The Sustainable Materials Management Webinar Series

Health and Safety Issues with Electronic Scrap Recycling

Tuesday February 16, 2016/1:30 – 2:45PM EST

Presenter:

Lloyd B. Andrew III, CIH, CSP, President
EnvirOSH Services, Inc®
E-Scrap

Safety & Health Hazards Identification and Control

Presented by
Lloyd B. Andrew III, CIH, CSP
Located in Houston, TX
  • Clients across North America
Specialized in E-Scrap Industry
OSHA and DOT
  • Compliance Audits, Reviews, and Inspection Assistance
Industrial Hygiene
  • Air and Noise Monitoring
Safety
  • Safety Manuals and Written Programs
  • Training
Insurance Premium Reduction Programs
Worker’s Compensation Savings
SAFETY AND HEALTH HAZARDS

Safety Hazards (immediate)
- Strains, sprains
- Cuts, scrapes
- Struck by moving equipment

Health Hazards (longer term)
- Inhalation of hazardous substances
- Absorption of hazardous substances on skin
- Ingestion of hazardous substances left on hands
- Noise
Ergonomics (Strains and Sprains)

- Poorly Designed Shipping Containers
  - Gaylord Boxes and Super Sacks
- Excessively High Stacked Pallets
- Heavy Materials
- Disassembly
  - Awkward Postures
  - Repetitive Motions

EnvirOSH Services, Inc.®
www.envirosh.com
Ergonomics Engineering Controls

- Process Flow and Work Procedures
- Workstation Design and Layout
  - Container Locations - Throwing Materials
  - Workbenches – Height Adjustable
  - Lifting Aids
- Shipping/Receiving Containers
- Tools
ERGONOMICS WORKSTATION DESIGN
ERGONOMIC EVALUATION

- Industrial Athletes
  - CRT/TV Disassembly
  - Weight Lifted per Day
- Observe Workers
  - Wrist Positions
  - Repetitive Motions
- Standing All Day
  - Some Disassembly Job Sitting
  - Rotate Workers
Ergonomics Tool Design

- Poor Wrist Posture
  - Flexed Wrist
Ergonomic - Tool Design
MACHINE GUARDING (CUTS, ETC.)
“LETTER OF INTERPRETATION”

Machine did not have a guard; OR, It is so old, it is “grandfathered” and does not need a guard

“At the time of the inspection it was noted that the ...machines were not adequately guarded

- Citations which were issued under 29 CFR 1910.212(a)(3)(ii)

OSHA Response: “The requirements of the standard are that guards shall be designed and constructed so as to prevent employees from having any part of their bodies in the danger zone during the operation cycle. ..... We feel confident that an acceptable abatement will be derived by the company.”
Equipment Guarding

- Conveyors
  - Head and Tail Pulleys
  - Sides
- Rotating Shafts
- Rotating Belts
- Abrasive Wheels
LOCKOUT / TAGOUT PROGRAM
HAZARDOUS ENERGY CONTROL

- Equipment specific written procedures
- Required training certification
- Periodic (Annual) Inspections and Program review
  - Authorized Employee
  - Certify: ID Machine, Date, Inspector & Employee
Lockout / Tagout Hazardous Energy Control Program

- Lock with one key for each person on the line
- Covers all energy sources
  - Hydraulic
  - Pneumatic
  - Gravitational
  - Mechanical
  - Electrical
  - Thermal
  - Chemical
POWERED INDUSTRIAL TRUCKS (FORKLIFTS) (STRUCK BY MOVING EQUIPMENT)

- OSHA Required Training
  - Written Test
  - Skills demonstration
  - Retraining every 3 years
- Daily inspections
- Permanent aisles marked with sufficient safe clearance
FORKLIFTS - DOCK SAFETY

- Tractor Trailer Securement
  - Dock Locks
  - Wheel Chocks
  - Light Control System
  - Stand in Front of Tractor

- Dock Plates
  - Secured with side rails
  - Safe Lifting/Moving Method

- Entering Trailers
  - Load Shifting
  - Dock Lights – Trailer Floor Condition

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Material Handling and Storage

- Educating Customers
  - Staking Loads
  - Securing Loads in Trailers
- Pallet Stacking Heights
  - Cube the Trailer
  - Safe Method to Stack/Unstack
- Storage Racks
  - Documented Inspections
    - Not bent/damaged, secured, capacity posted
- Emergency Aisles & Exits Clear
Health Hazards

Health Hazards (longer term)
- Inhalation of hazardous substances
- Absorption of hazardous substances on skin
- Ingestion of hazardous substances left on hands
- Noise

Poor Hygiene Program
- Employee Turnover
- Class Action Suit
  - “Do We Sue’em, and How” Lawyers
  - Late Night TV ads and Billboards
WHAT IS THE DIFFERENCE?

