Lead Salts of Selected Fatty Acids: Human health tier II assessment

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Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Octadecanoic acid, lead(2+) salt	1072-35-1
9,12-Octadecadienoic acid, (Z,Z)-, lead salt	16996-51-3
9-Octadecenoic acid, lead(2+) salt, (Z)-	1120-46-3
Docosanoic acid, lead salt	3249-61-4
Octanoic acid, lead(2+) salt	7319-86-0
Octadecanoic acid, lead salt	7428-48-0
Lead, bis(octadecanoato)dioxotri-	12578-12-0
9-Octadecenoic acid, 12-hydroxy-, lead(2+) salt (2:1), [R-(Z)]-	13094-04-7
Dodecanoic acid, lead salt	15306-30-6
9-Octadecenoic acid, lead salt, (Z)-	15347-55-4

Chemical Name in the Inventory	CAS Number
Octanoic acid, lead salt	15696-43-2
Decanoic acid, lead(2+) salt	15773-52-1
Dodecanoic acid, lead(2+) salt	15773-55-4
Hexadecanoic acid, lead(2+) salt	15773-56-5
Hexadecanoic acid, lead salt	19528-55-3
Tetradecanoic acid, lead salt	20403-41-2
Decanoic acid, lead salt	20403-42-3
Docosanoic acid, lead(2+) salt	29597-84-0
9,12-Octadecadienoic acid, (Z,Z)-, lead(2+) salt	33627-12-2
Lead, bis(octadecanoato)dioxodi-	56189-09-4
Octadecanoic acid, 12-hydroxy-, lead(2+) salt (2:1)	58405-97-3
Fatty acids, tall oil, lead salts	61788-54-3
Fatty acids, C12-18, lead salts	68131-60-2
Oils, menhaden, lead salts	68424-76-0
Oils, fish, lead salts	68553-63-9
Fatty acids, tallow, hydrogenated, lead salts	68605-98-1
Fatty acids, C8-18 and C18-unsaturated, lead salts	84776-36-3
Dodecanoic acid, lead salt, basic	90342-56-6
Hexadecanoic acid, lead salt, basic	90388-09-3
9-Hexadecenoic acid, lead(2+) salt, (Z)-, basic	90388-15-1
Octadecanoic acid, lead salt, basic	90459-51-1

Chemical Name in the Inventory	CAS Number
9-Octadecenoic acid, lead salt, basic, (Z)-	90459-88-4
Tetradecanoic acid, lead salt, basic	90583-65-6
Fatty acids, castor oil, hydrogenated, lead salts	91697-36-8
Fatty acids, C14-26, lead salts	93165-26-5
9-Hexadecenoic acid, lead(2+) salt, (Z)-	93858-24-3
Tricosanoic acid, lead salt	93966-37-1
Tetracosanoic acid, lead salt	93966-38-2
Hexacosanoic acid, lead salt	94006-20-9
Eicosanoic acid, lead(2+) salt (2:1)	94266-31-6
Eicosanoic acid, lead salt	94266-32-7

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:**www.nicnas.gov.au**

Disclaimer

ACRONYMS & ABBREVIATIONS

Grouping Rationale

This group of 41 chemical compounds predominantly consists of lead salts of naturally occurring fatty acids. These compounds have been included in this group due to the expectation that the physico-chemical properties will not vary greatly, leading to the compounds within this group having related end uses. The toxicity is considered to result entirely from the presence of the lead component (cation). The lead compounds with an unspecified oxidation state will predominantly contain lead in the +2 oxidation state. In addition, information outlined in the Organisation for Economic Co-operation and Development's (OECD) Guideline on Grouping of Chemicals (OECD, 2007) provided guidance on grouping of chemicals based on physico-chemical or toxicological criteria.

Import, Manufacture and Use

Australian

Of the 41 lead compounds in this group, no specific Australian use, import, or manufacture information have been reported under previous mandatory and/or voluntary calls for information, except in the following cases:

Octadecanoic acid, lead(2+) salt **(CAS No: 1072-35-1)**

Reported commercial use including:

- as lubricants and additives.

Reported site-limited use including:

- as stabilisers.

This lead compound was listed on the 2002 High Volume Industrial Chemicals List (HVICL), with a total reported volume between 1000 and 9999 tonnes.

Octanoic acid, lead(2+) salt **(CAS No: 7319-86-0)**

Due to the lead compound's historical use in paints, this compound was included in a NICNAS mandatory call for information (2006) regarding use in industrial surface coatings and inks. The use of this chemical in paints was reported to be zero.

International

For the majority of the group the following international uses have been identified from the Global Automotive Declarable Substance List (GADSL) via US Environmental Protection Agency's Aggregated Computer Toxicology Resource (ACToR):

The lead compounds have reported domestic use including:

- in pigments.

The lead compounds have reported site-limited use including:

- metallurgical, e.g. bearing metals, brass, aluminium and steel; and
- as stabilisers.

The following individual lead compounds have international uses identified from Galleria Chemica, European Union Registration, Evaluation and Authorisation of Chemicals (EU REACH) Dossiers, Substances and Preparations In the Nordic countries (SPIN) database and eChemPortal (European Commission IUCLID and OECD Chemical Data Sheets, EnviChem- Finnish Environment Institute), the Global Automotive Declarable Substance List (GADSL) via US Environmental Protection Agency's Aggregated Computer Toxicology Resource (ACToR):

9-Octadecenoic acid, lead(2+) salt, (Z)- **(CAS No: 1120-46-3);**

Octanoic acid, lead salt **(CAS No: 15696-43-2);**

Octanoic acid, lead (2+) salt **(CAS No: 7319-86-0);**

Lead, bis(octadecanoato)dioxodi- **(CAS No: 56189-09-4);**

Octadecanoic acid, lead (2+) salt **(CAS No:1072-35-1);**

Octadecanoic acid, lead salt **(CAS No: 7428-48-0);**

Lead, bis(octadecanoato)dioxotri- **(CAS No: 12578-12-0).**

Each of these lead compounds have one of more of the following reported uses:

Domestic use including in:

- paints, lacquers and varnishes; and
- cleaning/washing agents.

Commercial use including as:

- corrosion inhibitor for use in petroleum;
- lubricants and additives, such as high pressure solid, internal lubricants and a lubricant in extrusion of plastics; and
- process regulators.

Restrictions

Australian

Lead and lead compounds are listed in the Poisons Standard (the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP)) (SUSMP, 2012) in:

Appendix I, Uniform Paint Standard

Lead compounds are not permitted to be used in domestic or industrial paints at > 0.1 %.

The proportion of a substance for the purposes of this Schedule is calculated as a percentage of the element present in the non-volatile content of the paint.

Appendix C

LEAD COMPOUNDS in paints, tinters, inks or ink additives except in preparations containing 0.1 per cent or less of lead calculated on the non-volatile content of the paint, tinter, ink or ink additive.

Appendix C substances, other than those included in Schedule 9, are considered of such danger to health as to warrant prohibition of sale, supply and use. These substances are poisons prohibited from sale, supply or use because of their known potential for harm to human and/or animal health.

Schedule 6

LEAD COMPOUNDS unless specified in Appendix C or:

(a) when included in Schedule 4 or 5;

(b) in paints, tinters, inks or ink additives;

(c) in preparations for cosmetic use containing 100 mg/kg or less of lead;

(d) in pencil cores, finger colours, showcard colours, pastels, crayons, poster paints/colours or coloured chalks containing 100 mg/kg or less of lead; or

(e) in ceramic glazes when labelled with the warning statement: *CAUTION - Harmful if swallowed. Do not use on surfaces which contact food or drink.* Written in letters not less than 1.5 mm in height.

Schedule 6 substances are considered to have moderate potential for causing harm, the extent of which can be reduced through the use of distinctive packaging with strong warnings and safety directions on the label.

Schedule 5

LEAD COMPOUNDS in preparations for use as hair cosmetics, unless specified in Appendix C.

Schedule 5 substances are considered to have low potential for causing harm, the extent of which can be reduced through the use of appropriate packaging with simple warnings and safety directions on the label.

