

# Radiation Therapy Mold Room Safety



PO Box 320 / Orange City, Iowa 51041 / USA

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*Throughout the medical community, health and safety in the workplace have become areas of significant concern — especially in the mold room. Exploring mold room safety and reviewing all areas of potential hazards is important. It is also imperative to address personal safety and regulatory compliance. This booklet explores these issues. If you have any questions concerning procedures or equipment, please call CIVCO at 800.842.8688.*

# Mold room safety tips

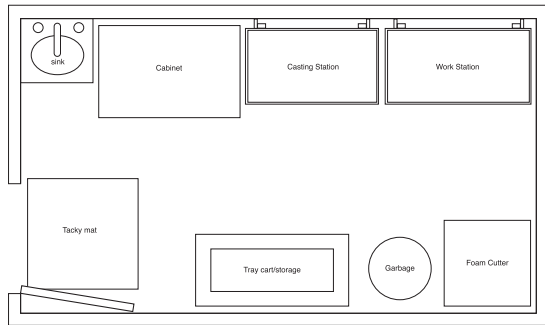
- a.) 1. Wear protective clothing
  - apron, lab coat or smock
  - cover hair with a cap
2. Wear gloves
  - NOTE: leather gloves are recommended for 203°F alloy.
3. Wear a respirator when filling or filing blocks, or an air quality test is required. Before using the respirator, the wearer must first be trained by the employer in proper respirator use in accordance with applicable safety and health standards. Leave the contaminated area immediately if you become dizzy, have impaired breathing, or experience any other distress. OSHA standard 29 CFR 1910.134(e)(5) requires that the respirator wearer be fitted properly.
4. Wear eye protection.
5. Leave all of the above protection devices in the mold room at all times.
- b.) Alloy melter temperature should be checked daily to confirm proper temperature adjustment.
- c.) Alloy dross or skimming should be collected and periodically recycled.
- d.) Minimize spills and splashes which create additional alloy dust and cleanup.
- e.) Minimize vigorous filing and sanding of blocks. Minimize “hot” repairs of cavities. Always wear a respirator for these operations.
- f.) Always use a vacuum for cleanups and avoid sweeping. A HEPA vacuum is recommended.
- g.) Do not eat, drink, or smoke in the mold room.
- h.) After completion of work in mold room, wash face, hands, and arms.
- i.) Confirm daily that all engineering controls are working and that safety procedures are being followed.

# Mold room layout

A mold room is actually a specialty workshop and manufacturing facility. We think in terms of efficiency, convenience, safety, and manufacturing capacity when designing the “ideal” mold room. No matter how the mold room is physically laid out, every mold room contains at least three main areas: a hot-wire foam cutter, an alloy melter and a casting plate and block breakout/detailing area. These are the “work stations.”

It is often the little things in the mold room that get overlooked — and can create significant problems in the future. Here are some tips to keep in mind for good mold room design and safety: air should be exchanged five to six times per hour to remove harmful fumes and dust; the door should be kept closed at all times; a tacky mat should be by the door to keep contaminants from leaving the room; a freestanding sink should be installed to prevent lead/cadmium from entering the water stream; all surfaces should be non-porous and smooth for easy cleaning; regular air sampling tests should be taken.

1. Strip old trays
2. Cut foam
3. Cast block with alloy
4. Discard foam, work the block to fit tray
5. Store completed blocking trays
6. Always wash hands before leaving



**Sample mold room**

# Engineering Controls

The mold room should be a separate room in which the only function is to construct shielding blocks. The door to the mold room should be kept closed at all times.

The mold room should be fitted with a return air vent connected to the HVAC system. By slightly closing the air vents into the room, a negative air pressure is created. Air is then drawn into the room under the door and through other small openings, preventing fumes and dust from being drawn out of the room.

It is recommended that the air in the mold room be exchanged 5 to 6 times per hour through the building's heating and air conditioning system. This can be checked out by an air conditioning engineer. If this is not practical, an air purifying system is recommended. Electronic systems are available that will handle 0.3 microns of particular matter.

## Shielding blocks

### Materials:

Polystyrene cellular foam board

*Dow styrofoam*® CFC-free meets government regulations

Low melting alloy - 158°

Bismuth - 50% Tin 31.3% Lead 26.7% Cadmium 10%

## Alloy

The most conventional area of concern in mold room operations today is that which regards cadmium and lead based shielding alloys. In a typical mold room, the potential for exposure to hazardous levels is extremely low if the recommended safe practices are followed.

