# Lead Fact Sheet

## Objective

This document is intended to enhance awareness of what processes emit lead, increase the integrity of lead inventory data from point sources, and provide several approaches to calculating lead emissions. Mention of trade names and commercial products does not constitute endorsement or recommendation for use.

## Revised Standard

The Environmental Protection Agency (EPA) finalized a revised standard for lead (Pb) on November 12, 2008. The standard was revised from 1.5 micrograms per cubic meter (µg/$m^3$) of air, to 0.15 µg/$m^3$. The final rule is at https://www.epa.gov/lead-air-pollution/national-ambient-air-quality-standards-naaqs-lead-pb.

## Where Does Lead Come From?

Lead is a toxic, naturally occurring metal used in many manufactured products found in and around our homes, such as lead-based paint. The major sources of Pb emissions have historically been motor vehicles and industrial sources. Lead emissions from motor vehicles have decreased dramatically since the early 1970's when Pb reduction standards for gasoline were first implemented. The EPA indicates that Pb emissions from transportation declined 95 percent between 1980 -1999. Most point source Pb air emissions in Iowa are from gray and ductile iron foundries, steel foundries, aluminum foundries, electric utilities and facilities with coal-fired boilers, steel mills, cement kilns, lead-acid battery manufacturers, metal fabricators, and waste incinerators.

## What source categories typically emit Lead and Lead Compounds?[1]

- Metallurgical Industry
  - Primary Lead Smelting
  - Secondary Lead Smelting
  - Primary Copper Production
  - Secondary Copper Production
  - Primary Zinc Smelting
  - Secondary Aluminum Operations
  - Iron and Steel Foundries
  - Ore Mining, Crushing, and Grinding
  - Brass and Bronze Processing

- Combustion Sources
  - Stationary External Combustion
  - Stationary Internal Combustion
  - Municipal Waste Incineration
  - Industrial and Commercial Waste Incineration
  - Sewage Sludge Incinerators
  - Medical Waste Incineration
  - Hazardous Waste Incineration
  - Drum and Barrel Reclamation
  - Scrap Tire Incineration

[1] While every attempt was made to make this a comprehensive list of lead-emitting source categories, it is possible that some source categories have been unintentionally omitted and therefore it should not be considered to be an all-inclusive list.

- Open Burning of Scrap Tires
- Crematories
- Pulp and Paper Industry
- Portland Cement Manufacturing

- Other Sources
  - Pressed and Blown Glass
  - Lead-Acid Battery Production
  - Lead Oxides in Pigments
  - Lead Cable Coating
  - Frit Manufacturing
  - Ceramics and Glazes
  - Solder Manufacturing
  - Electroplating
  - Circuit Board Manufacturing
  - Stabilizers in Resins
  - Asphalt Concrete
  - Application of Paints
  - Shooting Ranges and Explosive Ordinance Disposal Sites
  - Rubber Products
  - Miscellaneous Lead Products
    - Ammunition
    - Type Metal Production
    - Abrasive Grain Processing
    - Other Metallic Lead Products

- Mobile Sources
  - Combustion Emissions
  - Road Dust
  - Evaporative Emissions From Fuel Distribution For Mobile Sources

## How do I calculate emissions of Lead and Lead Compounds (for Title V and Minor Source emissions inventory reporting requirements)?

- *Stack Test Data*
  The preferred method to determine emissions of Pb or Pb Compounds is by using DNR-approved stack test data as measured from the applicable emission unit. The most accurate stack test data is a result of performance testing conducted specifically for Pb or Pb Compounds. The Pb performance test methods are EPA Method 12 (Determination of Inorganic Lead Emissions from Stationary Sources) and EPA Method 29 (Determination of Metals Emissions from Stationary Sources) as specified in 40 CFR Part 60 Appendix A. Sample calculations using performance test data to determine annual actual Pb emissions are provided below:

  - **Gray Iron Foundry Emissions (calculated using stack test data)**
    *Cupola (with wet-scrubber) Example— 50 tons/hour*
    Lead stack test = 0.295 pounds (lbs) of Pb/hour
    Annual actual hours of operation = 6,000 hours
    (6,000 hours/yr) *(0.295 lbs of Pb/hour) *(1 ton/2,000 lbs)
    = 0.89 tons of Pb/year

- **Lead-Acid Battery Manufacturer Emissions (calculated using stack test data)**
  *Grid Casting (with baghouse) Example— 2 tons/hour*
  Lead stack test = 0.008 lbs Pb/hr
  Annual actual hours of operation = 8,000 hours
  (8,000 hours/year)*(0.008 lbs of Pb/hour)*(1 ton/2,000 lbs)
  = 0.032 tons of Pb/year

