“Industrial Hygiene is the art and science of the anticipation, recognition, evaluation and control of environmental health hazards arising in or from the workplace.”

Source: Fundamentals of IH, 4th edition
Fundamental Concepts of Industrial Hygiene

- Occupational Exposures
- Routes of Entry
- Exposure Limits
- Sampling
- Controls
Hazards in the Work Place

Primary Focus

► Biological
► Noise
► Hazardous Chemicals
What’s the Big Deal?

► Workers employed in the poultry industry are **10.4 times** more likely to have a noise related incident than private industry (2013 BLS data)

► Poultry industry workers are **2 times** more likely to be exposed to hazardous chemicals than private industry workers (2013 BLS data)

► A recent NIOSH study found the **greatest risk** for Campylobacter infections occurred in new workers in the first month of employment in the live-hang section of the production line (de Perio et al 2013)
Occupational Controls for Hazards

Hierarchy of Controls

1. **Elimination**
   - Physically remove the hazard

2. **Substitution**
   - Replace the hazard

3. **Engineering Controls**
   - Isolate people from the hazard

4. **Administrative Controls**
   - Change the way people work

5. **PPE**
   - Protect the worker with Personal Protective Equipment
Biological Hazards
What are Bacterial Pathogens?

- Short answer: Bacteria that causes infection
- Each bacteria has a specific effect and results in symptoms in an infected individual
Biological Hazards – To Name Just a Few

► Brucellosis
► Campylobacteriosis
► Salmonella
► E-coli
► Psittacosis
► Cryptosporidiosis
► Bacterial Endotoxins
► Listeria
So where might YOU or YOUR WORKERS be exposed?
Manual Dock Worker/Receiver
Live Hang/Re-Hang
Kill Room
Handling Operators
Harvesters
Biological Hazards – Processing Operations

- Cutting
- Deboning
- Box Filling
- Bagging
- Packaging
- Maintenance
Biological Hazards – Causes of Infection

► Wearing PPE improperly or not wearing PPE
► Poorly designed Ventilation
► Poor personal hygiene practices
► Training not adequate for employees
  ● Wearing PPE into break room areas
  ● Not washing hands adequately
  ● Poor sanitation techniques
Biological Hazards – Recommended Controls

► Engineering Controls

- Hands Free Soap, Water Fountains, and Waste Receptacles
- Add Local Exhaust Ventilation in high dust areas
- Sanitize and dry transport cages thoroughly as recommended by the USDA FSIS [USDA 2010]
Administrative Controls

- Provide training on PPE, personal hygiene, and foot sanitizers usage often

Personal Protective Equipment (PPE)

- Provide the proper PPE for the job
Noise
Noise - Anatomy and Physiology of the Ear
Noise - Audiograms – Noise-Induced Loss

85 dBA Exposure

N = 72
MEAN AGE = 57
MEAN EXP = 16

90 dBA Exposure

N = 47
MEAN AGE = 47
MEAN EXP = 20

95 dBA Exposure

N = 40
MEAN AGE = 47
MEAN EXP = 15
Noise - Cumulative Effect of Noise over time
# Noise – Typical Levels and Exposure Pathways

<table>
<thead>
<tr>
<th>Sound Pressure Level - (dB)</th>
<th>Sound Pressure- (Newtons/m²)</th>
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<tbody>
<tr>
<td>130</td>
<td>Threshold of Pain</td>
</tr>
<tr>
<td></td>
<td>Pneumatic Chipper</td>
</tr>
<tr>
<td>120</td>
<td>Jet Plane Take off (70 m)</td>
</tr>
<tr>
<td></td>
<td>Forging Hammer</td>
</tr>
<tr>
<td></td>
<td>Pneumatic jack hammer</td>
</tr>
<tr>
<td>110</td>
<td>Shout with hand cupped between mouth &amp; ear</td>
</tr>
<tr>
<td>100</td>
<td>Shout at 1 foot</td>
</tr>
<tr>
<td>90</td>
<td>Normal Voice at 1 foot</td>
</tr>
<tr>
<td>80</td>
<td>Raised Voice at 1 foot</td>
</tr>
<tr>
<td>70</td>
<td>Normal Voice at 2 Feet</td>
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<tr>
<td></td>
<td>Average conversation</td>
</tr>
<tr>
<td>60</td>
<td></td>
</tr>
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<tr>
<td>10</td>
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</tr>
</tbody>
</table>

