

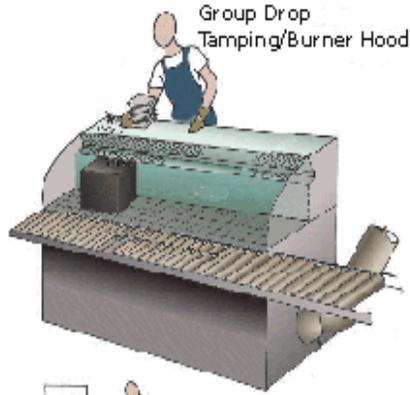
# Lead Battery Manufacturing

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## Battery Assembly

Battery assembly combines the plates (see [Plate Processing](#)), container, and other parts into a functional battery. Battery charging is also an important part of assembly.

- [Stacking](#)
- [Group Burning](#)
- [Intercell Welding and Post Burning](#)
- [Formation](#)



[View larger diagram of group drop, tamping, and burning hood.](#)

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## Battery Assembly > Stacking

After curing, the plates are stacked either by hand or by machine so that positive and negative plates alternate with an insulating separator in between. The major source of lead exposure in the stacking process is from oxide from the plates which can become easily airborne.



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### Stacking

#### Potential Sources of Exposure

- Exposure to lead dust may occur from improperly handling plates in unsealed envelopes.
- Tamping plates in unventilated areas, such as the rack, creates a puff of dust.
- Lead oxide that accumulates on equipment, racks, and floors may become airborne.
- Clearing stacking equipment jam-ups.
- Exposure to lead may increase when scrap plates are handled improperly.
- Leaning against equipment may increase clothing contamination.
- Exposure to lead may increase from emptying clean-out trays improperly.
- Lead dust may escape from the stacking machine if the hinged panels are not closed.



Figure 1  
Ventilated scrap barrel



Figure 2  
Contaminated clothing

## Possible Engineering Controls

- Use downdraft or slot ventilation at workstations.
- Provide a grating or a perforated plate tamping stand.
  - ▶ [Stacking table, single exhaust booth hood](#)
  - ▶ [Stacking, slant stacking station \(industrial\)](#)
- Use a ventilated scrap barrel (Figure 1).
- Use a central vacuum drop.
  - Consider adding particulate drop out points so that large particles will drop out and not plug the lines.
- Provide exhaust ventilated storage rack.
  - ▶ [Plate storage rack hood](#)
- Place pallets of plates on a rotating base.
- Use local exhaust ventilation with machines that use shuttles for moving plates.
  - These machines may have higher airborne levels due to abrasion of the plates.
- Use a [laminar flow \(supplied-air\) island](#) over operators workstation.
- Provide a plastic or glass, see-through plate between the stackers breathing zone and the plates.
- Provide rubber mats or grated walking surfaces.



Figure 3  
Central Vacuum drop station



Figure 4  
Hand stacking

## Possible Work Practice Controls

- Tamp, break, or separate plates only in ventilated work areas.
- Handle groups of plates with the hands only rather than leaning them against the stomach, chest, or chin.
- Wear an apron (Figure 2).
- Maximize the distance between the operators breathing and the plates by not stacking assembled groups more than three high.
- Place, do not throw, defective plates into scrap barrel.
  - ▶ [Scrap handling, barrel/drum exhaust hood](#)
- Cover drums with a plastic bag before removing them from the area.
- Keep access doors and other openings closed.
- Provide adequate PPE, a change of clothes, and shower rooms (see [OSHA Lead Requirements for PPE, Housekeeping, and Hygiene Facilities](#)).

- Maintenance:
  - Ensure ventilation is working properly.
  - Prevent cross drafts.
- Housekeeping:
  - Vacuum work station and adjacent areas to prevent accumulation of oxide dust.
  - Vacuum off each row of plates before using.
  - Use dust suppression techniques, such as keeping floors wet, using dust suppression compounds, or vacuuming.
  - Vacuum clean-out trays (Figure 3); do not dump them into barrels.

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## Battery Assembly > Group Burning

After the plates have been stacked, they are joined with small connecting parts and burned together to form cell elements or groups. This operation is conducted either manually at a burning station or by using an automatic cast-on-strap (COS) machine. The major source of lead exposure in the group burning process comes from lead fumes that workers may come into contact with during the following operations:



Group burning operation

- o [Automatic COS Machines](#)
- o [Manual Group Burning](#)
- o [Group Repair Operations](#)
- o [Cleaning Molds](#)
- o [Adjusting/Repairing Equipment](#)

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### Automatic COS Machines

#### Potential Sources of Exposure

- o Exposure to lead may increase from handling dry plates or moving plates in and out of the workstation.
- o Lead oxide that accumulates on racks, equipment, and floors may become airborne.
- o Lead particles may become airborne when groups are dropped into the cases.
- o Lead particles may become airborne during cleaning and roughing with a wire brush.
- o Increased exposure to lead may occur during dressing or feeding the lead pot.