Given these restrictions, domestic use in paints identified from international sources can be considered to not be relevant to Australia.

Further information regarding the restriction of lead in cosmetics is provided in the NICNAS Existing Chemicals Information Sheet: Lead in Cosmetics (November, 2008).

International

The risk of exposure to lead and lead compounds has been recognised internationally, which has resulted in broad restrictions regarding occupational and public exposure.

Cosmetics

Lead compounds appear on the following:

- The Canadian list of prohibited and restricted cosmetic ingredients ("Hotlist").
- The EU Cosmetic Directive 76/768/EEC Annex II: List of substances which must not form part of the composition of cosmetic products.
- The New Zealand Cosmetic Products Group Standard - Schedule 4: Components cosmetic products must not contain.
- The Thailand Cosmetic Act - Prohibited Substances.

Existing Worker Health and Safety Controls

Hazard Classification

The members of this group are not individually listed in the Hazardous Substances Information System (HSIS), therefore, by default, are covered by the generic 'lead and lead compounds' classification as hazardous with the following risk phrases for human health in HSIS (Safe Work Australia):

Repr. Cat. 1; R61 (Reproductive toxicity - may cause harm to the unborn child)

Repr. Cat. 3; R62 (Reproductive toxicity - possible risk of impaired fertility)

Xn; R20/R22 (Harmful by inhalation and if swallowed)

Xn; R33 (Danger of cumulative effects)

Exposure Standards

Australian

Lead, inorganic dusts and fumes (as lead) have the following exposure standards reported in HSIS (Safe Work Australia). These exposure standards apply to the lead compounds in this assessment:

Time Weighted Average (TWA): 0.15 mg/m³ for lead compounds (as lead).

Short-Term Exposure Limits (STEL): No specific exposure standards are available.

International

For lead compounds in general the following exposure limits were identified:

TWA = 0.05 mg/m³ [Bulgaria, Canada, China, Italy, Malaysia, USA]

TWA = 0.10 mg/m³ [Austria, New Zealand, Republic of South Africa, Sweden]

TWA = 0.15 mg/m³ [Argentina, Egypt, EU (Directive 98/24/EC), Malta, Singapore]

TWA = 0.20 mg/m³ [Thailand]

STEL: 0.10 mg/m³ [Austria]

STEL: 0.15 mg/m³ [Canada]

STEL: 0.45 mg/m³ [Argentina, Egypt]

Health Hazard Information

For this group of chemicals, the hazard associated with each health endpoint is considered to be due to the lead cation. While no experimental data were available on the lead compounds in this group, data sources for determining the hazard for the lead cation include animal studies on well characterised organic and inorganic lead compounds, and a large amount of literature on observations in humans.

Toxicokinetics

Inorganic lead compounds can be absorbed orally, dermally or via inhalation (NICNAS, 2007).

When ingested, the absorption of inorganic lead compounds in the human gastrointestinal tract is influenced by different factors, the most significant being age. Children (up to the age of eight) are estimated to absorb up to 50 % of the lead dose they ingest while adults would absorb up to 10 %. This route of absorption can be dependent on solubility and particle size with smaller particles being absorbed more readily than larger ones.

In an oral repeat dose toxicity study, rats were dosed with 0, 200, 500 or 1000 ppm lead acetate and tested for four, eight and 12 weeks. The blood lead concentration (PbB) level range was 40 - 100 ug/dL and the kidney lead was highest at four weeks. For all test groups the urinary lead excretion was highest at four weeks and then decreased with continued exposure to lead (REACH).

If inhaled, the size of lead compound particulates can dictate the site of deposition and rate of absorption (NICNAS, 2007).

Absorption via the dermal route has shown to be the least efficient (NICNAS, 2007). Less than 0.3 % of lead from lead acetate in cosmetics was absorbed dermally over a 12 hour (h) period. When lead nitrate was applied to the skin, 30 % of the dose was absorbed. It is not known if the absorption was systemic or confined to the layers of the skin.

Inorganic lead is distributed in the body independently of source compound and route of exposure. The spatial distribution of lead in bone is similar between children and adults; however, adults generally have a higher concentration. When in the blood, 99 % of lead is bound to proteins within erythrocytes (NICNAS, 2007).

Lead stored in bone can be released into the blood after exposure has ceased. Within bone, distribution is not uniform and lead accumulates in areas that are undergoing active calcification at the time of exposure (NICNAS, 2007).

Mobilisation of lead from bone increases during pregnancy when maternal bone is catabolised to produce the foetal skeleton. It has been shown that up to 80 % of lead in human cord blood comes from maternal bone stores and can be transferred into the foetal skeleton during its formation.

The blood lead (PbB) concentration is a reflection of recent exposure and does not capture the more significant impact and slower elimination kinetics of the chemical in bone (ASTDR, 2007). The accumulation of lead in bone is considered a biomarker for long-term exposure over a lifetime. As a result, the affinity of lead for bone would suggest that lead levels in bone, rather than lead levels in blood, provide more relevant predictive information for some health effects associated with long term exposure.

Acute Toxicity

Oral

The compounds in this group are not individually listed in HSIS, therefore, by default, are covered by the generic 'lead and lead compounds' hazard classification with the risk phrase 'Harmful if swallowed' (Xn; R22) in HSIS (Safe Work Australia). While there are no experimental data available specific to these chemicals, data from observations in humans exposed to lead (compounds not specified) are presented in the following sections. In the absence of more comprehensive information, there is insufficient evidence to support a recommendation to amend the classification for this group of chemicals.

Dermal

Several lead compounds were reported to exhibit low acute toxicity in animal tests as evidenced by reported LD50 in rats of > 2000 mg/kg bw (REACH).

Inhalation

The compounds in this group are not individually listed in HSIS, therefore, by default, are covered by the generic 'lead and lead compounds' hazard classification with the risk phrase 'Harmful by inhalation' (Xn; R20) in HSIS (Safe Work Australia). While there are no experimental data available specific to these chemicals, data from observations in humans exposed to lead (compounds not specified) are presented in the following sections. In the absence of more comprehensive information, there is insufficient evidence to support a recommendation to amend the classification for this group of chemicals.

Observation in humans

In this section, route specific data are not provided but exposure is reported in terms of absorbed dose. The concentration of lead in the blood is the most commonly reported value. However, lead in bone, hair and teeth are also reported in the literature.

Adult Exposure

The majority of the data have been collected from accidental or intentional exposure via ingestion or inhalation, and there are rich data regarding the dose-effect of lead exposure in humans (NICNAS, 2007; ASTDR, 2007). Exposure can cause encephalopathy (the signs of which include: hyperirritability, ataxia, convulsions, stupor and coma) in addition to gastrointestinal effects such as colic (the effects can be displayed as: abdominal pain, constipation, cramps, nausea, vomiting, anorexia and weight loss) (ASTDR, 2007; WHO, 1995). It was recorded that signs of acute toxicity were observed in adults with a PbB level ranging from 50 - 300 µg/dL. However, that is challenged in a more recent study that only noted signs of encephalopathy in adults with PbB levels greater than 460 µg/dL (NICNAS, 2007; ASTDR, 2007).

Colic is indicative of gastrointestinal impact and is typically displayed as an early sign of exposure to lead (NICNAS, 2007; ASTDR, 2007). Colic has been noted in individuals exposed to high levels of lead and can be evident as a result of occupational exposure where workers generally register PbB levels between 100 – 200 µg/dL, although symptoms have been reported by workers with PbB levels between 40 – 60 µg/dL.

Exposure to lead has been reported to cause proximal renal tubular damage in the kidney (NICNAS, 2007).

Paediatric Exposure

Data were compiled from a paediatric population regarding the dose-response after acute exposure to lead. Signs of encephalopathy were noted in children with PbB levels between 90 – 800 µg/dL. The mean value reported for PbB levels related to death (327 µg/dL) is similar to that noted for encephalopathy (330 µg/dL). Gastrointestinal effects (abdominal pain, constipation, cramps, nausea, vomiting, anorexia and weight loss) were reported at PbB levels between 60 – 450 µg/dL. Data collected from additional reports indicate that acute encephalopathy was noted in children with PbB levels of 80 – 100 µg/dL and infants at PbB levels of 74.5 µg/dL (NICNAS, 2007).