While cadmium-free alloy was designed to eliminate cadmium from the workplace, it does not eliminate the potential problem of *lead*. Based on all current studies and published reports, it would appear that alloy fumes do not present a real problem when following certain safety procedures. The potential problem of cadmium is minimized to the extent that it is difficult to make a valid argument supporting the use of 203°F, especially since the elevated pouring temperature creates a greater potential for serious burns.

More information on alloy is available in the following published reports:

Airborne concentrations of toxic metals resulting from the use of low melting-point lead alloys to construct radiotherapy shielding,

Edwin C. McCollough and David H. Senjem, Medical Physics Jan/Feb 1981

Cadmium-free lead alloy for reusable radiotherapy shielding,

C. Robert Blackwell, M.S., and Kim D. Amundson,

Medical Dosimetry, Vol. 15, 1990

The safety of low melting point bismuth/lead alloys: A review,

Glenn P. Glasgow, Ph.D., Medical Dosimetry, Vol. 16, 1991

OSHA has set standards for exposure to cadmium and lead primarily to cover industrial work environments. These standards also apply to mold rooms and mold room personnel. See OSHA Booklet 3136. (Call CIVCO to request a copy of this booklet.)

## Alloy melters

The primary area of concern is the alloy melting unit and the potential for releasing cadmium and/or lead oxide fumes into the room's atmosphere.

An article in Medical Dosimetry (Vol. 16) by Dr. Glen Glasow reports, in part, in a Mayo Clinic/Foundation Study that, "under extreme conditions the detection of hazardous metallic oxide fumes fell far below the prescribed limits and that in some cases could not be detected at all."

The recommended pouring temperature of alloy is:

Low melting 158°F / 175°-185°F pouring temperature

Medium melting 203°F / 220°-225°F pouring temperature

The determining factor in the release of metallic oxide fumes is temperature. The higher the temperature, the greater the potential for release of metallic oxide fumes.

It can be concluded that it is essential to have an alloy melter that provides

consistent and even heat. Some melters will fluctuate 15° to 20°F and have a very uneven heating pattern ie: (showing possibly 180°F on the top 2" of alloy and over 200°F at the bottom).

It appears that with the increased chances of metallic oxide fumes from the 203°F alloy's elevated pouring temperature (220°F) and the increased chances for personal injury (from burns), the 158°F alloy would be the alloy of choice for custom blocking.

## Alloy flash fumes

Although the concern over potential fumes from the melting units has certainly drawn the most discussion, there are several areas that have a greater potential for health problems. The first area of concern is the filling of voids in the shielding blocks by using a propane torch (which at 1200°F will cause flash vaporization of the toxic metals in questions). It is recommended that the operator use a soldering iron and a fume mask during this operation to minimize the potential for fume inhalation.

## Alloy dust

The area that has absolutely the greatest potential for causing problems is alloy dust (particulate matter) which can be ingested or inhaled. Ingestion of alloy dust can occur when mold room personnel doesn't wear gloves or simply fail to wash their hands after handling blocks. The dust is then ingested while eating or smoking. Inhalation of the dust occurs when vigorous filing and sanding, or more commonly during floor sweeping, causes the dust to become airborne and then inhaled. It is recommended that personnel filing and filling blocks wear a fume mask. Clean-up in the mold room should be done with a vacuum to prevent the dust from becoming airborne.

The HEPA filter vacuum, although somewhat expensive, would be the ideal choice since the HEPA vacuum traps particulate matter down to 0.3 microns.

## Dust collection floor mat

A tacky surface mat or fabric mat set directly inside the mold room door forces personnel leaving the mold room to walk on the mat which gathers hazardous

dust. The tacky mat is discarded after it is “loaded” with debris. A fabric mat is vacuumed with the mold room vacuum as part of regular maintenance.

## Mold room vacuum

The fundamental problem with industrial vacuums is that their filtering systems are not as efficient as a HEPA filter vacuum, allowing a percentage of small particulate matter back into the rooms atmosphere.

The HEPA vacuum is designed to trap particulate matter down to 0.3 microns which minimizes the risk of dust re-entering the room atmosphere. While the HEPA vacuum is expensive it does eliminate future problems.

## Air concentrations

OSHA has set threshold limit values for air concentrations of methylchloride and styrene, which are the by-products of the hot-wire cutting process, at 200 (PPM). Most facilities, with the recommended air exchange in the mold room (5 to 6 times per hour), will fall below the OSHA limits. Air sampling tests for these organic materials are available from CIVCO.

