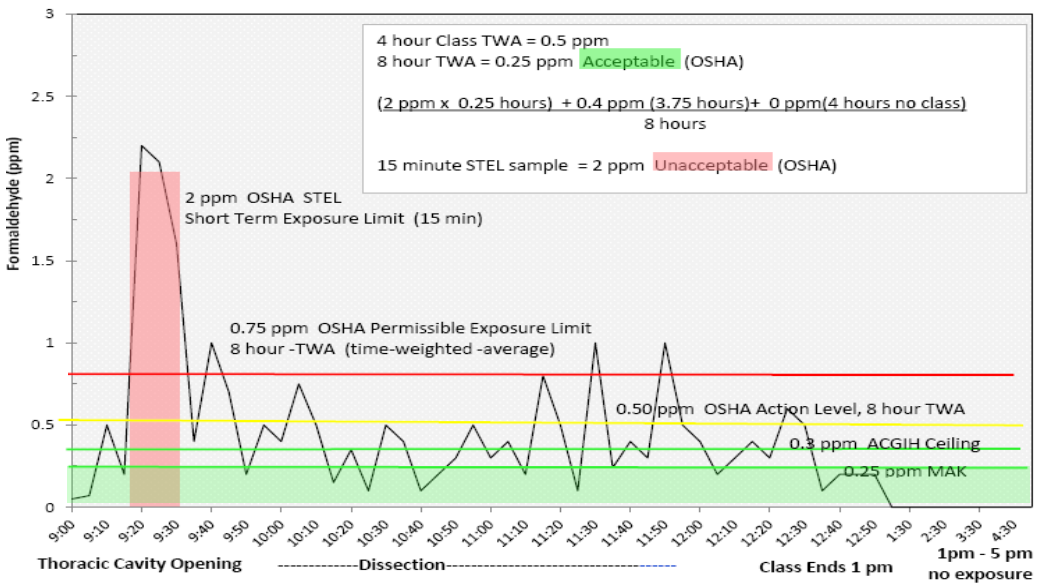
Do choose validated methods with known accuracy
OSHA Compliance Accuracy ± 25% for 8 hour TWA and STEL
+ 35% for Action Level TWA

Choice Depends on
Availability and cost of sampling equipment, laboratory analyses, personnel

Gross Anatomy Laboratory
Formaldehdye Exposure Scenario



Gross Anatomy Laboratory
Formaldehdye Exposure Scenario



GROSS ANATOMY AIR MONITORING

PERSONAL SAMPLES 2-3 TIMES HIGHER THAN AREA SAMPLES

TWA samples for 3 class; general dilution ventilation 3.2 ACH, preserved with 2.3% formalin
Limitations in comparisons: area samples of 4-6 hour duration; personal 1.1 – 6 hours)

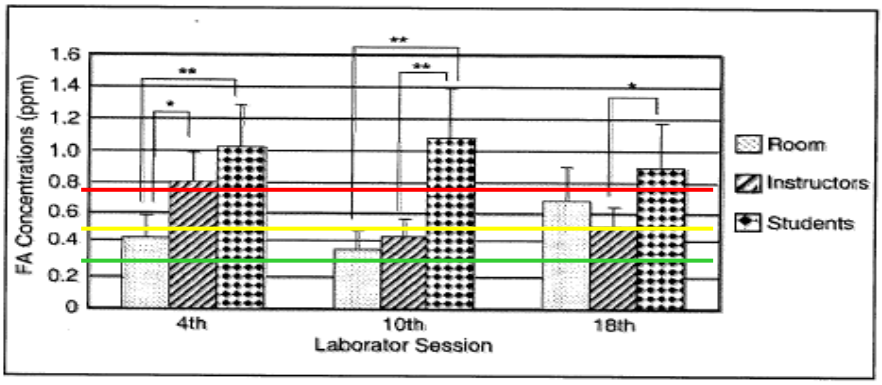


Fig. 3: Averages of the indoor formaldehyde concentrations and personal exposure levels for instructors and students. Asterisks represent significant differences: *, $P < 0.05$, **, $P < 0.01$

Source: Ohmichi, K, et. Al. Formaldehyde Exposure in a Gross Anatomy Lab, ESPR 13 (2) 120-124 (2006)

