Industrial Machinery Safety and Safety Program Development

Milpitas, CA 95035
www.lewisbass.com
Lewis Bass International is a Safety Engineering Firm

*Product Liability Prevention*: machine design, manuals and safety label reviews

LBI helps companies produce machinery that can meet complicated safety regulations of both the US, European and Asian marketplace
An engineering consulting firm with expertise in mitigating machinery hazards including:

- Electric shock
- Energy
- Mechanical
- Fire
- Toxics
- Corrosives
If we were Tylenol, what headache would you want us to get rid of?
And if you thought you had headaches...
Presentation Topics

- What is an AHJ?
- What are their Duties and Responsibilities?
- Who regulates the safety of machinery?
- How does LBI certify a machine?
- What exactly is a field label?
- What proves code compliance?
- What does a typical machine inspection consist of?
- What are the consequences of unchecked machinery?
- How does the Fire Department come into play?
- Why do a Hazard Analysis?
- What Safety Programs must be in place in our facility?
- What about the future?
What is an AHJ?

AHJ = Authority Having Jurisdiction
Building Inspectors
Fire Marshals
Mechanical Inspectors
What are their Duties?

Duties:
- Inspect their areas of the City/County for safety compliance
- Cite infractions to codes
- Sign off on permits for their area
- Final inspections
- Delegate necessary inspections to independent 3rd Parties
Responsibilities:
- Ensure facilities are safe to occupy
- Ensure equipment is installed safely for usage
Who regulates the safety of machinery?

- AHJ
  - Electrical Inspector
  - Mechanical
  - Fire

- Federal OSHA and California OSHA
Difference between OSHA and AHJ’s

OSHA regulates worker safety in the workplace & AHJ’s regulate the safety of the building and the installation of machinery in the building

Note: Cal OSHA has extensive rules on accident prevention, electrical safety, machine guarding, & hazardous materials
How does LBI certify a machine?

<table>
<thead>
<tr>
<th>Category</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>Field Label</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Safety Review</td>
</tr>
<tr>
<td>Chemical</td>
<td>Hazard Analysis</td>
</tr>
<tr>
<td>Seismic</td>
<td>Seismic Calculations</td>
</tr>
<tr>
<td></td>
<td>Seismic Analysis</td>
</tr>
<tr>
<td>Manuals</td>
<td>Usage and Operation Safety Review</td>
</tr>
<tr>
<td>Safety Warnings</td>
<td>Labeling</td>
</tr>
</tbody>
</table>
What makes a machine reasonably safe?

- Built according to recognized standards
- Reviewed by a competent “third party”

California Code of Regulations (CCR) title 8, section 3206 specifically states: "When the term “approved” is used in these orders, it shall refer to products, devices, systems, or installations that have been approved, listed, labeled, or certified as conforming to applicable governmental or other nationally recognized standards, or applicable scientific principles. The approval, listing, labeling, or certification of conformity, shall be based upon an evaluation performed by a person, firm, or entity with appropriate registered engineering competence or by a person, firm, or entity, independent of the manufacturer or supplier of the product, with demonstrated competence in the field of such evaluation.”
What about foreign machines?

- Many machines designed in Europe, China and Japan do not meet US codes and standards.

- A machine designed for CE (European safety mark) or other international marks may not meet US codes and standards.

- Have you had any listed machines from foreign countries that were labeled but didn’t pass inspection here?
Field Labeling

- Inspects **ONLY** the electrical parts of unlisted machinery – Does not include chemical or mechanical

- Field Labeling requires a 3rd Party, which is anyone sanctioned by the cities to do the inspection
Typical Permit Procedure

- The building contractor takes the plan to the AHJ to pull a permit.
- The plan checker adds a condition for third party label on “unlisted” machinery (often improperly requiring a NRTL label such as UL, ETL, or CSA as they use these terms synonymously with field labeling).
- The electrical contractor installs the wiring up to the machine (disconnect point).
- LBI reviews manuals, schematics & B of M, inspects, tests, and provides checklist of what needs to be fixed, & once fixed, puts a field label on the machinery.
- The AHJ gets a report and signs off the permit.
What are the typical things that fail inspection?