- **Metal Fabricator Emissions (calculated using stack test data)**
  *Induction Furnace (with baghouse) Example— 8 tons/hour*
  Lead stack test = 0.175 lbs of Pb/hour
  Annual actual hours of operation = 6,500 hours
  (6,500 hours/year)*(0.175 lbs of Pb/hour)*(1 ton/2,000 lbs)
  = 0.57 tons of Pb/year

- *Lead Content & Particulate Matter*
  If a Pb test has not been performed, the alternative is to determine a Pb emission rate based on a total particulate matter (PM) emission rate and known Pb content of the material or product processed in the applicable unit or process. One way to determine this is to use total PM performance test results or PM emission factors to determine the PM emission rate (lbs per hour) from the applicable emission unit. The Pb fraction (by weight) of the material or product processed may be determined by conducting a Pb analysis of the dust collected in the control equipment, by the known Pb content of a raw material, or by performing another type of analysis. Assuming the determined or known Pb content of the material is equivalent to the fraction of PM emitted will allow you to determine the Pb emission rate in terms of pounds per hour (lbs/hr). One example of this scenario is using a PM emission factor and multiplying it by a known Pb content, as percent by weight. For example:

  The total PM emission factor for the pouring and cooling process from a gray iron foundry is 4.2 lbs of PM/ton of gray iron produced. If the known Pb content of the metal processed is 0.3% by weight, then the Pb emission factor (EF) is:

  EF = (4.2 lbs PM/ton of gray iron produced)*(0.003 lbs of Pb/lb of PM)
  = 0.0126 lbs of Pb/ton of gray iron produced

  Another example is to use total PM performance test data and the known or determined Pb content of the material processed to estimate Pb emissions from an emission unit or process. For example:

  The total PM stack test emission rate from an electric arc furnace at a steel foundry is 3.75 lbs/hr based on performance testing results. If the measured Pb fraction as sampled from dust collected in a baghouse is 0.5% by weight, then the estimated Pb emission rate (ER) from the electric arc furnace is:

  Pb ER = (3.75 lbs of PM/hr) *(0.005 lbs of Pb/lbs of Total PM)
  = 0.019 lbs of Pb/hr

  Sample calculations using Pb content & total PM stack test results to determine annual actual Pb emissions are provided below:

- **Steel Mill Emissions (calculated using stack test data and a known percent by weight composition)**
  *Electric Arc Furnace (with baghouse) Example— 100 tons/hour*
  Total PM stack test = 6.25 lbs of PM/hour
  Lead fraction of dust sample collected in baghouse = 2.25% by weight
  Annual actual hours of operation = 6,500 hours
  Pb emission rate = (6,500 hours/year)*(6.25 lbs of total PM/hour)*(0.0225 lbs of Pb/lb of total PM) x (1 ton/2,000 lbs)
  = 0.46 tons of Pb/year

- **Steel Foundry Emissions (calculated using stack test data and a known percent by weight composition)**
  *Electric Arc Furnace (with fabric-filter baghouse) Example—10 tons/hr*
  Total PM stack test = 5.10 lbs of PM/hour
  Lead fraction of dust sample collected in baghouse = 0.65% by weight
  Annual actual hours of operation = 7,550 hours
  Pb emission rate = (7,550 hours/year)*(5.10 lbs PM/hr)*(0.0065 lbs of Pb/lbs of total PM)*(1 ton/2,000 lbs)
  = 0.13 tons of Pb/year

- **Aluminum Foundry Emissions (calculated using stack test data and a known percent by weight composition)**
  *Melting Furnace (with fabric filter baghouse) Example— 20 tons/hr*
  Total PM stack test = 4.10 lbs/hr
  Lead content of the scrap aluminum = 0.63 % by weight
  Annual actual hours of operation = 8,400 hours
  Pb emission rate = (8,400 hours/year)*(4.10 lbs of total PM/hr)*(0.0063 lbs of Pb/lb of total PM)*(1 ton/2,000 lbs)
  = 0.11 tons of Pb/year

- *WebFIRE / AP-42 / NESHAP Background Documents / MACT Guidance Documents*
  EPA has multiple resources on the internet to provide guidance in calculating Pb emissions. EPA has developed a new internet version of the old FIRE database called WebFIRE. It is available at http://cfpub.epa.gov/oarweb/index.cfm?action=fire.main. Emission factors for Pb and Pb Compounds are now included in WebFIRE, including those for the following source categories:

  - gray and ductile iron foundries
  - steel foundries
  - aluminum foundries
  - coal-fired boilers
  - steel mills
  - cement manufacturing (kilns)
  - lead-acid battery manufacturers
  - metal fabricators
  - waste incinerators

  AP-42 is a compilation of air pollutant emission factors which is available at https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors. Emission factors for Pb and Pb Compounds for the above mentioned source categories are also available in AP-42. *This document should not be solely relied upon when using emission factors from WebFIRE and AP-42. Rather, the user should reference the actual websites to make sure the most recent emission factors are applied when calculating Pb and Pb compound emission estimates*.