Figure 1  
Ventilated COS machine



Figure 2  
Vacuum plates before use

#### Possible Engineering Controls

- o Install down draft or slot ventilation at the feed end (Figure 3).
  - ▶ [Stacking table, single exhaust booth hood](#)
- o Enclose machine in a ventilated room (Figure 4).
  - ▶ [Cast on strap \(Farmer\), total enclosure w/ exhaust](#)
  - ▶ [Cast on strap \(Dynacast II\), emission controls](#)

- Provide an access door for maintenance and a small port for drossing and loading the lead pot.
- Provide local exhaust ventilation at the melting pot, mold heating section, dross pot, lug brush, and the casing areas.
- Position ventilation slot in the direction of the generated lead particulate, not behind the brush.
- Install an exhausted semi-enclosure around the brush to help collect particulate entrained in the brush.
- Install a laminar flow (supplied-air) island above the workstation.
- Use slot ventilation at burning and group dropping stations.
- Use an enclosed Lazy Susan for holding the stacked groups for the team stack and burn operations.
- Place a plastic sheet at the stacking side to control the height of the stacks and prevent cross drafts.
- Provide an exhaust ventilated enclosure for the lead pot and dross container.



**Figure 3**  
Tamp plates over ventilated work station



**Figure 4**  
Enclosed COS machine



**Figure 5**  
Automatic COS machine

### **Possible Work Practice Controls**

- Avoid setting torches at excessive temperatures.
- Tamp plates only over ventilated workstations (Figure 3).
- Do not bang plates excessively.
- Use a grating or perforated plate tamping stand.
- When dropping groups into container, place opening toward exhaust ventilation.
- Handle groups only with hands; do not lean them against the stomach, chest, or chin.
- Wear an apron.
- Maximize the distance between the operators breathing zone and the plates by not stacking assembled groups more than three high.
- Stand on platform when practical.
- Keep openings to a minimum.
- Close access doors.

- Place, do not throw, defective plates into a ventilated scrap barrel.
  - ▶ Scrap handling, barrel/drum exhaust hood
- Cover drums with a plastic bag before removing.
- Provide rubbers or gratings for walking surfaces.
- Provide adequate PPE, a change of clothes, and shower rooms (see OSHA Lead Requirements for PPE, Housekeeping, and Hygiene Facilities).
- See Grid Production and Parts Casting for additional possible engineering and work practice controls.
- Maintenance:
  - Ensure ventilation is working properly.
  - Prevent cross drafts.
  - Substitute cooler flames such as air-propane or air-MAP gas for oxy-acetylene.
  - Change torch head to decrease time required for burning.
  - Provide a plastic or glass plate between the breathing zone and the plates.
- Housekeeping:
  - Vacuum work stations and adjacent areas to prevent accumulation of oxide dust.
  - Vacuum off each row of plates or groups before use.
  - Vacuum tops of plate trays.
  - Vacuum clean out trays (do not dump them into barrels).
  - Use dust suppression techniques such as keeping floors wet, using dust suppression compounds, or vacuuming.

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## Manual Group Burning

### Potential Sources of Exposure

- Exposure to lead fumes may occur when burning with torches.
- Exposure to lead may result from moving groups in and out of the workstation and in and out of the burning box.
- Lead cross contamination can occur between the stacking and the burning stations during the manual group burning process.
- Lead particles may become airborne when groups are dropped into the cases.



Figure 5  
Exhaust burning box

- Exhaust ports of pneumatic systems may cause settled dust to become airborne.

### Possible Engineering Controls

- Place the opening toward exhaust ventilation when dropping groups into a container.
  - ▶ [Group drop, tamping/burner hood](#)
  - ▶ [Stack and burn, bench hood](#)
- Use down draft or slot ventilation at the work station.
- Install a rotating rack so the operator does not need to lean over contaminated racks to reach groups.



Figure 6  
Manual post burning operation

- Exhaust the burning box for both fume and dust (Figure 5).

- ▶ [Tiegal machine, enclosure assembly](#)
- ▶ [Tiegal anchor, sinking machine](#)



Figure 7  
Ventilated torch

- Use local exhaust ventilation around torch head (Figure 8).
  - ▶ [Post burning, portable tool exhaust](#)
- Use slot ventilation at burning and group dropping stations.
- Use a smaller torch tip to lower fume exposure.
- Use an enclosed Lazy Susan to hold the stacked groups for the stacking and burning operations.
- Use a [laminar flow \(supplied-air\) island](#) above the operators workstation.

### Possible Work Practice Controls

- See Work Practice Controls for [Automatic COS Machines](#).

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## Group repair operations

### Potential Sources of Exposure

- Exposure to lead may occur while repairing groups.

### Possible Engineering and Work Practice Controls



Figure 8  
Handle groups carefully

- Handle groups only with hands (Figure 8).
- Do not lean groups against the stomach, chest, or chin.
- Wear an apron.
- See [Protective Clothing and Equipment](#).
- See [Battery Repair](#) for addition possible engineering and work practice controls.