In paediatric populations, acute colic has also been reported as an effect of poisoning associated with exposure to lead and is noted to occur when the PbB level is greater than or equal to 60 µg/dL (NICNAS, 2007; ASTDR, 2007). In addition, it has been reported that exposure to lead can inhibit the formation of the haem-containing protein cytochrome P450 (NICNAS, 2007).

Corrosion / Irritation

Skin Irritation

In general, lead compounds are not considered irritating to skin (REACH). No effects were reported in skin irritation assays in rabbits citing OECD Test Guideline (TG) 404 using lead oxide, dibasic lead phosphite and dibasic lead phthalate.

Eye Irritation

In general lead compounds were not reported to be irritating to eyes or having caused serious eye damage (REACH). In an eye irritation assay (OECD TG 405) in rabbits (New Zealand White) using dibasic lead phthalate, all symptoms reported were fully reversible within seven days.

Observation in humans

No studies were located that recorded skin or eye irritation in humans as a result of exposure to lead compounds.

Sensitisation

Skin Sensitisation

Several lead compounds were reported to be non-sensitisers (REACH). It was reported that the compounds gave negative results for skin sensitisation in guinea pigs when tested according to OECD TG 406.

Observation in humans

Although altered immune parameters were described in occupational and paediatric groups that were exposed to lead, there were no reports of skin or respiratory sensitisation to lead in humans (ASTDR, 2007).

Repeated Dose Toxicity

Oral

The compounds in this group are not individually listed in HSIS, therefore, by default, are covered by the generic 'lead and lead compounds' hazard classification with the risk phrase 'Danger of cumulative effects' (R33) in HSIS (Safe Work Australia). While no data are available for the chemicals in this group, data available from animals studies on other lead compounds, and observations in humans, support this generic 'lead and lead compounds' classification and are presented in the following sections.

In a study using lead acetate the lowest observed adverse effect level (LOAEL) of 200 ppm (corresponding to PbB levels of 40-60 mg/dL) was derived based on body and kidney weights (REACH). In a repeated dose toxicity study in Sprague Dawley (SD) rats following the guidelines set out in a US EPA chronic feeding study, lead acetate was administered via drinking water (ad libitum) to 18 males rats per dose group at 0, 200, 500 or 1000 ppm per day for four, eight or 12 weeks. Decreased body weight and increased kidney weight as a percentage of body weight were reported at all dose ranges from four weeks (REACH).

Dermal

While no data are available for the lead compounds in this group, no significant adverse effects were reported following repeated dermal exposure to several other lead compounds (REACH).

In a report available on repeat dose toxicity during dermal exposure, rats were exposed to lead acetate, lead oleate, lead arsenate or tetraethyl lead for 24 hours. The test groups had lead compounds applied either directly to the skin or to skin that

had been mechanically injured. Dermal absorption of lead was shown to occur in both test groups. However, comparatively greater absorption of lead was reported in the groups where the skin had been mechanically injured.

Inhalation

While no data are available for the chemicals in this group, no significant adverse effects were reported following repeated inhalation exposure to lead nitrate (REACH).

Aerosolised lead nitrate was administered to mice (Swiss Webster) via inhalation at 2.5 mg/m³ per day for 14 or 28 days. It was determined, considering total retention of the inhaled lead, that each mouse received a dose of 80 µg/day of lead.

A statistically significant reduction in the relative size of the spleen and thymus in both test groups was reported when compared with the control group. Increased lung weight was noted in both test groups and an increase in lead concentration was reported in the liver, lung and kidney; although the 28 day group was noted to show a greater lead concentration than the 14-day group. There were no apparent differences in body weight and food consumption noted for either test group.

Observation in humans

Lead has multiple modes of action in biological systems; as a result, any system or organ in the body can potentially be affected by lead exposure. For the purposes of this report, the effects of lead toxicity on the most sensitive target organs have been identified and summarised (NICNAS, 2007; ASTDR, 2007).

Neurological Effects

Lead encephalopathy is considered the most severe neurological effect of lead exposure in adults. Occupational lead exposure has also been linked to neurotoxicity and studies have shown that the following signs and symptoms have been noted in those recorded to have PbB levels of between 40 – 120 µg/dL: malaise, forgetfulness, irritability, lethargy, headache, fatigue, impotence, decreased libido, dizziness, weakness, paraesthesia, visual motor coordination impairment, cognitive performance impairment, decreased reaction time, mood and coping ability as well as affecting memory.

Haematological Effects

Lead exposure impacts the haematological system by inhibiting haem synthesis and decreasing the lifespan of erythrocytes, which results in the onset of microcytic and hypochromic anaemia (NICNAS, 2007). It has been estimated that the PbB threshold for a decrease in haemoglobin to be seen in occupationally exposed adults is 50 µg/dL. For children the threshold is estimated to be PbB 40 µg/dL.

Cardiovascular Effects

Studies investigating the effect of PbB on blood pressure in humans are not conclusive (NICNAS, 2007; ASTDR, 2007). The cardiovascular endpoint of concern for humans when exposed to low levels of lead is an increase in systemic blood pressure. Longitudinal occupational studies investigating the possible relationship between low level lead exposure and blood pressure have been undertaken, with mixed results. Subsequently, based on the available literature, it is suggested that a relationship between low level exposure to lead and increased systemic blood pressure cannot be determined (NICNAS, 2007).

Renal Effects

Nephrotoxicity associated with lead is characterised by proximal tubular nephropathy, glomerular sclerosis and interstitial fibrosis. The deterioration in renal function is characterised by enzymuria, proteinuria and an impaired ability to transport organic anions and glucose, in addition to a decreased glomerular filtration rate. Studies summarised in ATSDR (2007) indicate

that an increase in nephrotoxicity is proportional to an increase in PbB levels. Effects on glomerular filtration are reported at or below 20 µg/dL, enzymuria and proteinuria are reported at equal to or greater than 30 µg/dL and severe deficits in function and pathological changes are reported in association with PbB levels 50 µg/dL.

Genotoxicity

In general, lead compounds are considered genotoxic to mammalian cells.

The genotoxic effects of lead were reviewed and presented by the ATSDR (2007). The majority of the in vitro point mutation tests in bacteria were negative, while mammalian clastogenicity tests were generally positive.

It was reported that in bacterial reverse mutation assays, lead was negative both with and without metabolic activation (REACH). However, in vitro chromosomal aberration tests using Chinese hamster ovary (CHO) cells and human lymphocytes were positive without metabolic activation. An in vivo micronucleus assay using human peripheral lymphocytes (from those working with lead compounds) was positive, below the maximum tolerated dose.

Carcinogenicity

A review conducted by the International Agency for Research on Cancer (IARC) in 1980, which was updated in 1987 and again in 2006, indicated that there was sufficient evidence in experimental animals for the carcinogenicity of inorganic lead compounds, and limited evidence in humans for the carcinogenicity of inorganic lead compounds (IARC 1980; IARC, 1987; IARC 2006). The review resulted in the classification of inorganic lead compounds as probably carcinogenic to humans (Group 2A).

A subsequent review by the International Lead Association (LDAI, 2008) concluded that there is consistent evidence from studies in rodents that soluble lead compounds, or those that are considered bioavailable, are carcinogenic in animals; notably, reproducible renal tumours have been reported in male rats following administration of high levels of lead via food or water.

This evidence is sufficient to classify the chemicals in this group as potential carcinogens.

Reproductive and Developmental Toxicity

The lead compounds in this group are not individually listed in HSIS, therefore, by default, are covered by the generic 'lead and lead compounds' hazard classifications with the risk phrases ‘Possible risk of impaired fertility’ (R62) and ‘May cause harm to the unborn child’ (R61) in HSIS (Safe Work Australia). While no data are available for the lead compounds in this group, the available data on other lead compounds support these classifications.