- Nameplate
- Warning labels
- Conductors
- EMO buttons
- Interlocks
- Outlets and lighting
Types of things inspected

- Labels must meet ANSI Z535.4
  - Notice, warning, caution, danger
  - Color, icon, and message
- Labels required for:
  - High voltage
  - Disconnect
- Arc Flash situation:
  - Energized maintenance
  - Approach boundaries: limited, restricted, prohibited
  - Clothing for flash protection
- Power conductor gauge is determined by:
  - Full load current
  - Insulation type (make sure all wires are rated for the highest voltage)
  - Number of wires in a cord or conduit or tray
- Earth ground is determined by the circuit breaker size.
  - Earth ground can often be a smaller gauge.
  - The purpose is to trip the breaker, not to stay cool.
  - A bolt is not for conducting. Don’t stack a wire between two nuts.
More inspection items

- Power cords are de-rated.
  - Bigger gauge compared to wires in conduit.
- Clean room wire has special insulation
  - Often requires FM4910 rating (low smoke generation).
- Emergency stop button
  - Covers kinetic energy (motion and jamming)
- Emergency off button
  - Covers potential energy (voltage)
- EMO is a combination of the two.
  - Required if the hazard can exist.
  - Must be conveniently located.
  - EMOs are red on yellow, and latching.
  - EMOs and interlocks must work by holding up a voltage (so they fail to a safe condition)
  - Resetting the EMO cannot cause an automatic restart.
- Power cabinets must implement one or more of the following three safety features:
  - The cabinet door must be interlocked to automatically drop the power, or
  - The cabinet door must have a key or custom tool to open, or
  - The cabinet door must be 100% completely guarded for high voltage
What proves code compliance?

- Inspection and Certification Evidence
  - A listing mark
  - A field label
  - A safety report
What are the AHJ’s enforcement options?

- Consequences of not having a completed inspection:
  - AHJ may not permit the equipment to be used for production
  - Delay in startup/use
  - May domino effect to delay building sign-off

- What other options does the AHJ have at their discretion?
  - They may grant Limited Usage or Off hour usage. The machinery can also be used to train on but **no production**, used for preparation of inspection and install to make sure it works.
Consequences of Uninspected Machinery

- Electrocution
- Fires
- Chemical Leaks
How does the Fire Department come into play?

- Fire department inspectors role in occupancy:
  - Different occupancies have different rules
  - Fire prevention
  - Hazardous materials
What about HAZMAT?

- Hazmat falls under the Fire Department in most jurisdictions
- Some Cities require a Hazmat report (e.g. San Jose)
- Others require a 1 page memo
Why Are Hazmat Studies Important?

- Our valley has the most concentrated amount of toxic chemicals and gases in the whole state

- Potential issues:
  - Fire, chemical spills, accidental released of gas, earthquakes, a combination of all of above
Just how dangerous is DANGEROUS?

- Biomed:
  - Huge production of chemicals used for drugs
  - Release of viruses into the environment
More Dangers

- Chemicals used in Photovoltaic Solar Cells:
  - Hydrofluoric Acid – Highly Corrosive (kills you if it gets on 5% of your body in high enough concentrations)
  - Selenium – When combined with other elements can be more toxic than Arsenic (Hydrogen Selenide is one example)

- Gases & chemicals used in semiconductor:
  - Phosphene – very poisonous
  - Arsine – gaseous form of arsenic
  - Boron – poisonous & flammable
  - Silane – Very flammable (burns at room temperature)

- Refineries
With the advent of new technologies, many AHJ’s & Fire Dept. must work closely together.

No city wants to be the lead story on the 7 o’clock news because of a catastrophe.

If a machine has a heated chemical bath, and the heater is not listed, then the Fire Department in most cities require that the heater be inspected and labeled. In our reports, that would be included in the reports given to the AHJ’s as well.
The objectives of the Building Department and the Economic Development Department of a city may sometimes seem to be in conflict.

What happens when the City Inspector and the tenant disagree?
- Alternate Means and Methods (we meet the intent of the requirement by adding these additional interlocks, detectors, etc.)
- Escalate to the Chief (not usually effective)
More cities are outsourcing the expertise as a means of handling budget constraints.

Increasingly complex machinery, standards & codes changes require specialized expertise.