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## Cleaning molds

### Potential Sources of Exposure

- Lead particulate may become airborne while cleaning molds using compressed air or torches.



Figure 9  
Clean molds carefully

### Possible Engineering and Work Practice Controls

- Clean molds using alternative methods, such as vacuuming, that do not produce airborne lead particulate (Figure 9).
- Use local exhaust ventilation around torch head.
  - ▶ [Post burning, portable tool exhaust](#)
- Use portable side draft or slot ventilation.

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## Adjusting/Repairing equipment

### Potential Sources of Exposure

- Lead exposure may increase while adjusting and repairing equipment, or during changeovers.

### Possible Engineering and Work Practice Controls

- Ensure ventilation is working properly.
- Prevent cross drafts.
- Wear an apron.
- See [Protective Clothing and Equipment](#).

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### Battery Assembly > Intercell Welding and Post Burning

After workers place all the groups in the battery case, the straps are fused together using a torch or high electrical power source. This process can also be done through the partition (TTP), using a case that has been punched. The connections are then welded. The units are tested and the posts are attached. The major source of lead exposure in the intercell welding process comes from lead fumes.



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### Intercell Welding and Post Burning

#### Potential Sources of Exposure

- Lead fumes are emitted during the manual burn welding process. This is a minimal source of exposure for through the partition (TTP) welding.
- Exposure to lead may occur from manual handling of burning jigs or contaminated dams.
- High lead exposure may occur when repairing batteries.
- Contaminated air from other areas may be exhausted into the work station as a result of exhausting too much air from a other workstations.
- Lead particles may become airborne if the pressure of the torch flame is too high.



Figure 1  
Ventilated torch

#### Possible Engineering and Work Practice Controls

- Use local exhaust ventilation around the torch or provide a portable welder exhaust hood on a monorail or other configuration connected to a suitable exhaust collection system (Figure 1).
  - ▶ [Post burning, portable tool exhaust](#)
  - ▶ [Post tacking, portable hood](#)
  - ▶ [Post/intercell burning, backdraft hood](#)
- Use a plastic or glass see-through guard between the breathing zone and the conveyer carrying the battery.
- Use canopy or slot hoods if lead pots are used.
- Use a down draft or slot hood ventilated workstation when performing battery assembly (Figure 1).

- Install a laminar flow (supplied-air) island above workstation.
- Keep torch hose lengths to a minimum to prevent employee from working outside the ventilated area.
- Keep burning temperatures low by substituting air-propane or air-MAP gas for oxy-acetylene flames.
- Provide adequate PPE, a change of clothes, and shower rooms (see OSHA Lead Requirements for PPE, Housekeeping, and Hygiene Facilities).

#### **Possible Engineering and Work Practice Controls**

- Ensure ventilation is working properly.
- Perform battery repair at a ventilated workstation.
- Vacuum oxide spills immediately with a central vacuum system or HEPA vacuum.
- Avoid pointing torch flame into battery containers whenever possible.

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## Battery Assembly > Formation

In the dry charge (plate) formation process, the first step, called tacking consists of plates being placed in a tank and lead bars being welded, or "tacked" on. Battery plates are then formed (or charged) in tanks. The major source of lead exposure in the formation process comes from lead fumes. Wet (case) formation does not include any associated lead exposures during formation because batteries are assembled and filled with acid prior to charging.



Batteries being charged in the wet formation process

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### Formation

#### Potential Sources of Exposure

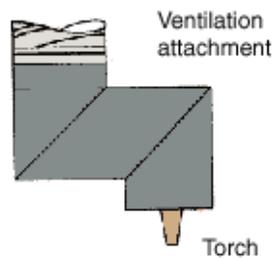
- Lead fumes are emitted from using a torch to weld lead.
- High exposure to lead may occur from moving plates in and out of acid tanks, drying ovens, and racks.
- Exposure to acid splash or mist may occur when placing the plates in the acid tanks.
- Lead dust may become airborne during the cleaning of panel lugs using brushes.

#### Possible Engineering Controls

- Use local exhaust ventilation on the torch.
  - ▶ [Post burning, portable tool exhaust](#)
- Cover and ventilate tanks while tacking.
- Use the "tackless formation" process.
- Provide adequate PPE, a change of clothes, and shower rooms (see [OSHA Lead Requirements for PPE, Housekeeping, and Hygiene Facilities](#)).

#### Possible Work Practice Controls

- Ensure ventilation is working properly.
- Wet down plates before they are put into the system.
- Use fork lifts to move groups in and out of drying ovens.
- Use instruments to move plates in and out of tanks.
- Vacuum racks and ovens before moving plates.
- Keep floors around ovens, racks, and storage areas clean.



[View larger image of exhaust ventilated torch](#)



Figure 1  
Formation area

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