In a reproductive and developmental toxicity screening test in SD rats, lead acetate was administered via drinking water to nine females at 0.6 % weight per volume (w/v) (equivalent to 502 mg/kg bw/day) at gestation days 5 – 21 (Ronis et al, 1996; LDAI, 2008). A stillbirth rate of 19 % was recorded in the test group compared with a 2 % rate noted in the control group. The dams and offspring had PbB levels > 200 µg/dL.

In a subsequent reproductive and developmental toxicity screening test in SD rats, lead acetate was administered via drinking water to 10 females at 0.05 % w/v, eight females at 0.15 % w/v and nine females at 0.45% w/v, during gestation days 5 – 21 (Ronis et al, 1998). Stillbirth rates of 3(±3), 10(±6) and 28(±8) % were recorded for increasing dose groups respectively. This was compared with a 4(±3) % rate noted in the control group. At birth, the male pups had PbB levels of 40(±1), 83(±8) and 120(±120) µg/dL for increasing dose groups respectively, while the female pups had PbB levels of 42(±7), 67(±16) and 197(±82) µg/dL. A developmental LOAEL of 0.05% (equivalent to 42 mg/kg bw/day) was reported for this study (LDAI, 2008).

Reproductive toxicity observations in humans

Recent studies have investigated the effect of lead exposure in occupational groups and general populations living near industrial plants. Although evidence reported is predominantly qualitative and dose-effect relationships have largely not been established (NICNAS, 2007; WHO, 1995), it has been suggested that moderately high PbB levels in humans could result in spontaneous abortion, pre-term delivery, alterations in sperm and decreasing male fertility (ASTDR, 2007).

Developmental toxicity observations in humans

Data pertaining to low level exposure to lead contributing to developmental toxicity in infants and young children were recently reviewed. Consensus exists between the reports which suggest that PbB levels in humans greater than 10 µg/dL can affect paediatric intellectual development (ASTDR, 2007; Donovan, J, 1996). In addition, data regarding the effects on children of higher levels of lead exposure were reviewed. Although neurobehavioural deficits were reported in children with PbB levels less than 10 µg/dL, there is uncertainty attached to these estimates of reported effects (ASTDR, 2007). Even so, the US Centers for Disease Control and Prevention (CDC) has a reference level of 5 µg/dL, above which it is recommended that public health action be initiated (CDC).

Risk Characterisation

Critical Health Effects

The main critical effects for human health are reproductive and developmental toxicity, potential genotoxicity, and limited carcinogenicity. The chemical is also expected to have acute and repeated dose toxicity.

Public Risk Characterisation

The use of lead and lead compounds in products available to the public in Australia is restricted and the restrictions are listed in the Poisons Standard (SUSMP, 2012). These restrictions will prevent risks from domestic use of these compounds.

Historical use of lead compounds in surface coatings suggests that the potential for the public to be exposed, through flaking paint and during home renovation, still exists. While it is possible that the public will be exposed to lead or lead compounds, the risk can be managed by following appropriate guidelines.

Occupational Risk Characterisation

Given the critical health effects, the risk to workers from this chemical is considered high if adequate control measures to minimise occupational exposure to the chemical are not implemented. The chemical should be appropriately classified and labelled to ensure that a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) has adequate information to determine appropriate controls.

NICNAS Recommendation

Assessment of the chemical is considered to be sufficient, provided that the recommended amendment to the classification is adopted, and labelling and all other requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Public Health

Current restrictions control the use of lead and lead compounds in cosmetics, paint, tinters, inks or ink additives, which effectively reduces the risk of public exposure.

The availability and permissible lead content in products, such as paint, are regulated in terms of availability and concentration (SUSMP, 2012). Products that historically contained lead or lead compounds still pose an exposure risk to the public due to their existence in the public domain.

The National Health and Medical Research Council (NHMRC) of Australia has published recommendations regarding how the public can manage exposure to lead by mitigating the risk (NHMRC, 2009). Methods for the safe approach to painting a house (when there is a likelihood of lead paint having been used previously) have been published by the Australian Government Department of the Environment—now the Department of the Environment (Environment, 2009).

Work Health and Safety

The health risk to workers from these chemicals is controlled when correct classification and labelling are considered, and adequate control measures to minimise occupational exposure and protective clothing are implemented. Safe Work Australia (SWA) encourages working safely with lead and promotes the *National Code of Practice for the Control and Safe Use of Inorganic Lead at Work [NOHSC: 2015 (1994)]* and the *National Standard for the Control of Inorganic Lead at Work [NOHSC:1012 (1994)]*. These Codes of Practice, in addition to the *Model Work Health and Safety Regulations, 2011* are available from the SWA website.

The chemicals in this group are recommended for classification and labelling under the current Approved Criteria and adopted Globally Harmonized System of Classification (GHS) and Labelling of Chemicals as below. This does not consider classification of physical hazards and environmental hazards.

If empirical data become available for any member of the group indicating that a lower (or higher) classification is appropriate for a specific chemical, this may be used to amend the default classification for that chemical.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Harmful if swallowed (Xn; R22)* Harmful by inhalation (Xn; R20)*	Harmful if swallowed - Cat. 4 (H302) Harmful if inhaled - Cat. 4 (H332)
Repeat Dose Toxicity	Danger of cumulative effects (R33)*	May cause damage to organs through prolonged or repeated exposure - Cat. 2 (H373)
Genotoxicity	Muta. Cat 3 - Possible risk of irreversible effects (Xn; R68)	Suspected of causing genetic defects - Cat. 2 (H341)
Carcinogenicity	Carc. Cat 3 - Limited evidence of a carcinogenic effect (Xn; R40)	Suspected of causing cancer - Cat. 2 (H351)
Reproductive and Developmental Toxicity	Repro. Cat 1 - May cause harm to the unborn child (T; R61)* Repro. Cat 3 - Possible risk of impaired fertility (Xn; R62)*	May damage the unborn child. Suspected of damaging fertility - Repr. 1A (H360Df)

[a] Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

[b] Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

[*] Existing Hazard Classification. No change recommended to this classification

Advice for consumers

Products containing the chemical should be used according to label instructions.

Advice for industry

Control measures

Control measures to minimise the risk from exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemical is used. Examples of control measures which may minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- using local exhaust ventilation to prevent the chemical from entering the breathing zone of any worker;
- health monitoring for any worker who is at risk of exposure to the chemical if valid techniques are available to monitor the effect on the worker's health;
- air monitoring to ensure control measures in place are working effectively and continue to do so;
- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemical.

Guidance on managing risks from hazardous chemicals are provided in the *Managing Risks of Hazardous Chemicals in the Workplace—Code of Practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to assist with meeting obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((m)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemical are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (m)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of Safety Data Sheets for Hazardous Chemicals— Code of Practice* and *Labelling of Workplace Hazardous Chemicals—Code of Practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of the chemical has not been undertaken as part of this assessment.