- Voice communication is nearly impossible.
- Shout with hand cupped between mouth & ear
- Shout at 1 foot
- Normal Voice at 1 foot
- Raised Voice at 1 foot
- Normal Voice at 2 Feet
- Average conversation

0.002 Library
0.0002 Bedroom at Night
0.0002 Threshold of Hearing

0.02 Conversational Speech

0.02 Typical Business Office

0.2 Inside Motor Bus

Traffic on City Street Corner

Punch Press

Automatic Screw Machine
Noise - OSHA Exposure Limits

**Action Level**
85 dBA 8- Hr. TWA
or 50%

**Permissible Exposure Limit**
90 dBA 8 - Hr. TWA
or 100%

**Ceiling Limit for Impact Noise**
140 dB
Noise - Noise Monitoring Equipment

Sound Level Meter (SLM)
Integrating Sound Level Meter (ISLM)
Noise Dosimeter
Octave Band Analyzer (OBA)
Impact Meter
Noise - Personal Noise Dosimetry

- Dosimeter
- Acoustic Calibrator
- Cover
- Microphone
- Windscreen
- Microphone on Shoulder
- Dosimeter over back hip
! **Required** for all employees exposed above 90 dBA 8 - Hr. TWA, all employees with STS exposed to 85 dBA 8 - Hr. TWA or more, all employees without baseline audiogram and exposed to 85 dBA 8-hour TWA or more.

**Must** be offered to all employees exposed to 85 dBA 8 - Hr. TWA or more
Noise - Hearing Protection Equipment Field Experience

Noise Reduction Rating (NRR) is the amount of attenuation (noise reduction) in dB that is provided by a hearing protection device. This number is provided by the manufacturer.

**OSHA Field Experience**
Field Attenuation = \( \frac{1}{2} \) (NRR - 7)

**NIOSH Field Experience**
- Ear Muffs provide 70% of the NRR
- Foam Ear Plugs provide 50% of the NRR
- Rigid Ear Plugs provide 25% of the NRR
Noise Hazards – Common Meat Industry Exposures

- Processing equipment
- Chain-driven machinery
- Grinders
Noise Hazard – Recommended Controls

► **Engineering Controls**
  - Use Belt driven Machines
  - Provide anti-vibration machine mountings
  - Utilize acoustical enclosures

► **Administrative Controls**
  - Rotation of workers to areas with lower noise levels

► **Personal Protective Equipment (PPE)**
  - Ear plugs, Ear Muffs
Chemical Hazards
Chemical Hazards – Forms and Types

► Dusts
► Fumes
► Mists
► Vapors
► Gases
Chemical Hazards – Exposure Pathways

In order for a chemical to cause harm, one must come in direct contact with it, and it has to get into the body or on the skin. These are the four routes of entry for chemical exposure.

► Inhalation
► Skin absorption
► Ingestion
► Injection
Chemical Hazards – Dose-Response Relationship

Response vs. Dose

- Graph showing the relationship between dose and response.
Chemical Hazard – Exposure Limits and Guidelines

- OSHA PELs
- ACGIH TLVs
- NIOSH RELs
- AIHA WEELs
Chemical Hazards - Exposure Limit Terminology

OSHA Permissible Exposure Limits (PELs)

ACGIH Threshold Limit Values (TLVs)

8-hour time-weighted average (TWA)

Short-Term Exposure Limit (STEL)

Ceiling Limit (C)
Chemical Hazards – Sampling Techniques

► Unfortunately, there is no “black box” meter that is calibrated for every contaminant such that one can turn it on and it can measure what’s in the air.

► There are a variety of sampling techniques that require sampling media and laboratory analysis of the media.

► Where possible, you should use OSHA or NIOSH sampling and analytical methods.
Chemical Hazards – Traditional Sampling

► Most of the OSHA and NIOSH sampling methods call for a sampling pump and collection media.