Trash / Metal Recycling

Hazardous Substances

E-Scrap Recycling

www.envirosh.com
CDPH – FACT SHEET
“ELECTRONIC WASTE RECYCLING: WORKING SAFELY”

<table>
<thead>
<tr>
<th>E-waste component</th>
<th>Potential hazard</th>
<th>Potential health effects from long-term exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode ray tube (CRT) glass, batteries, solder, older</td>
<td>Lead dust</td>
<td>Anemia, kidney damage, high blood pressure, nerve and brain damage, miscarriage,</td>
</tr>
<tr>
<td>printed circuit boards</td>
<td></td>
<td>birth defects</td>
</tr>
<tr>
<td>Batteries, switches, thermostats, fluorescent tubes</td>
<td>Mercury vapor</td>
<td>Nerve and brain damage, birth defects</td>
</tr>
<tr>
<td>Nickel-cadmium batteries, printed circuit boards, phosphor coating on CRT glass</td>
<td>Cadmium dust</td>
<td>Kidney disease, bone problems, lung cancer</td>
</tr>
<tr>
<td>Older printed circuit boards</td>
<td>Beryllium dust</td>
<td>Lung disease, probably lung cancer</td>
</tr>
<tr>
<td>Plastic cases and parts</td>
<td>Flame retardant dust</td>
<td>Possible thyroid hormone problems</td>
</tr>
</tbody>
</table>
# Hazardous Substances in E-Waste

<table>
<thead>
<tr>
<th>Substance</th>
<th>Occurrence in e-waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Halogenated compounds:</strong></td>
<td></td>
</tr>
<tr>
<td>PCB (polychlorinated biphenyls)</td>
<td>Condensers, Transformers, Capacitors, Light Ballasts</td>
</tr>
<tr>
<td><strong>Fire Retardants:</strong></td>
<td></td>
</tr>
<tr>
<td>• TBBA (tetrabromo-bisphenol-A)</td>
<td>Fire retardants for plastics (thermoplastic components, cable insulation)</td>
</tr>
<tr>
<td>• PBB (polybrominated biphenyls)</td>
<td></td>
</tr>
<tr>
<td>• PBDE (polybrominated diphenyl ethers)</td>
<td></td>
</tr>
<tr>
<td><strong>Fluorocarbons</strong></td>
<td></td>
</tr>
<tr>
<td>• Chlorofluorocarbon (CFC)</td>
<td>Cooling unit, Insulation foam (refrigerators, air conditioners, etc.)</td>
</tr>
<tr>
<td>PVC (polyvinyl chloride)</td>
<td>Cable insulation</td>
</tr>
</tbody>
</table>
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<thead>
<tr>
<th>Substance</th>
<th>Occurrence in e-waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heavy metals and other metals:</strong></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>Small quantities in the form of gallium arsenide within light emitting diodes, printer/copier drums</td>
</tr>
<tr>
<td>Barium</td>
<td>CRT Getters, Plasma TVs</td>
</tr>
<tr>
<td>Beryllium</td>
<td>Power supply boxes which contain silicon controlled rectifiers, x-ray lenses, and some microwave oven magnetrons with ceramic insulators</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Rechargeable NiCd-batteries, fluorescent layer (CRT screen phosphor powder), printer inks and toners, photocopying-machines (printer drums)</td>
</tr>
<tr>
<td>Chromium VI</td>
<td>Data tapes, floppy-disks, Plasma TVs</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Plasma TVs and batteries</td>
</tr>
</tbody>
</table>