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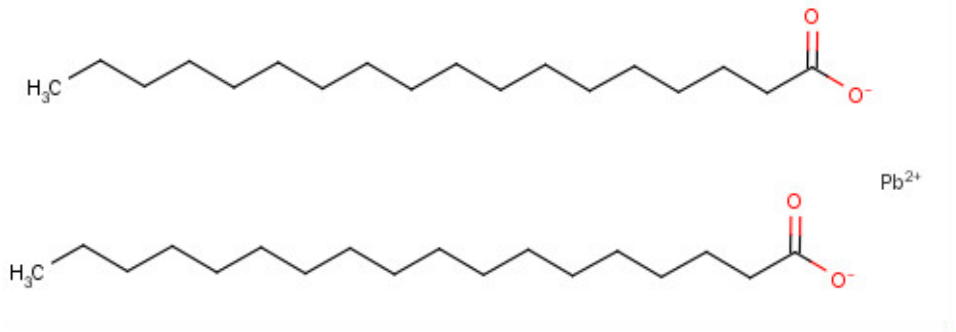
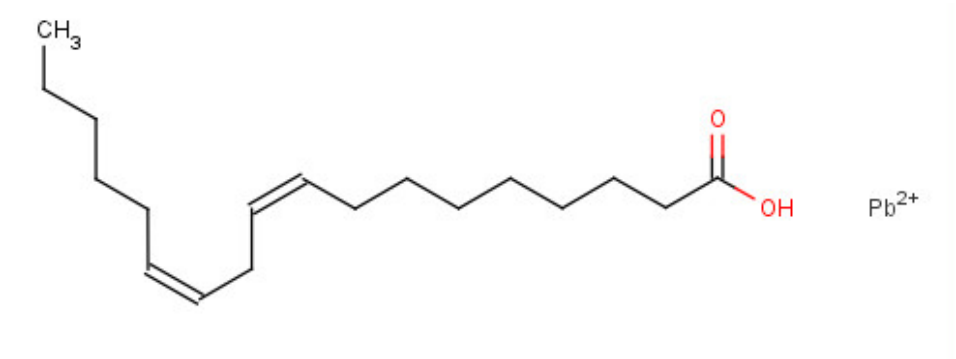
Last Update 07 February 2014

Chemical Identities

Chemical Name in the Inventory and Synonyms	**Octadecanoic acid, lead(2+) salt** Lead distearate Lead(2+) octadecanoate Lead(II) octadecaoate Lead(2+) stearate Lead(II) stearate
CAS Number	1072-35-1
Structural Formula	

	
Molecular Formula	C18H36O2.1/2Pb
Molecular Weight	774.1

Chemical Name in the Inventory and Synonyms	**9,12-Octadecadienoic acid, (Z,Z)-, lead salt** (9Z,12Z)-Octadeca-9,12-dienoic acid, lead (2+) salt 9,12-Octadecadienoic acid (9Z,12Z)-, lead salt 9,12-Octadecadienoic acid (9Z,12Z)-, lead salt (1:?) Lead linoleate
CAS Number	16996-51-3
Structural Formula	
Molecular Formula	C18H32O2.xPb
Molecular Weight	766.1

Chemical Name in the Inventory and Synonyms	**9-Octadecenoic acid, lead(2+) salt, (Z)-** Lead(II) oleate (2:1) 9-Octadecenoic acid (9Z)-, lead(2+) salt (2:1) Oleic acid lead salt Lead dioleate
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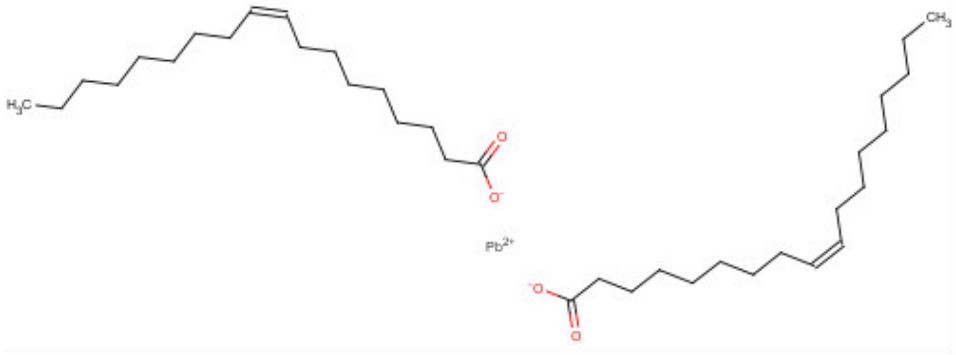
Structural Formula	

	
Molecular Formula	C18H34O2.1/2Pb
Molecular Weight	770.1

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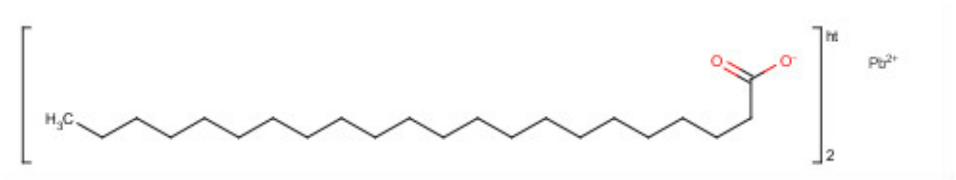
Structural Formula	
Molecular Formula	C22H44O2.xPb
Molecular Weight	886.4

Chemical Name in the Inventory and Synonyms	**Octanoic acid, lead(2+) salt** Lead dioctanoate Lead(II) octoate Lead(2+) octanoate Lead dicaprylate
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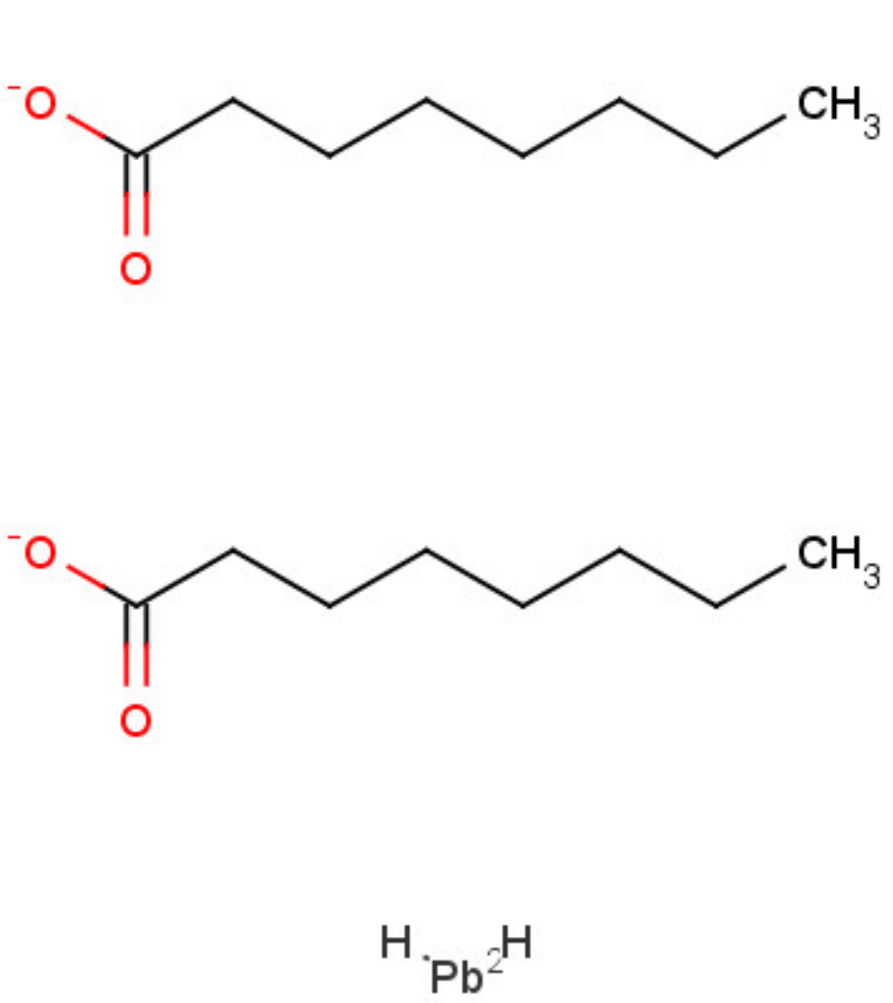
Structural Formula	