NESHAP background documents and MACT guidance documents may be used to find emission information about lead emissions for specific processes or industry types that are not available elsewhere. Background and guidance documents may be searched for at http://nlquery.epa.gov/epasearch/index.html. Example calculations using emission factors to determine actual Pb emissions are provided below:

- **Cement Kiln Emissions (calculated using an emission factor and actual throughput data)**
  *Kiln (with electro-static precipitator) Example— 180 tons/hr*
  Actual annual throughput = 1,250,000 tons of clinker produced
  SCC number = 3-05-006-06
  Lead emission factor from WebFIRE = 0.00071 lbs of Pb/ton of clinker produced
  Pb emission rate = (1,250,000 tons of clinker produced)*(0.00071 lb Pb/ton of clinker produced)*(1 ton/2,000 lbs) = 0.44 tons Pb/year

- **Waste Incinerator Emissions (calculated using an emission factor and actual throughput data)**
  *Waste Incinerator (with electro-static precipitator) Example— 2 ton/hr*
  Actual annual throughput = 10,000 tons of waste charged in incinerator
  SCC number = 5-01-001-07
  Lead emission factor from WebFIRE = 0.003 lb of Pb/ton of waste charged in incinerator
  Pb emission rate = (10,000 tons of waste charged/year)*(0.003 lb Pb/ton waste charged)*(1 ton/2,000 lbs)
  = 0.02 tons of Pb/year

- **Coal-Fired Boiler Emissions (calculated using an emission factor and actual throughput data)**
  *Coal-Fired Boiler (pulverized coal-fired, dry bottom boiler with electro-static precipitator control) Example—5,000 MMBtu/hr:*
  Actual annual throughput = 2,750,000 tons of sub bituminous coal combusted
  Lead emission factor from AP-42, Table 1.1-18 = 0.00042 lbs of Pb/ton of coal combusted
  Pb emission rate = (2,750,000 tons of coal/year)*(0.00042 lbs of Pb/tons of coal)*(1 ton/2,000 lbs)
  = 0.58 tons of Pb/year

## Reliability of Emission Factors

While Pb emission factors for some processes are readily available through WebFIRE or AP-42, calculations using these emission factors should only be used when stack test and facility-specific data are not available. Emission factors in WebFIRE and AP-42 are assigned a rating with "A" being the highest quality and "U" being the lowest quality. The rating of these emission factors is important in determining the accuracy of the Pb emissions estimate.

## Why Does It Matter?

The revised standard increases protection for children and other at risk populations against a variety of adverse health effects. Lead is persistent in the environment and accumulates in soils and sediments through deposition from air sources, direct discharge of waste streams to water bodies, mining, and erosion. Ecosystems near point sources of Pb demonstrate a wide range of adverse effects including losses

in biodiversity, changes in community composition, decreased growth and reproductive rates in plants and animals, and neurological effects in vertebrates.

## Health and Environmental Impacts

Airborne Pb can be inhaled or, after it settles out of the air, can be ingested. Ingestion is the main route of human exposure. Once taken into the body, Pb distributes throughout the body in the blood and accumulates in the bones. Exposure to Pb is associated with a broad range of health effects, including the oxygen-carrying capacity of the blood, central nervous system, cardiovascular system, kidneys, and immune system.

Children are more vulnerable than adults to the damaging effects of Pb in air. They breathe in more air per minute than adults and breathe through the mouth more often than adults. Children typically spend more times outdoors and are more physically active. Lead exposure also occurs through hand-to-mouth activities. Lead effects children much more than adults as their brains are still developing and more susceptible to the poisonous effect.

## Ambient Air Monitoring

The new standard requires ambient air monitoring near large sources of Pb emissions and in urban areas with more than 500,000 people. The DNR has reviewed and will continue to review emission inventory reports for Pb emissions to determine where ambient air quality monitors will be required. Facilities with actual emissions above or near 0.50 ton/yr of Pb may be contacted by the DNR seeking additional information.

## Questions?

*For questions regarding emission calculations:*

Contact: Nick Page
Phone: 515-725-9544
E-Mail: nick.page@dnr.iowa.gov
OR
Contact: Pete Zayudis
Phone: 515-725-9578
E-Mail: peter.zayudis@dnr.iowa.gov

*For questions regarding stack testing:*

Contact: Mark Fields
Phone: 515-725-9526
E-Mail: mark.fields@dnr.iowa.gov

*For questions regarding modeling:*

Contact: Brad Ashton
Phone: 515-725-9527
E-Mail: brad.ashton@dnr.iowa.gov

*For questions regarding monitoring:*

Contact: Sean Fitzsimmons
Phone: 515-725-9528
E-Mail: sean.fitzsimmons@dnr.iowa.gov