[www.envirosh.com](http://www.envirosh.com)
# Hazardous Substances in E-Waste

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<th>Substance</th>
<th>Occurrence in e-waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heavy metals and other metals:</strong></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>Wire, ribbons, CRT yokes, plasma TVs</td>
</tr>
<tr>
<td>Indium</td>
<td>LCD panels, flat panel displays, touch screens</td>
</tr>
<tr>
<td>Lead</td>
<td>CRT funnel, CRT frit, some plasma TVs, batteries, printed wiring/circuit boards</td>
</tr>
<tr>
<td>Lithium</td>
<td>Lithium batteries</td>
</tr>
<tr>
<td>Manganese</td>
<td>Batteries</td>
</tr>
<tr>
<td>Mercury</td>
<td>Fluorescent lamps - backlighting in LCDs, compact fluorescent lamps (CFLs), other lamps (metal halide, high pressure sodium, high intensity discharge (HID), mercury vapor, neon, ultraviolet, and others, digital light processing TVs (DLPs), some alkaline batteries, mercury wetted switches/relays, thermometers, thermostats, barometers, medical equipment, pressure or vacuum gauges, electronic games and toys</td>
</tr>
</tbody>
</table>
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<th>Occurrence in e-waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heavy metals and other metals:</strong></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>Rechargeable Nickel Cadmium (NiCd) batteries, Nickel Metal Halide (NiMH)batteries, CRT electron guns, Plasma TVs</td>
</tr>
<tr>
<td>Rare Earth elements (Yttrium, Europium)</td>
<td>Fluorescent layer (CRT-screen)</td>
</tr>
<tr>
<td>Selenium</td>
<td>Older photocopying-machines (photo drums)</td>
</tr>
<tr>
<td>Silver</td>
<td>Plasma TVs and other equipment</td>
</tr>
<tr>
<td>Zinc</td>
<td>Batteries, plasma TVs</td>
</tr>
<tr>
<td>Zinc sulphide</td>
<td>Interior of CRT screens, mixed with rare earth metals</td>
</tr>
</tbody>
</table>
## Hazardous Substances in E-Waste

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<thead>
<tr>
<th>Substance</th>
<th>Occurrence in e-waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acids and Caustics:</strong></td>
<td></td>
</tr>
<tr>
<td>Sulfuric acid</td>
<td>Lead acid batteries</td>
</tr>
<tr>
<td>Potassium hydroxide or sodium hydroxide</td>
<td>Batteries: Alkaline, nickel cadmium, nickel metal halide</td>
</tr>
<tr>
<td><strong>Coolants:</strong></td>
<td></td>
</tr>
<tr>
<td>Ethylene glycol and propylene glycol</td>
<td>Projection tubes</td>
</tr>
<tr>
<td>Silicon oils</td>
<td>Transformers</td>
</tr>
<tr>
<td>Aliphatic Polyalphaolein (PAO) fluids</td>
<td>Transformers and other electronics</td>
</tr>
</tbody>
</table>
## Hazardous Substances in E-Waste

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<tr>
<th>Substance</th>
<th>Occurrence in e-waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Particulates (Dusts, powders, etc.):</strong></td>
<td></td>
</tr>
<tr>
<td>Toner Dust</td>
<td>Toner cartridges for laser printers / copiers</td>
</tr>
<tr>
<td>Phosphor Coatings</td>
<td>CRTs and Lamps</td>
</tr>
<tr>
<td>Inks</td>
<td>Printers, copiers, All-in-One scanners</td>
</tr>
<tr>
<td><strong>Radioactive Substances:</strong></td>
<td></td>
</tr>
<tr>
<td>Americium</td>
<td>Medical equipment, fire detectors, smoke detectors</td>
</tr>
<tr>
<td>Radium</td>
<td>Medical equipment, smoke detectors</td>
</tr>
<tr>
<td>Tritium, Krypton-85, Promethium-147, Natural Thorium</td>
<td>High Intensity Discharge (HID) Lamps</td>
</tr>
<tr>
<td><strong>And Many More</strong></td>
<td></td>
</tr>
</tbody>
</table>
Phosphor Coatings
Fluorescent and Neon Lamps

Chemical Formulas (examples)
- \((\text{CeMg})\text{SrAl}_{11}\text{O}_{18}:\text{Ce}\)
- \((\text{Y,Gd})\text{MgB}_{5}\text{O}_{10}:\text{Ce,Pr}\)
- \(\text{Sr}_2\text{P}_2\text{O}_7:\text{Eu}\)
- \((\text{Ca,Zn,Mg})_3(\text{PO}_4)_2:\text{Sn}\)
- \((\text{Sr,Ba,Mg,Ca})_5\text{Cl}(\text{PO}_4)_3:\text{Eu}\)
- \((\text{Ba,Mg})_2\text{Al}_{16}\text{O}_{27}:\text{Eu}\)
- \(\text{Mg}_4(\text{F})(\text{Ge,Sn})\text{O}_6:\text{Mn}\)
- \((\text{Ce,Tb})\text{MgAl}_{11}\text{O}_{19}:\text{Ce:Tb}\)
CDC (Center for Disease Control) E-Scrap Studies