	
Molecular Formula	C8H16O2.1/2Pb
Molecular Weight	495.6

Chemical Name in the Inventory and Synonyms	**Octadecanoic acid, lead salt** Stearic acid, lead salt Lead octadecanoate Lead stearate Octadecanoic acid, lead salt (1:?) Octadecanoic acid, lead salt
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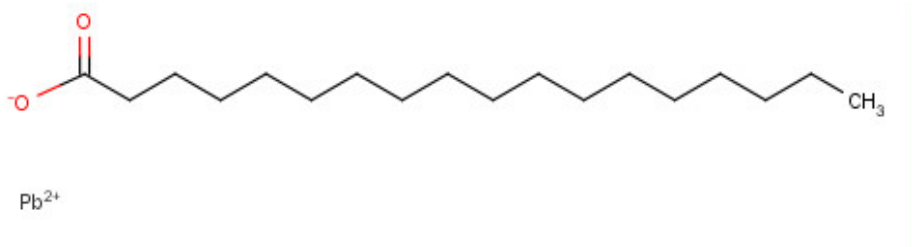
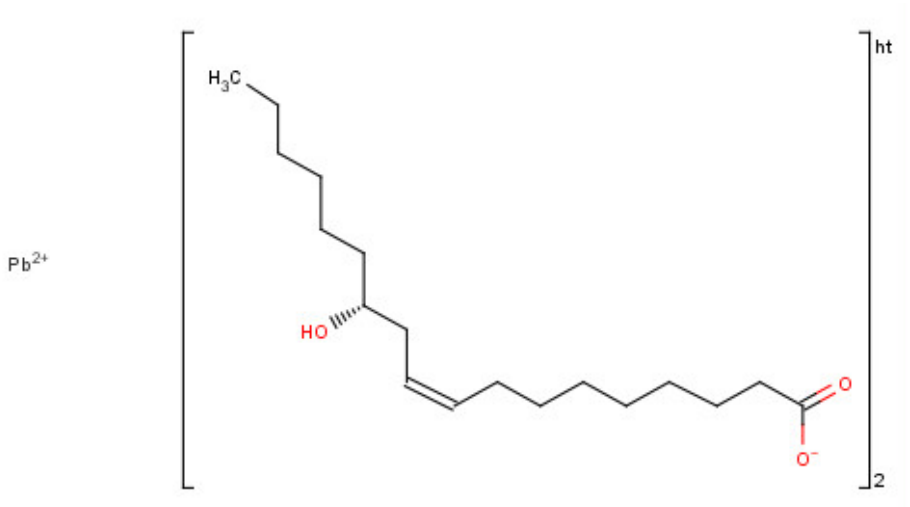
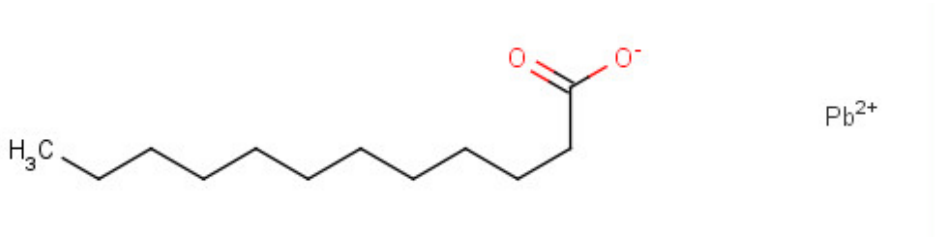
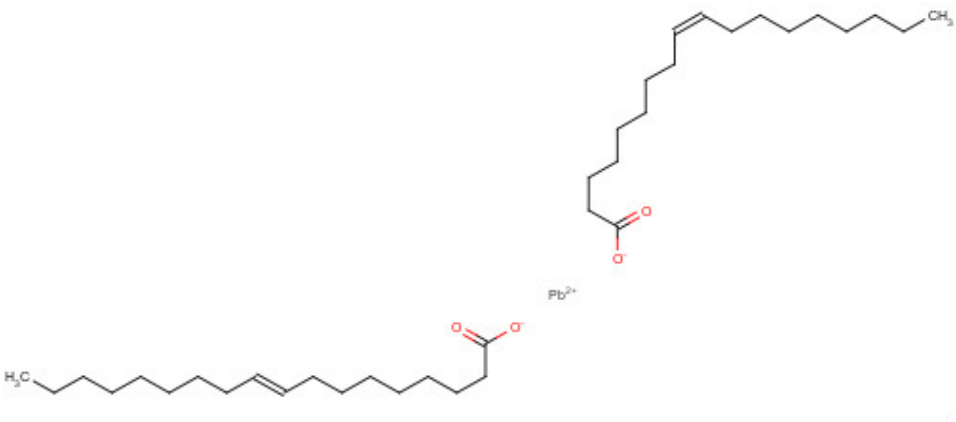
Structural Formula	

Molecular Formula	C18H36O2.xPb
Molecular Weight	490.7

Chemical Name in the Inventory and Synonyms	**Lead, bis(octadecanoato)dioxotri-** Lead, dioxobis(stearato)tri- Dioxobis(stearato)trilead Lead, bis(octadecanoato)dioxotri-
CAS Number	12578-12-0
Structural Formula	
Molecular Formula	C36H70O6Pb3
Molecular Weight	1220.5

Chemical Name in the Inventory and Synonyms	**9-Octadecenoic acid, 12-hydroxy-, lead(2+) salt (2:1), [R-(Z)]-** Lead(2+) (R)-12-hydroxyoleate Lead diricinoleate
CAS Number	13094-04-7
Structural Formula	
Molecular Formula	C18H34O3.1/2Pb
Molecular Weight	802.1

Chemical Name in the Inventory and Synonyms	**Dodecanoic acid, lead salt** Lauric acid, lead salt Lead laurate
CAS Number	15306-30-6
Structural Formula	
Molecular Formula	C12H24O2.xPb
Molecular Weight	406.5

Chemical Name in the Inventory and Synonyms	**9-Octadecenoic acid, lead salt, (Z)-** 9-Octadecenoic acid (9Z)-, lead salt 9-Octadecenoic acid (9Z)-, lead salt (1:?) Lead oleate
CAS Number	15347-55-4
Structural Formula	
Molecular Formula	C18H34O2.xPb
Molecular Weight	770.1

Chemical Name in the Inventory and Synonyms	**Octanoic acid, lead salt** Lead octanoate

	Octanoic acid, lead salt Octanoic acid, lead salt (1:?) Lead caprylate
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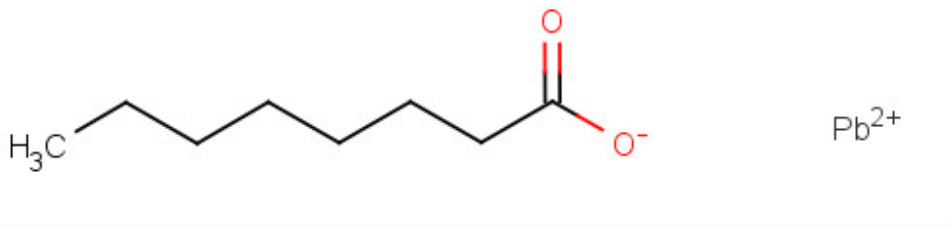
Structural Formula	
Molecular Formula	C8H16O2.xPb
Molecular Weight	350.4