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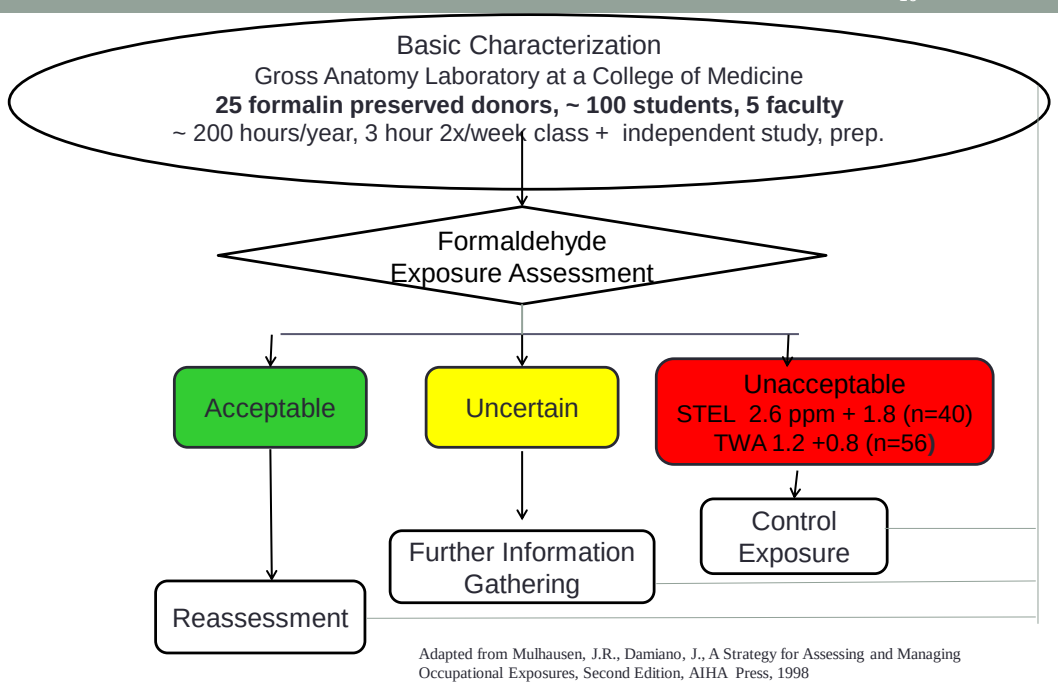

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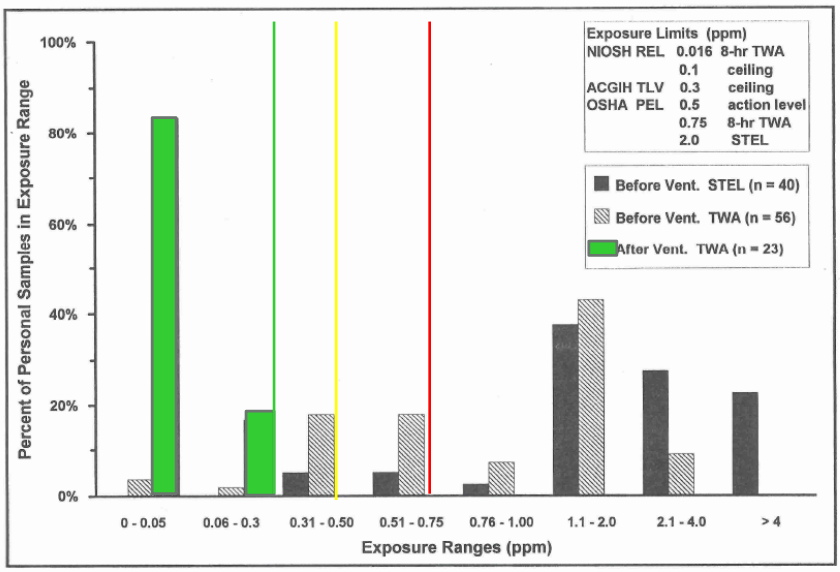

Figure 3. Breathing zone formaldehyde levels in a gross anatomy laboratory before and after local exhaust ventilation.