- NIOSH Health Hazard Evaluation (HHE) Program
  - Lead, cadmium, chromium, and noise
  - Ineffective engineering controls
  - Poor work practices
  - Dry sweeping
- Lead “take-home” exposures
- New Study Planned
  - Metals
  - Flame Retardants
# OSHA Citations - Lead

<table>
<thead>
<tr>
<th>Standard Cited</th>
<th>Allegations Brief Description Of Standard</th>
<th>Proposed Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910.1025 C01</td>
<td>Lead (air monitoring)</td>
<td>$6,930</td>
</tr>
<tr>
<td>1910.1025 E01 I</td>
<td>Lead (engineering controls)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 E03 I</td>
<td>Lead (written program)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 F02 I</td>
<td>Lead (respiratory protection program)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 D01 II</td>
<td>Lead (full shift air samples)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 D07</td>
<td>Lead (air sampling-if changes)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 G01</td>
<td>Lead (protective clothing)</td>
<td>$6,930</td>
</tr>
<tr>
<td>1910.1025 I02 I</td>
<td>Lead (change rooms)</td>
<td>$6,930</td>
</tr>
<tr>
<td>1910.1025 I03 III</td>
<td>Lead (no take home PPE)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 I03 I</td>
<td>Lead (require showering)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 I03 II</td>
<td>Lead (provide showering)</td>
<td>----</td>
</tr>
</tbody>
</table>
**OSHA Citations - Lead**

<table>
<thead>
<tr>
<th>STANDARD CITED</th>
<th>ALLEGATIONS Brief Description Of Standard</th>
<th>Proposed Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910.1025 H01</td>
<td>Lead (clean surfaces)</td>
<td>$6,930</td>
</tr>
<tr>
<td>1910.1025 H02 I</td>
<td>Lead (no compressed air cleaning)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 H02 II</td>
<td>Lead (cleaning floors)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1025 I04 II</td>
<td>Lead (lunchrooms-positive clean air)</td>
<td>$6,930</td>
</tr>
<tr>
<td>1910.1025 J01 I</td>
<td>Lead (medical surveillance program)</td>
<td>$6,930</td>
</tr>
<tr>
<td>1910.1025 L01 II</td>
<td>Lead (training)</td>
<td>$6,930</td>
</tr>
<tr>
<td>1910.1025 M02 I</td>
<td>Lead (signs)</td>
<td>----</td>
</tr>
<tr>
<td>1910.1200 H01</td>
<td>Hazard Communication (training)</td>
<td>----</td>
</tr>
</tbody>
</table>
DUST CONTROL
DRY MOPPING AND SWEEPING
“Sweeping Blindfolded”

- **Sweeping - Particle Sizes**
  - Visible particles
    - > 50 microns
  - Particle size inhaled into lungs
    - < 100 microns
  - Particle size inhaled deep into lungs
    - < 10 microns

- **Sweeping**
  - Can’t even see the truly hazardous particles

EnvirOSH Services, Inc.®

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COOLING FANS
COMPRESSED AIR “CLEANING”

- Not Cleaning
  - Simply Making Dust Airborne
  - Rearranges the Dust
- Cooling Fans
  - Stir Up the Dust

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HOUSEKEEPING
“CAPTURE IT – CONTROL IT”

- Engineering Dust Control Systems
  - Capture, Contain, Convey, and Collect
VENTILATION SYSTEMS
“CAPTURE IT – CONTROL IT”

- Ventilation capture hood design and use
  - 1 Duct Diameter
HOUSEKEEPING
“CAPTURE IT – CONTROL IT”

- Control It – Wet It
  - Handheld mist sprayers
  - Mops
  - Walk behind sweepers
  - Fixed spray misting nozzles

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LCD Mercury Tubes

- Mercury released
- Can volatilize for hours or days
- Leaving broken tubes exposed to wind currents allows mercury to float around the building
**ELIMINATE EXPOSURE KEEP MERCURY CONTAINED**