## Management responsibility

Management should take a proactive position in establishing and enforcing mold room safety procedures to insure that employees are not placed in a hazardous environment. Listed below are areas of concern where management should establish procedures and monitor compliance.

**Training** - Provide all mold room personnel with written materials on mold room safety and conduct a review of all procedures.

**Warning signs** - Display signs on safety procedures in the mold room. A sign should be posted on the mold room door to indicate hazardous materials area - authorized personnel only.

**Exposure monitoring and medical surveillance** - Provide regularly scheduled tests and measurements of hazardous materials in mold room atmosphere. Provide for urine and blood tests for mold room personnel.

**Engineering controls** - Oversee the implementation of recommended controls.

**Assign compliance monitoring** - Assign a designated person to monitor adherence to policy.

**Requirement****Lead Standard****Cadmium Standard**

Initial monitoring

Conduct initial monitoring to determine employee exposure levels.

Conduct initial monitoring to determine employee exposure levels.

Periodic monitoring

Conduct quarterly monitoring for employees at or above the Permissible Exposure Limit (PEL) and at least every six months for employees exposed at or above the Action Level.

Conduct monitoring for employees at or above the Action Level at least every six months.

Engineering and work practice controls

Implement as required to reduce exposures to below the PEL.

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Written compliance program

Prepare a written plan if employee exposures are above the Action Level.

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Monitoring results

Notify employees in writing within five days of receipt of monitoring results.

Notify employees in writing within 15 days of receipt of monitoring results.

Respiratory protection

Provide respiratory protection as necessary.

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Personal protective equipment

Provide protective work clothing and equipment if necessary. Prohibit removal of work clothing from changing rooms. Notify cleaner/lauderer regarding contaminated clothing.

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<b>Requirement</b>	<b>Lead Standard</b>	<b>Cadmium Standard</b>
Housekeeping	Maintain work areas as free as possible of accumulated lead.	Maintain work areas as free as possible of accumulated cadmium.
Hygienic facilities and lunchrooms	Provide changing rooms, showers, and handwashing facilities.	Provide changing rooms, showers, and handwashing facilities.
Medical Surveillance	Implement medical surveillance programs, initially and annually, for all employees exposed at or above the Action Level, including the periodic biological monitoring of affected employees. Provide medical removal protection for employees with elevated blood lead levels.	Provide medical removal protection for employees with elevated blood cadmium levels. Implement medical surveillance programs, initially and annually, for all employees exposed at or above the Action Level, including periodic biological monitoring of affected employees.
Training	Train all affected employees, initially and annually.	Train all affected employees, initially and annually.
Documentation	Retain documentative records for 30 years.	Retain documentative records for 30 years.
Exposure Limits	Permissible Exposure Limit (PEL): 8-hour time-weighted average (TWA): 50 micrograms per cubic meter of air (50 $\mu\text{g}/\text{m}^3$ ). Maximum permissible limit for an extended work shift: 400 $\mu\text{g}/\text{m}^3$ /hours worked in the day. Action Level (AL): 30 $\mu\text{g}/\text{m}^3$	Permissible Exposure Limit (PEL): 8-hour time weighted average (TWA): 5 micrograms per cubic meter of air (5 $\mu\text{g}/\text{m}^3$ ). Action level(AL): 2.5 $\mu\text{g}/\text{m}^3$

# Alloy recycling/mold room services

In today's world, environmental safety has become a great concern. With increased awareness and increasingly stringent OSHA disposal standards, a safe and convenient disposal program for sludge/dross has become a necessity. CIVCO offers an alloy recycling program that's both convenient and cost-effective.

*Here's how it works...*

CIVCO provides your facility with four one-gallon plastic buckets with snap-on lids for storing your alloy sludge. Along with the buckets, you also receive two shipping cartons with preprinted boxes addressed to CIVCO in Orange City, Iowa.

Once you have collected 30 to 40 pounds of sludge, simply box-up the container and return it to CIVCO via UPS Ground. Shipping charges are the responsibility of your facility. Upon receipt of the sludge we will recycle it, following EPA regulations, at no charge.

## **Air sample test kit:**

The air test kit includes UPS next day air shipping to your facility. The pump is shipped to you on Monday and received on Tuesday. Test for eight hours on Wednesday and ship to CIVCO on Thursday for receipt at CIVCO on Friday.

*Pumps not received on Friday will be charged rental for an additional week.*

MT-AIRTEST: includes air monitor pump, one-week rental, cassette filter and written report.....\$225.00

# Questions?

Call CIVCO

800.842.8688



800.842.8688 / 712.737.8688



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