Chemical Name in the Inventory and Synonyms	**Decanoic acid, lead(2+) salt** Lead(2+) decanoate Lead dicaprate
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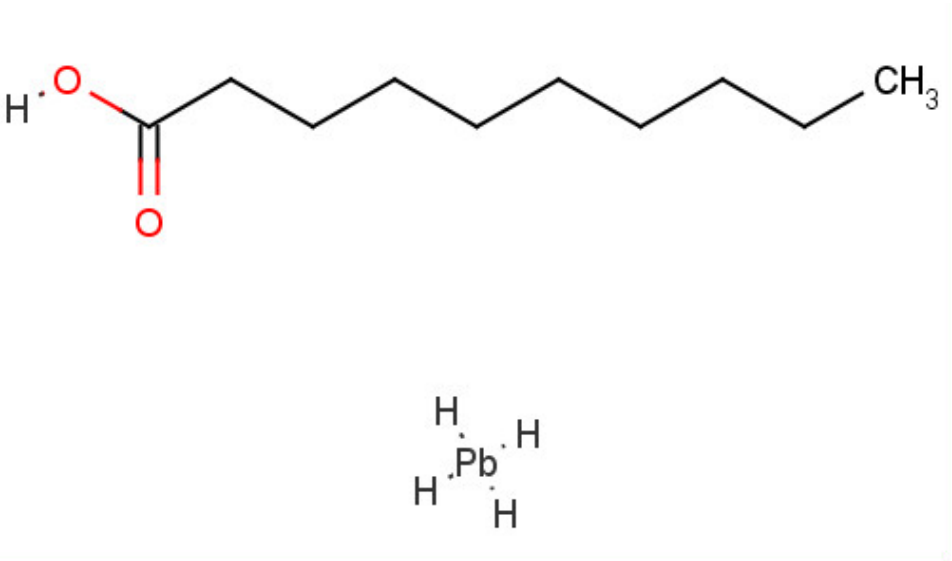
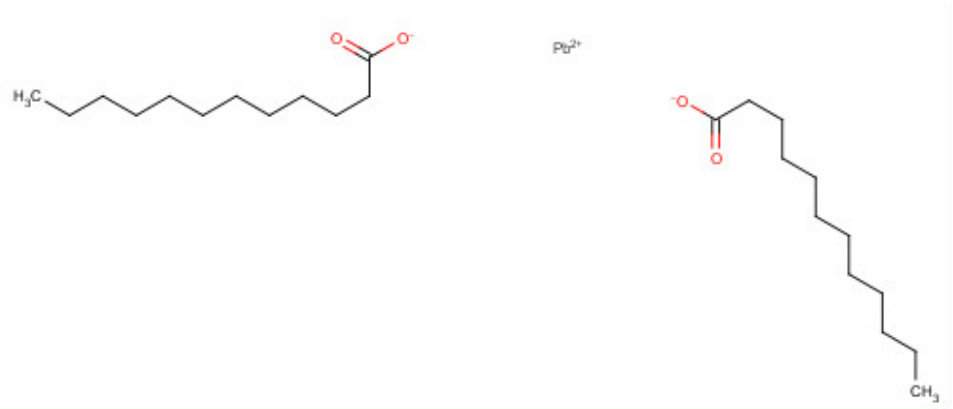
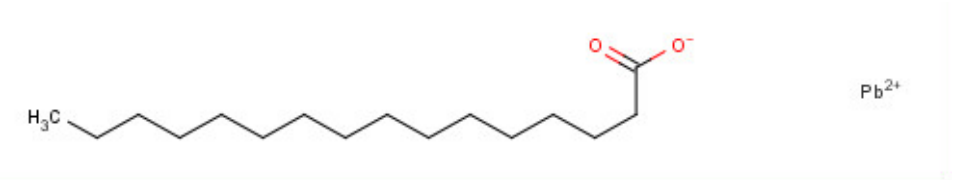
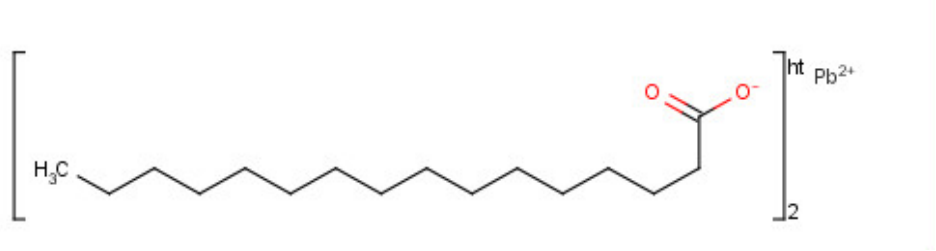
Structural Formula	
Molecular Formula	C10H20O2.1/2Pb
Molecular Weight	383.5

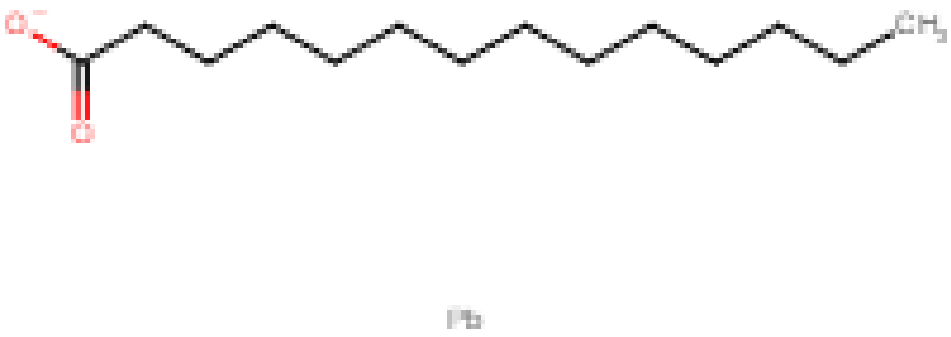
Chemical Name in the	**Dodecanoic acid, lead(2+) salt**

Inventory and Synonyms	Lauric acid, lead (2+) salt Dodecanoic acid, lead(2+) salt Dodecanoic acid, lead(2+) salt (2:1) Lead dilaurate
CAS Number	15773-55-4
Structural Formula	
Molecular Formula	C12H24O2.1/2Pb
Molecular Weight	605.8

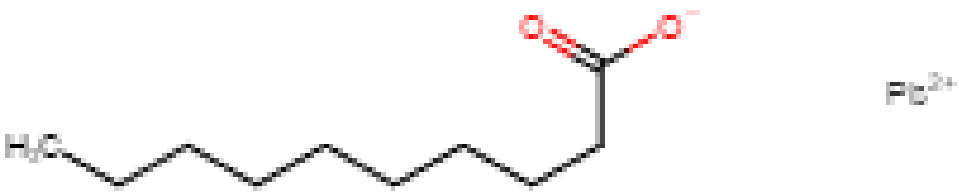
Chemical Name in the Inventory and Synonyms	**Hexadecanoic acid, lead(2+) salt** Palmitic acid, lead(2+) salt Lead dipalmitate
CAS Number	15773-56-5
Structural Formula	
Molecular Formula	C16H32O2.1/2Pb
Molecular Weight	462.6

Chemical Name in the Inventory and Synonyms	**Hexadecanoic acid, lead salt** Lead palmitate

CAS Number	19528-55-3
Structural Formula	
Molecular Formula	C16H32O2.xPb
Molecular Weight	718.0

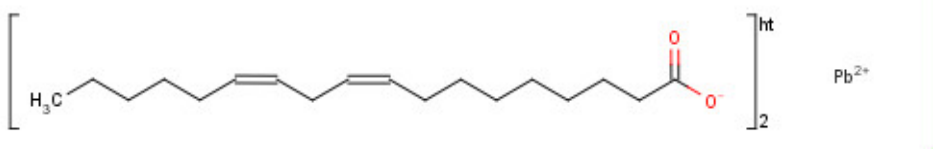
Chemical Name in the Inventory and Synonyms	**Tetradecanoic acid, lead salt** Lead tetradecanoate Myristic acid, lead salt Tetradecanoic acid, lead salt Tetradecanoic acid, lead salt (1:?) Lead myristate
CAS Number	20403-41-2
Structural Formula	
Molecular Formula	C14H28O2.xPb

Molecular Weight	436.6

Chemical Name in the Inventory and Synonyms	**Decanoic acid, lead salt** Decanoic acid, lead salt Lead caprate
CAS Number	20403-42-3
Structural Formula	
Molecular Formula	C10H20O2.xPb
Molecular Weight	378.5

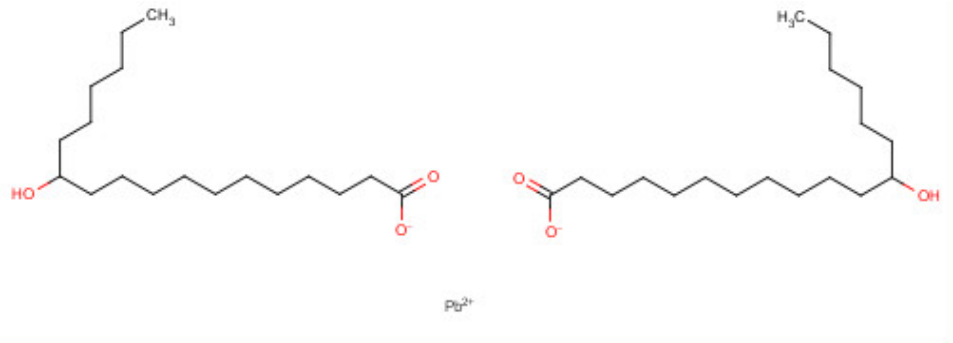
Chemical Name in the Inventory and Synonyms	**Docosanoic acid, lead(2+) salt** Lead didocosanoate Lead dibehenate
CAS Number	29597-84-0