► Media must be analyzed in a laboratory after sampling.

► Only use an American Industrial Hygiene Association (AIHA) accredited laboratory.
Chemical Hazards – Filter Cassette Sampling Train

- Filter Cassette in the breathing zone
- Connecting tubing over the shoulder
- Sampling Pump on the back of the hip
Chemical Hazard – Organic Vapor Monitor

As received from Lab

Lid removed

Contents of can

Front of badge
Diffusion side

Back side

Badge on worker
Chemical Hazard – Direct Read Equipment

Some of the more popular direct-reading equipment.

- Single-gas meters
- IAQ Meter
- Mercury Vapor Analyzer
- Confined Space Meter
- Air velocity meter
- Heat Stress Monitor
- Aerosol Monitor
Chemical Hazards – Meat Industry Specific

- Ammonia
- Chlorine
- Carbon Dioxide
- Hydrogen Peroxide
- Peracetic Acid
- Hexavalent Chromium
Chemical Hazard - Ammonia

► Ammonia is a gas with a characteristic pungent odor and is used as a refrigerant, and occasionally, as a cleaning compound

► Ammonia is considered a high health hazard because it is corrosive to the skin, eyes, and lungs. Exposure to 300 parts per million (ppm) is immediately dangerous to life and health.

► Ammonia has a low odor threshold (20 ppm)

► OSHA Permissible Exposure Limit (PEL) of 50 ppm over an 8-hour time-weighted average
Chemical Hazard – Chlorine

► Soluble chlorine (a combination of chlorine byproducts such as monochloramine, dichloramine, hypochlorous acid, and hypochlorite)

► Chloramines (Chloramines are formed by the reaction between chlorine disinfectants and nitrogenous compounds such as ammonia, amines, or organic nitrogen-containing material from the meat)

► OSHA Ceiling Limit for Chlorine of 1 ppm which should not be exceeded anytime during the work day

► Chloramines do not have occupational exposure limits
Chemical Hazard – Carbon Dioxide

- Carbon dioxide can be a solid form as dry ice which is used to keep meats cold
- Considered to be a potential inhalation toxicant and a simple asphyxiant
- OSHA Permissible Exposure Limit (PEL) of 5,000 ppm over an 8-hour time-weighted average
- NIOSH Immediately Dangerous to Life and Health (IDLH) of 40,000 ppm should not be exceeded anytime during the work day
Chemical Hazards – Hydrogen Peroxide/Peracetic Acid

► Widely used for sanitation and disinfection purposes
► Vapor can cause extreme irritation of eyes, nose, and throat
► OSHA Permissible Exposure Limit (PEL) for Hydrogen Peroxide of 1 ppm over an 8-hour time-weighted average
► ACGIH TLV Short term exposure (STEL) of 0.4 ppm over a 15-minute time-weighted average
Chemical Hazard – Hexavalent Chromium

► Part of a 2015 OSHA Regional Emphasis Program for Poultry processing facilities

► Worker exposure to Hexavalent Chromium (HexCr) occurs during "hot work" such as welding on stainless steel and other alloys containing chromium.

► Hexavalent Chromium is highly toxic and can damage the eyes, skin, nose, throat, and lungs and is a recognized carcinogen

► OSHA Permissible Exposure Limit (PEL) of 0.005 mg/m$^3$ as an 8-hour time-weighted average
Chemical Hazards- Recommended Controls

► Engineering Controls

- Ensure proper ventilation to reduce contaminant levels in the work areas. Utilize localized ventilation where appropriate to remove toxicants from source generation (Engineering Control)

- Utilize cleaning techniques that minimize aerosolization (Engineering Control)

► Administrative Controls

- Frequent training on potential chemical hazards, proper work practices, and the appropriate PPE
Chemical Hazards- Recommended Controls

► Administrative Controls

- Perform inspections to ensure chlorine/ammonia concentration levels are within specified parameters and cleaning chemicals are utilized at the proper dilutions

► Personal Protective Equipment (PPE)

- Provide the proper PPE for the job
Move Forward with Confidence
Questions?

If you would like more information, or have industrial hygiene questions, contact me.

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