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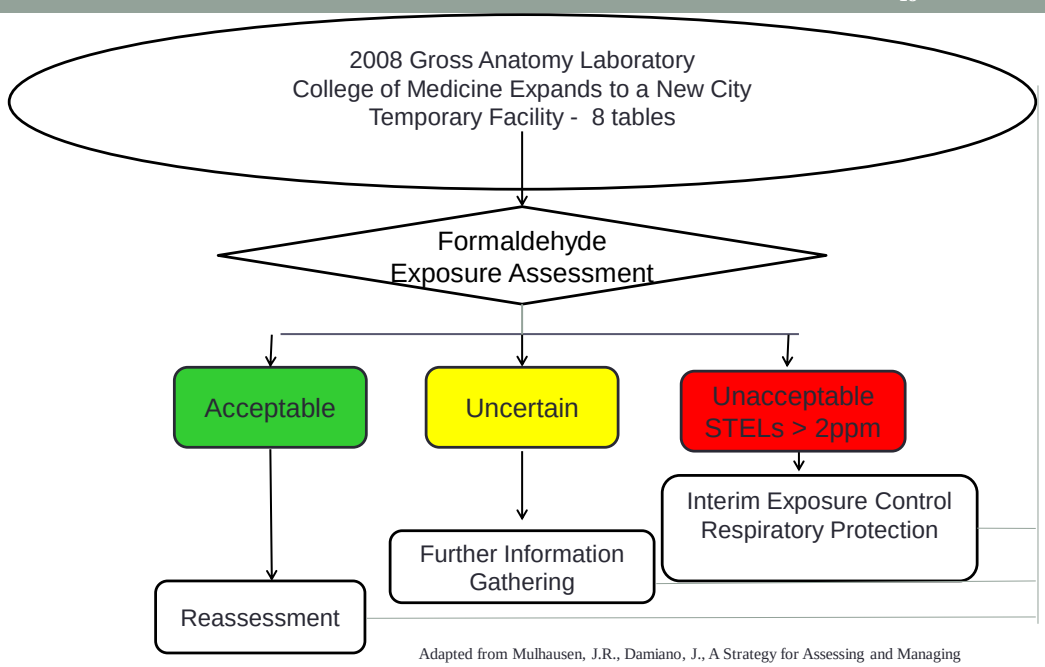

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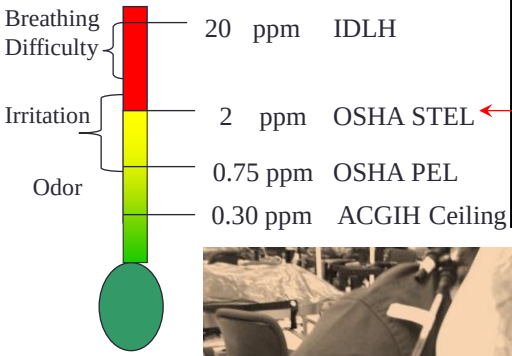
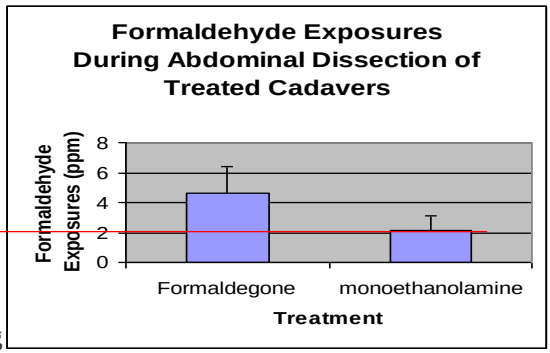
Formaldehyde

Personal Air Monitoring Results





Faculty wearing PAPR:
Powered Air Purifying Respirator
and personal formaldehyde monitor
Photo by Frank Demer

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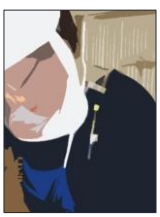
Respiratory Protection
Faculty, Staff and Students

Medical Clearance
Training
Fit Testing
Procurement

Fast!

Teaching
Communication
Challenges



Formaldehyde cartridge change out every 3 hours

Prevent Dermal Exposure PPE

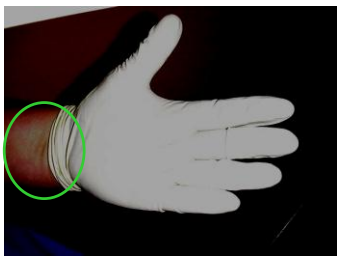


Photo by Frank Demer

Seeing is believing

Fluorescent tracer splash pattern on forearm – seen under black light shows longer (nitrile, not latex) gloves needed for formalin waste pouring in a veterinary pathology lab

References

Bibliography on AAA website

http://www.osha.gov/SLTC/formaldehyde/index.html

OSHA Method 1007 Passive Badge DPNH method

NIOSH Method 2016 Formaldehyde (DPNH)

Mulhausen,J.R., Damiano, J. A Strategy for Assessing and Managing Occupational Exposures, AIHA Press, 1998.