- Identify and segregate all E-Scrap containing mercury
- Do not allow mercury out (do not break open) device
  - Lamps, batteries, thermometer, switch, etc.
- Place in approved shipping container
- Send to mercury processing facility
  - Retort facility

[Images of hazardous waste labels and a shipping container]
ENGINEERING CONTROLS

- **Ventilation**
  - Exhaust outside and/or special air filtering
  - HEPA filters do not contain mercury vapors

- **Workstation disassembly table design**
  - Smooth, impermeable, dark surfaces
  - No cracks or crevices
OSHA Respiratory Protection Program

- Voluntary versus Required
- Comfort Masks versus Dust Masks
- Dust Masks versus Respirators
- Medically Qualified/Medical Evaluation
- User Seal Checks versus Fit Tests
- Annual Review Written Program
RESPIRATOR TYPES
Voluntary Use Respirators

- OSHA’s Respiratory Protection Program Appendix D
  - Follow Respirator Manufacturer’s Instructions
  - Use The Appropriate Respirator For the Air Contaminant of Concern
  - Do Not Wear A Respirator Into an Atmosphere That It Is Not Designed to Filter Out
  - Do Not Use Someone Else's Respirator

- Medically Qualified
  - Tight Fitting Respirator

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WRITTEN RESPIRATOR PROGRAM

- Worksite Specific Hazard Assessment
  - Basis for respirator Selection
- Written Program
  - Program Administrator
  - Respirator Selection
  - Cartridge change out schedule
  - Inspection, Maintenance, and Storage
- Medical Evaluations
- Annual Training and Fit Tests
- Annual Program Evaluation
  - Employee interviews
PERSONAL PROTECTIVE EQUIPMENT

- Safety Glasses
- Safety Work Boots
- Gloves
  - Impact and Cut Resistant
- Arm Guards
  - Cut Resistant
- Work Uniform
- Hard Hat
  - Only if Overhead Hazard Exists
- OSHA PPE Written program
  - Certified hazard assessments

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Hearing Conservation

- Written Program
- Annual Audiometric Testing
  - Read the Reports
- Annual Employee Training
- Hearing Protection
  - Available: 85 dB(A)-TWA
  - Required: 90 dB(A)-TWA
- Post the OSHA standard
HAZARD COMMUNICATION AND GHS

- Globally Harmonized System of Classification and Labeling of Chemicals
- Training (Dec. 2013)
  - Chemical Hazard Classification System
  - MSDS to SDS (16 sections)
  - Revised written program
NEW OSHA GHS LABELING

SPECIAL CHEMICAL PRODUCT

DANGER

Causes damage to the liver and kidneys through exposure to the skin
Wash hands after each use and before eating
Highly flammable liquid and vapour
Keep away from heat and ignition sources

FIRST AID

Call emergency medical care
Wash affected areas thoroughly with soap and water

DJH Chemicals, Inc. Nashua, NH 03062
Telephone: 603-598-1553

12345678
OTHER FREQUENT OSHA STANDARDS

- OSHA Poster
- OSHA 300 Log versus 300A
  - 7 Days and 5 years

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Emergency Action Plans

- Types of Emergencies
  - Fires
  - Medical Emergencies
  - Workplace Violence
  - Severe Weather
- Exits and Aisle ways
  - Marked, Aisle Ways Maps
- Assembly Points
  - Head Count
- Evacuation Drills
SAFETY TRAINING MATRIX

- Hazard Communication (once)
- Hazardous Energy Control Program
  - Equipment specific procedures (annual)
- Hearing Conservation (annual)
- Respiratory Protection (annual)
  - Voluntary use – OSHA’s Appendix D
  - Required Use
- Personal Protective Equipment (once)
- Powered Industrial Trucks (3 years)
- Bloodborne Pathogens (annual)
- Fire Extinguishers (annual)
SUMMARY

- E-Scrap Processing is Hazardous
- Use Services of Qualified Experts
  - CIH – Certified Industrial Hygienist
  - CSP – Certified Safety Professional
- Questions
  - Lloyd B. Andrew III, CIH, CSP
  - Phone: 281-290-8309
  - Website: www.envirosh.com
  - Email: lloyd.andrew@envirosh.com
QUESTIONS?

PLEASE USE THE GO TO WEBINAR DIALOGUE BOX