What’s next...can we even imagine?
For cities:
- Field labeling of unlisted machinery
- Hazmat using Hazard analysis:
  - Typically an end-to-end review
  - Guided by a “top event” like fire, explosion, or toxic
  - Qualitative “what if?” questions and consequences
  - Safeguards to prevent accidents

Benefits for the cities are:
- Completed reports within 1-2 days following certification
- Understanding and controlling the risks
For manufacturers:
- Certification of machinery
- Workplace safety consultation:
  - OSHA requirements
  - Worker safety training
  - Policies and procedures
  - Arc flash training, analysis & calculation
- Design consulting

Benefits for the manufacturers are:
- Much faster installation and permit approval
- Cost effective (compared to NRTL’s), also no destructive tests
- Reduced risk of accidents
- A more common, lower cost design that works in all the various markets
After showing their Compliance Safety and Health Officer credentials at the opening conference, they will discuss why they are there (employee complaint, compliance safety and health officer saw a violation while passing by, you are a targeted high hazard industry, a recent serious injury, etc.)

First thing a Cal/OSHA inspector is likely to request is your IIPP (Injury Illness Prevention Plan). They want to see that it is current, covers the minimum required program elements, and is not just a plan that sits in a binder in the office but is effective. Based on your specific business, you are expected to determine what risks may be present and develop programs to minimize them. LBI can help.

The next thing they will likely ask for is your Cal/OSHA log of accidents and illnesses.

Then training records.

Then they will look to see if you have the required legal postings up.

Then anything else may be within their scope up to a wall-to-wall...
1. 1926.451 – Scaffolding - (same rank as 2009) - 9,093 violations - Scaffold accidents most often result from the planking or support giving way, or from the employee slipping or being struck by a falling object.

2. 1926.501 – Fall Protection - (same rank as 2009) - 6,771 violations - Any time a worker is at a height of four feet or more, the worker is at risk and needs to be protected. Fall protection must be provided at four feet in general industry, five feet in maritime and six feet in construction.

3. 1910.1200 – Hazard Communication - (same rank as 2009) - 6,378 violations - Chemical manufacturers and importers are required to evaluate the hazards of the chemicals they produce or import, and prepare labels and safety data sheets to convey the hazard information to their downstream customers.

4. 1910.134 – Respiratory Protection - (same rank as 2009) - 3,803 violations - Respirators protect workers against insufficient oxygen environments, harmful dusts, fogs, smokes, mists, gases, vapors and sprays. These hazards may cause cancer, lung impairment, other diseases or death.

5. 1926.1053 – Ladders - (was #7 in 2009) - 3,072 violations - Occupational fatalities caused by falls remain a serious public health problem. The US Department of Labor (DOL) lists falls as one of the leading causes of traumatic occupational death, accounting for eight percent of all occupational fatalities from trauma.
Fed/OSHA’s Top 10 List for 2010

6. 1910.147 – Lockout/Tagout- (was #5 in 2009) - 3,321 violations - "Lockout-Tag out" refers to specific practices and procedures to safeguard employees from the unexpected startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

7. 1910.305 – Electrical, Wiring Methods - (was #6 in 2009) - 3,079 violations - Working with electricity can be dangerous. Engineers, electricians and other professionals work with electricity directly, including working on overhead lines, cable harnesses, and circuit assemblies. Others, such as office workers and sales people, work with electricity indirectly and may also be exposed to electrical hazards.

8. 1910.178 – Powered Industrial Trucks - (was #8 in 2009) - 2,993 violations - Each year, tens of thousands of injuries related to powered industrial trucks (PIT), or forklifts, occur in US workplaces. Many employees are injured when lift trucks are inadvertently driven off loading docks, lifts fall between docks and an unsecured trailer, they are struck by a lift truck, or when they fall while on elevated pallets and tines.

9. 1910.303 – Electrical, General Requirements - (was #9 in 2009) - 2,556 violations - Working with electricity can be dangerous. Engineers, electricians, and other professionals work with electricity directly, including working on overhead lines, cable harnesses, and circuit assemblies. Others, such as office workers and sales people, work with electricity indirectly and may also be exposed to electrical hazards.

10. 1910.212 – Machine Guarding - (was #10 in 2009) - 2,364 violations - Any machine part, function, or process that may cause injury must be safeguarded. When the operation of a machine or accidental contact injures the operator or others in the vicinity, the hazards must be eliminated or controlled.
1. **IIPP – 397 violations.** This is the top level document a company must have in California that outlines its safety program. From a Cal/OSHA standpoint, not only must you have an IIPP in place, it must be *effective, which includes employee involvement and training.*

2. **Lockout/Blockout – 316 violations.** Any time equipment is being cleaned, maintained, set-up, or adjusted, electrical (lockout) and mechanical (blockout) energy must be controlled to prevent unexpected start-up.

3. **Air Tanks – 461 violations.** Air tanks, which are pressure vessels, require a permit issued by DOSH (Department of Occupational Safety & Health) to be in operation.