Structural Formula	
Molecular Formula	C22H44O2.1/2Pb
Molecular Weight	886.4

Chemical Name in the Inventory and Synonyms	**9,12-Octadecadienoic acid, (Z,Z)-, lead(2+) salt** Linoleic acid, lead(2+) salt Lead dilinoleate
CAS Number	33627-12-2
Structural Formula	
Molecular Formula	C18H32O2.1/2Pb
Molecular Weight	766.1

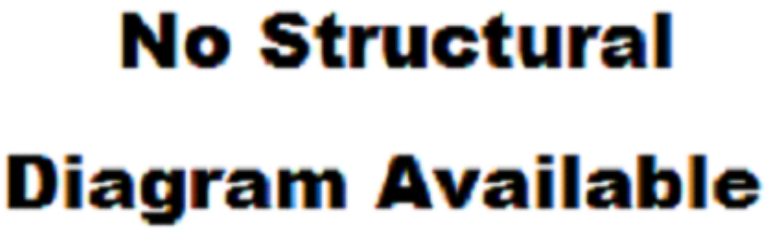
Chemical Name in the Inventory and Synonyms	**Lead, bis(octadecanoato)dioxodi-** Dibasic lead stearate Octadecanoic acid, lead salt, dibasic Dioxobis(stearato)dilead Lead stearate Stearic acid, lead salt, dibasic
CAS Number	56189-09-4
Structural Formula	
Molecular Formula	C36H70O6Pb2
Molecular Weight	1013.4

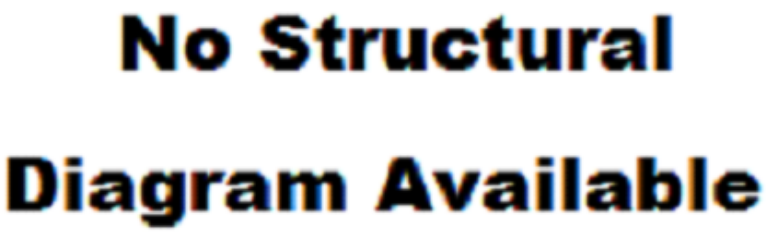
Chemical Name in the Inventory and Synonyms	**Octadecanoic acid, 12-hydroxy-, lead(2+) salt (2:1)** Lead bis(12-hydroxystearate)
CAS Number	58405-97-3
Structural Formula	

	
Molecular Formula	C18H36O3.1/2Pb
Molecular Weight	806.1

Chemical Name in the Inventory and Synonyms	**Fatty acids, tall oil, lead salts** Lead tallate
CAS Number	61788-54-3
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Fatty acids, C12-18, lead salts** (C12-18) Fatty acids, lead salt
CAS Number	68131-60-2

Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Oils, menhaden, lead salts** Menhaden oil, lead soap Menhaden oil, lead salt
CAS Number	68424-76-0
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Oils, fish, lead salts** Lead fishate

CAS Number	68553-63-9
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Fatty acids, tallow, hydrogenated, lead salts** Tallow acids, hydrogenated, lead salt
CAS Number	68605-98-1
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the	**Fatty acids, C8-18 and C18-unsaturated, lead salts**

Inventory and Synonyms	
CAS Number	84776-36-3
Structural Formula	**No Structural Diagram Available**
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Dodecanoic acid, lead salt, basic**
CAS Number	90342-56-6
Structural Formula	

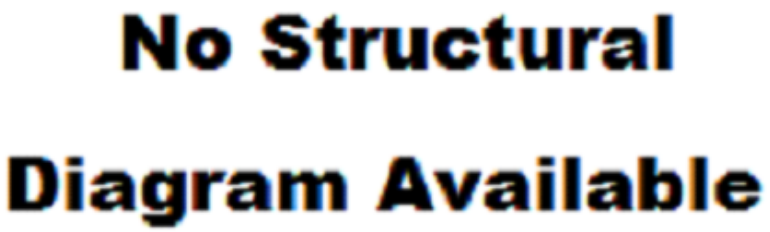
	
Molecular Formula	Unspecified
Molecular Weight	605.8234

Chemical Name in the Inventory and Synonyms	**Hexadecanoic acid, lead salt, basic**
CAS Number	90388-09-3
Structural Formula	**No Structural Diagram Available**

Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**9-Hexadecenoic acid, lead(2+) salt, (Z)-, basic**
CAS Number	90388-15-1
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	714.01

Chemical Name in the Inventory and Synonyms	**Octadecanoic acid, lead salt, basic**

CAS Number	90459-51-1
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**9-Octadecenoic acid, lead salt, basic, (Z)-**
CAS Number	90459-88-4
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the	**Tetradecanoic acid, lead salt, basic**

Inventory and Synonyms	
CAS Number	90583-65-6
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	661.93

Chemical Name in the Inventory and Synonyms	**Fatty acids, castor oil, hydrogenated, lead salts**
CAS Number	91697-36-8
Structural Formula	

	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**Fatty acids, C14-26, lead salts**
CAS Number	93165-26-5
Structural Formula	
Molecular Formula	Unspecified
Molecular Weight	

Chemical Name in the Inventory and Synonyms	**9-Hexadecenoic acid, lead(2+) salt, (Z)-** Lead(2+) (Z)-hexadec-9-enoate Lead dipalmitoleate

CAS Number	93858-24-3
Structural Formula	
Molecular Formula	C16H30O2.1/2Pb
Molecular Weight	714.0

Chemical Name in the Inventory and Synonyms	**Tricosanoic acid, lead salt** Lead bis(tricosanoate)
CAS Number	93966-37-1
Structural Formula	

	
Molecular Formula	C23H46O2.xPb
Molecular Weight	914.4

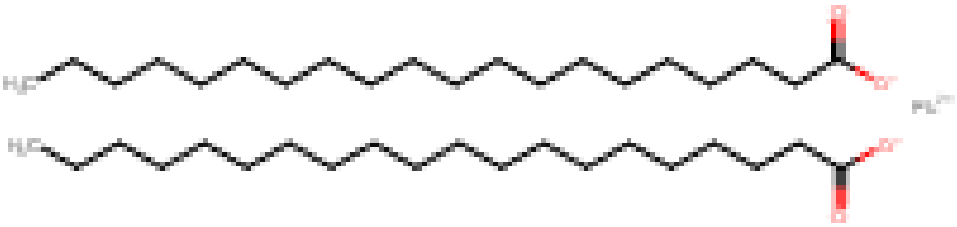
Chemical Name in the Inventory and Synonyms	**Tetracosanoic acid, lead salt** Lignoceric acid, lead salt Lead tetracosanoate Lead lignocerate
CAS Number	93966-38-2
Structural Formula	

	
Molecular Formula	C24H48O2.xPb
Molecular Weight	942.5

Chemical Name in the Inventory and Synonyms	**Hexacosanoic acid, lead salt** Hexacosanoic acid, lead salt Lead cerotate
CAS Number	94006-20-9
Structural Formula	

	
Molecular Formula	C26H52O2.xPb
Molecular Weight	998.6

Chemical Name in the Inventory and Synonyms	**Eicosanoic acid, lead(2+) salt (2:1)** Lead icosanoate (1:2) Lead diarachidate
CAS Number	94266-31-6
Structural Formula	

	
Molecular Formula	C20H40O2.1/2Pb
Molecular Weight	830.3

Chemical Name in the Inventory and Synonyms	**Eicosanoic acid, lead salt** Lead icosanoate Lead arachidate
CAS Number	94266-32-7
Structural Formula	**No Structural Diagram Available**

Molecular Formula	C20H40O2.xPb
Molecular Weight	830.2

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