4. **Portable Fire Extinguishers – 166 violations.** Issues regarding placement, use, maintenance, and testing of portable fire extinguishers provided for use by employees.

5. **Electrical Equipment Clearance – 149 violations.** Sufficient clearance must be provided around all electrical equipment for safe operation and maintenance.

6. **Respiratory Protection – 141 violations.** Respirators protect workers against insufficient oxygen environments, harmful dusts, fogs, smokes, mists, gases, vapors, and sprays. Employers need to have a written respiratory protection program and it needs to be part of the company’s IIPP.

7. **Control of Hazardous Materials – 128 violations.** Employers are required to prevent or minimize the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals.

8. **Hazard Communication (HazCom) – 115 violations.** Employers must provide information to their employees about the hazardous substances to which they may be exposed. This includes a written hazard communication program, labels and other forms of warning, material safety data sheets (MSDS), information, and training.
9. **Emergency Eyewash and Shower Equipment – 113 violations.** Eyewash equipment must be provided at all work areas where, during routine operations or foreseeable emergencies, the eyes of an employee may come in contact with a substance that can cause corrosion, severe irritation, permanent tissue damage, or which is toxic by absorption. An emergency shower must be provided at all work areas where, during routine operations or foreseeable emergencies, areas of the body may come in contact with a substance which is corrosive, severely irritating to the skin, or which is toxic by skin absorption.

10. **Powered Industrial Truck Operator Training – 103 violations.** All employees, prior to operating powered industrial trucks (e.g., forklifts, etc.), must be trained and evaluated by successfully completing a training program.
NFPA 70E the “Standard for Electrical Safety in the Workplace” is considered an industrial consensus standard and is intended for use by employers, employees, and OSHA. OSHA has not “adopted” NFPA 70E simply because adoption would require the lengthy and expensive process outlined in Section 6(b) of the OSHA Act. OSHA has instead referenced compliance to NFPA 70E using Section 5(a)(1) of the Occupational Safety and Health Act of 1970, commonly referred to as the “general duty clause,” as their basis for implementation. The general duty clause states that employers “shall furnish to each of its employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees.” Cal/OSHA has the equivalent in Injury and Illness Prevention Program (IIPP) in Section 3203.
In a recent standard interpretation letter dated 7/25/03, OSHA’s Russell Swanson stated: “Industry consensus standards, such as NFPA 70E, can be used by employers as guides to making the assessments and equipment selections required by the standard. Similarly, in OSHA enforcement actions, they can be used as evidence of whether the employer acted reasonably.” It is clear from the above evidence that OSHA is using NFPA 70E as an industrial consensus standard. Further, OSHA expects employers and employees to comply with the provisions of NFPA 70E regardless of whether or not it has been “adopted” as an OSHA requirement. They are not officially adopting it, or making it part of the code. But, they will certainly be using it to determine if you are protecting your employees.
Regulated Carcinogens

§ 5200. Methyleneedianiline
§ 5201. 1,3-Butadiene
§ 5202. Methylene chloride
§ 5206. Chromium (VI)
§ 5207. Cadmium
§ 5208. Asbestos
§ 5209. Carcinogens
  • 2-Acetylaminofluorene
  • 4-Aminodiphenyl
  • Benzidine (and its salts)
  • 3,3'-Dichlorobenzidine (and its salts)
  • 4-Dimethylaminoazobenzene
  • alpha-Naphthylamine
  • beta-Naphthylamine
  • 4-Nitrobiphenyl
  • N-Nitrosodimethylamine
  • beta-Propiolactone
  • bis-Chloromethyl ether
  • Methyl chloromethyl ether
  • Ethyleneimine

§ 5210. Vinyl Chloride
§ 5211. Coke Oven Emissions
§ 5212. 1,2 Dibromo-3-Chloropropane (DBCP)
§ 5213. Acrylonitrile
§ 5214. Inorganic Arsenic (arsine gas)
§ 5215. 4,4-Methylenebis (2-Chloroaniline)
§ 5216. Lead
§ 5217. Formaldehyde
§ 5218. Benzene
§ 5219. Ethylene Dibromide (EDB)
§ 5220. Ethylene Oxide

ALL have special requirements from reporting of use in writing to Cal/OSHA, labeling, air monitoring of the worker’s exposure, etc.
I don’t think 2 Tylenol would handle this...
LBI may assist you to avoid these headaches
Thank you!

408.942.8000
www.lewisbass.com